THE EFFICACY OF QUESTION-ANSWERING INSTRUCTION FOR IMPROVING YEAR 5 READING COMPREHENSION

Volume 1

by

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PLEASE NOTE

The greatest amount of care has been taken while scanning this thesis,

and the best possible result has been obtained.
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The work presented in this thesis is, to the best of my knowledge and belief, original, except as acknowledged in the text. I hereby declare that I have not submitted this material, either in whole or in part, for a degree at this or any other university or institution.

Gail Brown
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ABSTRACT

The purpose of this thesis was to capitalise upon information processing models to develop and test the impact of a question-answering intervention on Year 5 students’ reading comprehension, question-answering and vocabulary performance. This study provides empirical evidence that question-answering instruction can lead to statistically significant comparisons in reading comprehension performance that favoured intervention participants compared to students completing regular classroom reading instruction. The current thesis reported the features of intervention that contributed to differences in posttest performance.

The current study involved a quasi-experimental, pretest-posttest design that targeted students \((n = 267\) students) enrolled in regular Year 5 classrooms \((n = 10\) classes) across three schools. Classes were assigned to one of two treatment groups: an experimental group \((n = 6\) classes) who received a question-answering reading comprehension intervention and a control group \((n = 4\) classes) who continued with their regular classroom reading program. Each teacher nominated whether they wished their class to be allocated to the experimental or the control group, and there were no statistically significant pretest differences between the experimental and control groups. Classroom teachers implemented the intervention over ten weeks.

Multilevel modelling procedures controlled for potential differences at the individual student level and the class level. Comparisons were made between students \((n = 100)\) who completed their regular classroom reading program and students \((n = 167)\) who completed the intervention, controlling for pretest scores. Multilevel modelling statistical procedures demonstrated that participants who had experienced the question-answering intervention displayed higher scores on a standardised reading
results support the efficacy of the intervention and the theory on which it is based.

Previously, question-answering research demonstrated improvements only in researcher-devised reading comprehension measures. Additionally, these limited findings involved small group instruction by researchers, mostly with students with learning disabilities, over short time periods. The intervention applied a cognitive strategy to a hierarchy of skills and knowledge that began with word meanings, extended to sentences, and then to text passages. The intervention included a structured lesson format that confirmed and extended existing knowledge, as well as providing opportunities for positive student-teacher interactions. Significant improvements in student performance due to the intervention were a result of specific practice with selected teaching examples in the context of a general cognitive strategy that reinforced the goal of the intervention - learning how to write answers to questions.

The application of information processing models in extant research of effective instruction in literacy and numeracy has been documented. The current intervention is the first application of this theoretical framework to a complex skill in reading comprehension, namely question-answering. Potential future applications of this instructional technology to complex cognitive skills are discussed.
CHAPTER ONE:
INTRODUCTION

Reading comprehension has never been more important than right now—this very minute! Understanding complex, highly abstract ideas is the key element for success in today's advanced societies. Individuals communicate the intricate relations between complex concepts and knowledge using literacy skills. The pervasiveness of the Internet has led to a seemingly limitless increase in the volume and accessibility of information. Without clear understanding of information, successful functioning in our communities remains restricted. Consequently, a proliferation of research has examined effective reading comprehension teaching strategies. Entire volumes have been devoted to the state of reading (Kamil, Mosenthal, Pearson, & Barr, 2000; National Institute of Child Health and Human Development [NICHHD], 2000a) and reading comprehension (Muth, 1990; Pearson & Johnson, 1978; Pressley & Afflerbach, 1995). Reviews of research have focussed directly on reading comprehension and its instruction (Dole, Duffy, Roehler, & Pearson, 1991; Fielding & Pearson, 1994; Pearson & Fielding, 1991; Pressley, Eldinary et al., 1992; Rosenshine & Meister, 1994) and have examined reading comprehension instruction in relation to specific student populations (Gersten, Fuchs, Williams, & Baker, 2001; Mastropieri & Scruggs, 1997; Weisberg, 1988). Despite this plethora of research and literature, the most effective instructional programs for reading comprehension are yet to be identified.

However, two key limitations have persisted. Firstly, researchers have often failed to identify effective reading comprehension teaching strategies in sufficient detail to serve as an instructional program for classroom teachers. Instead, general methods of implementation have been suggested using terms like “explicit instruction” (Pearson & Dole, 1987, p. 151), “thinking aloud” (Kucan & Beck, 1996, p. 259) and “direct instruction” (Carnine, Silbert, & Kameenui, 1997, p.1). Whilst these general methods have the potential to inform the teaching of reading comprehension, classroom teachers have not been able to incorporate these methods into specific classroom instructional programs.

Secondly, researchers have often failed to define clearly specific reading comprehension skills in sufficient detail to underpin classroom instruction (Dole et al., 1991; Fielding & Pearson, 1994; Guszak, 1967; McNeil, 1987; Pearson & Fielding, 1991; Pressley, El-Dinary et al., 1992; Rosenshine & Meister, 1994). Recently, the National Reading Panel, comprising experts in reading instruction and research, reviewed reading research and extant reading comprehension research predominantly published in scientific journals for the purpose of improving classroom instruction in America (NICHD, 2000a). Based on empirically validated research, this panel recommended instruction in seven categories of specific reading comprehension skills, including question-answering instruction. However, recommendations emanating from this report remained limited to general teaching strategies for classroom teachers. As such, there has been little consideration of the critical role of materials and specific teaching examples for positively supporting classroom instruction in reading comprehension: that is, a specific instructional program for classrooms (Gersten et al., 2001). Hence, teachers have been provided
with suggestions for general methods for teaching comprehension and still have not
been provided with either a clearly defined instructional program for the teaching of
specific reading comprehension skills or with classroom materials to implement
such a program effectively.

Recent theoretical advances, using information processing models, offer
potential for strengthening reading comprehension research (Bransford, Brown, &
Cocking, 2000; Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Donovan,
Bransford, & Pellegrino, 2001; Gordon, Hendrick, & Johnson, 2001; Shavelson &
Towne, 2002). Information processing models utilise analogies between computer
systems and human cognition. As a result, these models provide a possible
framework for detailed analysis and simulation of complex cognitive tasks,
including those found in classrooms and workplaces (Baddeley, Aggleton, &
Conway, 2001; Kintsch, 1998; Miyake & Shah, 1999b; Newell, 1990; van
Merrienboer & Paas, 2003). Information processing models have been used to
simulate the cognitive processing in decoding, one aspect of reading (Coltheart et
al., 2001). Until the current study, there does not appear to have been any
application of these information processing models to the design of classroom
materials in reading comprehension that was specifically focussed on how to answer
questions.

Question-answering is a key skill that underpins reading comprehension and,
as such, could be readily taught within a classroom instructional program.
Answering questions is a universal activity, a common indicator of reading
comprehension and integral to our daily lives. Historical and recent research has
examined question-answering from a range of perspectives and confirmed the
importance of answering to classroom functioning, and specifically to reading comprehension (Andre, 1987; Armbruster, 1992; Beck, McKeown, Hamilton, & Kucan, 1997; Cazden, 1988; Guszak, 1967; Rickards, 1979; Weedman & Weedman, 2001). Despite this wealth of discussion and research, specific instructional programs for question-answering have not been forthcoming. Durkin’s (1978-9) seminal paper documented that classroom teaching practices predominantly involved repeated teacher assessments of answers to questions, rather than instruction on how to comprehend the question, and instruction in specific cognitive skills for answering questions.

A small body of research has examined the relations between questions and answers as a potential means for providing classroom instruction in reading comprehension (Pearson & Johnson, 1978; Raphael, 1982). By clearly linking questions with answers and with passages of text, this research has provided direction for how students might go about the task of answering questions and, therefore, specific classroom instructional programs in question-answering instruction. However, reading comprehension research, and specifically question-answering research, has been plagued by methodological flaws (Lysynchuk, Pressley, d’Ailly, Smith & Cake, 1989). For example, reviewing experimental research in comprehension strategy instruction, Lysynchuk et al. (1989) concluded that this research was plagued with methodological weaknesses including questionable validity and reliability, limited empirical data, small sample sizes, specific types of participants and insufficient details of methodology to enable replication.

The primary purpose of the current thesis, in the context of a sophisticated
research design, is to: a) extend the application of information processing models to the development of a comprehensive classroom instructional program in question-answering for Year 5 students; b) determine the effectiveness of a theoretically designed question-answering program to enhance the reading comprehension, question-answering, reading vocabulary and reading fluency performance of Year 5 students; c) utilise sophisticated statistical tools and rigorous quantitative research methods to analyse the efficacy of the question-answering program; and d) develop an empirically validated question-answering program that can be readily implemented by classroom teachers.

The present investigation was also designed to address some of the limitations identified in previous research by: a) capitalising upon and extending the application of information processing models to underpin the development of a potentially potent question-answering intervention based upon the strongest theory available; b) testing the effectiveness of the intervention utilising instruments with sound psychometric properties, and hence demonstrated validity and reliability; c) implementing the intervention in ecologically natural classroom settings, to increase external validity and, hence, increase significance for classroom instruction; d) extending previous findings based on quantitative data to further inform and extend future research; e) applying powerful statistical tools to elucidate the findings; and f) extending the current knowledge base in terms of the complex relationships between different measures of reading comprehension.

Within this focus on reading comprehension, recent calls for effective reading instruction have been based on appropriate classroom curricula and predominantly focussed on prevention of failure in learning to read (Vaughn &
Fuchs, 2003). In reading comprehension strategy instruction, some “powerful learning environments” (van Merrienboer & Paas, 2003, p.3) have documented significant gains in student performance, notably excluding standardised reading comprehension measures (De Corte, Verschaffel & Van de Ven, 2001; De Corte, Verschaffel, Entwistle, & Van Merrienboer, 2003). The current thesis examines a theory-based intervention with efficacy that, for the first time, potentially extends to significant improvements on standardised reading measures for Year 5 students. An overview of the relevant information processing theory and reading research that provided the foundation for that intervention is now presented.
CHAPTER TWO:

THEORETICAL FOUNDATIONS IN INFORMATION PROCESSING

The purpose of this chapter is to provide a theoretical foundation for the present investigation. Firstly, the rationale for devising interventions based on scientific method is presented. Secondly, an overview of information processing models is outlined. Next, reviews of research into three key theoretical constructs from information processing models (attention, working memory and skill development) and implications for the present investigation are discussed. Finally, the significant environmental factors that previous research has demonstrated to impact on human behaviour are discussed and the implications of this research for the present investigation are presented. Hence, the purpose of this chapter is to demonstrate that the present investigation was founded upon sound theoretical models with the potential to contribute to the development of the reading comprehension intervention used in the current study.

Scientific Method in Education

Scientific method has emphasised that the design, implementation and evaluation of high-quality intervention research needs to be firmly grounded on scientific principles (Carnine, 1997; Donovan et al., 2001; Gersten, Baker, & Lloyd, 2000; Kuhn, 1962; Popper, 1968; Rose, 2002). Shavelson and Towne (2002) proposed that:

To be scientific, the design must allow direct, empirical investigation of an important question, account for the context in which the study is carried out,
align with a conceptual framework, reflect careful and thorough reasoning, and disclose results to encourage debate in the scientific community. (p. 1)

Extant literature has confirmed the importance of scientific instruction founded on theory-based research and recognised that theory, research and practice are all inextricably intertwined (Bransford et al., 2000; Donovan et al., 2001; Shavelson & Towne, 2002). Historically, scientific method has been acceptable in traditional sciences, like physics and biology, yet debated in education (Shavelson & Towne, 2002). However, the context of increasing accountability in education has demanded cost-effective, empirically validated instructional programs as necessary precursors to large-scale implementation across education systems (Donovan et al., 2001; Hoffman, Assaf, & Paris, 2001; Klinger, Ahwee, Pilonieta, & Menendez, 2003; McGehee & Griffith, 2001; Serafini, 2000).

Initial studies applying scientific principles to classroom-based research raised three issues. Firstly, controlled laboratory conditions used in traditional scientific research were replaced by an applied research design more appropriate to classrooms (Gall, Borg, & Gall, 1996; Gay & Airisian, 2000; Pressley, 2003; Tuckman, 1999). Secondly, educational researchers lamented the lack of high quality research in classrooms (Bryan, 1999; Walker, 2000; Ysseldyke, 2001) and the difficulties of implementing well-controlled research designs due to the realities and demands of school practice (Gersten et al., 2000; Kamil, 1994; NICHD, 2000a; Pressley & Harris, 1994). Shortcomings identified in educational research have included a lack of statistical information, limitations in documenting training procedures and a lack of appropriate measurement tools (NICHD, 2000a). Thirdly, debates in educational research defined learning in a binary manner in terms of
either behaviour or cognition (Gardner, 1985; Mackintosh, 1997; Thorley, Hotchkis, & Martin, 1991). Behavioural and cognitive views of learning have been replaced by recent, more comprehensive, work using information processing models (Bransford et al., 2000; Thorley et al., 1991). Information processing models have enabled “scientists to begin serious study of mental functioning: to test their theories rather than simply speculate about thinking and learning” (Bransford et al., 2000, p. 8). Hence information processing models have facilitated a scientific approach to the study of learning. Through the application of scientific method to the current study, causal connections between the independent variable and performance changes were made possible. Therefore, scientific method established a firm foundation for the conclusions in the current study.

Implications for the Present Investigation

The present investigation utilised scientific method. The research design enabled an investigation of the efficacy of classroom materials that provided question-answering instruction to Year 5 students and that were designed using information processing theory and models. Adherence to the principles of scientific method ensured high internal validity through the use of valid and reliable instruments, integrity of program implementation and standardised scoring procedures. Similarly, high external validity was ensured by implementations in natural classroom settings by classroom teachers with typical Year 5 students and replications over time and across schools. Development of the question-answering program, the independent variable, was founded upon theoretical principles from information processing.
Information Processing Theory and Models

Overview

Information processing theory is based upon the analogy between computer systems and human cognition and is the central theory used in cognitive science (Bransford et al., 2000; McGilly, 1994). Cognitive science includes information processing theory and neuroscientific theories of brain functioning. However, the broad field of cognitive science and detailed discussion of brain functioning has been excluded because it is considered beyond the scope of the current thesis for several reasons. Despite numerous advances, neither teachers nor their classroom programs have been influenced by such research to date (Council for Exceptional Children, 2003; Joseph, Noble, & Eden, 2001). Further, the role of brain regions in reading continues to be debated (Johnson, Hetzel, & Collins, 2002). Information processing theory is not concerned with physical (chemical or electrical) changes in the brain.

Information processing theory, and specific models within that theory, provides the foundation for the current study. Information processing theory proposes broad parallels between computer software programs and the sequences of human cognitive processes and, therefore, humans are regarded as symbol systems (Newell, 1990). Information processing models provide more detail about knowledge representations and cognitive processing than either cognitive science or information processing theory. These more specific models elaborate precise constructs and mechanisms within information processing theory and provide clearer directions for the current study. Three broad constructs within information processing theory are attention, working memory, and skill development processes.
Specific information processing models proposed for each construct allow
researchers more scope in specifying the cognitive representations and processes.

In educational settings, the application of information processing models has
been limited to inferences about cognitive processes supported by empirical data and
observable behaviour (Aitkenhead & Slack, 1985; Ellis & Young, 1988; Glass &
Holyoak, 1986). Information processing models hypothesise cognitive processes that
mediate between observable inputs from the environment and the observable outputs
of human behaviour (Baddeley, 1986; Kintsch, 1998; Lachman, Lachman, &
Butterfield, 1979; Newell, 1990). Inputs have been defined as environmental stimuli
registered by sensory mechanisms and perceived through perceptual analyses
(Lachman et al., 1979; Newell, 1990). Outputs from information processing models
comprise observable behaviours and covert cognitive processes that may lead to
observable behaviours in the longer term.

In broad terms, information processing models are based on the premise that
humans process information from their environment in order to meet their goals and
needs. As such, the goals of individuals are a critical component in all information
(p. 111) that spans the knowledge and cognitive processes used across goals for
individuals. Newell claims this theory was the basis for “general intelligent
behaviour” (p. 113). Within Newell’s theory, simple behaviours are linked to simple
goals and groups of simple behaviours and goals are hierarchically, and
successively, organised into more complex goals and behaviours. Subsequently,
Anderson (2002) developed an overarching model that linked the most specific
biological goals to the most general social goals of individuals. Therefore, within
this overarching information processing model, people’s complex goals and needs are dependent upon the successful completion of simpler subgoals, that are hierarchically organised.

Information processing models define different types of knowledge. Firstly, declarative knowledge is defined as the network of known facts (Aitkenhead & Slack, 1985; Anderson, 1993; Hasselbring, Goin, & Bransford, 1988; Sieck & Yates, 2001; Sorace, Heycock, & Shillcock, 1999). Facts are stored as declarative knowledge and retrieved more accurately and effortlessly depending on either the strength of the relationship between the stimulus and the response (Hasselbring et al., 1988) or on the number of encounters with a particular stimulus or “instance” (Logan, 1988, p. 492). Declarative knowledge is the information component, the knowledge, within all information processing models. Secondly, procedural knowledge is defined as knowledge of “how to” do something, that is, knowledge of sequences of steps in a strategy (Howell & Nolet, 2000; Pellegrino & Goldman, 1987). Therefore, procedural knowledge is necessary to determine answers for problems for which there is no pre-existing known fact. Procedural knowledge is the processing component, the thinking steps, within all information processing models. Prior knowledge, a foundational concept within information processing models, includes both declarative and procedural knowledge and is defined as memory of prior environmental events (Bransford et al., 2000).

Information processing models also allude to the effects of the environment on learners. The declarative knowledge base arises out of the environment in which facts are presented. Procedural knowledge arises out of environmental demands to complete certain tasks. Over time, declarative and procedural knowledge are
elaborated and complex skills and performance typical of experts becomes evident (Bransford et al., 2000; De Corte, 2003; De Corte et al., 2003; Engelmann & Carnine, 1982). Within the environment, social interactions and reinforcement techniques are theorised to maintain and strengthen declarative and procedural knowledge and the consequent behaviours (Luria, 1973, 1982; Mackintosh, 1994; Thorley et al., 1991).

Rather than examining all of the cognitive processes within information processing theory, researchers have examined specific theoretical constructs posited to exist within models. Three theoretical constructs from information processing models - attention, working memory and skill development - have been proposed by researchers and are discussed in the following sections of this chapter. Each section concludes with the implications from research for the current investigation.

Attention Processes

Overview

At any one point in time, learners are inundated by countless stimuli from their environment. Attention is theorised by researchers as the process by which learners search for and process selected parts of their environment (Howell & Nolet, 2000; Lachman et al., 1979; Newell, 1990). It has been proposed that if learners could not somehow limit what they attended to, their information processing system would potentially overload and they would be unable to function (Howell & Nolet, 2000; van Merrienboer & Paas, 2003). Therefore, even though learners are exposed to countless stimuli, not all stimuli are attended to and processed. Cognitive processes of attention selected particular stimuli within an environment to attend to at the expense of other stimuli (Lachman et al., 1979; Newell, 1990). Attentional
processes were postulated to involve the synthesis of selected environmental information by learners as they constructed an internal representation that matched signals from the environment and their goals or purposes (Neisser, 1967).

**Historical Perspectives on Attention**

Broadbent’s (1958) view of attention proposed an on-off mechanism that limited the amount of information registered at the sensory level. He suggested a single channel limited capacity model of attention (Baddeley, 1986; Lachman et al., 1979). Broadbent utilised split span procedures wherein participants heard information through headphones that presented different information to each ear. Broadbent concluded that each ear was a separate channel and that processing of stimuli was serial (consecutive) rather than concurrent (at the same time). He theorised the existence of a sensory buffer that held information for a few seconds. Broadbent further proposed that serial processing meant that completion of two tasks was only possible where there was switching between one task and another (rather than in parallel). Subsequently, Treisman (1964a, 1964b) further examined auditory processing and suggested that Broadbent’s (1958) binary on-off switching mechanism was more of a continuum and that attention might be gradually increased or decreased along that continuum. Also, early models suggested that rather than capacity limits occurring at the sensory level, these limits occurred at the perceptual stage, during the selection of responses (Deutsch & Deutsch, 1963).

Additional research using visual attention highlighted the additional impact of long-term memory to clarify the impact of meaning on attention (Neisser, 1967; Neisser & Becklen, 1975; Norman, 1968; Norman & Bobrow, 1975). Norman (1968) proposed that meaning, termed semantic selectivity, affected attention to
information from the environment. Norman qualified Treisman’s (1964a) proposed attenuation of stimuli based on matching the stimulus to its stored representation in long-term semantic memory (Lachman et al., 1979; Norman, 1968). Several studies suggested that unattended stimuli were only partly analysed to determine if they matched a real world representation and that both long-term memory and short-term memory impacted on attentional processes (Neisser, 1967; Neisser & Becklen, 1975; Norman, 1968; Norman & Bobrow, 1975). Neisser (1967) confirmed that attended and unattended stimuli differed in completeness of processing and supported Treisman’s proposed attenuation of processing. Furthermore, Neisser and Becklen (1975) suggested that participants consciously controlled the amount and completeness of processing of different stimuli in their environment depending upon their goal or purpose.

Recent Research on Attention

Recent research has confirmed that specific attentional processes are mediated by meaning (Treisman, 1993) and focussed on attention to stimulus features, through Treisman’s revised feature integration theory (Fisher & Tanner, 1992; Fisher & Young, 1987; Treisman, 1993). Treisman’s latter theory proposed that attentional processes occurred in two stages: preattention and divided attention. Treisman described preattentional processes (the first stage of attention) in terms of analysis and discrimination of features that were part of a concept (e.g. determining the shape, size and colour of an object). Treisman claimed that preattentional processes encoded composites of features that were accessed from short-term or long-term working memory. According to Treisman, preattentional processes involved parallel, simultaneous processing of all the features of a concept. For
example, the size, colour, shape and orientation of a complex stimulus.

Secondly, Treisman (1993) proposed that divided attention (the second stage of attention) involved recognition of objects as collections of features. Within Treisman’s model, the divided attention stage included creation of an internal representation based on analyses of physical characteristics of stimulus. For example, encoding of the stimulus as a small, green square based on analysis of physical features. Divided attention included analysis, encoding and representation of the object’s environmental features. Comparisons between information in current processing and stimulus representations in long-term memory enabled recognition of the stimulus, as a typical example of a small, green square. Treisman supported her model empirically by showing that features with highly distinctive properties facilitated discriminations between concepts.

Treisman (1993) also supported the hierarchical processing of features during parallel processing and the interactive nature of cognitive processing. As stimuli were attended to and encoded, subsequent cognitive processing was proposed to involve a dynamic, constantly changing system (Ward, 2002). By making suggestions to participants, Treisman examined the effects of presenting advance information about the relevant stimulus features (e.g. asking participants to look for a small, green square). She found that this advance information facilitated cognitive comparisons between features of environmental stimuli processed in working memory and the cognitive representation of a specific stimulus, held in long-term memory (Duncan & Humphreys, 1989; Fisher & Tanner, 1992; Fisher & Young, 1987). Treisman documented the control of attention by both advance presentation and environmental stimuli. As such, Treisman’s work supported the
presentation of examples that required processing of particular stimulus features and advance presentation of stimulus names.

Further developing Treisman’s (1993) concept of preattention, Gilbert (1996) used the notion of “prepractice” and examined the effects of practice in searching for examples of a semantic category on learning a complex task. Gilbert found that practice in locating a particular type of stimulus benefited the learning of a complex task. She extended Treisman’s (1993) concept of presentation of advance information into the learning of a complex task. Therefore, Gilbert’s study supported the importance of prior knowledge on subsequent learning.

Another direction in recent research examined the strategic, goal-directed nature of attention. Research in strategic attention focussed on aspects of real world environments rather than controlled laboratory conditions (Moray, 1993). Supporting Treisman’s (1993) approach, Moray proposed that both environmental and cognitive factors determined attention. Moray claimed that skilled or expert behaviour resulted from a mental model that fully represented the environment. He suggested that by using their complete mental model, experts sampled the real environment and were strategic about attention, rather than having to process and reprocess the entire model of the environment. Moray’s view was supported by research findings that experts processed a smaller, more specific amount of environmental information that was most relevant to the task at hand (Haider & Frensch, 1996). Experts, in the context of this study, were defined by their high level of prior knowledge. Moray’s model also supported Engelmann and Carnine’s (1982) concepts of sameness and difference during the initial, attention stage of information processing. In the context of attending to stimuli, learners required information
about specific stimulus features that were linked directly to the goal of the task at hand: Learners needed to know what to attend to in their environment in order to achieve their goal. On subsequent occasions, this goal would be achieved more effectively and efficiently if learners attended to the particular stimulus features and environmental conditions that were associated with the initial steps required to complete the overall, desired goal.

In summary, Treisman (1993) and Moray (1993) confirmed that learners focussed on specific parts of their environment. Where Treisman examined groups of features and composite mental representations of individual concepts, Moray documented mental models of groups of concepts. As such, Moray’s theoretical model merely represented hierarchically higher levels of knowledge representation and cognitive processing in comparison to Treisman’s model. The levels and hierarchy were reminiscent of Newell’s (1990) hierarchical cognitive bands at successively higher, more abstract levels. This recent work (Moray, 1993; Treisman, 1993) supported the importance of goals and purposes on attentional processes raised earlier (Neisser & Becklen, 1975; Norman, 1968). Taken together, these models strongly suggest that the cognitive processes involved in selectively attending to stimuli in the environment are hierarchically organised and simultaneously focussed on both specific stimulus (featural) effects and strategic (goal driven) effects that are dependent on the goals of the learner.

Implications for the Present Investigation

Theoretical propositions based on selective attention processes described above imply that potentially strong interventions can incorporate both a specific stimulus focus and a focus on strategic, goal-driven behaviour to affect attention and
preattention. In addition, these foci should be related to the goal of the instructional program, namely question-answering for the purpose of the present investigation.

The question-answering intervention in this research capitalised on recent advances in theory by incorporating explicit instructions in the materials that ensured learners selectively attended to the most relevant dimensions of their environment in regard to question-answering skills, as advocated by Treisman (1993), Moray (1993) and Engelmann and Carnine (1982). The materials in the current thesis included a dual focus both on specific features of examples used in the materials and on purposes and goals of question-answering in classrooms. The materials focussed on the selection and sequencing of teaching examples that included particular features, applying Treisman’s concept of feature analysis. The sequencing of teaching examples, concept names and prompt words within the materials, provided “advance information” (Treisman, 1993, p. 22) as advocated by Treisman and prepractice as supported by Gilbert (1996). The consistent lesson format (Rosenshine & Stevens, 1986) provided a strategic, advance organiser for students for each lesson as advocated by Moray (1993). Question types from previous reading research (Raphael, 1982; Raphael, 1984; Raphael & Wonnacott, 1985) provided a strategic, goal-directed framework (Moray, 1993) that integrated question types and the purpose of learners, that is, to write answers to questions(see Chapter 3).

Models of Working Memory

*Defining Working Memory*

Research into working memory has focussed on how selected aspects of the
environment were processed and temporarily stored during complex cognitive processing involving multiple steps. Working memory was defined as "the dynamic part of the memory system that is responsible for maintaining temporary information during mental operations" (Hitch & Towse, 1995, p. 3). Recent theoretical models have examined working memory from a range of philosophies and moved beyond previous consideration of short-term memory (limited to storage of information) to include both processing and information storage (Baddeley & Logie, 1999; Kane, Bleckley, Conway, & Engle, 2001; Miyake & Shah, 1999b; Towse, Hitch, & Hutton, 1998). Working memory research has proposed that capacity limitations, notably during complex tasks, resulted in differences in the success and speed of task completion that varied across individuals and over time (Case, 1974, 1985).

Two broad trends have emerged from the substantial body of research undertaken in this area (Miyake & Shah, 1999b). Firstly, a general consensus supported the view that defined working memory to include limitations that can arise from multiple causes (Miyake & Shah, 1999b). Secondly, working memory limitations are theorised to have the potential to change over time in response to environmental conditions (Halford, Wilson, & Phillips, 1998; Miyake & Shah, 1999b; van Merrienboer & Paas, 2003). The impact of environmental conditions on working memory limitations was theorised to be significant in the completion of complex tasks, in the laboratory and in everyday life. The following section provides an overview of key aspects of this extensive body of work relevant to the present investigation.

**Historical Perspectives of Working Memory**

Short-term memory, the predecessor of working memory, originated from the
distinction between two types of memory, that is, transitory information stored in short-term memory and relatively permanently storage of information in long-term memory (Hebb, 1949). The emphasis on short-term memory originated from the view that the longer the information remained stored in short-term memory, the more likely this information was to become part of long-term memory.

Effects of Number of Items

Miller’s (1956) classic study examined short-term recall of sequences of numerals with adult participants where increased lengths of the numeral sequences had a negative impact on recall. Miller further proposed that all human information processing was limited to seven plus or minus two chunks of information. Two broad reasons for the loss of information from short-term memory were proposed: trace decay and interference. Trace decay was the loss of information from memory that was not maintained for a sufficient time. In contrast, interference involved the effects of other stimuli on the memory of specific, newly presented stimuli. Broadbent (1958) proposed that information was lost, after a few seconds, as a result of trace decay that occurred in the time between information storage in short-term memory and requested information recall. Therefore, Miller’s classic study supported Broadbent’s notion of trace decay.

In contrast, Melton (1963) suggested that recall of information from short-term memory was affected by interference. During a recall task, Melton claimed that presentation of each subsequent item replaced each previous item in short-term memory. He claimed that, over a period of time, the memory of successive items presented early in the sequence may spontaneously recover up to a point where they competed with subsequent items. Whereas Broadbent (1958) had focussed on time
delay, Melton focussed on the effects of items on each other. Therefore, Melton’s view was reminiscent of the effects of stimulus features on selective attention raised in the previous section (Treisman, 1993). In addition, Melton claimed that interference effects in short-term memory and long-term memory were the same and, consequently, that short-term and long-term memory were one storage system.

Effects of Rehearsal and Participant Involvement

Further research has examined the role of interference and rehearsal on short-term memory (Baddeley & Scott, 1971; Keppel & Underwood, 1962; Peterson & Peterson, 1959). Initially, Peterson and Peterson (1959) found that auditory sequences of three consonants were forgotten within a twenty second period. Forgetting occurred if participants were prevented from rehearsing by performing a verbal counting task unrelated to the letters to be remembered. Supporting interference effects, Keppel and Underwood (1962) argued that Peterson and Peterson (1959) had averaged data across a series of trials to support their trace decay interpretation. Keppel and Underwood claimed that the first trial showed little, if any, forgetting and that forgetting increased across trials. Baddeley and Scott (1971) suggested that the effects on first trials were extremely short-term (within 5 seconds) and so small that a large number of participants were needed to examine forgetting. In addition, Baddeley and Scott suggested that effects on a first trial were extremely short-lived and were affected by the number of words presented rather than word frequency. Modification of the Peterson and Peterson (1959) task methodology (that switched to different material or separated trials by a short time, perhaps only a few minutes) led to reduced interference effects (Wickens, 1970).

In further research on the effects of interference (Hockey, 1973), differential
effects were based on whether the participants were passively or actively engaged in the task presented. Hockey suggested that passive participant responses reflected the trace decay effects as performance was significantly affected by time delay. Hockey also claimed that responses by active participants (who rehearsed) were affected by interference as the number of items presented between trials increased.

Effects of Presentation Mode

Early research also suggested that the type of encoding process affected whether information was stored in short or long-term memory (Baddeley & Dale, 1966; Dale & Baddeley, 1969). As a result, Broadbent’s (1958) original model of short-term memory (focussing on trace decay) was adapted into the modal model of short-term memory (Atkinson & Shiffrin, 1968). The term “modal model” arose from the different posited mechanisms for peripheral storage and processing that were based on each sense or modality (Baddeley, 1986). Generally, this research supported reliance on phonological (speech) coding for short-term memory and reliance on meaning (semantic) coding for long-term memory (Baddeley, 1986; Baddeley & Dale, 1966; Dale & Baddeley, 1969). This early emphasis on storage resulted in measures of working memory focussed on recall. After a single presentation of a series of items, participants were required to recall as many items as they were able. Memory span tasks, such as word span and digit span, provided measures based on the longest list of words or digits that could be recalled correctly on 50% of trials when tested immediately (Hitch & Towse, 1995). However, word span and digit span did not correlate with task performance (Daneman & Carpenter, 1980).

Therefore, early research in working memory documented effects on short-
term memory that resulted from rehearsal of items, the number of items presented, the active involvement of participants and the mode of presentation. However, an emphasis on storage alone appeared to be insufficient to explain working memory processes and, consequently, this led to a change in the direction of research.

Effects of Cognitive Processing

The next major era in working memory research was to focus research on cognitive processing, rather than storage (Craik & Lockhart, 1972; Munsinger & Kessen, 1966). Craik and Lockhart introduced two types of processing that occurred in short-term memory — maintenance rehearsal and elaborative rehearsal. Maintenance rehearsal involved repeated processing of an item at one level of processing, whereas elaborative rehearsal involved repeated processing of items at successively deeper levels of processing. Craik and Lockhart claimed that elaborative rehearsal was critical for information to become part of long-term memory.

Munsinger and Kessen (1966) proposed that capacity limitations depended on the type of cognitive processing rather than on short-term information storage. Supported by Kaufman, Lord, Reese and Volkman (1949), Munsinger and Kessen proposed that different amounts of information were processed during complete (accurate) cognitive processing compared to partial (e.g., estimation) cognitive processing. Munsinger and Kessen found that additional processing differences and significant performance differences were attributed to researcher-controlled variables, namely participants’ ages, stimulus characteristics and duration of stimulus presentation. While their focus was on cognitive processing, the variables that they manipulated during their research were stimulus characteristics (stimulus
size, features and relationships). In contrast to their original aim and the direction of the research at the time on processing levels, Munsinger and Kessen based their conclusions on stimuli and stimulus features, that is, on the information presented to learners. Their research examined visual discrimination of black and white geometric figures that differed in terms of the number of angles. Therefore, Munsinger and Kessen investigated cognitive processes through the manipulation of stimulus characteristics.

More importantly, Munsinger and Kessen’s (1966) findings with regard to stimulus characteristics held potential for more complex stimuli. In particular, they examined the differences in responses for timed and untimed processing of complex stimuli, and included the categorisation of visual stimuli using novel category names and with participants of different ages. Munsinger and Kessen reported that younger participants were less sensitive to stimulus characteristics in terms of the variability of features, particularly under timed conditions. They confirmed that working memory limitations in younger participants constrained their cognitive processing of additional and novel information. In addition, they found that experience with highly variable stimuli within a category type was beneficial and that experience and processing were integrally related, since the benefits of training (experience) were more noticeable under timed conditions. Munsinger and Kessen’s conclusion was that performance differences in training with highly variable stimuli were the result of qualitative differences in cognitive processing. Despite the limited types of stimuli (simple visual shapes), this study provided some potential directions for future research in the effects of training (or instruction) on complex learning of categories.
Problems with measuring processing depth and with serial processing led researchers to reconsider their sole focus on cognitive processing (Baddeley, 1986). Empirical results supported benefits to long-term memory based on maintenance rehearsal, rather than elaborative rehearsal (Glenberg, Smith, & Green, 1977; Mechanic, 1964; Nelson, 1977). Maintenance rehearsal, mere repetition of stimuli, enabled some limited recognition responses and yet it did not establish complex and detailed associations between stimuli (Baddeley, 1986). For example, Craik and Lockhart (1972) examined elaborative rehearsal and required production responses (e.g., responses to questions like “What can you remember?”). In contrast, research supporting maintenance rehearsal required recognition responses (e.g., providing the stimulus and responses to questions like “Do you remember seeing this?”) (Glenberg et al., 1977; Mechanic, 1964; Nelson, 1977). Therefore, differences in methodology fuelled debate about the relative effectiveness of elaborative and maintenance rehearsal and questioned the predominant focus on processing.

Morris, Bransford and Franks (1977) proposed that manipulations of stimulus features and mode of presentation affected cognitive processing and recall. Morris et al. found improved recall occurred when fine discriminations were made between stimuli, and when encoding and recall involved the same mode of processing (either visual or aural). Rather than level of processing, Morris et al. focussed on processing mode. Again, the link to stimulus features and the effects of stimuli on each other during processing supported subsequent research on attention (Treisman, 1993). This work also questioned the focus on processing of that time by emphasising the critical role of environmental stimuli for working memory.

Some early research proposed that working memory capacity limitations
were based on trade-off or resource sharing interpretations of processing or storage (Posner & Rossman, 1965). Posner and Rossman presented participants with two pairs of digits: The first pair of digits was to be remembered and the second pair of digits was to be transformed in some way. Their results showed that performance on the retention of the first pair of digits declined as a result of the difficulty of the processing of the second pair of digits. Results were consistent across processing time limits (i.e., the time interval for retaining the digits to be recalled). Their work was an early foundation for subsequent work focussing on working memory that included both storage and processing of information, rather than either in isolation.

In summary, early research on short-term storage of information raised the mode of presentation, stimulus characteristics, number of items presented, involvement of participants and rehearsal of items as critical issues in task performance. Research on processing began with a focus on types of rehearsal and reconfirmed issues concerned with environmental stimuli, and complex interactions involving stimulus characteristics, the type of processing and the response required in the task (e.g., selection or production of answers). To conclude, historical research had focussed on either short-term storage or short-term processing with neither being sufficient to explain the issues and complexities of working memory.

Recent Research on Working Memory

Recent research focussing on working memory has combined the two historical research foci above to examine the interdependence of storage and processing, which is discussed in the following section. Working memory was defined as the “interface between external representations and internal representations”, and was crucial in complex task performance (Miyake & Shah,
Current working memory models emerged out of discontent with a separate focus on either information storage or cognitive processing: "The theory of short-term memory as a passive storage buffer was replaced by the theory of working memory as a dynamic system with processing and storage capabilities" (Daneman & Hannon, 2001, p. 208). Working memory surfaced as a critical and complex, theoretical construct in the study of human cognition. Working memory was redefined as "the system or mechanism underlying the maintenance of task-relevant information during the performance of a cognitive task" (Shah & Miyake, 1999, p. 1). Four themes have emerged from recent research: the proposed structure of working memory; working memory capacity limitations during complex task completion; potential effects of environmental stimuli on working memory; and potential effects of training on working memory.

**Working Memory Structure**

Working memory is no longer considered distinct from other parts of the cognitive system (Miyake & Shah, 1999a). However, conflicting models have been put forward as to whether working memory structure is unitary or multidimensional (Jurden, 1995; Miyake & Shah, 1999b). Support for multidimensional working memory suggested a potential for parallel processing, whereas views favouring unitary working memory suggested serial processing of each step or task in sequence. Working memory limitations implicated multiple subsystems that temporarily stored and processed information (Anderson, 1993; Anderson, Reder, & Lebiere, 1996; Baddeley, 1986; Markman, 1998). The Baddeley-Logie Model (Baddeley & Logie, 1999) was adapted from Baddeley’s (1986) original model and was strongly supported (Kintsch, Healy, Hegarty, Pennington, & Salthouse, 1999).
In the original model (Baddeley, 1986), domain-specific subsystems included a central executive, phonological loop and visuospatial sketchpad (Baddeley & Logie, 1999). The revised model (Baddeley & Logie, 1999) outlined subsystems that contained subcomponents, including a visual cache and inner scribe within visuospatial sketchpad. Models subsequently derived from the Baddeley-Logie Model supported the existence of subcomponents (Barnard, 1999; Schneider, 1999), subsystem interaction (Keras, Meyer, Mueller, & Seymour, 1999) and coordination of subsystems (O’Reilly, Braver, & Cohen, 1999).

Alternatively, predominant support for a unified working memory, and a unified cognitive system, came from Newell (1990) and from Case and his colleagues, with research using children (Case, 1985, 1995; Case, Kurland, & Goldberg, 1982). Several models supported Newell’s (1990) unitary proposal (Engle, Kane, & Tuholski, 1999; Pascal-Leone, 1970; Salthouse, 1993; Turner & Engle, 1989). Newell’s (1990) model proposed a unified working memory within a unified cognitive system. Rather than dividing memory into short-term and long-term, Newell suggested that cognitive processing systems were “a single homogeneous body of knowledge” (p. 50) and that all previous knowledge is used to carry out actions that fulfil goals.

Newell’s model was unified in two ways. Firstly, Newell claimed that this ambitious model used similar, universal principles that applied across all symbolic systems of knowledge and included, for example, words read in sentences, number systems in math, scientific formulae, objects in pictures, diagrammatic representations in a map or circuit drawing and visual images in signs. Secondly, Newell’s hierarchical organisation of knowledge was the means by which all prior
knowledge was accessed through progressively more abstract and general concepts that included all lower level concepts. However, Newell’s theoretical position did not include situations where these abstract, higher-order concepts were incompletely specified. Hence, his notion of access to all previous knowledge, while theoretically sound, was based in the assumptions of his theoretical model and the complete specification of each hierarchical level of knowledge.

Case (1995) extended Newell’s (1990) concept of complete specification of knowledge. Griffin, Case and Seigler (1994) examined the effects of interactive computer games for early mathematics concepts with young 5- and 6-year-old participants at risk of school failure. These programs provided effective training by establishing a complete specification of number concepts at all hierarchical levels. The effects of these programs transferred to untaught tasks for the trained participants. Griffin et al.’s results supported Newell’s (1990) unified view within the assumption of complete specification of knowledge. This work linked directly to Engelmann and Carnine’s (1982) concept of complete specification of the full range of examples that will communicate a single interpretation to all learners. This structural basis for generalisation (Engelmann & Carnine, 1982) provided an illustration of Newell’s unified view of memory. However, this unified view, proposed by Newell (1990) and subsequently supported by Engelmann and Carnine (1982) and Griffin et al., required control of the environment to communicate a complete specification of knowledge.

An additional criticism of unitary models suggested these models failed to distinguish between language-based and non-language-based variables (Jurden, 1995). Rather than the unified view, Jurden’s results supported the
multidimensionality of working memory. Jurden proposed that verbal working memory accounted for 37% of the variance in general knowledge (measured by vocabulary, science knowledge and paragraph comprehension) and that quantitative working memory accounted for 16% of the variance in speed (measured by speeded numerical operations and basic math facts).

More recently, Nelson and Goodmon (2003) proposed a further multidimensional model of working memory. Their Processing Implicit and Explicit Representations Model (PIER2) included connections between a particular word, related words and episodic memory (i.e., memory of particular experiences or episodes). Nelson and Goodmon defined explicit knowledge as knowledge that included both stimulus information and information about the episodic experience with that particular stimulus. They defined implicit knowledge as knowledge that included information activated for related stimuli. For example, the word “magazine” may implicitly activate related words like “read”, “article”, and “book”. This model of working memory supported multiple subsystems rather than a unitary system. To summarise, recent models of working memory predominantly have supported multiple subsystems rather than a unitary system, and, therefore, implied parallel processing (Kintsch et al., 1999; Miyake & Shah, 1999a).

**Working Memory Capacity Limitations**

Recent research has outlined multiple factors that contributed to capacity limitations in working memory and attempted to elucidate the relative contributions of specific factors during complex task completion (Kintsch et al., 1999; Miyake and Shah, 1999b). Experimentally, complex tasks were investigated using the dual-task paradigm (Berch & Foley, 1998; Foley, 1997; Hunt & Lansman, 1982). The
methodology used in a dual-task ("easy-to-hard") paradigm (Berch & Foley, 1998, p. 832) involved participants who completed relatively easy and relatively difficult primary tasks alone and in combination with easy and difficult concurrent (secondary) tasks (Daneman & Hannon, 2001; Hannon & Daneman, 2001; Lustig, May, & Hasher, 2001). Dual-task paradigms assumed that both the primary task and the secondary task were completed concurrently, with their storage and processing occurring in parallel (simultaneously) rather than the two tasks being completed sequentially.

Early measures of performance, within a dual-task paradigm, included the Compound Stimulus Visual Information Test that required hand cues that matched visual cues (Pascal-Leone, 1970) and the Digit Placement Test that required ordering of visually presented digits according to order of magnitude (Case, 1972). Recent performance measures involved more complex processing such as requiring understanding of sentence meaning and recall of words at the end of sentences (Daneman & Hannon, 2001; Gordon et al., 2001; Hannon & Daneman, 2001). For example, Daneman and Hannon (2001) used reading span measures reported performance on tasks that involved cognitive processing (deciding whether a sentence made sense) and cognitive storage (remembering the last word in a number of sentences).

Berch and Foley (1998) questioned the effects of variation in task difficulty of the primary and secondary tasks within a dual-task paradigm. Two major problems with the dual task paradigm were, firstly, determining the relative difficulty of the tasks involved and, secondly, potential sequencing effects in the presentation order of task combinations (Hunt & Lansman, 1982; Lansman & Hunt,
1982). Logically, when two tasks were completed concurrently, the difficulty of both tasks impacted on task performance. Lansman and Hunt (1982) suggested that designation of one task as the primary task implied that cognitive resources were preferentially devoted to this task but that performance on this primary task was affected as the difficulty of the secondary task increased. Confounding issues included whether the two tasks competed for cognitive resources, and that dual task performance included not only the demands from both tasks but also the additional demands required to coordinate the two tasks (McLeod, 1977; Navon & Gopher, 1979; Wickens, 1980). Lansman and Hunt (1982) documented further confounding that arose when increasing task difficulty lead to qualitative as well as quantitative changes in strategies used. They also found that these effects varied with the types of tasks, and the mode of task presentation (Lansman & Hunt, 1982). To explain these differential results, Berch and Foley (1998) suggested that interference effects between tasks were reduced when different modalities were used for each task. A final limitation of the dual-task paradigm, acknowledged by Lansman and Hunt, was the artificiality of laboratory tasks and lack of application to real-world tasks and settings.

Re-interpreting dual-task experiments, Towse et al. (1998) suggested that increased task difficulty was confounded with increased processing times for larger numbers of items and/or, by processing speed during complex tasks. Previous interpretations of dual-task paradigms rested upon a resource-sharing interpretation, that is, simultaneous (parallel) completion of both tasks (Case, 1985; Daneman & Carpenter, 1980; Turner & Engle, 1989). Towse and Hitch (1995) proposed that task switching (attending cognitively to one task, completing it, then switching attention
to the other task), rather than parallel processing, accounted for differences in children's performance. Towse and Hitch found that processing time, rather than task difficulty, explained performance differences. However, Hitch, Towse, & Hutton, (2001) and Towse et al. (1998) used word length and word sequence to manipulate storage and processing time. This new procedure directly contrasted the resource sharing view with the task-switching view (Hitch et al., 2001; Towse et al., 1998). Resource sharing predicted children's performance and implicated decay, rather than capacity limitations (Hitch et al., 2001; Towse et al., 1998). This conclusion refocussed research back to specific stimulus features and the processing of those features (Doane, Alderton, Sohn, & Pellegrino, 1996; Doane, Sohn, McNamara, & Adams, 2000; Treisman, 1993).

Similar results were reported for sentences and words, and research results suggested that processing speed was specific to the task being completed and that processing speeds were able to account for difference in working memory span (Towse et al., 1998). However, the tasks, themselves, may have precluded resource-sharing interpretations. A lack of errors on any task suggested that, for these participants, the tasks may not have been sufficiently difficult to have incurred any resource sharing, thereby implicating stimulus effects. The alternative explanation, by Towse et al. (1998), was that adults were affected by resource-sharing, whereas children were not. Subsequently, Hitch et al. (2001) reported that combined effects of speed and span accounted for 63% of the variance in performance and that processing speed accounted for more variance (28%) in performance than span measures (8% of the remaining variance after speed), after age effects were partialled out (p. 193). Hitch et al. (2001) also found these effects were larger for
reading than for arithmetic.

Towse, Hitch, & Hutton (2002) confirmed that the effects of processing speed were confounded with performance. Interpolated tasks included multiplication and addition (math tasks), and pseudohomophones and nonhomophones (word meaning tasks). Towse et al.'s (2002) results confirmed that neither the nature nor the difficulty of the interpolated task affected accuracy of recall across all age groups. Immediate feedback and low error rates, again, provided possible confounds that implicated stimulus effects as part of task difficulty. Error effects may also have been confounded with feedback where the expectations of participants affected subsequent performance. This was reminiscent of preattention and goal-directed effects in attention research (Moray, 1993; Treisman, 1993). These findings supported the detrimental effect of the duration of the interpolated task on children's performance.

Working memory capacity limitations have also been re-examined with regard to Miller's (1956) general limit of seven (plus or minus two) pieces of information. Anderson (1996) reinterpreted Miller's (1956) study and suggested that Miller's results included both storage of information in short-term memory and the cognitive processes used to report that information. Rather than Miller's capacity limitations based solely on information storage, Anderson claimed performance was affected by either decay of stored information or insufficient capacity for cognitive processes that reported the information or some combination of both information decay and processing capacity effects. In addition, empirical results limited Miller's conclusions to "unidimensional perceptual stimuli" where participants chose between two possible responses (Lacouture, Li, & Marley, 1998, p. 165). Halford et
al. (1998) proposed that working memory limitations were defined in terms of relations between items to be processed. Halford et al. cited multiple studies to support their conclusion that four pieces of information was the capacity limit for working memory during complex tasks. They suggested lowering Miller’s earlier proposed limitation from seven chunks to four within the context of complex stimuli and tasks.

In addition, working memory has been considered in terms of cognitive load and the design of instruction (Sweller, van Merrienboer, & Paas, 1998; van Merrienboer & Paas, 2003). Sweller and his colleagues defined cognitive load as the pressure on working memory to store and process information during complex tasks. They suggested that decreases in cognitive load could be achieved by simplifying tasks and increasing task difficulty over a period of time and emphasised the importance of completing simple “part-task practice” as critical for compilation and increasing automaticity (discussed in the following section on skill development) (van Merrienboer & Paas, 2003, p. 11). Completed examples, completion tasks (as opposed to production tasks) and “goal-free problems” have been specifically suggested to reduce working memory limitations and predominantly provide support to learners (van Merrienboer & Paas, 2003, p. 15). However, these suggestions provided support predominantly for cognitive processing limitations and placed less emphasis on similar supportive mechanisms that might be used for simplifying the amount of information presented. The researchers failed to focus, simultaneously, on the salient features of the materials that communicate concepts within the complex task, that is, control of the environmental stimuli or teaching examples used with learners (Engelmann & Carnine, 1982; discussed in the next section).
In summary, research into working memory capacity limitations using dual-task paradigms has suggested that working memory capacity limitations be revised downwards from Miller's (1956) seven chunks of information, possibly to four chunks of information (Halford et al., 1998). More specifically, dual-task paradigm research into complex tasks has implicated subtask difficulty, processing speed and processing time as potential variables that might impact on working memory capacity. Cognitive load theory also provides some potential directions for supporting students during complex task performance.

*Environmental Stimuli and Working Memory*

Working memory research has documented the effects of environmental stimuli. Lacouture et al.'s (1998) research in working memory capacity limitations also examined Thurstone's (1927/1994) judgements about item characteristics and the role of interference, referred to as "noise" (p. 166). Lacouture et al. (1998) used simulations and considered the effects of stimulus characteristics on response rate and nature. Results documented adverse effects on performance as a result of increases in the number of stimuli presented (Lacouture et al., 1998). Firstly, Lacouture et al. (1998) examined stimulus representation and response selection as separate components of information processing using simulations, with response selection being affected by feedback on individual items. Lacouture et al. (1998) also had limited results to simple stimuli that varied in one dimension. Next, Lacouture et al. (1998) extended stimulus effects and response selection effects to categorisation tasks and confirmed the critical importance of the number of possible responses during tasks. Therefore, Lacouture et al.'s more general (1998) findings supported multidimensional working memory and the interdependence between
storage of information (stimulus representations) and cognitive processing (response selection) as this applied to more complex stimuli.

Berch and Foley (1998) examined the effects of two types of relationships between stimuli. Firstly, they examined the presentation of particular stimuli that could be categorised within a group (termed class inclusion). Class inclusion involved the knowledge that, for example, oranges belonged to the category “fruit” while carrots belonged to the category “vegetables”. They also examined the relationships between more than two stimuli, that is between three or more stimuli that were related in one way (namely, transitive inference) (Berch & Foley, 1998). Transitive inference involved a relationship between three concepts (Halford et al., 1998). For example, two premises like “Mary is taller than Tom”, and “Tom is taller than Mark”, can be integrated into one transitive inference: “taller (Mary, Tom, Mark)”. Halford et al. (1998) suggested that class inclusion and transitive inference were of equal difficulty and that class inclusion was also a ternary relation that involved, for example, “fruit, divided into apples, and nonapples” (p. 825). However, Berch and Foley suggested that these two types of relationships between stimuli were not of equal difficulty. However, the research evidence about the relative difficulty of class inclusion and transitive inference was unclear (Foley, 1997).

Over successive trials, proactive interference effects increased, and consequently, Lustig et al. (2001) described these high reading span participants as “those who are best able to handle the proactive interference (PI) that builds up” (p. 200). Lustig et al. suggested that measures of average performance were confounded by interference. They proposed that working memory span reflected the processing
and memory of the current trial (and item), and/or the processing and memory of past trials (and items), or some combination of these. More importantly, this research direction focussed specifically on manipulating the characteristics of items presented and resultant effects on processing working memory span scores (Lustig et al., 2001; May, Hasher, & Kane, 1999). Manipulations of item characteristics included reducing similarities between items within and across trials and led to significantly increased working memory span scores (Lustig et al., 2001) and again was reminiscent of Treisman’s (1993) focus on stimulus features.

Earlier, Munsinger and Kessen (1966) had reported significant effects based on the duration of stimulus presentation and stimulus characteristics. They claimed that longer presentation duration led to qualitatively different processing of stimuli. During shorter presentations, Munsinger & Kessen proposed that participants only sampled stimulus characteristics (partially processed stimuli), rather than fully processing all of the features of stimuli in the environment. Munsinger and Kessen required participants to remember and name the category to which the presented stimulus belonged. Recent reading span measures (Daneman & Hannon, 2001) where participants were required to remember words and judge sentence meaning, were compatible. Other recent research (Doane et al., 1996) has highlighted further effects of stimuli on both information storage and cognitive processing and concurrently supported Munsinger and Kessen (1966). Doane et al. (1996) were also concerned with whether stimuli were processed completely or partially. However, while Munsinger and Kessen (1966) focussed on duration, Doane et al. focussed on accuracy and latency of responses (being the time between stimulus presentation and response beginning) for each stimulus presentation rather than duration of stimuli
presentations. Doane et al. proposed that during initial training, similarities between target stimuli and distractors resulted in more complete processing. They suggested that complete processing was stimulus-driven processing and their results supported significant differences in response accuracy and latency between treatment groups based on stimulus characteristics. After controlling for training effects, Doane et al. (1996) showed that cognitive processing of minimally different stimuli led to superior performance on transfer tasks compared to training with stimuli that were easy to discriminate (maximally different stimuli). These results were similar to Englemann and Carnine's (1982) claims about sameness and differences between stimuli and Treisman's (1993) processing of specific stimulus features.

Further supporting Munsinger and Kessen (1966), Dailey, Lovett and Reder (2001) examined individual differences in working memory capacity limitations by manipulating storage demands (numbers of digits to be recalled), processing demands (the amount of reading to be completed) and the rate of presentation. Dailey et al. proposed working memory capacity limitations were dependent on rehearsal strategies and presentation rate. More specifically, Dailey et al. suggested that presentation rate, if sufficiently fast, minimised the use of rehearsal strategies that potentially affected working memory capacity limitations. Dailey et al. explained working memory capacity limitations using both information storage (declarative representations of activated information structures) and cognitive processing (procedural representations of rehearsal of processing steps). Further supporting the interaction between storage and processing, Dailey et al. suggested that individual differences in terms of the amount of past experience (or practice)
resulted in different levels of declarative and procedural knowledge.

Earlier support for this connection between declarative and procedural knowledge came from Halford et al. (1998) who claimed that relational complexity incorporated “the number of interacting variables that must be represented in parallel to implement the process” (p. 805). They suggested that whether a task was processing serially or in parallel was determined by a detailed analysis of two components, namely how the task was performed (procedural knowledge) and the required information (declarative knowledge). Complex cognitive tasks involved transforming an input, through a series of changes, into the desired output. Halford et al. proposed that processing demand (working memory capacity) was a function of the number of parallel storage and processing variables (i.e. declarative and procedural knowledge).

In addition, and particularly critical for the current investigation, Halford et al. (1998) suggested that working memory capacity was constant in the short-term and variable in the long-term. In the short-term, Halford et al. acknowledged that a trade-off existed between task difficulty and processing demand, such that more difficult tasks required more capacity to be devoted if performance levels were to be maintained (speed-capacity trade-off). They suggested that if accurate performance were to be maintained and capacity was limited, more difficult tasks would take longer to complete. Logically, if difficult tasks were completed in the same amount of time, performance was likely to be less accurate. Therefore, by extension, if there were no limitations on capacity, increasing the difficulty of tasks would reduce neither the accuracy nor the speed of performance. However, in the long-term, Halford et al. proposed that working memory capacity was affected by practice and
pre-existing knowledge since the development of expertise led to the acquisition of both more efficient processing rules and information structures that were connected. The foundation of their argument was parallel representation of declarative and procedural knowledge. They suggested that cognitive representations could include either processing steps or information structures (or both) and that practice, over time, strengthened the relationships between both. From the perspective of cognitive load theory, Sweller and his colleagues made similar recommendations with a predominant focus on cognitive processing efficiency (Sweller et al., 1998; van Merrienboer & Paas, 2003). Their model also directly linked declarative and procedural knowledge and suggested that the efficacy of instructional programs may be affected by levels of prior knowledge (Sweller et al., 1998; van Merrienboer & Paas, 2003).

Halford et al.'s (1998) conclusions created considerable debate amongst researchers and related commentary articles. Support for Halford et al.'s findings arose from several researchers based on neural evidence (Waltz, Knowlton, & Holyoak, 1998), examples from motor movements (Nikolic, 1998), and use of embedded rules (generalised steps that applied within some complex tasks) and hierarchical organisations (knowledge of facts stored in categories) (Borisyuk, Borisyuk, & Kazanovich, 1998; Frye & Zelazo, 1998). Several researchers also queried the perspective from which relational complexity had been judged by Halford et al.: Anderson (1998), Goswami (1998), Navon (1998), Pascal-Leone (1998) and Sweller (1998). Researchers were concerned with whether relational complexity was determined externally (based on observable performance), or internally, based on goals, outsider observations, or chunk size, respectively.
(Goswami, 1998; Navon, 1998; Pascal-Leone, 1998; Sweller, 1998). For example, Anderson queried the level at which the analysis of relational complexity occurred. In questioning Halford et al.'s (1998) concept of relational complexity, Navon (1998) used the analogy of workers in a shoe factory, where either the number of shoes produced (observable output) or the number of available labour hours (available internal resources) could be used to determine factory capacity. His conclusion was that capacity, particularly in terms of the number of shoes produced (observable output) was dependent to some extent on the type of shoes that were to be made, that is, on the orders received in the factory (the goals). Navon's view was reminiscent of the goal driven effects for attention that were discussed earlier (Moray, 1993; Newell, 1990) where Moray focussed on the effects of goals on behaviour. Sweller (1998) emphasised that chunk size was a critical component of relational complexity and linked chunk size to expert performance. Supporting Halford et al.'s position for long-term performance, Sweller agreed that long-term memory was also a critical component of relational complexity.

Further supporting Halford et al.'s (1998) connection between stimulus features and cognitive processing, subsequent research in comparative visual search, specifically examined the cognitive strategy steps that might be used with complex stimuli (Pomplun et al., 2001). Pomplun et al. used variations in different stimuli, in terms of their features. Thereby, Pomplun et al. examined differences in cognitive search strategies, linking Halford et al.'s work with Englemann and Carnine's (1982) concepts of sameness and difference. Pomplun et al.'s (2001) findings supported the use of a "clustering strategy" that was distinguished from other types of search procedures based on the way that stimuli in the environment were examined. They
proposed three search procedures that differed in the way that the environment was examined during identification of complex stimuli. The clustering strategy was supported by data based on working memory constraints. It also supported the identification of complex stimuli based on the number of stimuli within the environment and, in support of Engelmann and Carnine (1982), the similarities and differences between those stimuli. Therefore, Pomplun et al.’s (2001) study clearly supported the link between stimulus features and cognitive processing, with an emphasis on stimuli and their features for determining cognitive processing within a constrained working memory capacity limitation.

In summary, research strongly supported the effects of environmental stimuli on working memory capacity limitations. Particular types of stimuli, their features, their presentation rate and their relationships to other stimuli affected both cognitive processing and the storage of information. Variations in stimuli along these dimensions were theorised to impact on both working memory capacity limitations and complex task performance.

*Potential Effects of Training on Working Memory*

Finally, several researchers noted that training in relational complexity significantly affected working memory capacity limitations and individual performance on complex tasks (Gentner & Ratterman, 1998; Goswami, 1998; Heath & Hayes, 1998; Wright, 1998). Wright (1998) supported the positive effects of general training and world experience for reducing working memory capacity limitations. However, the potential impact of specific training in particular environmental stimuli was supported by empirical evidence (Gentner & Ratterman, 1998; Goswami, 1998; Heath & Hayes, 1998). The implication from these studies
was that young students could complete more complex tasks previously thought to be beyond their working memory capacity.

Extending previous research in working memory capacity limitations, Halford et al. (1998) suggested that chunking and segmentation were two ways in which complex concepts or tasks might be simplified. Where the working memory limit was exceeded, they recommended breaking down either of the information to be presented (using chunking), or the processing steps (using segmenting), or both, to within a limit of four chunks. Within Halford et al.'s model (p.810), chunking referred to the combination of related chunks of information into functional units that included fewer dimensions ("e.g., c,a,t becomes a chunk if the three letters form a new single chunk, 'cat'"). This reduced the amount of information to be processed (in the "cat" example from three chunks, to one chunk; Newell, 1990). Segmentation referred to breaking a complex task down into several sets of processing steps that might be completed serially and would not exceed the capacity limitation, rather than processing the same steps in parallel. Using different terminology, Sweller and his colleagues supported these strategies as they recommended "part-task practice" as one way to increase the functional size of working memory (Sweller et al., 1998; van Merrienboer & Paas, 2003, p. 13)

Research results have demonstrated that children's performance in complex tasks increased following training, and suggested reductions in working memory limitations (Case et al., 1982). Effective training improved complex task performance (and reduced working memory capacity limitations) and included explicit modelling of the strategy, encouragement to use the strategy (Case, 1974), verbal rehearsal training (Bray, Hersch, & Turner, 1985; Bray, Justice, & Zahm,
1983; Cuvo, 1974, 1975; Ornstein, Naus, & Liberty, 1975; Ornstein, Naus, & Stone, 1977) and training focussing on processing speed and organisation of information (Kail, 1990). Developmentally, verbal rehearsal strategies changed in three ways. Firstly, older children were more likely to spontaneously use verbal rehearsal strategies (Hulme, Thomson, Muire, & Lawrence, 1984; Hulme & Tordoff, 1989; Kail, 1990). Secondly, over time, verbal rehearsal strategies became more selective, reaction time reduced and strategies were focussed on specific stimuli (Kail, 1990, 1995). Replicating previous research (Spring & Davids, 1988), Kail and Hail (1994) empirically documented relationships between processing speed, naming and reading comprehension. Subsequently, Kail (1995) proposed that developmental changes were accompanied by specific changes that resulted directly from experience, practice or training. In addition, Kail (1995) empirically demonstrated indirect links between processing speed and complex tasks, such as reading comprehension. Kail (1995) concluded that development led to general improvements in processing speed. Further, automaticity, as indicated by naming speed, was not a direct result of development, but of training and practice.

Summary

Research has confirmed working memory involves a system of cognitive structures and cognitive processes hypothesised to concurrently store and simultaneously process information en route to a desired goal. Capacity limitations in working memory have been documented for complex cognitive tasks. Parallel processing research and cognitive load theory both suggest that a small number of chunks of information (two to four chunks) presented at any one time represent the maximum capacity of individuals (Halford et al., 1998; Sweller et al., 1998; van
Merrienboer & Paas, 2003). Over a period of time, the types and amount of information presented in the environment potentially impacted on working memory capacity, and, therefore, the completion of complex tasks. Research has demonstrated that training in selected environmental stimuli, verbal rehearsal and recall, have had significant effects on the performance of children, and therefore, presented clear potential for informing and strengthening reading comprehension research.

Implications for the Present Investigation

Working memory research has involved individual testing of participants on various tasks. In contrast, the current investigation sought to implement a teacher-administered question-answering instructional program that targeted an entire class of students in order to develop an intervention of potential practical significance to the classroom. Also, working memory research involved stimuli that differed in a single dimension, rather than complex stimuli. The current thesis was concerned with complex stimuli (sentences and text passages) that required parallel processing. Within these inherent differences, the current study applied research on working memory to the design of materials for question-answering. More specifically, the easy-to-hard paradigm used in dual-task research (Berch & Foley, 1998; Foley, 1997; Hunt & Lansman, 1982; Lansman & Hunt, 1982) was adapted and applied to the design of materials.

Also, the principles of breaking down information into smaller parts (chunking) and breaking down complex cognitive processing into simpler steps (segmenting) were used extensively in the materials (Halford et al., 1998; Sweller et al., 1998). By varying the amount of information presented and the difficulty of
component tasks within the complex skill of question-answering, successful completion during initial instruction was more likely. Rather than students being overwhelmed by working memory limitations during typical classroom tasks, the design of the intervention facilitated successful completion of question-answering, that became increasingly difficult over time. Research examining the development of cognitive skills in children, particularly related to working memory development, has documented that children have difficulty with capacity limitations during completion of complex tasks and with organising information to be learned. To address the issue of capacity limitations, the intervention in the present investigation was designed to introduce small amounts of information with simple examples within a lesson, and provided opportunities for practice in question-answering with multiple examples. Furthermore, the selection of responses was limited to two (yes or no, selection tasks) during initial instruction, as this further reduced the working memory load for students, whilst at the same time ensuring that students were active in the learning process.

Specific features of teaching examples were purposefully varied to establish cognitive processing that facilitated transfer to new questions. Combining research on attention and research on working memory suggested that improvement in performance would result from using specific teaching examples. Therefore, teaching examples were varied in selected features that were relevant and irrelevant for specific concepts involved in question-answering. Munsinger and Kessen's (1966) results confirmed that complex stimuli, with wide variations, were difficult for younger participants to process, particularly under timed conditions. Therefore, the variations in stimulus features were controlled to reinforce the cognitive
processing linked to the source of the answer, and therefore, linked to the question types. Research supported continued use of multiple examples of concepts (concepts with relevant and irrelevant features) that resulted in cognitive processing appropriate for new, unseen questions and tasks and facilitated transfer of skills.

Given that previous research has shown that verbal rehearsal training impacts upon performance, verbal rehearsal training permeated the intervention used in the present investigation in the form of regular review and repeated presentation of information and strategy steps. The materials ensured external support was available to all students in the form of word prompts to complete cognitive steps through verbal rehearsal. The intervention design presented questions of a particular type that involved one form of cognitive processing, and verbal rehearsal of that processing using word prompts to limit working memory load. The framework of question types was related to the cognitive processing strategy through the wording of the strategy steps (see Chapter 3).

Hence, the intervention design for the present investigation capitalised on advances in working memory theory and research.

Expertise and Skill Development over Time

Previous discussion of attention and working memory research was limited to short-term events, usually within one trial or one session. However, skill development is a gradual process that takes time and involves both qualitative and quantitative changes to increasingly more efficient strategies (Anderson, 1982, 2002; Goldman, Mertz, & Pellegrino, 1989; Strayer & Kramer, 1994). The development of expert performance can take a period of ten years or more (Ericsson,
Krampe, & Tesch-Romer, 1993). Skills involve fluent coordination of perception, cognition, and action; for example, driving a car, playing musical instruments, sport, and even in reading (Bransford, et al., 2000; Chaffin & Imreh, 2002; Ericsson, et al., 1993; Langan-Fox, Armstrong, Balvin & Anglim, 2002; Proctor & Dutta, 1995).

For more than a century, researchers proposed that skill development improved with practice for a period of time, plateaued and then improved again as a result of overlearning (Bryan & Harter, 1899). More recent research has shown that episodic knowledge (specific knowledge of particular examples or personal experiences), and general knowledge were important for skill development (Anderson, 1982, 1987; Anderson & Fincham, 1994; Anderson, Fincham, & Douglass, 1997; Doane et al., 1996; Kuhn, Garcia-Mila, Zohar, & Anderson, 1995; McClelland & Rumelhart, 1985). In skill development research, three key issues have been examined, without definitive answers: the development of automaticity; networks of representations; and the impact of social interactions on skill development. These three issues are discussed in the following sections.

*Automaticity and its Development*

Information processing models differed based on definitions and relative roles of declarative and procedural knowledge (Anderson, 1993; Hiebert, 1986; Hiebert & Warne, 1986; Silver, 1986). Declarative knowledge resulted from encoding of events or stimuli from the environment. Over time, “procedural knowledge must be compiled from declarative knowledge through practice” (Anderson, 1993, p. 22). Alternatively, Newell (1990) proposed that all knowledge is procedural since representations of the network of known facts (declarative knowledge) require cognitive processing and, therefore, facts are identified directly
by those processes used to encode representations. Ongoing debates between theorists suggest there is considerable overlap in terms of movement of facts (and methods) from initially being procedurally processed (worked through step by step under conscious control) to being declaratively processed or known (worked through automatically without a large amount of control). The current thesis has not made a clear distinction between declarative and procedural knowledge as a consequence.

For the current thesis, rather than viewing declarative and procedural knowledge as separate, the overall framework of procedural knowledge was proposed to have remained intact, but, with increasing skill, the declarative network was built up over time. For example, when a child learnt a simple number fact like $3 + 4 = 7$, perhaps, initially they counted with concrete materials, moved on to counting with pictorial representations, then moved further to mentally counting procedures. Finally, when they had encountered this problem for a sufficient number of times, the solution became a “known fact” (i.e. part of their declarative network). Similarly, in learning to read, children learned initially to sound out individual words procedurally, by sounding out each letter, and with practice over time, words were automatically retrieved from declarative memory. Automatic word retrieval (declarative knowledge) had no effect on procedural knowledge used for decoding. For example, automatic decoders presented with an unknown word would revert to sounding out the word (see Chapter 3 for further details specific to reading).

The procedural–declarative conversion has been theorised to apply to more complicated processes that are part of everyday life like typing or driving a car (Adams, 1990; Bransford et al., 2000; Hiebert, 1986; Hiebert & Warne, 1986; Silver, 1986). Initially, considerable instruction was required in the “how to” for
many complex tasks but, with practice, tasks become relatively effortless and “automatic”. This metamorphosis in one’s ability to perform either a simple task or a complicated group of tasks has been theorised to involve gradual changes in the information (declarative knowledge) and steps used (procedural knowledge). Through qualitative changes, performance became more efficient and more automatic: the same end was accomplished, but the process was much smoother, faster, relatively effortless, and less prone to error. Individual differences existed between people in the time needed to improve skills, in the changes used to accomplish improvements and in ultimate levels of performance (Ericsson & Charness, 1994; Ericsson et al., 1993).

Logan (1985) considered automaticity was more than just a general improvement in skill. He defined automaticity in terms of certain properties of performance and considered performance to be automatic when it occurred quickly, effortlessly, and relatively autonomously. Logan distinguished between skill and automaticity: “automatic processes are thought to work in rather limited task environments compared to skills” (p. 368-9). Logan viewed automatic processes as specialists working on rather small aspects of a behavioural problem that the overall skill addresses. Logan suggested that skilled performance applied to broader domains by recruiting large numbers of individual skills. In clarifying this distinction, Logan proposed that skills were more than the sum of their automatic parts.

Alternative views existed to explain the development of automaticity over time. Theories of mathematical ability (Khanemann, 1973; Pellegrino & Goldman, 1987) espouse that automaticity of basic facts allowed for more attention, along with
cognitive capacity, to be devoted to higher order component processes within a
task (e.g. trading in multi-digit addition or details of a problem in problem solving).
Such reasoning has also been extended to reading (Stanovich, 1980), spelling (Juel,
Griffith, & Gough, 1986), and writing (Northwest Education Magazine, 2003). In
addition, reading comprehension models from an information processing perspective
were also built upon this foundation and will be discussed in more detail in the
following chapter (Just & Carpenter, 1992; LaBerge & Samuels, 1974).

The acquisition of automaticity has been theorised to occur through a gradual
withdrawal of attention (Khanemann, 1973). By extension, a totally automatic task
has been assumed to require no attention at all. But, for any task, some attentional
resources—even if only minimal—were needed for performance. Alternatively,
Logan (1988) assumed that no task was ever purely automatic. Attention, alone, was
insufficient to determine automaticity—other factors affected an automated task,
such as physical ability, number of trials or practices, method used to acquire skills.
Logan argued that automaticity involved memory retrieval and reflected “a
transition from algorithm-based performance to memory-based” (p. 493), and this
change paralleled procedural to declarative changes. However, Logan’s theory
claimed that each “instance” (occurrence) of a stimulus resulted in obligatory
encoding of the stimulus and obligatory retrieval of all past instances, and that all
instances were separately encoded, stored and retrieved (p. 492). Logan proposed
that automaticity resulted from increases in available information that was retrieved
since all previous instances were retrieved from memory when the stimulus was next
presented.

Rather than a withdrawal of attention, Logan focussed on the amount of
available information, which was determined by the number of previous presentations or instances (that is, through practice). Logan suggested that the number of instances or contacts with a fact or concept increased available information and, consequently, increased automaticity. While this had some merit, no mention was made of potential links between facts and possible applications of generalised rules to new facts or new situations. Logically, if a rule was taught and its execution became automatic, then its application to new facts, not previously encountered, affected the processing time of those facts. Basic to Logan’s theory was the consistent presentation of an identical stimulus, a notion which in practice seems naive. Also, Logan assumed that every identical presentation of that stimulus resulted in an identical trace of memory being set up. Each trace was proposed to be totally separate and independent of all other traces.

An alternative interpretation, in line with Logan’s (1988) distinction between skills and processes, might be to refer to individual letter sound knowledge or word knowledge as becoming increasingly automatic. In addition, the skill of automatic word reading or sentence understanding may be increasingly automatised through such rules. Whether knowing individual letters or words or word meanings was considered to be an automatic process or a skill was not clear. However, the hierarchical nature of the information presented (building hierarchically from individual letters to words and phrases then to sentences) was, again, reminiscent of Treisman’s (1993) and Moray’s (1993) views of attention and the chunking processes from working memory research (Halford et al., 1998; Sweller et al., 1998).

Logan’s (1988) theory took no account of possible effects of different types
of practice or the sequence used in practice for automaticity, nor of maintenance of automaticity. Rather, the only determinant of automaticity was the number of instances. Research evidence confirmed the role of practice, review and maintenance in ensuring retention of automatic skill levels (Brophy & Good, 1986; Hasselbring et al., 1988; Lloyd & Keller, 1989; Rosenshine & Stevens, 1986). In addition, research has reinforced the importance of “deliberate practice” possibly over considerable periods of time, even years, for expert performance, implying automaticity, to develop (Ericsson et al., 1993; Sloboda, Davidson, Howe, & Moore, 1996).

Logan (1988) claimed that automaticity was stimulus specific and situation specific. However, the notion that automatic recall was situation specific implied that increases in automaticity of facts or knowledge, for example addition facts or letter sound knowledge, did not result in any effects on other mathematical or reading skills. This conflicts with a relationship well documented in mathematics research (Fleischer, Garnett, & Shepherd, 1982; Resnik, 1983; Russell & Ginsberg, 1984) and reading research (Denton, Vaughn, & Fletcher, 2003; Elliott, Lee, & Tollefson, 2001; Good III, Simmons, & Kameenui, 2001; Kaminski & Good III, 1998). The treatment of similar stimuli that represented the same knowledge (in visual or aural modes), how these similarities were accounted for in encoding and retrieval, and the effect of automaticity were not explained within Logan’s model. For example, Logan’s model provided for no link between related stimuli, for example, lower case and upper case letters, yet intuitively, some relationship existed in memory between related facts and knowledge.

Another viewpoint concerned the strengths of memory traces for individual facts (Schneider, 1985; Schneider & Detweiller, 1987; Schneider & Detweiller,
1988; Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977; Strayer & Kramer, 1990). Rather than using additional examples of each fact as proffered by Logan (1988), the strength model proposed that each successive presentation of a stimulus was encoded in an identical memory set and that the connection to this memory set became progressively stronger with more presentations. Shiffrin and Schneider (1977, p. 131) used “consistent mapping” to refer to repeated presentations of the same stimulus in the same conditions with the same response that increased automaticity. In contrast, Shiffrin and Schneider (1977, p. 132) defined “varied mapping” to refer to differences in situations and conditions that affected stimulus-response relations and where the memory trace was “so weak that the algorism finished prior to direct memory access” (Strayer & Kramer, 1990, p. 291). Again, the criticism levelled at Logan about the naivety of identical stimulus presentation applies equally to consistent mapping. Ackerman (1988) defined an alternative view of consistent mapping in terms of the consistency of presentation and the variability in participant performance. In addition, Ackerman suggested that motivation may impact on performance during skill development.

Recent research has built upon this foundation research into automaticity, and examined response rates in general, along with relations between response rate, intelligence, “cognitive speed” in social interactions (Fulford, 2001, p. 31) and skill development over time (Fulford, 2001; Rabbitt, Osman, & Moore, 2001; Roberts & Newton, 2001; Roberts & Pallier, 2001). Rabbitt et al.’s (2001) conflicting results were reported for speeded tasks across individuals within a group and for individual participants during a single session. Research involved average reaction times in choice tasks and the effects of stimuli on reaction times (Rabbitt et al., 2001;
Roberts & Newton, 2001; Roberts & Pallier, 2001). For timed tasks, Rabbitt et al.'s results indicated that participants who were less able and who were older had a greater range of performance than participants who were younger and more able. In addition, variability in performance, from trial to trial, was highly correlated with variability in performance from session to session. Results documented significant effects of practice. During initial practice responses were slow, with large variations between trials as participants attempted to determine the most effective steps for making inferences. With subsequent practice, as participants selected specific steps that gradually proved to be effective across examples, they responded faster and became less variable. Rabbitt et al. claimed that participants used these initial trials to practise and deliberately controlled their cognitive processing. Furthermore, Rabbitt et al. suggested that response rates benefited from previous error responses and that those errors slowed processing in order to improve accuracy.
Roberts and Pallier (2001) documented patterns of performance across ten choice tasks similar to those used by Rabbitt et al. (2001). Roberts and Pallier separated response rates into “movement time”, the time taken for sensory and motor components of information processing, and “decision time”, the time taken for the cognitive processing used to determine the response (p. 281). They examined the validity of within-individual scores and between-individual scores for ten measures that reflected “elementary cognitive tasks”, including sentence verification tasks (Hunt & Lansman, 1982). Roberts and Pallier’s results questioned the validity of within-individual differences and documented the potential role of practice for across session and across task variations in performance changes. Validity concerns for within-individual differences were dependent upon similarities in the modes for presenting stimuli and responding to stimuli, termed “dimensional-overlap” (p. 312). Roberts and Pallier confirmed the validity of mean performance levels for all ten speeded tasks and strong correlations with intelligence test performance.

In addition, response rate has been examined in relation to inspection times and response selections for stimuli (Roberts & Newton, 2001). Roberts and Newton noted inadequacies in information processing models using mental models (Johnson-Laird, 1985; Johnson-Laird & Byrne, 1991) and deduction rule-based theories (Anderson et al., 1997; Rips, 1994) and proposed that cognitive processing in reasoning and making inferences occurred in two stages: “preconscious heuristics” and “conscious analytic processes” (p. 1032). Rather than examining automaticity in isolation, Roberts and Newton suggested that analytic processes were only applied after attention was directed automatically to certain stimuli as a result of preconscious heuristics. They suggested that preconscious heuristics were
goal-directed and focussed attention on specific stimuli. Roberts and Newton claimed that support for automatic use of preconscious heuristics arose from “matching bias” results where participants were directed to particular stimuli mentioned in instructional rules presented prior to the selection task (p. 1032).

Reminiscent of Treisman’s (1993) preattentional processes that controlled attention by advance presentation, the automatic nature of preconscious heuristics increased inspection times on selected environmental stimuli related to goals.

However, this automatic sequence of behaviours (advance information presentation, preconscious heuristics, selection following longer inspection times) occurred only under timed conditions that required a rapid response (Roberts & Newton, 2001). Roberts and Newton claimed that this pattern of responses resulted from incomplete representations during early practice that became more complete with practice over time. They claimed that the incomplete representations caused slower, less reliable responding during early learning. Their conclusions suggested qualitative differences in cognitive processing that were dependent on the timeframe for task completion. Roberts and Newton suggested that responses to timed tasks were affected by incomplete representations, as the timeframe precluded complete representations. However, Roberts and Newton proposed that either encouragement or the context of a free-time task led to more complete representations and that correct responses were more likely. Therefore, this research reconfirmed the role of practice and the importance of prior presentation, particularly under timed conditions, for improving automaticity and directing attention to particular stimuli to elicit desired responses within different contexts and purposes.

Fulford (2001) proposed a model of cognitive speed which drew together
language, reading and cognitive research with potential impacts on a range of communication systems including oral communication, reading comprehension, lecturing, computer technology and radio and television commercials. Fulford proposed that cognitive processing speed was similar to the frequency of radio or sound waves or the rate of play of an audiotape, in terms of the amount of information that can be sent or received. She suggested that cognitive processing speed was measured in words per minute and paralleled reading fluency research (see Chapter 3). Not focussing solely on rate, Fulford included comprehension defined as “the act of grasping an idea through listening or reading” (p. 32) and linked this model to Carver’s (1992b) rauding model of reading. She combined empirical findings on speech rates (“average of 125-150 wpm”) with internal conversations that included self-monitoring and involved a speaker thinking about what he or she is saying or a listener thinking about what is heard (p. 33). Fulford proposed that internal conversations occurred at the same rate as speech, and, when combined with the speech rate during an interaction or conversation, resulted in conversation that flowed at a rate between 250-300 words per minute. Fulford theorised that one way communication, for example listening to audiotapes or reading, was able to be completed at this rate.

In addition, Fulford (2001) explicitly linked this model to the provision of instruction in classrooms and lectures with research on working memory capacity. She hypothesised that presenters provided information to their class at average speech rates and suggested that capacity was available for interested students to monitor for understanding of content and ask questions about how presented information linked with existing, prior knowledge. However, available cognitive
capacity was potentially used for thinking about content or topics (other than what was presented) as bored students minimised their attention to the lecture or class instruction. Fulford placed the responsibility for maximising attention on the presenter (teacher or lecturer), and indirectly on classroom activities and materials. She suggested that the presenter’s goal was to present information at the appropriate rate to fully engage available cognitive capacity. Where this occurred, Fulford claimed that internal conversations facilitated interactions between newly presented content and existing student knowledge. Fulford’s view confirmed the importance of social interactions discussed in the following section on skill development.

Finally, promotion of automaticity has been recommended within a model of complex task performance that promoted “part-task practice” (van Merrienboer & Paas, 2003, p. 11). Part-task practice was especially critical for recurrent skills, defined as skills that follow rules and are consistently presented. During complex tasks, van Merrienboer and Paas’ recommended that automaticity should be developed through both strengthening and compilation (Anderson, 1996, 2002), similar to Halford et al.’s (1998) chunking process. In agreement with the literature supporting the importance of distributed practice, van Merrienboer and Paas confirmed that the quality and quantity of practice was critical for establishing automaticity of declarative and procedural knowledge.

*Skill Development and Expert Knowledge Representations*

Differences between novice and expert performance have been well-established by previous research (Bransford et al., 2000; Chaffin & Imreh, 2002; Ericsson & Charness, 1994; Rikers, Schmidt, & Boshuizen, 2002). Such differences reflected the qualitative and quantitative changes that occur over time, including the
development of automaticity. Information processing models suggested mechanisms for these changes over time, beginning with a focus on lower level skills incorporated into a hierarchy of skills and knowledge over time (Anderson, 2002; Newell, 1990).

While practice was implicated as critical during skill acquisition and the development of expertise, specific mechanisms for the changes in skill performance over time were uncertain (Haider & Frensch, 1996). Qualitative and quantitative changes were documented in terms of automaticity (Logan, 1988; Logan & Klapp, 1991), in terms of increasingly efficient performance in components of individual tasks (Anderson, 1982; Anderson & Fincham, 1994) and efficient completion of increasingly larger sequences of tasks (Anderson, 2002; Newell, 1990) or some combination of these effects (Anderson, 1987; Haider & Frensch, 1996). During skill development, practice focussed on cognitive processes and documented ways that change skills from being procedurally completed to becoming declarative (Anderson, 1987).

In addition, research has documented effects on "which information is processed" and how this changes during skill acquisition (Haider & Frensch, 1996, p. 306). As with alternatives of instances (Logan, 1985, 1988) and strengths of connections (Schneider, 1985; Schneider & Detweiller, 1987; Schneider & Detweiller, 1988) outlined earlier, Haider and Frensch proposed that skill acquisition moved beyond both instance and strength views and toward perceptual views (Gibson, 1965, 1976; Gibson & Levin, 1975). Haider and Frensch suggested that increasing sensitivity to environmental cues led experts to focus on different types of information, and that experts use less information during processing (Bransford et
al., 2000). Further, this information was not dependent on the specific stimuli used, but on the strategy components that developed gradually during sustained, long-term practice. Supporting this view, additional research confirmed the interplay between stimulus-specific and general strategy information demonstrated by improved performance based on transfer tasks (Doane et al., 1996; Doane et al., 2000).

The interaction between declarative and procedural knowledge was documented by working memory research in the previous section. The interaction between information and processing has been documented also in terms of knowledge and problem solving strategies used by experts and novices in map reading (Anderson & Leinhardt, 2002). Anderson and Leinhardt used maps as “external representations” and examined how maps were used to learn concepts presented in geography. Their research focussed specifically on the interaction between the network of expert knowledge representations in maps (declarative knowledge) and the cognitive problem solving strategies used by experts (procedural knowledge). After acknowledging clear differences between expert and novice performance, their emphasis was on the role of teachers in establishing declarative and procedural knowledge in students using multiple examples of task completion to demonstrate rule-based strategies. Anderson and Leinhardt’s (2002) conclusions confirmed that effective instruction involved teachers using their own detailed, domain specific knowledge, cognitive strategies and deliberate, multiple practice examples for students. In addition, Anderson and Leinhardt confirmed the critical importance of relating these examples to the real world.

Also focussing on knowledge representations, Rikers et al. (2002) confirmed
the critical interaction between information and processing demonstrated by experts’ performance, using medical practitioners. Rikers et al. defined subexperts as those who had a large amount of declarative knowledge, but very little experience in their field. In contrast, experts used both detailed declarative knowledge and numerous past experiences. They examined the performance of experts, subexperts and novices and found significant differences in recall performance and in the effects of time. Rikers et al. defined “knowledge encapsulation” to include expert cognitive structures that clustered together large numbers of related concepts in rich networks (p. 27). Their research empirically documented that recall by experts included inferences from a detailed knowledge network that were only possible from many hours or years of deliberate practice (Ericsson et al., 1993). Rikers et al. showed that expert performance was significantly different to novice and subexpert performance, particularly under timed conditions.

Research into expert performance and skill development has also examined the effects of general world knowledge and domain specific knowledge in complex skill performance (Alberdi, Sleeman, & Korpi, 2000). Alberdi et al. used Wisniewski and Medin’s (1994) view of “knowledge as selection” performance (Alberdi et al., 2000, p. 56). Rather than selection of previous knowledge, Wisniewski and Medin (1994) proposed that specific prior knowledge and general background knowledge interacted in complex ways during category formation. The presentation of “meaningfully labelled exemplars” (Alberdi et al., 2000, p. 56) to children provided prior knowledge that enabled participants to categorise further examples according to exemplar categories (Wisniewski & Medin, 1994). Wisniewski and Medin (1994) had expected that subsequent exemplars would be
categorised based on surface features of categories of examples. However, they found that subsequent examples were categories based on abstract features of exemplars, rather than surface features, that were qualitatively different from participants who had no prior presentations (Wisniewski & Medin, 1994). This work confirmed the significant effects of prior presentation of categories of concepts for improving student performance in complex tasks that used those categories.

The presentation of positive and negative examples of concepts has been documented to be a critical component in effective instruction on concepts and skill development over time (Bruner, 1960; Engelmann & Carnine, 1982; Niedelman, 1991; Thorley, 1987; Thorley et al., 1991). Positive examples are defined as those examples that contain certain features while negative examples do not contain those features (Engelman & Carnine, 1982). Supporting the importance of example selection, research reported that participants searched for common features among positive and negative examples of categories (Korpi, 1988). Korpi used think aloud protocols (Ericsson & Simon, 1984/1993) and categorisation of common everyday concepts (e.g. “cow”) into informal categories (e.g. a place where you get milk, an animal with a tail, a circus animal, cold things).

Lending further support to this approach, Alberdi et al. (2000) reported empirical results that combined Korpi’s (1988) use of general background knowledge with specific domain related knowledge using participants that were “professional scientists” (p. 85). Although their participants were experts in their field (botany), Alberdi et al. used “puzzling items and ill-defined categories” that were novel to the experts (p. 85). Their findings called for further research into the complex interactions between strategy use, general knowledge and specific domain
knowledge. This work highlighted both the rich connections in the knowledge representations of experts and also the hierarchical nature of those connections (Alberdi et al., 2000). Just as hierarchical levels were evident in attention research (Moray, 1993; Treisman, 1993), Alberdi et al. documented that participants made hierarchical links between function (places where milk is made) and higher order categories. This increasingly abstract hierarchical structure was built from a foundation in concrete, real world examples (Engelmann, 1980; Engelmann & Carnine, 1982; Thorley, 1987). It was this initial connection to the real world (through simple, clear examples) that was gradually internalised, organised (into increasingly higher order concepts) and, over time, developed into the knowledge representations of experts (Ericsson & Charness, 1994; Ericsson et al., 1993; Newell, 1990). The hierarchical order was established using the concepts of sameness and difference, where concepts were included in hierarchically higher categories based on the inclusion of at least one common characteristic (Engelmann & Carnine, 1982).

More specifically, recent cognitive load research has suggested implications for instructional design that involve the provision of cognitive scaffolds to support learners and decrease the effects of cognitive load (Sweller et al., 1998; van Merrienboer & Paas, 2003). Extending Berch & Foley’s (1998) dual-task paradigm to long-term learning, van Merrienboer and Paas proposed “simple-to-complex sequencing of categories of learning tasks” (p. 14). Parallelling the dual focus from attentional research on specific and strategic attention (Moray, 1993; Treisman, 1993), van Merrienboer and Paas proposed that, within one type of cognitive learning task, multiple examples with a range of features were presented. More
importantly, they also proposed that different types of cognitive learning tasks should be sequenced from easy to hard in order to gradually increase the cognitive demands on learners over a period of time, and as their automaticity of part-task completion increases. This work supported previously presented emphases on hierarchical, increasingly abstract task and stimulus features from information processing models (Anderson, 2002; Newell, 1990) and selection and sequencing of positive and negative examples from direct instruction research (Engelmann & Carnine, 1982).

In summary, research into the development of automaticity and skill development confirmed the interaction between declarative knowledge (information) and procedural knowledge (processing) raised in working memory research. In addition, both automaticity and skill development were found to be empirically grounded in sustained and deliberate practice, over a significant period of time, that developed rich networks of related knowledge and processing. Over time, the use of easy to hard examples of both declarative knowledge and procedural knowledge was empirically supported. These conclusions from research into skill development, mediated by automaticity, have potential for the development of similar expertise in question-answering and in instructional programs.

The Role of Social Interactions in Skill Development

From an information processing perspective, cognitive processes are considered both interactive and dynamic, with learners being able to consciously alter their own cognitive processes (Luria, 1982; Rumelhart & Norman, 1985; Ward, 2002). Cognitive processing (procedural knowledge) has been described as a series of steps that could be altered, was able to be simulated (for example, by computers)
and was able to be presented as a set of facts to be learned (Rumelhart & Norman, 1985). Therefore, information processing models potentially provided a comprehensive theoretical foundation for effective instruction in procedural knowledge (Anderson & Lebiere, 1998; Newell, 1990; Sweller et al., 1998).

In the current thesis, features of the intervention paralleled “Newell’s bands of cognition”, from the cognitive band through to the social band (Anderson, 2002, p. 3; Newell, 1990). Newell’s bands examined tasks in terms of the amount of time taken for cognitive processing and responding. In real time, the biological band included tasks measured in milliseconds, and the upper end of the cognitive band was proposed to include “the interval of a unit task (10 seconds)” (Anderson, 2002, p. 5). Anderson supported the link between unit tasks and Newell’s “intendedly rational band” of cognition that took minutes and hours of instruction and was more typical of educational outcomes in schools (p. 150). Therefore, in the same way that expert knowledge representations were organised hierarchically (Alberdi et al., 2000; Engelmann, 1980; Engelmann & Carnine, 1982; Thorley, 1987), Newell’s bands of cognition were organised hierarchically in terms of cognitive processing (Anderson, 2002).

Newell (1990) proposed that cognitive systems determined responses based on the environment and its goals “without regard to the way in which the internal processing accomplishes the linking of actions to goals (of means to ends)” (p. 150). Newell supported the importance of prior knowledge that included both declarative and procedural knowledge. Social bands of cognition were proposed to extend across days, weeks and months, and focussed on the interactive effects of others in determining both cognitive processing and observable responses (Anderson, 2002).
Newell debated the existence of higher levels such as the social band, historical band and evolutionary band. Luria’s (1982) model of rational behaviour was similar to Newell’s model into these upper (social) bands. Heavily influenced by Vygotsky, Luria proposed that social interaction provided the basis for “higher psychological processes” (p. 4).

Luria (1973, 1982) claimed that rational, observed behaviour developed out of gradual internalisations of interactions between one person and another, beginning with a child and an adult, usually mother and infant. Luria proposed that repeated social interactions led to conscious, goal directed behaviour within the external environment. Early in life, Luria suggested that these interactions were described as “ongoing social interaction which involves the communication of information from one person to another” (p. 154). Early language development provided many examples of echolalic responses, where the child merely repeated what the adult had said (Thorley, 1987). Luria’s (1982) internalisation of social interactions was interpreted as an extension of Newell’s (1990) bands of cognition that was “grounded in humans as physical systems in a dynamic world” (p. 42).

Viewing the environment as dynamic, Newell’s (1990) cognitive bands also described behaviour as a series of response functions related to environmental changes over time. These changes in environmental stimuli interacted with the goals of the human organism and resulted in purposive, goal-driven sequences of behaviours. Luria (1982) proposed that development over time resulted in qualitative changes in brain functions to meet goals. Luria (1973) claimed that over time brain functions involved multiple components acting together in a coherent way to achieve a certain goal. Therefore, Luria’s (1973, 1982) view of social
interactions confirmed the importance of environmental stimuli and their features instead of behavioural approaches to learning (Mackintosh, 1994, 1997; Thorley et al., 1991). Rather than simple mapping of a stimulus with a specific response, Luria (1973) proposed a "hierarchical structure" of cortical functioning that involved multiple cognitive processes for higher (abstract) levels of functioning (p. 74-5). He suggested a synthesis of cognitive processes, where conscious activity involved intentions and plans verified by "comparing the effects of his actions with the original intentions and correcting any mistakes he has made" (p. 80). Luria's model of rational thought proposed that environmental stimuli simultaneously affected multiple component cognitive processes that operated in parallel with ripple effects across a range of knowledge structures, including both declarative and procedural knowledge (Ward, 2002).

Also from a social interaction perspective, an alternative view of skill development focussed on the impact of motivation and goals (Ackerman, 1988; Langan-Fox et al., 2002). Building from models of automaticity previously presented, Langan-Fox et al. formalised skill development into three phases that emerged over a considerable period of time and were increasingly governed by automatic processing and strength views of automaticity (e.g. Schneider & Shiffrin, 1977). However, Langan-Fox et al. considered that previous models of skill development had focussed predominantly on internal process changes during skill development, to the exclusion of critical external influences that also affected the development of skilled performance. Influences like goals, emotions, motivation, and interruptions to long-term practice were proposed as potentially affecting the course of skill development.
In particular, Langan-Fox et al. (2002) reconfirmed the research evidence favouring distributed practice over massed practice (Krug, Davis, & Glover, 1990; Sloboda et al., 1996). Langan-Fox et al. suggested that different cognitive processing occurred during distributed practice compared to massed practice. In addition, supported by Mumford, Costanza, Baughman, Threlfall, & Fleishman, (1994), Langan-Fox et al. claimed that greater benefits were evident for distributed practice of complex tasks. Differential effects for interruptions were highlighted whereby interruptions were defined as external events that break focus on a task and demand immediate attention (Langan-Fox et al., 2002). In businesses, Langan-Fox et al. defined interruptions to include events like phone calls, email messages, deliveries and consultations with colleagues. In classrooms, Langan-Fox et al. suggested that interruptions included bells ringing, student talking, school messages, organising materials, truancy, tardiness and absenteeism. Such interruptions significantly reduced the amount of available instructional time in classrooms (Rosenberg, O’Shea, & O’Shea, 2002). Researchers have reported that interruptions have a significant adverse effect on complex task completion, and, in contrast, a potentially positive effect on simple task completion (Speir, Valacich, & Vessey, 1999). Langan-Fox et al. linked conclusions about interruptions to their proposed three stage skill development model, and explained results based on increases in automaticity affecting performance of complex and simple tasks. As simple skills were always performed at automatic levels, Langan-Fox et al. suggested that, rather than task complexity, it was the level of skill acquisition that determined the effects of interruptions on performance.

Finally, van Merrienboer and Pass (2003) outlined a model that proposed
when and how different types of information and processing by novice learners might be supported during the acquisition of complex skills. In order to align instruction with a theoretical cognitive architecture, the development of complex skills required that some information and skills be provided prior to task completion and other information and skills be supported during task completion. Prior to task completion, some information (possibly possessed by learners from prior experiences) was highlighted. In contrast, “procedural information is best presented when learners need it” and, therefore, prompted during task completion (p. 16). Van Merrienboer and Pass further suggested that prompts applied during task completion should be faded out over time as learners become less reliant on support. They suggested that repeated practice on simple subtasks, within a complex task, reduced the cognitive load of information storage and on-line processing in the longer term.

Summary of Expertise and Skill Development

From the perspective of skill development over time, researchers have confirmed the critical importance of environmental stimuli. Changes in performance that accompanied the development of skill and expertise were shown to be determined by previous experiences with particular stimuli, specific successful responses and subsequent social interactions related to the goals and purposes of the learner. Qualitative and quantitative changes in performance over time, associated with increasing automaticity, were reminiscent of the speed-accuracy trade off described earlier in relation to working memory research. The current study, focussing on the complex skill of question-answering, applied research findings in skill development to the design of the intervention materials.
Implications for the Present Investigation

The classroom environment involved Newell’s (1990) dynamic environmental conditions and, within that environment, Luria’s (1973, 1982) social interactions. The focus taken in the current thesis was to provide external representations for the knowledge structures and cognitive processes used during question-answering to facilitate the introduction of increasingly complex examples across lessons. The (classroom) environment included specific aspects of the materials, namely teaching examples, strategy steps and lesson format. The materials provided multiple examples of “unit tasks”, completed in about 10 seconds, within the cognitive band (Anderson, 2002, p. 3). Each cognitive strategy step was considered a unit task, and the set of steps was an application of “model tracing” with a “sequence of productions that produces behaviour exhibited by the student” (Anderson, 2002, p. 4). Declarative knowledge was explicitly presented in the materials using teaching examples, while procedural knowledge was explicitly presented in the cognitive steps outlined for answering different types of questions, with procedural prompts provided during completion of examples.

The lesson format provided opportunities for structured social interactions between the teacher and the class, as a whole, and the teacher and individual students. These interactions corresponded to the sequence of social interactions, in line with Luria’s (1973, 1982) model and Newell’s (1990) “social band” (Anderson, 2002, p. 1). Within the lesson format, social interactions focussed on small components of the cognitive task and small amounts of information related to presented passages and questions. At the same time, these structured interactions reflected participant goals. The teachers’ goal was to provide effective instruction in
how to answer a question, while the students' goal was to write answers to questions.

Capitalising on research demonstrating that automaticity is acquired through training and purposeful practice, the intervention for the current investigation also included practice in question-answering with multiple examples. Over time, the materials provided opportunities for planned practice at lower levels, practice in completion of component tasks, and opportunities for specific feedback about steps in the cognitive strategy (Sweller et al., 1998). Successful practice of component tasks and simple examples eliminated small strategy steps as potential errors when the more complex examples were presented in later lessons. Providing opportunities to practice specific examples and specific cognitive processes (termed "knowledge tracing") can be contrasted "to giving students more general practice" (Anderson, 2002, p. 5). More specific practice and feedback was predicted to result in effective learning of direct relationships between stimuli (questions, passages and answers) and more detailed declarative and procedural knowledge (Anderson, 2002; Ericsson et al., 1993; Haider & Frensch, 1996; Logan & Klapp, 1991). This contrasts a critical feature of the materials in the current study to the general practice in previous research on question-answering instruction (see Chapter 3).

In addition, expert performance was facilitated by distributed and deliberate practice over a considerable period of time, particularly for complex skills, like reading comprehension and question-answering. Therefore, the intervention was designed to provide more deliberate practice, focussed on specific question features over a longer period than had been previously reported in question-answering research (see Chapter 3).
Chapter Summary

The current study was concerned with the processing of simple to complex information (in questions), the simultaneous storage of that information (question words/meanings) while processing more complex information (passages of text), and the matching of the requirements of the question with either the information in the passage or relevant background information (from long-term memory). This chapter has provided an overview of the scientific evidence for embedding the current study in the theoretical foundation of information processing models and capitalising on previous research that was the foundation for the design of the intervention. Therefore, this chapter has demonstrated the theory and research that underpinned the development of the potentially powerful question-answering intervention utilised in the present investigation.
CHAPTER THREE:

PERSPECTIVES FROM RESEARCH ON READING AND QUESTION-ANSWERING

The current chapter defines reading and provides an overview of selected reading and reading comprehension research from an information processing perspective. Firstly, historical and current perspectives on reading and reading comprehension are discussed. Secondly, relevant research in question-answering and question types is outlined in relation to the current study. Thirdly, research in comprehension strategies and strategy instruction is reviewed. This section includes strategies used by students during classroom tasks and when sitting standardised tests. Finally, there is a critique of specific intervention studies related to the question types used in the current study. Implications of the relevant research for the present investigation conclude each section of the chapter. Hence, the purpose of this chapter is to demonstrate that the intervention developed for the present investigation was based on extant theory and research in reading and reading comprehension.

Research on Reading and Reading Comprehension

*Background Context for the Current Study*

Considerable research and debate across all media have attested to the crucial role played by reading for everyday functioning in modern societies. Reports of Australian adult literacy have documented that many adults have significant
difficulties understanding what is read (McLennan, 1997; Skinner, 1997). A convergence of scientific evidence from a broad review base has led to the identification of four key components of reading skills: Phonemic skills, vocabulary, reading fluency and comprehension (NICHD, 2000a). Identification of these four key components has emerged predominantly out of research on beginning reading and the prevention of difficulties in learning to read (Abbott, Walton, & Greenwood, 2002; Denton et al., 2003; Elliott et al., 2001; Good III et al., 2001; Kaminski & Good III, 1998; Snow, Burns, & Griffin, 1998). In addition, a complex picture of cognitive functioning relevant to reading has emerged from recent neurological advances (Johnson et al., 2002) and theory-based research (Coltheart, 2000; Coltheart et al., 2001; Hannon & Daneman, 2001; Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003).

Technological innovations and abundant research findings have had uncertain effects on classroom practice (Joseph et al., 2001). A recent teacher survey has noted similarities between reading instruction in the 1960s and the 1990s, with only minor changes in classroom instruction (Baumann, Hoffman, Duffy-Hester, & Ro, 2000). Replicating Austin et al. (1963), Baumann et al.’s study concluded, in agreement with authors forty years earlier, that reading instruction needs to continually evolve to meet student demands over time. Similarly, Durkin’s (1978-9) early calls for explicit instruction were supported subsequently by a number of reviews of comprehension research (Dole et al., 1991; Durkin, 1990; Fielding & Pearson, 1994; Pearson, 1985; Pearson & Fielding, 1991; Pearson & Raphael, 1990; Pressley, 2000; Pressley, Brown, El-Dinary, & Afflerbach, 1995; Rosenshine & Meister, 1994). Within the context of recent developments in accountability (e.g.,
No Child Left Behind Act, introduced in 2000 in America), the demand for effective classroom instruction in reading and reading comprehension has never been greater.

_Perspectives and Definitions of Reading_

Reading purposes have changed over time. Historically, researchers have agreed that reading included both decoding and comprehension skills. However, over time, repeated debates focussed on the relative emphasis on either decoding or comprehension during different stages of reading development, rather than the interrelationships between decoding and comprehension. Beck (1981) concluded that reading instruction during the early 1900s was directed towards word pronunciation skills and fluency in oral reading. Huey’s (1908/1968) classic view of reading was:

> Perceiving being an act, it is, like all other things we do, performed more easily with each repetition of the act. To perceive an entirely new word or other combination of strokes requires considerable time, close attention, and it is likely to be imperfectly done, just as when we attempt some new combination of movements, some new trick in a gymnasium, or a new ‘serve’ at tennis. In either case, repetition progressively frees the mind from attention to details, makes facile the total act, shortens the time, and reduces the extent to which consciousness must concern itself with the process.

(p.104)

A subsequent critique of reading definitions by Gray (1937) confirmed the directions raised by Huey’s (1908/1968) view, which remains relevant for the current study. Gray defined reading as the process of recognising visual or written symbols and also understanding what is read. Gray assumed that readers recognised
important ideas, reflected on those ideas, critically evaluated ideas, and clarified relationships between ideas. Kirk (1940) noted that the dual focus in Gray’s definition included narrow focus on decoding, and a major emphasis on comprehension of text meaning. Kirk outlined the gate-keeping role of decoding processes (as we would refer to them today), stating: “there can be no critical evaluation of reading material until one ‘gets the thought’ from the printed symbols” (p. 131).

Public opinion on reading methods fuelled the early debate about reading instruction (Flesch, 1955). Flesch’s focal issue was the relative emphasis on decoding rather than comprehending in classroom reading instruction. Rejection of Flesch’s arguments lead to Austin at al.’s (1963) review of classroom reading practices (“The First R” study) and Jeanne Chall’s (1967) synthesis of reading research, “The Great Debate”. Chall’s conclusions, favouring a method of reading instruction emphasising decoding, particularly for beginning reading, had minimal effect on the debate. Controversy was fuelled further by instruction focussed predominantly on meaning rather than on decoding (Goodman, 1965, 1976a, 1976b; Smith, 1978). A view of reading and reading instruction based on meaning, termed whole language, persisted, despite the lack of empirical scientific evidence (Almasi, Palmer, Gambrell, & Pressley, 1994; Andrews, 1989; Hempenstall, 1996a, 1997b; Nicholson, 1997; Stahl, McKenna, & Pagnucco, 1994; Tunmer & Chapman, 1996). Neither recent theoretical views of reading (Coltheart, 2000; Coltheart et al., 2001; Spear-Swerling, & Sternberg, 1994) nor empirical evidence (Snow et al., 1998) have favoured whole language reading strategies that predominantly focussed on meaning emphasis approaches (Castle, Riach, & Nicholson, 1994; Hempenstall, 2003;
Nicholson, 1997; Stahl et al., 1994; Stanovich, 1980, 1990). In addition, from a scientific view, critical methodological weaknesses have been elaborated that questioned Goodman’s (1965) original conclusions and consequent instructional implications (Castle et al., 1994; Nicholson, 1991, 1993). Well–designed replications failed to report results consistent with Goodman’s original findings and did not empirically support this approach to reading instruction (Castle et al., 1994; Nicholson, 1991, 1993).

While the goal of reading and reading instruction was universally grounded in meaning, common threads through reading debates indicated that reading involved the translation of information and ideas from written stimuli or symbols into some other forms of knowledge, be it cognitive, oral or written (Adams, 1990; Gibson & Levin, 1975; Mackay, 1985; Sidman, 1971). Written text was the environmental input into the reading process, along with the reader’s existing world knowledge (e.g., prior knowledge, see Chapter 2) and cognitive processes. Difficulties in operationalising reading definitions reflected the varying approaches of reading researchers and the purposes of their research (Mosenthal & Kamil, 1991).

Building upon an earlier model of Gough and Tunmer (1986), the “simple view” of reading proposed that reading comprised decoding multiplied by linguistic comprehension (Hoover & Gough, 1990, p. 127; Hoover & Tunmer, 1993). Reminiscent of earlier authors (Gray, 1937; Kirk, 1940), this model acknowledged both the complexity of the reading processes and the simplicity of this key relationship. According to Hoover and Gough’s simple view of reading, neither decoding nor comprehension alone were sufficient to ensure reading occurred; both
were essential (Hoover & Tunmer, 1993). They defined decoding in terms of word reading and listening comprehension in terms of skills and knowledge used to understand oral language. According to the simple view, reading involved both decoding and listening comprehension skills that were used in relation to visual input (printed words) rather than aural input. Furthermore, Hoover and Gough defined literacy as the difference between linguistic comprehension and reading comprehension. Support for the simple view of reading highlighted the interactive nature of decoding and comprehension processes (Chen & Vellutino, 1997), and confirmed the compensatory strategies that predominated during early reading, particularly for students experiencing difficulties (Stanovich, 1980). Carver (1992, 1992a, 1992b, 1993) challenged and extended the simple view in that he implicated reading rate and text difficulty in the cognitive processes involved in decoding and linguistic comprehension as part of an alternative model of reading. Both Carver’s model and the simple view of reading acknowledged that instruction in decoding text and instruction in text meaning were integrally related during effective reading instruction (Gough & Tunmer, 1986; Hoover & Gough, 1990).

Subsequently, researchers have documented clear differences between skilled and novice readers, whereby skilled readers are fluent and flexible in their performance of a wide variety of reading tasks, reflecting both decoding and understanding (Afflerbach, 1990; Anderson & Leinhardt, 2002; Bransford et al., 2000; Pressley, El-Dinary et al., 1992; Pressley, Johnson, Symons, McGoldrick, & Kurita, 1989; Pressley, Rankin, Gaskins, Brown, & El-Dinary, 1995). Fluency for skilled readers referred to their typically fast and accurate decoding and understanding of text. Skilled readers were flexible indicated by their ability to use
and adapt their skills and knowledge in a variety of ways during reading. Further, reviews of reading research have reported some changes in teaching methods over time, often in response to beliefs rather than to efficacy of practice (Barr, Kamil, Mosenthal, & Pearson, 1991; Della-Piana, 1973; Grossen, 1996; Hoffman & Rutherford, 1984; Kamil, et al., 2000; Pearson, 1984; Rosenshine & Stevens, 1984).

More recently, a review of extant reading research based on scientific evidence has provided clear directions for classroom reading instruction (NICHHD, 2000a). The recommendations emanating from this review were built upon the premise that prevention of failure in learning to read was preferred to remediation (Snow et al., 1998). Reviewing instructional interventions for students with learning disabilities, Swanson (2001) confirmed support that effective instruction, as in any skill, involved the interaction of both lower order skills (decoding in reading) and higher order skills (comprehension in reading). Therefore, research literature and theory has "paved the way" for the emergence of "balanced literacy instruction" that incorporates both specific and holistic teaching, with different emphases dependent upon the needs of students (Pressley, Roehrig, Bogner, Raphael, & Dolezal, 2002, p.1). Despite the lack of explicit acknowledgement, these results reflect the hierarchical viewpoint evident in information processing models (see Chapter 2).

Recent theoretical research has applied information processing models to beginning reading, specifically to the decoding component of reading using computer simulations (Coltheart, 2000; Coltheart et al., 2001; Hannon & Daneman, 2001). This theory-based research included examination of both the cognitive processes and the information represented during decoding, one aspect of reading within the simple view. Research predominantly focussed on early reading and
decoding fluency, at the letter sound level (Elliott et al., 2001; Good III et al., 2001; Kaminski & Good III, 1998) and at the passage level (Bain & Garlock, 1992; Daly III & Martens, 1994; Deno, Mirkin, & Chiang, 1982; Espin & Foegen, 1996; Fuchs & Deno, 1992; Hintze, Shapiro, & Lutz, 1994; Jenkins et al., 2003; Kuhn & Stahl, 2003; Wolf & Katzir-Cohen, 2001). This work was supported by models of reading with a theoretical foundation in information processing (Gough, 1972; Just & Carpenter, 1992; LaBerge & Samuels, 1974; Perfetti, 1985; Perfetti & Lesgold, 1977, 1979, Spear-Swerling & Strenberg, 1994). Most of these models limited discussion of reading to decoding, often at the single word level, and provided only general guidelines for reading comprehension as an extension of decoding or as a collection of related skills that required specific instruction following the acquisition of decoding (Stanovich, 1990). Stanovich claimed that this dominant view of reading from information processing theorists is based on the general concept of a resource-limited working memory (see also Chapter 2).

The view of reading used in the present study builds upon Huey’s (1908/1968) definition of reading, as much as upon subsequent research. Huey’s view commenced with the notion of perception, and was extended by others who used perceptual learning as a basis for explanations of some of the processes and concepts involved in reading (Gibson, 1965; Gibson & Levin, 1975; Gray, 1960; Robinson, 1966; Robinson & Kirby, 1988). The strength of this approach put forward by perceptual theorists lay in their ability to conceptualise the two critical processes that underpin all learning: analysis and synthesis (Wynne, 1971). For the present investigation, reading was defined as the set of knowledge representations and cognitive processes that operate, in concert and at multiple levels, to decode
written text and understand the meaning of that text. Using this definition within the simple view of reading (Hoover & Gough, 1990) and an information processing perspective, reading includes the cognitive processes used to transform written text into sounds and meaning (decoding) and the cognitive representations and strategies used during text processing, along with the observable responses to communicate meaning (comprehension). Therefore, skilled reading is defined as the elegant synthesis of complex strategies and knowledge that seamlessly results in observable responses to a specific reading purpose or goal. In the current study, that purpose was writing answers to questions. Reading comprehension is defined as the knowledge and cognitive processes used by readers when they demonstrate understanding of the meaning of more than a single word. This is related to Durkin’s (1978-9) definition of reading comprehension instruction in classrooms that occurs when a teacher facilitates student knowledge and processing, so that students demonstrate understanding of the meaning of more than a single word of text. In the current study, the intervention comprised one type of reading comprehension instruction, focussed on the materials the teacher implemented to facilitate question-answering. Consequently, reading comprehension included passage reading and the writing and selection of answers to demonstrate understanding of the passage.

*Historical Perspectives of Reading from Information Processing Models*

Early information processing models proposed that reading involves three components: phonological, visual and meaning components. All models linked these components to the stages of processing and the knowledge that was used during processing, with an emphasis on different types of knowledge in different stages of processing. Mackworth (1972) proposed an early information processing model of
the reading process that described the mediation role of articulation, reading aloud, in connecting meaning with visual information. However, Mackworth's model was too general to be useful for future research (Gibson & Levin, 1975). At this same time, Gough's (1972) "one second of reading" model involved a focus on fluency of letter and word reading and the mapping of visual letters onto sounds during reading (p. 331). Gough's model used previous empirical research (Rohrman & Gough, 1967) to support rates of reading processing that were often less than one second. Of particular relevance to the current study is Gough's proposition that the cognitive processes in sentence comprehension are critical in reading, rather than just the processing of letters or words. However, Gough failed to specify the nature of these higher order cognitive processes within his model (Brewer, 1972; Gibson & Levin, 1975).

LaBerge and Samuels' Model of Reading

LaBerge and Samuels' (1974) seminal paper applied information processing models to reading through a focus on available cognitive resources. LaBerge and Samuels acknowledged both the complexity of the reading process and the speed of multiple component processes. According to LaBerge and Samuels, automaticity did not require conscious attention in order to complete reading tasks. Their model assumed multiple component processes were completed, but only one process required conscious attention. Conscious attention was defined in terms of selectivity, capacity limitations and alertness. In addition, LaBerge and Samuels assumed that transitions between component processes were automatic, such that if a higher level process was automatic, they assumed that lower level subskills and relations between those subskills were also automatic. Their focus was on the development of
automatic component skills, predominantly focussed on decoding.

La Berge and Samuels (1974) championed the application of the fundamental information processing concepts of automaticity and capacity limitations to reading (see Chapter 2). Four main issues obviated the use of LaBerge and Samuels’ full model in the current thesis. Firstly, they focussed predominantly on decoding processes of letter sounds, with limited discussion of the comprehension and organisation of word meanings. Secondly, La Berge and Samuels assumed that word meanings were already known automatically from prior experience with oral language, that authors of books for children were aware of this and deliberately selected words already known to children. LaBerge and Samuels’ logical deduction was that, as word meanings were already known, learning to read in the early stages would be focussed on decoding; hence their focus on decoding processes. The facilitation from word meanings in assisting visual letter and word recognition was acknowledged, but not specified by, La Berge and Samuels.

Thirdly, LaBerge and Samuels’ (1974) operational definition of automaticity focussed solely on completion of subskills, which did not require attention, and was measured by response latency within the “catch-trial procedure” (Stanovich, 1990, p. 77). Stanovich identified methodological problems with this procedure included measurement, the complexity of instructions for children, a sole focus on response latency and confoundings with practice effects. Stanovich suggested that LaBerge and Samuels’ definition excluded components of automaticity that focussed on capacity limitations, and, therefore, conclusions based on capacity limitations were not directly demonstrated by empirical evidence. Subsequent research focussed on response rate using Stroop tasks (Stroop, 1935) which examined automatic
responses under timed conditions. This research remained focussed on attention rather than on the effects of resource limitations on component tasks within complex skills. However, Stanovich (1990) reported multiple studies demonstrating that, by the middle of first grade, Stroop measures were at ceiling levels and clearly documented automaticity of responses by participants. This failed to support LaBerge and Samuels’ capacity-based model of reading that relied on performance measured by response rate. Therefore, as many studies had focussed on single word decoding and single word meanings rather than text passages, the application of a capacity constrained model of reading comprehension for text passages remained unclear.

Finally, the LaBerge and Samuels (1974) model focussed predominantly on visual stimuli at the letter level. The difficulty with this approach was that letters and sounds for individual letters have no inherent meaning, that is, no real world counterpart, and, therefore, no meaning for young children when they are learning to read. Hence, this questioned the basic assumption of La Berge and Samuels’ model, that many connections between phonological components of spoken language and meaning were automatically known as these were within children’s spoken language. Therefore, there was no way that individual sounds could be linked to a meaningful object. The only way that young children learned the features of individual sounds through spoken language was by learning similarities in, for example, beginning sounds of different words, that is, by acquiring phonemic awareness. This focus on similarities in features between stimuli (letter sounds and words) is reminiscent of information processing models (Engelmann & Carnine, 1982; Tresiman, 1993).
Phonemic awareness, a foundational concept in early reading today, is developed as children see the aural relationships between words without necessarily involving visual letters or print (NICHHD, 2000a, 2000b; Snow et al., 1998). Phonemic awareness is defined as the ability to hear and manipulate sounds in words (Abbott et al., 2002). Examples of phonemic awareness are the use of pictures to demonstrate knowing that a group of words begins or ends with a specific sound, or orally reciting a group of words that rhyme (Abbott et al., 2002; Byrne & Fielding-Barnsley, 1995; Eldredge & Baird, 1996; Gough, Ehri, & Treiman, 1992; NICHHD, 2000b). La BERGE and Samuels’ (1974) model focused on visual features of letters and did not include specific mention of phonemic awareness, nor pictures, as a significant component in early reading, nor a direct link to meaning beyond the word level. Therefore, the establishment of phonemic awareness through the learning of relationships across words, based on similar sounds, was not included in La BERGE and Samuels’ model. Their focus was on specific responses to each letter stimulus, rather than the stimulus relationships of the common features across words that begin with the same sound. La BERGE and Samuels’ model did not examine relationships between stimuli, except through similarities in the visual features of letters.

Perceptual Model of Reading

Gibson and Levin (1975) proposed an alternative model of reading as a perceptual process. Rather than a sole focus on specific responses to specific stimuli, their model defined reading as a process of information extraction from text that is, in part, actively controlled by the reader’s purpose for reading. Their broad definitions of perception and perceptual learning were applied to their model of
reading. According to Gibson and Levin, perceptual learning was not the addition of new skills or knowledge, but rather, the changes in skills and knowledge that occur over time as learners develop "an expanding sensitivity to events (or event classes), in the world and the structural relations that exist between them" (Thorley et al., 1991, p. 171). More specifically, Gibson and Levin proposed that learners do not acquire new responses for each newly presented word (based on visual features, phonological information, or meaning). Gibson and Levin's perceptual process of learning to read suggested that a reader is increasingly focussed on searching for the most salient features and patterns within and across known words in order to read new words, and is dependent upon their purpose for reading.

The process of perceptual learning was theorised to consist of two complementary processes: analysis and synthesis (Wynne, 1971). Firstly, readers are able to see the distinctive, salient and permanent features within a word. Secondly, readers relate those invariant features in the stimulus word to other words that are similar or different. These patterns apply to both objects or events in the environment and the relationships between objects or events (Engelmann, 1980; Engelmann & Carnine, 1982; Mackay, 1985; Mackay, Soraci, Carlin, Dennis, & Strawbridge, 2002; Sidman, 1971; Sidman, Wilson-Morris, & Kirk, 1986; Thorley et al., 1991). Readers use prior knowledge of past environmental objects or events to predict future objects or events. Gibson and Levin (1975) defined this mechanism of relating distinctive environmental features to prior knowledge as higher-order learning. This process of analysis and synthesis paralleled the theoretical notions of attending to hierarchically ordered stimuli at a specific level (analysis) and simultaneously ensuring that needs and goals were met (synthesis; see Chapter 2).
The perceptual view of reading implied that the structure within the text was not only a feature of the text itself, but was constructed by readers in relation to the purpose for reading. This view applied to the search for sameness in word families (e.g., “cat”, “fat”, and “mat”), where visual or phonological sameness and differences assist with decoding. In addition, the same principle applied to the search for sameness (and differences) in meaning between two related vocabulary words like “magazine” and “book”. The process of recognition (for both word families and for vocabulary) involved the processing of sameness and difference (Engelmann & Carnine, 1982), and using analogies in reading (Goswami, 1991, 1999). Each word (either within the word family with similar visual letters and sounds, or a list of words with similar meanings) was identified jointly by two features (Engelmann & Carnine, 1982). Firstly, the similarities between that word and every other related word and, secondly, the unique difference which makes that one word (“cat”) different from the others (every other “-at” word) were identified (Engelmann & Carnine, 1982). Hence, perceptual views of reading provided an explicit link between the theoretical aspects of reading and information processing models, such as attention to specific common features of stimuli and the use of strategic attention focussed specifically on readers and goals (see Chapter 2).

*Stimulus Equivalence Model of Reading*

An additional research direction proposed that reading involved equivalence across stimuli in different modes (Sidman, 1971) and between different stimuli (Engelmann, 1980; Engelmann & Carnine, 1982). Sidman’s research focussed on existing stimulus relationships and the emergence of untaught stimulus relationships (Sidman, 1971), while Engelmann and Carnine (1982) championed the “structural
basis for generalisation” (p. 5). Rather than focussing on changes in knowledge and processing based on specific stimuli features, Sidman and Engelmann and their colleagues presented different combinations of stimuli and examined consequent new responses. Initially, this work began with animals, for example autoshaping with pigeons (Brown & Jenkins, 1968). Subsequently, classroom applications to reading and other skills have been recommended (Stromer, Mackay, & Stoddard, 1992). The focus on the relationships between stimuli, rather than on responses, established greater control over learning and success in establishing new responses within short periods of time (Engelmann, 1980; Engelmann & Carnine, 1982; Thorley et al., 1991). This work further supported Gibson & Levin’s (1975) perceptual reading model and the theoretical foundations established by information processing models (see Chapter 2).

In contrast, rather than focussing on the relationships between stimuli, early behavioural approaches to learning to read had focussed predominantly on relationships between responses and stimuli, specifically oral responses to the presentation of a single visual word (Skinner, 1950). A major difficulty with this behavioural approach for establishing new behaviours in response to novel (unseen) stimuli was the elicitation of the first correct response (Thorley et al., 1991). Behavioural approaches required each new stimulus to be presented and linked directly to the desired response by the instructor. Therefore, when a stimulus was presented for the first time, the learner was totally reliant on the instructor to explicitly tell them the correct response. In the absence of the instructor, learners had no way of knowing how to respond to the presentation of a novel, previously unseen, stimulus. Under conditions of stimulus control, rather than response control,
researchers placed a major emphasis on what was presented to learners (Englemann & Carnine, 1982; Mackintosh, 1994, 1997; Thorley et al., 1991). More importantly, information presented to learners was under the control of the researcher, or teachers in classrooms (Engelmann, 1980; Engelmann & Carnine, 1982; Thorley et al., 1991). Therefore, stimuli were presented based on features of sameness and difference. More importantly, when novel stimuli were presented to learners they were able to use their existing knowledge of known features to determine an appropriate response, even though they had never before seen that particular stimulus.

Sidman’s (1971) stimulus equivalence approach to learning to read began with pre-existing relationships between oral stimuli (known spoken words) and meaning (pictures of known objects). His approach was to establish relationships between visual stimuli (printed words) and oral stimuli (spoken words), by using these pre-existing relationships, that is, prior knowledge (see Chapter 2). For example, the concept of “dog” was represented by a picture of a dog, an orally spoken word “dog”, and a written word “dog”. The goal of Sidman’s (1971) research was the establishment of equivalence across three stimuli, reflecting semantic, phonological and visual representations of the one concept from the real world. Using pictures to represent semantics, Sidman focussed on meaning throughout reading instruction, and used existing knowledge (linking objects and pictures to oral language) to establish oral word reading. He directly taught the selection of the correct written word when that word was orally spoken. When the student learned this new relationship between two stimuli (known oral words and unknown written words), correct oral word reading and matching of pictures to
written words occurred, without direct teaching.

Engelmann's (1980) and Engelmann and Carnine's (1982) approach also focussed on relationships between stimuli where his concept of stimuli extended to teacher behaviours. Design of instructional programs by Engelmann and Carnine, therefore, included complete scripting for teacher presentations along with full specifications for all examples presented to students and completed by students during lessons. This suite of instructional programs, known mostly as "Direct Instruction" formed the basis for considerable research into student learning at the University of Oregon. Despite significant empirical support and widespread use in many countries, classroom teachers have not embraced this type of instruction (Hempenstall, 1996b, 1997a, 2003). Subsequently, applications of stimulus equivalence research were outlined for classroom practices, although this remained limited to decoding and single word comprehension (Dugdale, 1996; Lane, Clow, Innis, & Critchfield, 1998; Stromer et al., 1992). However, neither stimulus equivalence nor direct instruction recommendations have been widely applied to classroom instruction in reading comprehension.

*Kinstch and van Dijk's Model of Text Comprehension*

Kintsch and van Dijk (1978) proposed a related model for text comprehension that focussed on recall and summarisation comprehension tasks (Kintsch & van Dijk, 1978; van Dijk & Kintsch, 1983). Their model required the stating of a specific goal in order to specify reading processes and the analysis of text using propositions. Propositions were composed of concepts and arguments which served a range of semantic functions and syntactic functions. For example, the relations between concepts were represented using a specific layout reflecting
meaning (Kintsch & van Dijk, 1978). Kintsch & van Dijk assumed that readers use multiple processes that occur either in parallel or sequentially; and that, during reading, cognitive processes are completed interactively in ways that do not exceed cognitive capacity; that is, their model assumed that the decoding processes in reading are automatic. However, Kinstch and van Dijk did not specifically include reading fluency to reflect automatic decoding. Rather, they relied on text readability to indicate a lack of automaticity with decoding. Readability was defined in terms of the time taken for comprehension tasks to be completed, including question-answering tasks. Comprehension performance and time for task completion were seen as competing for the same cognitive resources and, therefore, reflected readability of text.

Specific to the cognitive processes used in reading, Kintsch and van Dijk (1978) outlined a model of cyclical processing at the proposition level of text that involved repeated processing to find “argument overlap among propositions” (p. 367) as a basis for a coherent textbase model for that passage of text. Therefore, overlapping (matching based on meaning, sameness) information between propositions created coherence. Further, where overlap between propositions did not occur, the reader would add additional information to the textbase to ensure coherence. Kintsch and van Dijk assumed readers process all information that is available and that the automatic cyclical processing of propositions requires few cognitive resources. They assumed that readers select either the most important propositions, defined as those with many connections to other propositions, or the most recently read propositions. Therefore, just as Engelmann and Carnine (1982) and Sidman (1971) had focussed on sameness in meaning across stimuli (single
words), Kintsch and van Dijk focussed on sameness (overlapping meaning) across propositions (groups of words).

Kintsch and van Dijk’s (1978) model reinforced the importance of reader’s goals, in the form of “schema”, that determine which propositions are relevant (p. 373). Kinstch and van Dijk recommended research that focussed on clear reader goals that were shared by all readers and used specific, well recognised text types that were read for specific purposes. Using this guide for research, the shared special purpose involved the same cyclical processing of texts by readers sharing that same purpose and using “a specific problem-solving set” (p. 373). The interaction of the textbase model with reader schema and background knowledge resulted in the situation model. The reader’s purpose determines which propositions are repeatedly processed in a series of cycles. Kintsch and Van Dijk assumed that individuals differed in their memory capacity, which potentially leads to differences in performance that are evident in terms of slower completion and less matching (overlap) between propositions. Deterioration in performance is in response to the cognitive resources required for multiple, simultaneous cognitive processes that include decoding, inference generation, continued text processing, storage of propositions in working memory, and using existing reader knowledge. Along with the reader’s purpose or task demands, the nature of the required response also impacts on the processing of text. Therefore, Kintsch and Van Dijk proposed a model that was based on working memory capacity limitations from information processing models (see Chapter 2) that explained performance differences in reading comprehension tasks.

In summary, LaBerge and Samuels’ (1974) information processing model
focussed reading researchers on automatic decoding and was limited to learner
responses to individual stimuli that included only letters and individual words. In
contrast, Sidman's (1971) and Engelmann's (1980, 1982) stimulus equivalence
research and Kinstch and Van Dijk's (1978) model focussed on the relationships
between stimuli and how concepts were the same or different in some way. Rather
than individual responses to each visual, semantic or auditory stimulus, as proposed
by LaBerge and Samuels (1974) and Skinner (1950), Sidman (1971), Engelmann
(1982) and Kinstch and van Dijk (1978) focussed on links between stimuli based on
similarities and differences in the concepts. These principles from information
processing models, based on sameness and stimulus equivalence, demonstrated
more effective and efficient control over the learning process than other
(behavioural) methods (Mackintosh, 1994, 1997; Thorley et al., 1991).

Recent Information Processing Models of Reading

Reviews of reading comprehension have repeatedly called for explicit
instruction in all comprehension skills for all students (Dole et al., 1991; Durkin,
& Raphael, 1990; Pressley, 2000; Pressley, Brown et al., 1995; Rosenshine &
Meister, 1994) and, in particular, for students with reading difficulties (Chan, 1991;
Gersten et al, 2001; Malone & Mastropieri, 1992; Mastropieri & Scruggs, 1997;
Shankweiler et al., 1999; Swanson & Trahan, 1996). “Balanced reading instruction”
emerged as an operational term for research that combined specific “skills
instruction in the context of massive holistic teaching!” (Pressley et al., 2002, p. 1).
Considerable research documented the range of reading processes and their
cognitive mechanisms using verbal protocols that elicited verbal explanations of
thinking processes from experts (Lane & Critchfield, 1996; Magliano, Wiemer-Hastings, Millis, Munoz, & McNamara, 2002; Pressley & Afflerbach, 1995) and children (Baumann, Jones, & Seifert-Kessell, 1993; Kucan & Beck, 1996; Meyers, Lytle, Palladino, Davenpeck, & Green, 1990). However, like calls for “explicit instruction”, the translation of specific strategies for instruction from verbal protocol work to classroom instructional programs remained unclear. In light of these calls, researchers have examined specific skills in reading comprehension in the context of information processing models of reading, some of which are outlined in the following sections.

*Extensions of Kintsch and van Dijk’s Model*

Kintsch and van Dijk’s (1978) model has been elaborated in several ways. For example, their original model was first modified by the leading edge strategy (Miller & Kintsch, 1980). Miller and Kintsch defined the leading edge strategy as a specific sequence within the cyclical processing of propositions that focused on hierarchical links between concepts or the most recently presented propositions. Subsequently, the Kinstch and van Dijk (1978) model was further elaborated by Kinstch into the Construction-Integration model (Kintsch, 1988, 1992). This elaboration placed more emphasis on the situation model than in the original model. Kintsch’s revised Construction-Integration model extended the links between propositions based both on common information, called “argument overlap”, and, for the first time, the embedding of information within propositions (Goldman, Varma, & Cote, 1996, p. 75).

In addition, Kintsch’s Construction-Integration model assumed that only those propositions activated within a fixed capacity working memory buffer were
able to be connected, and that only the most active propositions were maintained in working memory. Alternatively, Turner, Britton, Andraessen, & McCutchen, (1996) proposed that the number of propositions held in working memory was reduced based on a “strength value” (p. 34) that was dependent on each proposition’s connectedness to all other propositions and the proposition’s recency. The strength value determined which propositions were maintained in working memory during the subsequent processing cycle. These concepts linked directly to models of working memory and automaticity (see Chapter 2).

*Just and Carpenter’s Model*

An alternative revision of Kintsch and Van Dijk (1978) work was proposed by Just and Carpenter (1992) who applied the notion of resource capacity limitations more specifically to reading comprehension. Firstly, they took forward Kintsch and Van Dijk’s concepts of importance and recency of propositions, along with the inherent differences in cognitive capacity in working memory as a constraint on reading comprehension. When cognitive capacity was exceeded by task demands, Just and Carpenter predicted that performance would be slower, and performance was likely to be less accurate as results from ongoing processing were forgotten. Just and Carpenter’s model used the concept of activation level that was derived from information processing models. Activation level arises from spoken or written text, from ongoing processing or from retrieval of long-term memory. Just and Carpenter’s empirical results, involving syntactically ambiguous sentences, demonstrated that comprehension performance was affected by individual differences in working memory capacity.

Secondly, Just and Carpenter (1992) proposed that changes in performance
were dependent upon task difficulty, with smaller differences between participants when the task is relatively easy. In addition, they claimed that differences in activation levels of propositions in working memory capacity were variable across different text propositions rather than simply activated or not activated. Just and Carpenter acknowledged that different levels of representation might be activated in parallel (e.g., word level and sentence level), and that these might impact on activation levels of propositions gradually as text is read. Just and Carpenter’s model provided significant support for the capacity constraint effects on text processing, linked working memory capacity empirically to text comprehension performance for the first time, and directly applied working memory research to reading tasks (see Chapter 2).

*Correlational Support for Relations Between Reading Measures*

In addition to Just and Carpenter’s (1992) model, further empirical evidence emerged from related reading research investigating the efficacy of different types of reading measures, and relations between these measures (Deno et al., 1982; Fuchs, Fuchs, & Maxwell, 1988). Deno et al. (1982) examined correlations between standardised reading comprehension measures and curriculum-based measures of reading word lists, cloze passage, and passage reading. Empirical evidence provided strong correlational support between reading comprehension measures, across Grades 1 through 6, in spite of small samples sizes and changes in measures across grades (Deno et al., 1982). Fuchs et al. (1988), who focussed solely on comprehension measures, also reported correlations between the curriculum-based measures of passage reading, written recall and question-answering. Despite limiting participants to boys with mild to moderate reading difficulties, Fuchs et al. reported
higher correlations for text reading fluency than for other measures. This research empirically operationalised the concept of automatic decoding in terms of oral reading fluency (Bentz & Pavri, 2000; Elliott et al., 2001; Shinn, 1998).

The Place of Reading Fluency

Several researchers have continued to focus on automaticity in decoding text and a body of literature in curriculum-based measurement has emerged (Elliott et al., 2001; Espin & Tindal, 1998; Kaminski & Good III, 1998; Madelaine & Wheldall, 1999; Shinn, 1989, 1998). This research has focussed specifically, in early reading, on fluency in letter sounds (Elliott et al., 2001; Kaminski & Good III, 1998) and, in the later grades, oral reading fluency with passages of text (Kameenui & Simmons, 2001; NICHHD, 2000b; Wolf & Katzir-Cohen, 2001). Reading fluency measures feature in recent models of reading intervention as critical indicators of reading skill and progress (Denton et al., 2003; Fuchs, Mock, Morgan, & Young, 2003; Fuchs, 2003; Marston, Muyskens, Lau, & Canter, 2003; McCandliss, Beck, Sandak, & Perfetti, 2003; Speece, Case, & Molloy, 2003; Vaughn & Fuchs, 2003; Vaughn, Linan-Thompson, & Hickman, 2003).

As with early models of reading, fluent decoding played a crucial, gatekeeping role in reading. Auomaticity with decoding was vital if cognitive resources were to be devoted to reading comprehension (Carnine et al., 1997; Denton et al., 2003; Howell & Nolet, 2000; Kameenui & Simmons, 1990; Stanovich, 1980; Vaughn et al., 2003; Wolf & Katzir-Cohen, 2001). For beginning reading instruction, benchmarks for fluency in component reading skills (e.g., letter sound fluency) and oral reading fluency were predictive of future statewide testing results in later grades (Good III et al., 2001; Kaminski & Good III, 1998). Current,
available benchmarks for Year 3 students recommend oral reading fluency on grade appropriate reading materials of greater than 110 words read correctly per minute (Good III & Kaminski, 2003). For Year 5 Australian students, the most recent recommended oral reading fluency rates were between 100 and 120 words read correctly per minute, reading grade-appropriate reading materials (NSW Board of Studies, 1997). Recent empirical evidence confirmed the high correlation ($r = 0.83$) between text reading and reading comprehension for elementary (Year 4) students (Jenkins et al., 2003). Therefore, oral reading fluency was included as a measure in the current study (see Chapter 6).

*The Place of Reading Vocabulary*

In addition, recent research has validated the critical importance of vocabulary knowledge of word meanings as a correlate of reading comprehension (Anderson & Nagy, 1991; Beck & McKeown, 1991; Daneman, 1991; Hirsch Jr, 2003; Levin, Levin, Glasman, & Nordwall, 1992; Ryder & Graves, 1994; Snow et al., 1998), and particularly for students with learning disabilities (Jitendra, Edwards, Sacks, & Jacobson, 2004). Vocabulary knowledge was defined as the knowledge of words presented within the context of sentences or passages. Differences in vocabulary knowledge between individuals and over the period of their development have been documented (Beck & McKeown, 1991; Greenwood, Hart, Walker, & Risley, 1994; Hart & Risley, 2003; Levin et al., 1992; Ryder & Graves, 1994; Zechmeister, Chronis, Cull, D’Anna, & Healy, 1995). Vocabulary knowledge has been shown to play a critical, yet separate, role in reading comprehension, independent of working memory capacity (Dixon, LeFevre, & Twilley, 1988; Thordike, 1973). In addition, vocabulary knowledge has been incorporated in
reading comprehension instruction (Meyerson, Ford, & Ward, 1991; Ryder & Graves, 1994; Scruggs & Mastropieri, 2000; Wolf, Miller, & Donnelly, 2000; Wolf & Segal, 1999) and question-answering (Cunningham & Moore, 1993). Effective vocabulary instruction has involved the detailed and repeated presentation and discussion of the meanings of words before, during or after text reading (Beck & McKeown, 1991; McKeown, 1991; Stahl, 2003). As part of vocabulary knowledge, word meanings have been associated with grammatical knowledge (Hunston, Francis, & Manning, 1997; Petrovitz, 1997; Pinker, 1998; Scott & Nagy, 1997; Skwarchuk & Anglin, 1997) and with spelling (Cunningham & Stanovich, 1991; Gaskins, Gaskins, Anderson, & Schommer, 1995; Goldsmith, 1995). Therefore, a measure of vocabulary knowledge was included in the current study (see Chapter 6).

*Computer Simulation Models of Reading*

Research into computer simulations of reading comprehension processes has been reported in several related models (Fletcher, van den Broek, & Arthur, 1996; Goldman et al., 1996; Graesser, Swamer, Baggett, & Sell, 1996; Mannes & St. George, 1996; Turner et al., 1996; Van den Broek, Risden, Fletcher, & Thurlow, 1996) that built upon Kintsch’s earlier foundational comprehension models (Kintsch, 1988, 1992; Kintsch & van Dijk, 1978; van Dijk & Kintsch, 1983). These models operationalised the activation strengths in different ways and for different reading purposes, mostly focussed on recall and memory for text propositions. Goldman et al.’s (1996) simulated model combined the capacity constraints outlined by Just and Carpenter (1992) with Kintsch’s (1988) Construction-Integration model. Goldman et al.’s new hybrid model included a flexible working memory capacity, rather than fixed as in Kintsch’s (1988) model, that was able to control the type and
number of propositions that were active and remained in working memory across processing cycles. Using Kinstch's (1988) assumption that propositions within working memory will be connected, flexible maintenance of propositions in working memory had the potential to result in more connections and interconnected semantic networks. Goldman et al.'s simulations used a range of factual text passages to demonstrate successful computer simulations and they proposed a "Strategy Competition Module" which acted like the working memory executive described by Baddeley (1999), responsible for controlling and allocating resources in working memory (see Chapter 2).

Related simulation models of comprehension focussed more on situation models and inferences made between long-term memory and text propositions, with recall as the measure of reading comprehension (Fletcher et al., 1996; Mannes & St. George, 1996; Van den Broek et al., 1996). The focus of these simulated models was on cognitive representations created during completion of reading comprehension tasks and the inclusion of potential effects of world knowledge and past experiences on those representations. In some models, question asking was used to elicit evidence of cognitive representations and processing during comprehension. Questions asked focussed only on causal inferences and predictions and were limited to "why" questions and "how" questions that were required to elicit inferential processing (Graesser et al., 1996; Long, Seeley, Oppy, & Golding, 1996). These studies were less relevant to the current study due to their restricted foci and limited types of questions. The current study implemented an intervention that reflected a much more complete range of question types.
Models of Reading Related to Models of Working Memory

More specific research on working memory capacity has examined the completion of multiple, simultaneous reading tasks and empirically supported Just and Carpenter’s (1992) model. For example, in an early study, Daneman and Carpenter (1980) used a range of measures that attempted to examine both representations and cognitive processing components used during reading comprehension tasks. Prior to this paper, working memory research in reading had used word span measures that examined recall of groups of words, similar to Miller’s (1956) storage measure of short-term memory (see Chapter 2). The use of dual-task methodology (Stanovich, 1990) provided empirical support for the effects of capacity limitations on complex skills (see Chapter 2 for more detailed discussion).

Daneman and Carpenter (1980) investigated word span, with reading span measures and oral answers by examining their relationship to two types of questions based on text memory and Verbal Scholastic Assessment Task (SAT) scores (Donlon, 1984) with undergraduate university participants. Initially, they used reading span measures that involved untimed oral reading of groups of sentences, followed by recall of the last words in all sentences in that set. Reading comprehension was assessed using short passages of text with oral answers, from memory, to factual questions and questions about pronoun referents. Daneman and Carpenter reported that word span measures did not correlate with any other measure, and, more importantly, they also reported significant correlations between reading span, Verbal SAT, and oral answers to questions. Experiment 2 expanded span tasks to include oral, silent and listening spans, and involved the timing of oral
reading. Daneman and Carpenter proposed that their initial results, using untimed oral reading, were potentially confounded by reading fluency effects where skilled, fluent readers could have read sentences faster and, therefore, had much shorter time intervals between retention of a specific word and recall of that word. In a second study, participants were required to judge whether each sentence was true or false within 1.5 seconds, along with recalling last words in sentences. Participants were presented with groups of sentences at a uniform rate, and passage comprehension involved an additional fact question along with a question asking for a passage title.

Daneman and Carpenter reported statistically significant correlations across all span measures, including fact and pronoun questions. In addition, performance was negatively affected when the distance, that is the number of words in the text, between the pronoun and the referent was increased. Daneman and Carpenter (1980) concluded that reading span tasks reflected working memory capacity and proposed that working memory capacity played a potentially significant role in differences in language comprehension across individuals. Their analyses of errors on oral answers to questions suggested clear qualitative differences in text representations that were strongly related to reading span differences that included relations both between concepts within a single sentence and across several sentences. However, Daneman and Carpenter acknowledged their small, biased sample (well-educated university students) and the potential for other factors to impact where readers were not as skilled. An additional confound was Daneman and Carpenter’s lack of emphasis on reading fluency and the potential, differential impacts of fluency on reading comprehension across participants with different reading skills.
Subsequent research documented further support for reading span tasks and extended knowledge about the strategies used by participants in reading comprehension tests (Daneman & Hannon, 2001; Hannon & Daneman, 2001). Previously, researchers examined performance in dual tasks where the task difficulty was varied (Berch & Foley, 1998; Foley, 1997; see Chapter 2). Hannon and Daneman were concerned with increasing the difficulty in order to examine differences in performance by samples of relatively skilled readers (university students). They reported statistically significant correlations between different components of reading comprehension and their new measure of reading span. In their initial replication, Hannon and Daneman required participants to read sets of short paragraphs that comprised three sentences and included three nonsense terms and two real terms that were all related in some way. In addition, they increased the complexity of the sentences by increasing the number of features presented in the paragraph and by using nonsense terms that resulted in paragraphs like:

A MIRT resembles an OSTRICH but is larger and has a longer neck.

A COFT resembles a ROBIN but is smaller and has a longer neck.

A FILP resembles a COFT but is smaller, has a longer neck, and nests on land. (p. 108)

By increasing the number of concepts and their relations, Hannon and Daneman (2001) increased the level of difficulty of remembering individual presented facts and combined memory of new facts (for nonsense terms, stored in working memory) with known facts (for familiar terms, retrieved from long-term memory). In addition, while the passage reading remained untimed, Hannon and Daneman analysed response speed. Although previous research supported Daneman and Carpenter’s
(1980) findings, supportive results for reading span occurred only when information was presented at a predetermined, experimenter controlled rate, rather than controlled by each participant (Engle, Cantor, & Carullo, 1992). Hannon and Daneman’s questions included “knowledge access” items that required retrieval of prior knowledge from long-term memory, and “knowledge integration” items that required retrieval both of prior knowledge and of presented information (p. 109).

Firstly, Hannon and Daneman (2001) reported that the highest correlation was between speed of responding to questions and reading comprehension, measured by statements that required retrieval of information from long-term memory, that is, knowledge access and knowledge integration questions. Secondly, skilled readers performed significantly better on items where long-term memory of concepts and relations (not explicitly presented) was required. Thirdly, Hannon and Daneman were able to explain variance in standardised vocabulary knowledge using stepwise regression analyses. A further replication supported conclusions that the predominance of the variance in performance (59%) was explained by the combined factors of text memory, access to prior knowledge and response speed (p. 115).

In summary, Hannon and Daneman’s (2001) research provided crucial empirical evidence supporting the cognitive processes and representations theorised in information processing models to occur during comprehension of passages of text, with a particular emphasis on working memory capacity limitations (see Chapter 2).

Working memory capacity limitations were also implicated in complex sentence comprehension due to increases in stored information after processing is completed (Caplan & Waters, 1999) or during sentence processing (Gordon et al.,
2001; Gordon, Hendrick, & Levine, 2002). Gordon et al. (2001) examined the role of sentence structure and processing speed in mediating language comprehension. More specifically, Gordon et al. (2001) found that similarities and differences between noun phrases and complex sentence structures (embedded and relative clauses) affected both reading time and comprehension performance. Research supported significant effects of complexity and positioning of concepts on reading comprehension performance (Gibson, 1998). Gordon et al.’s (2001) findings supported the importance of the number of propositions within a sentence and the effects of relationships between propositions reflected by both reading comprehension performance and reading time.

Gordon et al.’s (2002) study confirmed some additional effects of working memory limitations on the syntactic processing of sentences. This study examined the effects of similarities between nouns or names to be remembered, and nouns or names in sentences that were read (Gordon et al., 2002). The effects were measured by reading times and accuracy of responses to true or false statements presented after the sentences (Gordon et al., 2002). Gordon et al. (2002) found that recall was significantly higher for proper names. In addition, they reported that both similarities between words to be remembered and reading of complex sentences lead to reduced comprehension. The adverse effects of complex sentence comprehension increased with additional increases in syntactic complexity and supported the conclusion that working memory limitations play a critical role in comprehension (Gordon et al., 2002).

Recent research by Swanson and colleagues has confirmed the role of automaticity as one possible source of individual differences in performance
(Jenkins et al., 2003; Swanson & Howell, 2001). Two working memory mechanisms were postulated to disrupt reading comprehension and both mechanisms were based in decoding inefficiencies (Jenkins et al., 2003; Perfetti, 1985). When decoding was not automatic, temporary representations in working memory for meaning were disrupted (or replaced) by representations for decoding the print (Perfetti, 1985). Secondly, the activation of semantic representations was also disrupted and readers had significant difficulty in activating any prior knowledge (Jenkins et al., 2003; Perfetti, 1985).

Jenkins et al. suggested that some common factors contribute to both comprehension and decoding processes. For example, detailed knowledge of word meanings has positive impacts on both comprehension and decoding of text, and this confirms the relationship between vocabulary and reading comprehension measures. Jenkins et al. focussed specifically on distinctions between decoding fluency of word lists and passages and their conclusions suggested that some cognitive processes contribute both to reading individual words and reading passages (and, therefore, comprehension) and that other cognitive (word reading) processes might not contribute to passage comprehension. By extension, instruction in words and word meanings, especially words related to comprehension and question-answering, may change a range of cognitive processes, some of which might contribute to reading comprehension and some of which contribute (only or predominantly) to word reading. Similarly, instruction in reading comprehension (at the passage level) might also impact on a range of cognitive processes, with differential effects on reading vocabulary (knowledge of word meanings) and reading fluency. These potential effects of instruction support the reciprocal relationship between decoding
and reading comprehension outlined in the simple view of reading (Gough & Tunmer, 1986; Hoover & Gough, 1990). Furthermore, these results suggested that there were potential effects of either decoding instruction or reading comprehension instruction that might affect either component.

**Implications for the Present Investigation**

In the current study, the simple view of reading was adopted (Gough & Tunmer, 1986; Hoover & Gough, 1990), supporting recent emphases on “balanced literacy instruction”, and incorporating both decoding and comprehension, with different emphases dependent upon the needs of students (Pressley et al., 2002, p. 1). Recent research has supported the application of information processing models to beginning reading, specifically to the decoding component of reading (Coltheart, 2000; Coltheart et al., 2001; Hannon & Daneman, 2001). The current study applied the theoretical information processing principles of analysis and synthesis (Wynne, 1971) to the skills and knowledge used in question-answering in designing the materials used in the intervention. The intervention’s purpose or outcome was the writing of answers to questions and, consequently, reading comprehension consisted of passage reading followed by selection of multiple choice and/or writing answers to demonstrate passage understanding. The importance of reading fluency and reading vocabulary, correlates of reading comprehension, justified inclusion of measures of reading fluency and reading vocabulary as dependent variables in the current study.

The features of the intervention drew from several aspects of information processing models. Closer approximation of research tasks, like reading span, to classroom tasks provided more specific directions for the design of the materials.
Recent research supported the integration of existing knowledge with new knowledge. This principle was applied through the selection of examples in the lesson sequence that included specific known features relevant to the question types taught. Working memory capacity limitations were also directly linked to passage comprehension through empirical evidence supporting reading span measures. Therefore, short sentences in short passages, with familiar topics were used during early instruction. Research has also supported both a specific focus on teaching examples and providing instruction at the word level combined with a strategic focus on the goal of writing answers to questions. In addition, researchers have suggested that both specific and overlapping cognitive processes might impact at the word level or passage level comprehension, or both. Therefore, the intervention materials sequenced examples that were controlled for both specific example features and general strategy steps in question-answering. This dual focus of the materials reflected the synthesis supported by both theoretical information processing models and reading comprehension research.

Critique of Question-Answering Research

The Importance of Question-Answering

Question-answering is such a frequent, ubiquitous activity in everyday life, as well as in classrooms, that it may have been overlooked. The importance of answering questions has been confirmed by its inclusion in several types of comprehension strategy instruction. For example, the following research-based instructional strategies include question-answering: reciprocal teaching (Palinscar & Brown, 1984; Rosenshine & Meister, 1994), Know-Want to know-Learn (K-W-L)
strategy (Ogle, 1986, 1989), Directed Reading-Thinking Activity (Stauffer, 1969, 1970, 1976), collaborative strategic reading (Klinger & Vaughn, 1998) and story schema activation (Hansen, 1981). Two critical reasons justify the importance of question-answering. Firstly, reading comprehension is a covert, cognitive process that teachers attempt to monitor using questions. Secondly, questions can assist in the comprehension process “for organizing and integrating text content” (Beck & McKeown, 1981, p. 913). Teachers have used questions for many purposes, including “to stimulate curiosity and inquiry, to stimulate learning, to test whether learning has occurred, and to interact with students in classroom routine” (Harrah, 1982, p. 21).

In addition, teacher behaviours, almost minute by minute, attest to the importance of questions and questioning in classrooms (Andre, 1987; Dillon, 1989a, 1989b; Gall, 1970; Harrah, 1982), in daily discourse (Cazden, 1988; Mishler, 1975a, 1975b) and in reading instruction (Crowell, Hu-pei Au, & Blake, 1983; Frase, 1968; Lanier & Davis, 1972; Shake, 1988; Weber & Shake, 1988; Yopp, 1988). Questions have lead to differential effects depending on their placement in relation to text. Options have included questions inserted in text (Burton, Niles, Lalik, & Reed, 1986; Rickards & McCormick, 1988; Serenty & Dean, 1986), presenting questions prior to text (Mannes & St. George, 1996; McCormick, 1989; Pressley et al., 1989; Symons & Pressley, 1993; Tang & Moore, 1992; Wiesendanger & Wollenberg, 1978; Wisniewski, 1995) and presenting questions after text (Rickards, 1979; Serenty & Dean, 1986; Wixson, 1983a). The current study presented questions after text reading.

Two additional, substantial research directions attested to the importance of
question-answering. One area of research reported mixed effects for the placement of questions in relation to the text (Hamilton, 1985; Rickards, 1979; Schmidt, 1989; Serenty & Dean, 1986; Shavelson, Berliner, Ravitch, & Loeding, 1974; Wixson, 1983a). The second research direction focussed on question asking, or self-questioning, during or after text reading (King, 1992, 1994; Mishler, 1975a, 1975b; Otero & Graesser, 2001). Neither the placement of questions nor question asking was investigated in the current study. More specifically, the current study focussed on questions and questioning in the context of reading text passages (Frase, 1968) and about the effects of types, or levels, of questions on information understood or learned during text reading (Andre, 1987; Armbruster & Ostertag, 1992; Armbruster, 1992; Armbruster et al., 1991; Benton, Glover, & Bruning, 1983; Burton et al., 1986; Carrier & Fautsch-Patridge, 1981; Graesser, Robertson, & Clark, 1983).

**Defining Question Types**

A hierarchical system consisting of six levels of educational objectives for the cognitive domain has influenced the development of many systems for classifying questions (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). Bloom et al.’s (1956) taxonomy presented a series of cognitive objectives that vary in cognitive demand from easy to hard. The cognitive processes thought to be used to find the answer to a question would logically be an effective way to classify questions (Gall, 1970). Systems for defining question types have been based on different interpretations of Bloom et al.’s (1956) taxonomy (Andre, 1979; Armbruster et al., 1991; Barrett, 1972; Halpain, Glover, & Harvey, 1985; Hamilton, 1985; Sanders, 1966; Shavelson et al., 1974) and specific systems for types of texts,
for example history texts (Armbruster, Anderson, Bruning, & Meyer, 1984) and English fiction (Hillocks & Ludlow, 1984). Using hierarchical linear models, a recent observational study of reading comprehension instruction across Grades 1 to 5 documented a statistically significant effect for using higher-level questioning (Taylor, Pearson, & Peterson, 2003). Such a conclusion strongly supported instruction in different question types, within which higher-level questions would emerge.

Pearson and Johnson’s (1978) taxonomy of question-answer relations was based on reading theories that viewed text reading as an interactive process involving the text and the reader, particularly the reader’s schemata or world knowledge. Their taxonomy identified three types of question based on the sources used to answer each type:

Textually explicit questions have obvious answers right there on the page. Some would call them factual recall questions. Textually implicit questions have answers that are on the page, but the answers are not so obvious. For ‘scriptally’ implicit questions, a reader needs to use his or her script (see Chapter 3) in order to come up with an answer. (p. 157)

Pearson and Johnson (1978) used multiple examples to clarify their interpretation of question types and proposed that their taxonomy was superior to the simpler, informally-accepted taxonomy of literal and inferential. Textually implicit questions were refined to exclude verbatim text answers and included questions where “there is at least one step of logical or pragmatic inferring necessary to get from the question to the response and both the question and response are derived from the text” (Pearson & Johnson, 1978, p. 161, italics in original). Therefore,
Pearson and Johnson suggested that interpreting anaphoric relations (making the connection between a referent, like a pronoun, and the noun) was regarded as an inferential process since the reader was required to make one logical cognitive step. Scriptally implicit questions were further defined by “an inference from the text to the reader’s fund of knowledge” (Pearson & Johnson, 1978, p. 164). Therefore, Pearson and Johnson’s taxonomy defined the three question types as “reading the lines, ... reading between the lines, ... and reading beyond the lines” for textually explicit, textually implicit and scriptally implicit question types, respectively (p. 163-4).

Other taxonomies successfully used Pearson and Johnson’s (1978) question types as a basis for more specific elaborations suited for older students and other text types (Armbruster et al., 1984; Hillocks & Ludlow, 1984) and for elucidating that domain specific knowledge in some areas may impact on the efficacy of question types for that domain (Andre, 1987; Mayer, 1983; Simon, 1980). However, the simplicity of Pearson and Johnson’s (1978) taxonomy was also criticised on the basis that some questions did not appear to fit the categories and that it was primarily suited for elementary grade reading instruction (Andre, 1987).

Initially, the difficulty of two question types, textually explicit and scriptally implicit, was examined and the difference in difficulty between these two types was significant (Pearson, Hansen, & Gordon, 1979). Subsequently, support for the validity of the Pearson and Johnson (1978) taxonomy was reported using a sample of fourth and fifth grade students who answered sets of questions of each type after reading short text passages (Thompson & Gipe, 1985). Both differences in performance and correlations between the types supported the question types.
However, Thompson and Gipe’s principal components analyses questioned the validity of the taxonomy. They suggested this result occurred as the taxonomy used overlapping question types that failed to fully explain the sources of answers to question. Within the complexity of text types and language comprehension, particularly those involving inferential processing of schema-based world knowledge, it is unlikely that there is a perfect question-answer taxonomy (Harrah, 1982). However, a more complete analysis of question types and question features was likely to increase the effectiveness of that instruction (Engelmann, 1980; Engelmann & Carnine, 1982; Hamilton, 1985, 1986; Harrah, 1982; Howell & Nolet, 2000).

Raphael’s (1982) interpretation of Pearson and Johnson’s (1978) taxonomy was used in the present study. This interpretation used the terminology of “Right There”, “Think and Search” and “On My Own” (p. 188) to indicate Pearson and Johnson’s text explicit, text implicit and script implicit question types, respectively. Selection of Raphael’s interpretation was based on age appropriateness of the language for the participants in the study, use of terminology that indicated processing steps within the definitions, and the ease of translation of the “Right There” question definition for teaching examples as these examples used one sentence. In addition, Raphael’s definitions clearly linked the Pearson and Johnson question types to a potential framework for the relationships between the question types, as well as the cognitive strategies that could be used to find the information needed to answer questions.

_Historical Research in Question-Answering_

The study of questions, in general, and their role in classrooms and discourse
has a long history (Distad, 1927; Holmes, 1931). However, knowledge of how
questions affect learning and text comprehension remains uncertain (Andre, 1987;
Dillon, 1982; Hamaker, 1986). Books and manuals have been written about
question-answering that present the purposes of questions, inform the teacher about
what students know and can do, and more importantly, provide information for
evaluating and planning classroom instruction (Dillon, 1988; Payne, 1951).

Davis and Hunkins (1965) examined questions in Fifth Grade social studies
textbooks and Trachtenberg (1974) analysed questions in world history materials;
and both found a predominance of questions that required knowledge level
responses as defined by Bloom et al.’s (1956) taxonomy. Supportive conclusions
reported a predominance of recall and recognition questions were asked by Second,
Fourth and Sixth Grade teachers from textbooks during reading instruction (Guszak,
1967). Subsequently, mixed results were found. For example, Hare and Pulliam
(1980) confirmed Guszak’s results when categorising questions in the same way, yet
found only around a third of questions directly linked to information in the text.
Further work, also using Guszak’s question categories, reported about 40% of
questions were directly linked to text during reading instruction by teachers in the
same grades (O’Flahavan, Hartman, & Pearson, 1988). However, unlike Guszak,
O’Flahavan et al. included both textbook and teacher questions in their analysis.
Therefore, early investigations failed to provide definitive results about the types of
questions used during reading instruction.

Rothkopf’s (1966, 1969) seminal research on adjunct questions and
mathemagenic behaviours shaped much subsequent research into questions and
questioning (Andre, 1987). Rothkopf raised three critical issues concerned with the
dependence of learning from passage information on the information asked in questions. Firstly, his participants were required to write short answers of one to two words and the majority of his questions involved factual learning of details presented in tests. Secondly, Rothkopf distinguished between the presentation of adjunct questions after passage reading with and without lookbacks to the passage (Andre, 1987). Clearly, the task of answering questions without lookbacks required significantly more dependence on memory, especially as time passed. Answering questions while allowing lookbacks to the passage, as used in the current study, required less dependence on memory of information from the passage and was more typical of classroom activities and assessments in reading comprehension (Durkin, 1978-9). Thirdly, Rothkopf’s conclusions were concerned with whether information learned from a passage was totally dependent upon the information asked in questions. Specifically, Rothkopf found differential effects for both the information that the question asked about and other information (not asked in the question) and that these differential effects were dependent upon the questions and their placement.

Durkin (1978-9, 1984) lamented the lack of classroom instruction in reading comprehension, and simultaneously reported a predominance of continued assessment of passages and questions. She operationally defined reading comprehension instruction to occur when the “teacher does/says something to help children understand or work out the meaning of more than a single, isolated word” (p. 489). Her conclusions about continued comprehension assessment were based on teacher behaviour during typical lessons, where teachers were correcting questions in relation to passage reading, and where teacher feedback for incorrect answers was
limited to telling students that their answer was incorrect. In addition, early research focussed on lower-order and higher-order question types defined by the type of cognitive processing completed by readers when answering these questions (Andre, 1979; Bahri & Al Hussain, 1997; Halpain et al., 1985; Shavelson et al., 1974; Watts & Anderson, 1971). Paradoxical results were reported from this research. Firstly, Shavelson et al. (1974) concluded that low ability students benefit more from higher order questions than higher ability students. In contrast, based on the reviews from the literature, other researchers concluded that higher order questions benefited all students (Andre, 1987; Hamaker, 1986).

Teacher questions, as distinct from textbook questions, have been considered, also with mixed results (Dillon, 1982, 1988, 1989a, 1989b; Gall, 1984; Redfield & Rousseau, 1981; Rosenshine, 1976; Winne, 1979; Wixson, 1983b). Rosenshine recommended the use of factual questions with feedback where teachers immediately reinforced whether an answer was correct. In contrast, Winne concluded that the type of questions made little difference to student performance. Redfield and Rousseau's metanalysis reported positive effects for higher order questions on student achievement, and was later supported by Dillon's conclusion that higher order questions facilitated higher levels of cognitive processing by students. Wixson's work supported Dillon's conclusion that matched question types with student cognitive processing. In summary, differential conclusions and effects for questions in this early research were dependent upon the type of comprehension assessments completed in different studies, the type of questions asked, and how question types were defined.
Recent Research Directions in Question-Answering

Question-answering has also been found to be highly correlated with other measures of reading comprehension (Fuchs et al., 1988). Prior to Fuchs et al., question-answering was reported to require the processing of sections of passages, and was found to be dependent upon whether or not answers could be inferred with or without reference to the text (Hansen, 1979). In addition, there was no systematic or consistent method of generating questions, nor any way of knowing whether a set of questions would be at an appropriate level of difficulty (Johnston, 1982). Fuchs et al. (1988) noted that question-answering was commonplace and acknowledged previous criticisms about question-answering as a valid measure of reading comprehension, reporting adequate interscorer agreement on answer scoring. They defined questions as “recall of information contained in idea units of high thematic importance” and this was difficult to conceptualise (p. 23). Finally, Fuchs et al.’s sample included only boys in junior high or middle school who were described by the authors as mild to moderately handicapped, reading almost two years behind their grade level, and receiving instruction in special education classrooms. Despite these limitations, Fuchs et al. reported that question-answering was correlated 0.82 with reading comprehension and 0.66 with word study subtests of the Stanford Achievement Test (Gardner, Rudman, Karlsen, & Merwin, 1982a, 1982b). They also reported higher correlations of 0.92 and 0.81 with reading fluency and lower correlations of 0.70 and 0.58 for recall measures with reading comprehension. This seminal study correlated specific reading comprehension skills, including question-answering, with each other and with general reading comprehension performance.

A decade after Durkin’s (1978-9) original work and using minor
modifications to her observational criteria, Wendler, Samuels and Moore (1989) re-examined classroom comprehension instruction of “award-winning teachers, teachers with master’s degrees, and other teachers” (p. 382). Their findings showed a slight increase of about five percent of time devoted to comprehension instruction compared to Durkin’s original results. However, there were no differences in the amount of time spent on various comprehension activities between the three types of teachers with differing levels of expertise. Therefore, Wendler et al. pessimistically concluded that additional reading training may not lead to improvements in classroom instruction. When asked to prepare specific lessons in comprehension, instruction, Wendler et al. observed that teachers increased testing of students’ comprehension defined as the time teachers spent asking questions, listening to answers and providing corrective feedback. Wendler et al. suggested that teachers in their sample may have misunderstood the difference between comprehension instruction and assessment or were unaware of research findings in favour of explicit modelling of comprehension processes. The important distinction missed by the authors, between their findings and Durkin’s findings, was the change in teacher behaviours; that is, increased specific corrective feedback. Durkin’s observations had overwhelmingly shown assessment occurred without feedback. In summary, despite their reported increase in specific feedback, Wendler et al. found that their request for comprehension instruction led to an increase in teachers giving assessment tasks rather than an increase in teacher instruction, supporting Durkin’s original findings.

Researchers have also focussed on the types of questions typically asked by classroom teachers (Alexander, Jetton, Kulikowich, & Woehler, 1994; Armbruster
et al., 1991; Gambrell, 1983; Weber & Shake, 1988), and questions used in
standardised comprehension tests (Crowell et al., 1983; Readance & Moore, 1983)
and the types of questions found in reading schemes (Armbruster & Ostertag, 1992;
Armbruster et al., 1991; Armbruster et al., 1984). Extending earlier work by Davis
and Hunkins (1965) and Trachtenberg (1974), Armbruster and Ostertag reported a
predominance of “knowledge questions” based on Bloom et al.’s (1956) “knowledge
and comprehension levels” (p. 83). Armbruster and Ostertag noted that the clear
difference between their results and earlier work was their increased focus on
questions that required information to be located and combined from several parts of
a text. Therefore, their findings conflicted with Guszak’s (1967) earlier conclusions
supporting a predominance of recall and recognition questions being asked by
primary teachers from textbooks during reading instruction. In summary,
Armbruster and Ostertag’s results supported a reduction in the proportion of
questions that required recall of one piece of information and an increased focus on
questions that required background knowledge or multiple pieces of information for
answers.

In a more recent, small scale study of three teachers, the researchers reported
that students were aware of the types of questions that were asked and the
information likely to be questioned, irrespective of the relative importance of that
information (Alexander et al., 1994). Undoubtedly, while definitive conclusions
about the effects of questions and question types remained elusive, a range of
question types continue to be used in classrooms and in textbooks during reading
lessons and at other times.
Implications for the Present Investigation

The goal of the intervention program in the current investigation was to improve student performance in writing answers to all types of questions. A framework for question types, covering the complete range of questions that might potentially be asked, was required. Examinations of questions used by teachers and in textbooks suggested that higher order and lower order questions needed to be presented with multiple examples. Raphael's (1982) question-answer relationships were used as this framework, with detailed examples specific to each question type presented within the materials to students.

Question wording and length were raised as a critical issue arising from question-answering research. Therefore, instruction included explicit presentations of multiple examples of the words used in questions, to clarify and confirm common understanding by all participants. Questions were increased in length across lessons, as participants had been provided with practice with questions during early lessons. Raphael's (1982) definitions of question types provided a strategic framework for lessons that linked information (where the answers came from) with the cognitive strategy (processing steps). Capacity limitations affected the amount of information that was temporarily stored during complex processing. Specifically, the longer the sentence or question, the more likely that the amount of information would exceed working memory capacity. Therefore, the materials sequenced shorter questions, and shorter text passages, during initial instruction, so that working memory capacity limitations were not likely to be exceeded. Gradually, as participants practised cognitive strategy steps with easier examples, the length of questions and passages was able increased across lessons without adverse effects due to capacity limitations.
Comprehension Strategies, Cognitive Processes and Question-Answering

Defining Strategies

Strategies used in reading comprehension have been reported using a variety of methodologies and in relation to a variety of comprehension skills (Brown, Pressley, Van Meter, & Schuder, 1996; Budd, Whitney, & Turley, 1995; Deschler & Schumaker, 1986, 1993; El-Dinary, Pressley, & Schuder, 1992; Ellis, Deschler, Lenz, Schumaker, & Clark, 1991; Guthrie, Britten, & Barker, 1991; Johnston, 1985; Kinder & Bursuck, 1993; Kletzien, 1991; Paris & Oka, 1988; Pressley, 1994; Pressley, Snyder, & Cariglia-Bull, 1987; Rosenshine & Meister, 1997; Scruggs & Mastropieri, 1993; Stevens, 1988; Swanson, 1989). Howell and Nolet (2000) used an analogy of military strategies for clarifying the nature of strategies and strategic knowledge. They proposed that, just as military strategy refers to the deployment of weapons, troops and resources during battle to win a war, strategic knowledge uses concepts, facts and rules to solve problems or achieve goals. Howell and Nolet defined strategies as “the procedures students follow to combine subtasks into larger tasks” (p. 44).

However, a strategy was not a specific set of steps that must be followed. Support for Howell and Nolet’s view suggested that, rather than a specific set of steps, a strategy was a type of guide that supported learners to develop internal cognitive structures and procedures, and enabled learners to perform higher-level operations and satisfy goals (Rosenshine, Meister, & Chapman, 1996). Rosenshine et al.’s view was reminiscent of the hierarchical discussions from information processing models (see Chapter 2). Explicit prompting in the use of strategies has
been recommended for students with learning disabilities (Swanson, 1989, 2001; Swanson & Howell, 2001). Furthermore, Swanson (1989) suggested that the existing skills and knowledge of students may have a critical and significant impact on the efficacy of strategy instruction, and may lead to differential instruction effects for different levels of pre-intervention performance.

Therefore, strategies were defined as cognitive processes that varied across individuals, as the same problem was able to be solved using different combinations of subtasks, which could have been combined in different ways (Howell & Nolet, 2000; Rosenshine et al., 1996). Strategies were similar to skills in information processing, except that the strategies involved some conscious attention and control (see Chapter 2). Strategies involved the synthesis aspect of cognitive processing, whereby specific knowledge and small sequences of cognitive processes were combined (in flexible, controlled ways) to form general higher-level combinations that served a particular goal or problem type. However, certain specific information and certain subtasks were generally essential if the problem were to be solved (Howell & Nolet, 2000, Sweller et al., 1998). In order for the strategy to synthesise the subtasks and information, these critical pieces of information and subtasks needed to be specified during the analysis phase of any strategy. Thus, the term “strategy” provided a general term for the analysis and synthesis processes described in information processing models (Wynne, 1971) and the reverse of the processes of chunking and segmenting of complex cognitive tasks used during instruction (see Chapter 2, Halford et al., 1998).

*Strategies and Cognitive Processes in Reading Comprehension*

In reading comprehension, cognitive processing during strategies was mostly
covert. One research procedure used to make such processing overt was the use of verbal protocols (Ericsson, 1988; Ericsson & Simon, 1984, 1993). Cognitive processing during specific comprehension skills has documented the range of reading strategies used by experts (Pressley & Afflerbach, 1995) and provided a basis for the development of transactional strategy instruction in reading (Anderson, 1992; Brown & Pressley, 1994; Brown et al., 1996; El-Dinary et al., 1992; Pressley, Brown, El-Dinary, & Afflerbach, 1995; Pressley, El-Dinary et al., 1992; Pressley, Schuder, Program, Bergman, & El-Dinary, 1992). Despite documenting the strategies used by experts and applying these to instruction, this work failed to acknowledge the hierarchical nature of strategies. Analysis of the essential concepts underpinning strategies, using a sound theoretical framework, and the synthesis of concepts and subtasks into higher level strategies was not directly outlined in this work.

Alexander and Hare (1984) examined the effects of lookbacks on question-answering responses for two of Pearson and Johnson’s (1978) question types, text explicit and script implicit. They reported that performance was improved significantly in the lookback condition, in particular, for immediate lookback in comparison to a delayed condition where lookback occurred after a period of time. Interviews with participants following the study suggested that differences across conditions were compromised as some participants interpreted the turning over of the passage booklet as implicitly indicating they were not to look back at the passage (Andre, 1987). More specific than just looking back at the passage, students were presented with question types that directed them where to look back, in the passage or elsewhere, to find the answer to a question. Logically, strategy steps resembled
information or document search rather than recall of passage content

Extending previous research (Dreher, 1992b; Guthrie & Mosenthal, 1987), Armbruster and Armstrong (1993) formulated a combined model that outlined the cognitive processes involved in searching for information as having four components: "Goal Formation, Text Selection, Information Extraction and Integration, and Evaluation" (p. 140). Armbruster and Armstrong's model was reminiscent of information processing cycles for reading comprehension (Just & Carpenter, 1992; Kintsch & van Dijk, 1978) and information processing models (see Chapter 2, for example, Newell, 1990), as the cognitive processes completed for finding information included a model of the cognitive processes used when searching a text. Also, Armbruster and Armstrong's (1993) document search model was similar to Gibson and Levin's (1975) perceptual model of reading that involved searching for features within the environment. The difficulty of the text passage (or multiple text passages), the purpose (or goal) of searching for information, and children's knowledge of the task and type of questions, were presented as being interactive within this combined model (Armbruster & Armstrong, 1993; Carver, 1992a; Symons & Pressley, 1993). Specific instructional recommendations by Armbruster and Armstrong involved classroom instruction in question types, including question-answer relationships as defined by Raphael (1982) and these were applied in the current investigation.

Building from earlier work with Kirsch (Mosenthal & Kirsch, 1991a, 1991b,
1992a, 1992b, 1993), Mosenthal’s (1996) model paralleled and extended Armbruster and Armstrong’s (1993) combined model. Mosenthal’s model conceptualised document literacy in terms of the complexity of the document, the strategy to be used, and the difficulty of the task to be completed. Integral to Mosenthal’s model were different question types outlined in terms of identifying presented facts, integrated information and causal relationships based on a “concreteness” scale that paralleled Raphael’s (1982) question types (p. 323). Mosenthal further elaborated the cognitive processing involved in locating information in passages. Acknowledging the frequency of document search tasks in middle school and secondary school, Mosenthal reinforced the importance of “document literacy” (p. 323) previously reported in the workplace (Guthrie, Seifert, & Kirsch, 1986) and noted for functioning in society (Guthrie, Schafer, & Hutchison, 1991; Kirsch & Jungeblut, 1986, 1992). Mosenthal particularly emphasised that a critical limitation of this research was the tendency to focus predominantly on document structures and difficulty, and the effects of document simplification and redesign, rather than on the cognitive processing strategies used by readers. Mosenthal’s document structure and literacy research extended to tasks including maps, graphs, charts and illustrations and across longer passages and chapters of texts from different books (Glover et al., 1988; Guthrie et al., 1991; Mosenthal, 1996).

Both Mosenthal’s (1996) model and Armbruster and Armstrong’s (1993) model reinforced the importance of a complete analysis of tasks, cognitive processes, goals, question types and text passages for controlling the cognitive processes required for comprehension, and question-answering (Engelmann &
Carnine, 1982; Howell & Nolet, 2000). Using questions during instruction has been documented to exert some control over the comprehension processes, and information attended to during passage reading. Early research suggested question features affected comprehension in terms of the information readers were required to remember and use in order to answer the question (Frase, 1968). While this study was limited to paragraph reading, Frase found that differences in recall of passages were based on the amount of information required to be processed by a question, whether on recall of single facts, comparison of presented facts or general questions about the passage as a whole. This conclusion focussed on the direct effects of questions on participants, who attended to certain information in the passage at the expense of other information, and the control that questions have over cognitive processing. Given these results for a single paragraph, Frase (1968) suggested that the effects of questions in longer passages were more controlling, as a much larger amount of information was presented in longer passages.

Hamilton’s (1985, 1986) use of detailed examples of questions with matched answers was one application of “matched and unmatched sets of examples and nonexamples” (Andre, 1987, p. 69). Hamilton defined matched examples as those that included the same irrelevant features in examples and nonexamples (correct responses and incorrect responses). In contrast, Hamilton defined unmatched examples as those that included correct responses and distractor items (incorrect responses) that included different irrelevant features. This required detailed analyses of the features of examples of correct responses, along with detailed analyses and manipulation of the features of incorrect responses. These manipulations in the features of the responses forced participants to attend to particular features within
examples to make correct responses. Hamilton's (1985, 1986) confounds included interactions between student ability with treatment conditions and mixed effects for different question types, and these compromised some conclusions about the control of questions over comprehension processes. However, this work was again related to research on attention to features (Treisman, 1993) and the concepts of sameness and differences (Engelmann & Carnine, 1982).

Supportive research had also suggested that "why" questions established and controlled cognitive processes involved in causal connections between events presented in passages and the search procedures for finding answers to questions (Graesser et al., 1983; Martin & Pressley, 1991). Questions that involved "elaborative-interrogation effects" (Martin & Pressley, 1991, p. 113) were defined as "why" or "how" questions about actions or events. These questions were found to be effective for improving comprehension as participants were forced to use cognitive processes that linked together causal events within a passage (Long et al., 1996, p. 194). Martin and Pressley found that these types of questions had been a positive effect on recall of presented information. More importantly, their study suggested that memory was affected both by the way facts are elaborated and integrated together and by the number of opportunities available to practice facts. However, the effects of these specific types of questions have only been examined during on-line processing of text, as the reading occurred using verbal protocols (Graesser et al., 1983) or with recall measures (Martin & Pressley, 1991). Positive effects for these specific question types have been limited to identifying a main idea in a short passage of text (a paragraph) and only when the main idea was explicitly stated within the passage (Greene, Symons, & Richards, 1996; Siefert, 1993).
Further, these studies were limited to adolescents (Greene et al., 1996) or readers with disabilities (Siefert, 1993).

**Strategy Use During Standardised Reading Comprehension Tests**

Researchers have examined strategy use during the completion of standardised reading comprehension tests (Cordon & Day, 1996; Daneman & Hannon, 2001; Farr, Pritchard, & Smitten, 1990; Katz, Blackburn, & Lautenschlager, 1991; Katz, Lautenschlager, Blackburn, & Harris, 1990; Powers & Leung, 1995). Powell and Steelman (1996) cautioned against simple interpretations and comparisons with standardised reading comprehension scores. There has been some suggestion that standardised reading comprehension tests measure text comprehension or the ability to understand text passages more effectively only under timed conditions (Carver, 1992). Cordon and Day used verbal protocols and performance differences to compare standardised reading comprehension tasks with questions about the main ideas presented in passages. Extending Farr et al.’s work, Cordon and Day reported similarities between the standardised reading tasks and the main idea tasks, and the most frequent strategy used across all tasks was rereading of text. While Cordon and Day proposed that similar strategies were used in both standardised reading tests and other reading tasks (e.g. reading for the main idea), this conclusion may have been confounded by the use of passages from standardised tests for the main idea tasks. In addition, there may have been some unknown features of those passages that facilitated rereading rather than other reading strategies. Cordon and Day suggested that eliciting verbal protocols (verbalising the cognitive strategies used during comprehension) led to detrimental effects on performance, and the suggestion that researchers should be aware of potential effects
of using think alouds, or verbal protocols, during reading comprehension research.

A more detailed, and controlled examination of strategies was reported by Daneman and Hannon (2001). In particular, earlier criticisms of SAT results suggested a lack of strategy use using evidence from comparative performance by subjects who were answering questions with and without access to the reading passages (Katz et al., 1991; Katz et al., 1990; Powers & Leung, 1995). Conclusions by Katz and colleagues about a lack of strategy use were based on performance answering questions at better than guessing levels by students who had not read the passages of text. Logically, it was highly unlikely that students did not use some strategy during high-stakes tests that might significantly affect their future (Freedle & Kostin, 1994; Powers & Leung, 1995). In addition, Powers and Leung reported that similar amounts of time were used by students to answer questions, whether or not the passage was available to be read.

Daneman and Hannon (2001) took the strategies outlined in Farr et al.’s (1990) descriptive paper and operationalised these into four treatments that manipulated whether some, all or none of the passage was read and whether or not the questions were presented before or after the passage. Their research questions were concerned with the effects of strategy use on comprehension performance. While there was no time restriction, total time taken to complete the treatment task was recorded along with performance on questions. Their results showed that participants’ significantly higher performance levels were achieved when they read the passage, then reread parts of the passage as they answered each question. An alternate, less effective strategy included reading the questions first, such that
participants simply searched passages for relevant information. In summary, research in strategy use during standardised reading comprehension tests confirmed differential performance across participants based on their selection of strategies. In addition, research evidence supported the importance of strategies as a potential instructional tool for improving reading comprehension performance.

*Research in Reading Comprehension Strategy Instruction in Classrooms*

Reciprocal teaching involves the use of specific reading comprehension strategies that have documented significant and positive results for a range of students (Hacker & Tenent, 2002; Kelly, Moore, & Tuck, 1995; Lysynchuk, Pressley, & Vye, 1990; Palinscar & Brown, 1984, 1988; Rosenshine & Meister, 1994). Reciprocal teaching (Palinscar & Brown, 1984, 1988) includes a set of four strategies (predicting, clarifying, questioning and summarising) implemented in a variety of ways using “scaffolded instruction” (Hacker & Tenent, 2002, p. 699). There have been differential effects and some problems with implementation that have required modifications (Marks et al., 1993). In particular, two recent studies were relevant to the current investigation (De Corte et al., 2001; Hacker & Tenent, 2002).

De Corte et al.’s (2001) study using strategy instruction was jointly adapted from reciprocal teaching (Palinscar & Brown, 1984, 1988) and transactional strategy instruction (Brown & Pressley, 1994; Brown, Pressley, Van Meter, & Schuler, 1996; Pressley, Brown et al., 1995; Pressley, El-Dinary et al., 1992; Pressley, Schuder, Program, Bergman, & El-Dinary, 1992). As distinct from reciprocal teaching, transactional strategy instruction involved small group instruction where teachers construct joint meaning using strategies with students who increasingly use
strategies independently over time (Brown & Pressley, 1994; Brown et al., 1996). Transactional strategy instruction was developed more collaboratively by researchers and teachers and continued over a longer time period compared to reciprocal teaching (De Corte et al., 2001). De Corte et al.’s study, with Year 5 students in whole classes like the current investigation, documented statistically significant performance increases in a reading measure that directly reflected the intervention and a transfer task, but no similar statistically significant increases in standardised reading comprehension performance. Their results also documented significant interactions between pretest performance levels and intervention effects, with students with lower pretest performance improving by significantly more than higher performing students.

Similarly to the current investigation, De Corte et al.’s (2001) intervention involved 24 lessons of approximately 50 minutes duration, measures of reading fluency (except at the word instead of passage level) and statistical analyses using hierarchical linear modelling (Bryk & Raudenbush, 1992; Goldstein, 1995; Rasbash et al., 2002). However, unlike the present intervention, no specific cognitive strategy steps were specified within De Corte et al.’s intervention, there was no selection and sequencing of teaching examples based on specific features or strategies, and classroom teachers implemented the materials in their own way. Their intervention was not based on a theoretical framework from information processing models, as in the present study, but rather on general recommendations from past research in cognitive load theory (Sweller et al., 1998). While De Corte et al. cited previous studies with a similar lack of improvement on standardised reading comprehension measures, they suggested that either the reading comprehension tests measured
different comprehension skills to those taught in their intervention, that the time limit may have had a detrimental effect, or that a longer intervention may have resulted in the desired improvements. In the current investigation, the instructional program involved 30 lessons of 50 minutes, slightly longer than De Corte et al.'s intervention and supporting the need for longer instructional programs.

Hacker and Tenent (2002) examined methodological problems that arose during implementation of reciprocal teaching across multiple classrooms with students in Year 1 through to Year 6 over more than three years. Significant difficulties arose in attempting to ensure treatment integrity that matched the recommendations from reciprocal teaching research to use the four strategies within the session, predicting, clarifying, questioning and summarising. Difficulties occurred with simulating student-teacher interactions, fading of teacher support, lack of student modelling, assessing progress, remaining in whole class teaching format and, with the inclusion of only four strategies. Lesson time during the study, across 17 classes, averaged forty minutes, in line with Palincsar, David and Brown’s (1989) recommendations. Questioning and summarising predominated in the instruction, and some teachers added a writing component that assisted with strategy completion and provided some evidence of ongoing monitoring. Undoubtedly due to a lack of treatment integrity, Hacker and Tenent were unable to attribute improvements in performance directly to reciprocal teaching, and instead suggested performance improvements resulted from complex effects that involved the interactions between teachers, students, and changes in instruction.

Classroom Instruction in Question-Answering

Information processing models are concerned with a single learner whereas a
classroom is concerned with a group of learners. Therefore, acknowledging that learners might be at different stages in learning to read, any group of learners possesses a range of existing knowledge and cognitive processing skills when presented with a particular stimulus as part of their classroom instructional program. The potential variables that are able to be manipulated in any learning situation involve the teaching examples presented during instruction, and the method of presentation of those examples to students. These factors require a more extensive model of classroom instruction beyond the models of reading previously outlined for an individual that extended into a lesson model for a whole class of students.

A model of instruction for a classroom was required to establish a structure within which lesson information could be delivered. Rosenshine and Stevens' (1986) model established prior knowledge, provided clear demonstrations, opportunities for practice and corrective feedback within the lesson format. Their research involved observations in classrooms where effective teaching occurred and their methodology was to collate the current instructional practices. This model set the scene for teachers to provide a classroom environment for effective learning that was shared by students, and included the importance of materials and examples presented to students. By using teaching strategies that provided clear guidance to students at all points in the lesson, this lesson format established relationships between sequences of classroom environmental stimuli. It was the sameness (overlap) in lesson structure, accompanied by the lesson content, that established accurate, and also novel responses by students, and enabled positive reinforcement and effective behaviour management by the teacher.
Implications for the Present Investigation

The application of the theoretical principles of analysis and synthesis from information processing models does not appear to have been applied to comprehension strategy instruction, nor used to design effective instruction for finding, and writing, answers to questions when the passages remained available. Previous research has focussed on reading comprehension, and question-answering, as memory tasks. The current investigation applied these principles to the design of classroom materials based on a theoretical analysis of the concepts used in question-answering and the synthesis of these concepts across lessons, with explicit presentation of cognitive steps for finding answers.

Rather than viewing question-answering as a memory task that required recall of specific information, participants in the current study were presented with a series of generic cognitive steps that might be used for locating the information appropriate to specific questions and question types. The cognitive strategy steps focussed explicitly on the connection between the text, the question and the answer. These steps required participants to work through cognitive steps, and repeatedly read questions, text and answers in order to match the information in the question with the information in the text and the answer. In addition, a consistent lesson format was provided based on Rosenshine and Stevens’ (1986) model to ensure that teachers were prompted to provide specific feedback on how the correct answer was arrived at (using the cognitive strategy steps) rather than just feedback on correctness of responses.
Methodological Limitations of Previous Question-Answering Intervention Research

Scope of Research

The need for high quality research using scientific method in classrooms has been documented (Gersten et al., 2000; Shavelson & Towne, 2002; Wong, 1995; see Chapter 2). Specifically, research in reading comprehension has been reviewed and found wanting in relation to areas of internal and external validity (Lysynchuk et al., 1989). The research literature was examined to identify previous research papers providing instruction in Raphael’s (1982) question answer relationships. This search provided ten appropriate research studies that reported reading comprehension interventions with school students (Benito, Foley, Lewis, & Prescott, 1993; Ezell, Kohler, Jarzynka, & Strain, 1992; Graham, 1995; Graham & Wong, 1993; McIntosh & Draper, 1996; Raphael, 1982, 1984, 1986; Raphael & McKinney, 1983; Raphael & Wonnacott, 1985). Other studies were examined as the authors reported performance data (without implementing interventions) involving empirical evidence based on Pearson and Johnson’s (1978) question types (Reutzel, Hollingsworth, & Eldredge, 1994; Wixson, 1983a). McIntosh and Draper’s (1996) study was excluded as it was concerned with reading mathematical texts. Two papers reported no student data and were excluded for discussion of effects and methodology (Raphael & Wonnacott, 1981; Raphael, 1986). Seven available papers were examined in detail (see Table 1 for an overview) as these researchers reported using an empirical intervention study based on similar question types with similar students to those that were used in the current investigation. Methodological flaws of these studies are discussed in the following section.
Internal Validity Issues

High internal validity ensures confidence that conclusions about changes in performance are attributable to the intervention rather than to some other variable (Lysynchuk et al., 1989); therefore, research control is demonstrated (Gall et al., 1996; Gay & Airisian, 2000; Tuckman, 1999). Reviewing research in previous comprehension strategy instruction, Lysynchuk et al. reported potential confounds from (a) allocations to groups; (b) Hawthorne effects (Campbell & Stanley, 1969); (c) differential exposure to treatments; (d) differential instructional time; (e) confounding of treatment administrators and conditions assigned, and (f) lack of reliability tests reported for dependent variables. Despite these serious methodological flaws, Lysynchuk et al. noted that studies included in their review had, subsequently, impacted significantly on research and classroom practices in reading comprehension.
Table 1

*Overview of Intervention Studies in Question Answer Relationships*

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graham, L., &amp; Wong, B. Y. L. (1993). Comparing two models of teaching a question-answering strategy for enhancing reading</td>
<td>Control: Average Grade 5 ((n = 45)) Experimental: Poor students ((n = 45)), Grade 5 ((n = \text{not reported})), Grade 6 ((n = \text{not reported}))</td>
</tr>
</tbody>
</table>


Seven studies relevant to the current investigation, outlined in Table 1 above, were examined for potential threats to their internal validity (see Table 2, below for an overview). Reporting of participants' pretest performance in studies relevant to the intervention content helps to ensure that differences in performance are attributable to interventions. However, while all studies reported student grade levels, only three studies out of seven reported complete data for treatment groups and grade levels for all groups (Benito et al., 1993; Ezell et al., 1992; Graham & Wong, 1993). Three of the seven studies used graphical displays as an alternative to reporting performance data or reported incomplete data for some means, without standard deviations (Raphael, 1984; Raphael & McKinney, 1983; Raphael & Wonnacott, 1985). No studies reported intervention features in sufficient detail to enable replication, for example, by including the number of lessons taught or the total amount of instructional time required. Aside from one example for each question type reported in some studies, no studies reported the detail, range or number of questions taught within the interventions.

With the exception of multiple baseline designs (Ezell et al., 1992; Graham, 1995), all studies potentially reflected implementer confounding as a result of experimenter implementation or implementation by classroom teachers within particular schools (Andre, 1987; Lysynchuk et al., 1989). In addition, Ezell's (1992)
multiple baseline study reported rising baseline data prior to intervention commencement for some question types, which may have confounded conclusions about intervention effects. Regression to the mean effects were potential confounds in three studies where only students with reading difficulties were included in the intervention (Benito et al., 1993; Ezell et al., 1992; Graham, 1995; Graham & Wong, 1993). The lack of integrity of implementation data strongly suggested a lack of monitoring of the interventions and brought into question conclusions from all studies. These concerns suggest that conclusions from all seven studies are suspect because of problems with internal validity.

A recent study in strategy instruction involving reciprocal teaching documented difficulties in standardising high quality strategy use and teacher dialogue across classrooms (Hacker & Tenent, 2002). Only four studies contained details of their scoring methods for correct answers along with reporting inter-rater reliability for that scoring (Benito et al., 1993; Ezell et al., 1992; Raphael & McKinney, 1983; Raphael & Wonnacott, 1985). Some studies included standardised reading comprehension means to confirm groups of students were poor readers (Graham, 1995; Graham & Wong, 1993) or were of different skill levels, for example, High, Low (Ezell et al., 1992; Raphael, 1984; Raphael & McKinney, 1983; Raphael & Wonnacott, 1985). Only one study reported posttest reading comprehension performance (Benito et al., 1993) and no studies reported statistically significant posttest reading comprehension performance favouring intervention groups. Overall, these seven studies had significant methodological flaws that potentially threatened important aspects of internal validity for research in reading comprehension (Lysynchuk et al., 1989).
### Table 2

**Internal Validity of Intervention Studies in Question-Answer Relationships**

<table>
<thead>
<tr>
<th>Study, кат.</th>
<th>Is training replicable</th>
<th>Control</th>
<th>Implementer</th>
<th>Regression to Mean</th>
<th>Lesson Effects?</th>
<th>Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benito et al., 1993</td>
<td>No</td>
<td>Intact Year 4 class</td>
<td>One class teacher</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Ezell et al., 1992</td>
<td>No</td>
<td>Year 3, multiple baseline</td>
<td>Teacher and peers baseline</td>
<td>Rising</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Graham, 1995</td>
<td>No</td>
<td>Average readers</td>
<td>Researcher</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Wong, 1993</td>
<td>No</td>
<td>Average readers</td>
<td>Researcher</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Raphael &amp; McKinney, 1983</td>
<td>No</td>
<td>Intact Year 5 teachers, classes</td>
<td>Teachers, trained</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Raphael, 1984</td>
<td>No</td>
<td>Intact Year 4 class</td>
<td>Researcher, Teachers</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Raphael &amp; Wonnacott, 1985</td>
<td>No</td>
<td>None</td>
<td>Teachers</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>
External Validity Issues

External validity involves the extent to which findings can be generalised to other groups and includes the validity and reliability of dependent variables, and empirical support for delayed effects or evidence supporting the match between documented effects and classroom activities (Campbell & Stanley, 1969; Lysynchuk et al., 1989; Tuckman, 1999). As stated previously, characteristics of participants were briefly reported; however, reported characteristics did not include specific information about reading performance, except for example, general statements like “most of these 19 children had moderate to severe decoding problems” (Graham & Wong, 1993, p. 272). Some researchers reported using curriculum materials and textbooks as the basis for instruction and this supported, in general, the match between classroom instruction and the interventions (Ezell et al., 1992). However, empirical data demonstrating the psychometric properties of researcher-devised measures was limited in that none of the seven studies reported tests of the reliability or validity of instrumentation nor correlations with standardised measures (Fuchs et al., 1988). Standardised measures of reading comprehension were not typically used and, further, the external validity of researcher-devised measures was also not reported. From an instructional viewpoint, criticisms of approaches linking significant gains only to researcher devised measures, supported the lack of transfer of strategies from specific to general (standardised) measures of reading (Niedelman, 1991; Resnik, 1987). Delayed effects of the interventions were reported in only two studies (Graham, 1995; Graham & Wong, 1993) (see Table 3).
## Table 3

*External Validity for Intervention Studies in Question-Answer Relationships*

<table>
<thead>
<tr>
<th>Study, Criteria</th>
<th>Pretest and Validity</th>
<th>Integrity and Scoring</th>
<th>Question Type</th>
<th>Standardised</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benito et al., 1993</td>
<td>Yes</td>
<td>No integrity, Scoring</td>
<td>Significant, and interaction</td>
<td>Not significant</td>
</tr>
<tr>
<td>Ezell et al., 1992</td>
<td>Multiple baseline</td>
<td>No integrity, Scoring</td>
<td>Rising baseline</td>
<td>Not included</td>
</tr>
<tr>
<td>Graham, 1995</td>
<td>No baseline</td>
<td>No integrity, No scoring</td>
<td>Graphs, some significant interactions</td>
<td>Not included</td>
</tr>
<tr>
<td>Graham &amp; Wong, 1993</td>
<td>Posttest only</td>
<td>No integrity, No scoring</td>
<td>Significant</td>
<td>Not included</td>
</tr>
<tr>
<td>Raphael &amp; McKinney, 1983</td>
<td>Posttest only</td>
<td>No integrity, No scoring</td>
<td>Interactions by grade, task and ability</td>
<td>Not included</td>
</tr>
<tr>
<td>Raphael, 1984</td>
<td>Posttest only</td>
<td>No integrity, No scoring</td>
<td>Graphs only, no data</td>
<td>Not included</td>
</tr>
<tr>
<td>Raphael &amp; Wonacott, 1985</td>
<td>Posttest only</td>
<td>No integrity, Scored</td>
<td>Response quality, mean changes</td>
<td>Pretest used as a covariate for statistics</td>
</tr>
</tbody>
</table>
Finally, for implementation in classrooms, the effects of question-answering interventions for students with widely different reading comprehension pretest performance levels required consideration. Few studies reported empirical data supporting differential posttest performance between students who began instruction with different levels of reading skills (Ezell et al., 1992). Some studies reported graphical results and suggested that effects of question-answering instruction on student performance were dependent on pre-existing reading skills (Raphael, 1984; Raphael & McKinney, 1983; Raphael & Wonnacott, 1985). These results strongly suggested an interaction between question-answering instruction and reading ability, with larger intervention effects evident on graphs for average and low performing students. However, these studies included only posttest performance on question-answering measures (Raphael, 1984; Raphael & McKinney, 1983; Raphael & Wonnacott, 1985).

Possible reasons suggested for this interaction included a lack of general world knowledge for lower performing students (Raphael, 1984), and increased existing reading strategy and world knowledge for higher performing students (Raphael & McKinney, 1983; Raphael & Wonnacott, 1985). Higher performing students were likely to have greater world knowledge (Hirsch Jnr, 2003), with question-answering instruction providing prompting to use that knowledge (Raphael, 1984). Raphael (1984) implicated working memory limitations affecting the performance of Year 4 students, but not Year 5 students. The current investigation assumed that similar working memory effects were likely to occur for both Year 4 and Year 5 students. However, Ezell et al.'s (1992) multiple baseline across question types study showed rising baselines for all ability levels of students
resulting from instruction in the first question type (Right There). In addition, the
effects of two types of reading instruction with younger (Year 2) students reported
no treatment by ability interactions in terms of reading comprehension performance
(Reutzel et al., 1994). Reutzel et al. found that interaction effects were evident,
showing low ability students made more oral reading errors in one reading
treatment; however, the treatments were not focussed on question-answering, nor on
similar types of comprehension instruction. Reported empirical data for question
types were for posttest only and informal inspection of the means indicated similar
performance levels for all ability levels (Reutzel et al., 1994). Therefore, similar to
Lysynchuk et al.’s (1989) conclusions for research in reading comprehension
strategies instruction, critical methodological weaknesses have plagued previous
question-answering intervention studies and threatened both internal and external
validity.

Implications for the Present Investigation

Problems with internal and external validity were controlled in the present
investigation by using scientific methodology and replications within the research
design, whereby the intervention was replicated in different classrooms and schools.
Implementation by classroom teachers increased the external validity and eliminated
previous confounding due to researcher implementation of interventions.
Methodology included standardised scoring procedures for all measures and
treatment integrity data that ensured standardised implementation (see Chapter 6).
Standardised measures, with documented reliability and validity, were used (see
Chapter 6). This research design enabled valid and reliable conclusions to be made
based on the empirical data reported in the results (see Chapter 7).
Chapter Summary

This chapter provided an overview of selected research in reading and reading comprehension relevant to the current investigation. Conclusions from reading comprehension research supported the theoretical underpinnings from information processing models, specifically the principles of analysis and synthesis, and a dual focus on both specific and strategic levels of knowledge and processing. The complexity of reading comprehension, with cognitive processes that contribute differentially to decoding and or comprehension, confirmed this dual focus and provided a foundation for the design of the question-answering intervention used in the current study. Previous research in question-answering was also examined and found to contain methodological flaws. The current investigation was planned to address methodological weaknesses in earlier work and to capitalise on powerful theoretical advances in information processing models. The following chapter outlines how the intervention program was designed to address these issues from theory and research.
CHAPTER FOUR:
INTERVENTION PROGRAM

The current chapter describes the features of the intervention used as the independent variable in the current study. Firstly, a brief overview of the design of the student question-answering materials is presented. Secondly, the analysis of cognitive processing (cognitive strategies) presented in the materials is linked to the theoretical foundation in information processing models and reading comprehension research. Next, the analysis of information (knowledge structures) presented in the materials is linked to the theoretical and practical research base. The chapter concludes with the synthesis of cognitive strategies (processing) and knowledge structures (information) using question types outlined in previous research (Raphael, 1982; see Chapter 3).

Overview

The intervention was designed to achieve two instructional goals. The first goal was to present the concepts (declarative knowledge) and cognitive strategy steps (procedural knowledge) used in the skill of question-answering based on generalisation from sets of presented examples. The second goal was to reduce student error responses during initial learning to a minimum, or as close to errorless learning as was possible, in order to communicate a single interpretation of knowledge structures and cognitive processing to all learners (Engelmann & Carnine, 1982).

The intervention comprised a set of student materials for 30 lessons
implemented by trained classroom teachers (see Appendix A). Teachers undertook training in the implementation of the intervention (see Chapter 6). Descriptive statistics pertaining to key features of the student books are outlined in 5 spreadsheets (see Appendix B). These tables show that, during the 30 lessons, students read 57 passages and completed 376 questions about those passages. The features in the intervention are based on theoretical principles derived from information-processing models (see Chapter 2) and research in reading comprehension (see Chapter 3). Specific intervention features are outlined in detail in the following sections.

Analyses of Cognitive Processing: Cognitive Strategies

The analysis of the cognitive processing (procedural knowledge) required for question-answering included the structured lesson format and cognitive strategy instruction. The materials explicitly presented cognitive processing required during classroom lessons (structured lesson format) and during question-answering (cognitive strategy steps).

Structured Lesson Format

The structured lesson format provided a typical script or schema for each lesson (see Chapter 2). Within each lesson, students were presented with sets of completed examples that were modelled by the teacher. Following teacher modelling and demonstration, students applied knowledge and cognitive strategies (from completed examples) to new examples independently (Rosenshine, 1995; Rosenshine & Stevens, 1986). In this way, the lesson format operationalised active
involvement of students during each lesson and a gradual increase in the
independence of completing the strategy from the classroom teacher to students. The
gradual increase in student responsibility and decrease in teacher support has been
recommended in reading comprehension research (Pearson & Fielding, 1991;
Pressley, 2000; see Chapter 3).

The structured lesson format established clear expectations of cognitive
processes appropriate in different parts of each lesson. The structured lesson format
was explicitly presented in the materials by stimulus prompts, for example
“Review”, “Part 1”, “Part 2”, “Part 3”, or “Independent Practice Story” (see
Appendix A, and below). These stimulus prompts represented parts of the lesson
format, recommended in previous research, which included “Review”,
“Presentation”, “Guided Practice”, and “Independent Practice” (Rosenshine, 1995;
Rosenshine & Stevens, 1986, p.381). These terms were defined in the teacher
manual for the materials (see Appendix A) and during teacher training (see Chapter
6).

The structured lesson format prompted a gradual release of responsibility for
cognitive processing within each lesson from teachers to students. Each lesson
began with the presentation of concepts and cognitive processes (declarative and
procedural knowledge). This presentation involved detailed and explicit modelling,
demonstration and discussion by teachers while students observed. Following these
teacher demonstrations, “Guided Practice” (Rosenshine & Stevens, 1986) involved
joint completion of multiple examples by teachers and students. Independent
practice followed guided practice and involved students reading a new passage and
completing multiple examples without assistance from teachers. Review of the
lesson included marking of student-completed examples and feedback given by
teachers about students’ answers.

By including this lesson format, lessons were predictable and, over time,
student expectations of the lesson were established. Across lessons, students learned
when they should listen, when they should verbally respond to teacher questioning,
and when they needed to complete written examples without teacher support. The
predictability of the structured lesson format was designed to enable students to
focus on cognitive strategy steps and the features of multiple examples that were
presented.

*Cognitive Strategy*

At a more specific level of cognitive processing, a cognitive strategy, was
presented in the materials. The cognitive strategy was a “cognitive problem solving
routine” that consisted of a series of cognitive steps that were to be used for
answering questions (Engelmann & Carnine, 1982, p. 23). The cognitive steps gave
direction to the learner as to “what to do, what to attend to, or how to label some
features of examples” (Engelmann & Carnine, 1982, p. 22). These cognitive steps
were defined and explicitly outlined, in the intervention, as “Steps for Finding
Answers” (see Appendix A, Student Materials, Lesson 1). More importantly,
cognitive steps used in question-answering, like most reading comprehension
processes, were generally not observable in classrooms (see Chapter 3).
Unobservable cognitive processes were translated into observable student
behaviours by the steps of the cognitive strategy. The observable behaviours
included circling, underlining, and writing that provided indications of student use
of cognitive processes (or steps) that were desirable for arriving at the answer to a
question (see Appendix A, Student Materials). The steps were explicitly outlined, modelled by the teacher and applied to multiple examples within the structured lesson format.

Permanent products of cognitive processing, that is, student-completed work, provided the classroom teacher with information that indicated three things. Firstly, completed work provided observable evidence of the cognitive processes being used by students. Secondly, where necessary, teachers used this observable evidence to assist in determining why some students were not arriving at the desired answers to questions. Observable student behaviours enabled teachers to determine possible errors in particular steps of the cognitive strategy which needed further instruction. Thirdly, over time, completed student work provided some evidence of student learning.

In addition, specific cognitive strategy steps were used to make the process of “checking” observable during question-answering. Further questions, that accompanied passages of text, were included in the materials to enable students to check that they had fully considered their answer. For example, the questions “Does this answer the question? Is this the whole answer?” were included in the materials (see Appendix A, Lesson 1). Specific stimulus prompts were included after each question, presented in brackets with that wording (see Appendix A, Lesson 1, Story 1). During the initial lessons, these “checking” questions required a written “yes” or “no” response by students, making the cognitive checking process observable. Across lessons, these stimulus prompts were gradually faded. Students were initially provided with explicit words prompting “checking” for every question (see Appendix A, Student Materials). Fading of stimulus prompts was achieved by
presenting prompts in a smaller font (see Appendix A, Lesson 3), by omitting some wording (see Appendix A, Lesson 3 & 4), and by substituting the question prompt with question marks (see Appendix A, Lesson 4). Therefore, responsibility for “checking” answers was established explicitly, required written student responses and gradually, across lessons, stimulus prompts for “checking” were reduced.

Across the sequence of thirty lessons, the cognitive strategy was repeatedly presented and gradually, across lessons, students were required to complete and increase the number of written responses within the review of “Steps for Finding Answers”. For example, “Steps for Finding Answers” were fully included in the first three lessons (see Appendix A). The presentation of “Steps for Finding Answers” (see Appendix A, Lessons 4 and 5) included blank words which were to be written by students. For subsequent lessons, the number of blank words was increased and students were required to write the “Steps for Finding Answers” in their workbooks. With changes in the steps for a new question type, “Steps for Finding Answers” were fully presented (Appendix A, Lessons 13 and 14). “Steps for Finding Answers” and “checking” represented cognitive processes which were not observable. There was no way of determining whether all, or any, of the students used these exact steps, or variations of these steps, when answering questions during the intervention. If students continued to complete materials, observable evidence across lessons suggested it was likely they were using these cognitive processes during question-answering.

Cognitive strategy steps were used with increasingly longer passages across lessons. Comparisons, for lengths of passages across lessons, increased the amount
of information to be processed and to be held in working memory (for example, Appendix A, Lesson 1 and Lesson 11). In addition, distractor sentences were included with irrelevant information. These sentences increased the amount of time required for question-answering as students re-read distractor sentences when searching for their answers. Distractor sentences were juxtaposed with (placed along side) relevant information. Increasing the number of distractor sentences in any passage, deliberately made finding an appropriate answer to a question more difficult, and more typical of classroom materials. By the end of the intervention, the length of the passages was similar to what would normally have occurred during classroom question-answering.

The intervention provided practice in cognitive processing, using a selection response. During the initial stages of presentation for each concept, answers were provided for all questions. Students were required to select whether an answer was correct or not, rather than to construct an answer. Therefore, students, with teacher modelling and demonstrations in each lesson, completed the cognitive strategy, and provided observable evidence of cognitive strategy steps, by circling and underlining. Observable behaviours indicated that students made explicit the connections between the question, the answer and the passage of text. Cognitive strategy steps were supported by providing some answers that were acceptable and some answers that were unacceptable (that is, positive and negative examples).

Despite completing cognitive strategy steps, some students may have been able to highlight and circle words, and appeared to arrive at the correct answer without knowing why that answer was correct. If this occurred, teachers were asked to provide additional demonstration and modelling of cognitive strategy steps.
Correction and feedback provided additional opportunities for students to apply cognitive strategy steps to multiple examples.

Summary

In summary, the intervention included a structured lesson format that was underpinned by the presentation of cognitive strategies to support student learning of how to answer questions. The following section outlines how the presentation of the information (knowledge structures) in the materials further supported student learning about question-answering.

Analyses of the Information: Knowledge Structures

Information-processing models included the information that was learned, that is, the concepts that were presented (declarative knowledge, see Chapter 2). In the current study, the information presented in the materials included a complete analysis of the concepts required in question-answering. Concepts required for question-answering were analysed at three levels: individual words, question wording, and text passages. Concepts were presented using positive and negative examples, the introduction of small amounts of information and the sequencing of student responses. A concept was defined as “a generalisation to the appropriate range of examples” (Engelmann & Carnine, 1982, p. 35). Discriminations between concepts were based on differences in features: “the basic nature of a concept is a qualitative irreducible feature that makes the particular concept different from all others” (Engelmann & Carnine, 1982, p. 35). All three levels of concepts were included in this definition of a concept, that is, individual words, questions and text
passages. Individual words were presented as concept labels which had meaning based on a range of examples. Questions were concepts which had meanings based on the words that made up questions. Text passages, which included sentences, were concepts which had meanings that both included the word meanings, the sentence meanings and included concepts which arose out of more than one sentence. In this way, the most basic level of concept (individual word meanings) was incorporated into the next higher level of concept (sentences or questions) which was further incorporated into the next higher level of concept (text passages).

The presentation and application of all concepts involved three principles. Firstly, multiple positive and negative examples were presented at each of the three levels of concept: word, question and passage. Secondly, small amounts of new information were introduced at one time. Thirdly, the type of written student response was controlled and sequenced within and across lessons. Simpler written selection responses were required before written production responses. Using these features, the materials increased the amount of information processed and temporarily stored during question-answering across lessons. These three principles emerged out of information processing models (Chapter 2) and reading research (Chapter 3). The following subsections present how these three theoretical principles (positive and negative examples, small amounts of information, control of student responses) were applied to the three levels of concepts used in question-answering (individual words, question wording, and passages of text).

*Positive and Negative Examples*

Each new concept was presented with multiple examples within and across lessons. The intervention introduced “sets of examples” (Engelmann & Carnine,
1982, p. 36) for each concept. Selection of positive teaching examples for each concept reflected the distinctive features of that concept. Across positive examples, the range of features was varied. Each set of positive examples presented distinctive features for that concept but varied other features that were irrelevant for defining the concept. This principle of sameness (of critical features) across positive examples provided students with the information to generalise to new examples based on the features of examples rather than being limited to the memory of the specific examples that had been taught (Engelmann & Carnine, 1982; Treisman, 1993; see Chapter 2).

Negative examples were also presented when teaching concepts (Engelmann & Carnine, 1982). Negative examples differed from the positive examples in the distinctive features required for that concept. However, negative examples included some of the same (irrelevant) features used in positive examples. Inclusion of irrelevant features in both positive and negative teaching examples focussed student attention more directly on the distinctive features (the differences) that separated one concept from another as demonstrated by previous research (Engelmann & Carnine, 1982; Treisman, 1993; see Chapter 2).

The selection and sequencing of the features of positive and negative examples were applied to individual words, question wording, and passages of text. These applications are discussed in the following sections.

*Individual Words*

The intervention presented individual words used in questions, called “Clue Words”, in isolation and presented the positive and negative examples for concepts in two phases (see Appendix A, Lesson 1). The initial teaching phase presented one
word (Clue Word) to represent each concept. For example, the concept of “place” was taught using the Clue Word “Where” and the concept of “time” was taught using the Clue Word “When”. In the initial teaching phase, a range of possible answers (positive examples) for each Clue Word was presented, and the one Clue Word was a temporary label (or name) for each concept. For example, with the concept of “time” linked to the specific Clue Word “When”, the set of positive examples (for answers) included “at ten o’clock... later, morning, soon, midnight, in a while, evening, till lunch, till one o’clock, till late” (see Appendix A). Positive examples all presented related but distinct examples of the concept of “time”.

Negative examples of one concept were presented at the same time as positive examples of another concept (Clue Words; see Appendix A). For example, negative examples for one concept, for example the Clue Word of “time”, were the positive examples presented for the Clue Word “where” for “place”. The positive examples of “place” included “home, in the kitchen, the river, Dubbo, the moon, Japan, floor, on the chair” (Appendix A, Lesson 1). Positive examples of “place” presented similar meanings since they were all about a location and were distinctly different from the positive examples of “time”. The range of meanings presented by the positive examples for one concept (for example, how each word or group of words referred to “place”) comprised the irrelevant features of the other concept. The variations in the range of these irrelevant features, while maintaining sameness in the range of meanings of “place”, both generalised and discriminated that set of examples for that concept (“place”) from the other concepts (“time”, “name”). Four distinct concepts, “time”, “place”, “name” and “reasons”, were presented together using a range of positive examples of each (see Appendix A, Lesson 1).
**Question Wording**

Information presented in question wording built upon the concepts established as individual words, linked by the term “Clue Word”. Clue Words were established in isolation and applied, within that lesson, to multiple questions. Subsequent question examples (presented with passages) using the same Clue Words presented the same word meanings applied in the task of question-answering. Therefore, question wording became a second level of knowledge established in the intervention. Meanings of questions as a whole were required for question-answering. Question meaning involved Clue Words (previously presented in isolation) along with additional words in that question (and their associated word meanings). Prior presentation of Clue Word meanings acted as a part of the preattention process (Treisman, 1993) that supported students in understanding the meaning of the question (see Chapter 2).

**Passages of Text**

Passages of text included concept features that had been presented within individual words and sentences (or questions). The passages included individual word meanings and question wording. Initial passages were simple and short, with few distractor sentences and written to match question wording and question type exactly. Passages were then used for the question-answering tasks. Passages established word meanings, and question meanings, and combined individual pieces of information at the word level and at the sentence level. Passage topics were familiar to students, to facilitate extension of meaning from words to sentences and to passages. Familiar topics, also, enabled students to link the meaning of words and questions with the answers which were provided. Students were able to discriminate
more easily when an answer to a question was acceptable. Using background knowledge for comprehension was recommended in the literature, and familiarity with passage topics facilitated the use of background knowledge (see Chapter 2, Chapter 3).

During initial instruction, no distractor sentences were included in passages. This lack of additional, extraneous information further enabled students to focus on the meaning of individual sentences and on the passage as a whole. The passages were, therefore, short and simple. For example, one passage consisted of three sentences, with three questions, leaving minimal room for error as each sentence from the passage matched a question that was asked (see Appendix A, p. 4).

*Introduction of Small Amounts of New Information*

The introduction of small amounts of new information was a repeated feature in many aspects of the materials. Small amounts of new information were presented in the examples of words, examples of questions and examples of passages. The purpose of introducing small amounts of new information was to reduce the likelihood that working memory capacity limitations would be overloaded during the completion of question-answering activities (see Chapter 2).

*Individual Words*

The presentation of a small number of individual words (used in questions) presented multiple examples for each concept. For example, the first lesson introduced only four Clue Words (What, Where, When and Why) in the first two lessons (see Appendix A). The word meanings were presented using sets of multiple examples over these first lessons and additional, multiple examples across all thirty
lessons. New Clue Words were introduced across lessons with multiple examples. In each lesson, students applied new Clue Words to questions and passages of text. Gradual introduction of a small number of Clue Words with multiple examples and applications provided students with opportunities to review existing, known information, and learn each new clue word without difficulty. Multiple positive examples were juxtaposed with negative examples (positive examples of known concepts) providing students with a structural basis for generalisation using the critical features for discrimination and generalisation. As small amounts of new information (additional Clue Words) were introduced, the number of concepts gradually increased across lessons (see Appendix B).

*Question Wording*

A second example of the gradual increase in difficulty was at the level of question wording through the introduction of increasingly longer, more complex questions. First, question wording and syntax were gradually increased with an additional phrase. For example, question wording included “In the middle of the night, how many animals hunt for food?” (see Appendix A, Lesson 6, Question 10). Subsequently, questions included an additional clause with a second Clue Word and this increased the amount of information to be processed. For example, a sample question with an additional clause was “What happened when Goldilocks sat on Baby Bear’s chair?” (see Appendix A, Lesson 8, Question 5). Including two Clue Words within one question increased the difficulty of processing and answering the question, as students were required to discriminate between the Clue Words to answer the question appropriately. This question structure increased the amount of
information to be processed when answering a question, adding to working
memory requirements gradually (see Chapter 2).

The introduction of complex question wording involved isolated
presentation of questions without passages or answers. Examples required students
to discriminate which Clue Word was required for cognitive processing to find the
answer (see Appendix A, Lesson 8). Complex questions were then applied to
passages and students were required to demonstrate their understanding of
increasing amounts of information presented within the context of question-
answering (see Appendix A, Lesson 8). Therefore, the amount of information to be
temporarily stored and processed was increased gradually both by increasing the
length of questions and by presenting the questions first in isolation and then with
passages (see Chapter 2).

*Passages of Text*

For the passages, small amounts of information were presented through the
use of short, simple passages during initial instruction. The use of distractor
sentences, containing irrelevant information for question-answering, increased the
amount of information presented to students. While students read and searched
through (distractor) information during their reading of the passage, the question-
answering task required students to focus on the relevant information for the
questions and, simultaneously, ignore the distractor sentences, placing a load on
working memory (see Chapter 2). Therefore, while the amount of information
presented increased, students were required to discriminate (much more often and
with larger amounts of information) as the number of distractor sentences was
increased. The intervention gradually increased the lengths of passages used across
lessons. Gradual increases in passage length across lessons were documented (see Appendix B).

*Control of Student Responses*

Student responses were controlled by the materials through the presentation of multiple examples. Initial student responses involved comparing target examples to other examples presented at the same time. The other examples included some that had a similar meaning (positive examples) and some that had different meanings (negative examples). Written student selection of examples with similar meanings preceded student production of examples (writing of answers) for the three levels of concepts.

*Individual Words*

Individual words were presented with completed examples prior to students writing examples. For example, the Clue Word “Which” presented word meaning with three completed examples before students were required to write examples (see Appendix A). The materials presented word meanings with the same sequence of student responses—worked examples followed by written selection of answers followed by written student answers. A second example of this sequencing of selection first was presented for multiple examples of anaphora (see Appendix A). This sequencing established a generalisation for each concept presented through the multiple positive and negative examples from which students selected, prior to producing their own responses in answers to questions.

*Question Wording*

Multiple examples of answers to questions were presented to students in the materials to establish sameness of meaning across the questions asked and the
sentence (answers) provided. Examples of answers also provided differences in
meanings between the question asked and the example answer. Synonymous word
meanings replaced exact match word meanings as students made correct responses
and as different question types were introduced.

*Passages of Text*

The length and features of text passages contributed to the amount of
information presented and the difficulty of the task for writing a response. Increases
in passage length resulted in increases in the time required to read the passage, the
time required to remember the passage and to search for the answer to a question
(see Chapter 2, Chapter 3). Therefore, the intervention presented short, simple
passages whenever a new concept was introduced at any level. The shortness of
passages provided students with less information to read and remember while
searching for their answer, and therefore, reduced the effects of working memory
limitations during question-answering (see Chapter 2).

*Summary and Conclusion*

The preceding section outlined detailed analyses of the concepts presented
and the cognitive strategies presented in the materials at three levels, the word,
question and passage levels. Concepts were presented by using positive and negative
examples, introducing small amounts of new information and controlling of student
responses. The intervention presented increasing amounts of information at three
levels (words, questions and passages) across lessons and attempted to remain
within capacity limitations of working memory (see Chapter 2). The reader is
referred to the complete copy of the materials for further examples (see Appendix
A).
Synthesis: Integration of Information with Processing

The integration of information and processing provided a structural basis for
discrimination and generalisation of both the cognitive strategy and the knowledge
structures. Question types were defined as presented in the materials (see Appendix
A) and adapted from definitions in previous question-answering research (Raphael,
1982). The question types enabled teaching examples to be embedded into the
cognitive strategy steps. The question types linked concepts across levels taught,
that is, word meanings, question wording and text passages. The communication of
sameness across sets of question types provided the basis for generalisation in both
the knowledge structures and the cognitive processing strategy (Engelmann &
Carnine, 1982).

*Question Types and Cognitive Strategy Steps*

Question types linked questions with passages and answers using different
amounts and types of information. The definitions of question types were repeatedly
presented to students in the materials. Question types directed students in the
cognitive steps for finding answers and used common words from concepts,
questions and passages. Question types grouped questions based on the cognitive
steps for finding the answer to the question.

*Common Words Used for Cognitive Strategy and Concepts*

The steps in the cognitive strategy used the concepts that were presented
(Clue Words). The common words built upon the concepts that had been presented
and applied these concepts in the task of question-answering. Therefore, the
cognitive strategy provided additional examples of the meanings of these words and
provided a specific task (question-answering) that used those words.
Controlling Amounts of Information to be Processed

The sequencing of the question types controlled the amount of information required for answering questions, particularly in the initial lessons of the intervention. Right There question types were introduced during the initial eleven lessons in the materials. Right There question types limited the cognitive strategy steps to matching the question to a single sentence in a passage, reducing working memory capacity limitations (see Chapter 2). The presentation of completed examples of Right There questions in the early lessons provided multiple opportunities for students to see worked examples and independently complete simple examples across a wide range of passages and question features. Therefore, the amount of information used during the task of question-answering for Right There questions was limited to matching sentences in passages to questions and answers.

Having established observable student written answers across this wide set of examples over eleven lessons, the intervention then presented the use of more than one sentence and the use of information from outside the passage for question-answering. This sequence of question types provided a detailed set of examples that included a wide range of features with Right There questions that used small amounts of information. The gradual introduction of the other question types increased the amount of information required for question-answering across lessons. More importantly, all of the features of examples (previously presented with Right There questions) were then used with the other question types.
Observable Evidence Of Cognitive Strategy Steps

The wording used in the cognitive strategy required observable evidence of cognitive steps completed. The circling, and underlining or highlighting, of words and sentences provided evidence of student cognitive processes that teachers could directly link to the cognitive strategy steps. With each question type, highlighting, underlining and circling involved different types and amounts of information that corresponded to the source of the answer. Therefore, students provided evidence that their written responses were generalising across a wide range of examples that required similar cognitive strategy steps for each question.

Question Types and Concepts Presented in the Materials

The first, simplest question type of “Right There” questions (Raphael, 1982) was presented to students through a wide range of examples taught over the first eleven lessons (see Appendix A, Lesson 1). Question types were defined and the two question types that were maximally different were contrasted (“Right There” and “On My Own”) (Raphael, 1982, p. 187). The simultaneous presentation of the contrasting types provided multiple completed examples to students, modelled by classroom teachers. Initially, each question type was presented as distinct using completed examples, and discrimination was facilitated by maximal differences in the source of the answer—one from a single sentence totally stated in the passage, the other using background or topic knowledge and very few words stated in the passage. Later in the lesson sequence, presentation of “Think and Search” questions (Raphael, 1982, p.187) provided a minimal difference, with a finer discrimination in the information used and the cognitive strategy steps.
Linking Concepts Across Knowledge Levels

The cognitive strategy steps used concepts that were increasingly broad. The steps began with words (Clue Words) and continued through to sentences for “Right There” questions. The strategy steps presented for “Think and Search” questions, then continued to link information across sentences. “On My Own” questions included steps which included using background knowledge and topic knowledge, while still using the Clue Words as the starting point. Therefore, the gradual changes in the strategy steps linked concepts at each successively higher level, from words to sentences (questions) to passages, across lessons.

Summary and Conclusion

Question types, adapted from definitions in previous question-answering research (Raphael, 1982), presented both the knowledge structures and critical steps for cognitive strategy steps required in the complex task of question-answering. The separate analyses of concepts presented and cognitive strategy steps were an essential part of the intervention. However, the synthesis embedded the knowledge structures into the cognitive strategy across lessons and provided multiple examples and opportunities for modelling of question-answering by classroom teachers for all students.

Chapter Summary

The intervention implemented in the present investigation operationalised recommendations from theory, research and literature from broad disciplines, including reading comprehension and information processing (see Chapter 2 and
Chapter 3). The complexity of question-answering required detailed analyses of knowledge structures and cognitive processing. The task of answering a question, either orally or in writing, required several complex, parallel cognitive processes simultaneously across different levels of information. Separate analyses of concepts and cognitive strategy steps provided an incomplete picture unless these were synthesised to provide deliberate practice in increasingly complex examples (see Chapter 2). The materials synthesised knowledge structures and cognitive processing and provided a single communication to all learners using an increasingly complex, and elaborated, set of examples. Across these thirty lessons, examples gradually became more like those presented in materials used during regular classroom reading programs (Engelmann & Carnine, 1982). The following chapter outlines hypotheses and research questions used to determine the efficacy of the materials for improving Year 5 student reading performance.
CHAPTER FIVE:

AIMS, HYPOTHESES AND RESEARCH QUESTIONS: RATIONALE

The purpose of the current chapter is to present a) a statement of the problem to be addressed; b) the overall aims of the thesis; c) hypotheses to be examined; d) research questions to be discussed, and e) a brief rationale for the hypotheses and research questions based on extant research. Hypotheses and research questions are organised in three sections, one for reading comprehension measures, one for vocabulary and oral reading fluency measures and the third for potential interaction effects resulting from pre-existing performance. Hypotheses outline predictions that arise directly from theory and research. Research questions address issues for which predictions from theory and research are vague or conflicting.

The Problem

Can information processing models be applied to the design of a question-answering program that will lead to statistically significant improvements in reading comprehension performance for Year 5 students? Will Year 5 students who have completed a theory-based question-answering program demonstrate significantly greater improvements in reading comprehension, question-answering, vocabulary and oral reading performance compared to students who have completed their regular classroom reading instruction? Will a theory-based question-answering program lead to similar improvements in reading performance for all students? The current thesis uses theoretical principles from information processing models to address the issues that underpin effective instruction. These principles have the
potential to create a classroom environment where students are provided with the necessary and sufficient conditions that can significantly improve student performance on measures of reading comprehension and question-answering.

Aims and Objectives of the Study

This study aims to contribute to and extend the application of information processing models along with reading comprehension research by:

1. testing the efficacy of a theory-driven question-answering program underpinned by information processing models designed to enhance the reading comprehension, question-answering and vocabulary performance of Year 5 students utilising powerful statistical tools; and

2. examining whether a theory-designed question-answering program differentially impacted on reading performance of students with differing levels of reading achievement prior to completion of the program.

The present investigation was also designed to address some of the limitations identified in previous research by: a) capitalising upon and extending the application of information processing models to underpin the development of a potentially powerful question-answering program based upon the strongest theory available; b) testing the effectiveness of the intervention utilising instruments with sound psychometric properties and hence demonstrated validity and reliability; c) implementing the intervention in ecologically natural classroom settings of potent
practical significance; and d) applying powerful statistical tools to elucidate the findings.

Statement of Hypotheses and Research Questions

Hypotheses and research questions present the possible effects of the intervention program under three broad headings. Firstly, hypotheses related to measures of reading comprehension are outlined. Secondly, research questions related to potential effects on measures of vocabulary and oral reading fluency, are outlined. Thirdly, research questions examining how the effects of the intervention are dependent upon pre-existing student performance are examined.

1. Effects of the Intervention on Measures of Reading Comprehension

Hypothesis 1.1: Year 5 (experimental) students who completed the question-answering program will demonstrate statistically significantly higher scores on a standardised measure of reading comprehension P.A.T.Comprehension (Australian Council for Educational Research, 1986) than scores of Year 5 (control) students who completed regular classroom reading programs.

Hypothesis 1.2: Year 5 students who completed the question-answering program will demonstrate statistically significantly higher scores on a measure of written question-answering on a narrative passage than Year 5 students who completed regular classroom reading programs.

Hypothesis 1.3: The performance of experimental students who completed the intervention on a measure of written question-answering on a factual
passage will be significantly higher than control students who completed classroom reading programs.

2. Effects of the Intervention on Measures of Vocabulary and Oral Reading

Fluency

Research Question 2.1: What are the effects of the question-answering program on Year 5 students’ performance on a reading vocabulary measure compared to Year 5 students who completed regular classroom reading programs?

Research Question 2.2: What are the effects of the question-answering program on Year 5 students’ performance on oral reading fluency measures compared to Year 5 students who completed regular classroom reading programs?

3. Potential Effects of Pre-existing Skills on Intervention Effects

Research Question 3.1: Are the effects of the question-answering program differential for students of differing levels of prior reading ability as measured by scores on standardised tests of reading comprehension, question-answering, reading vocabulary, and oral reading fluency?

Rationale for Hypotheses and Research Questions

In the following section, the rationale for each hypothesis and research question is presented. Each rationale directly links key points from current research
and theory to the present study. The rationale is explicitly linked to hypotheses and research questions by presenting them under the same numbered headings corresponding to the aims, hypotheses and research questions.

1. Rationale for Hypotheses: Intervention Effects on Reading Comprehension Measures

Hypothesis 1.1

Research to date has failed to report significant improvements in standardised measures of reading comprehension following instruction in question types. Previous research has been found to have serious methodological flaws (see Chapter 3). No previous study the author is aware of has used theory-based instruction designed to control and sequence both the information presented and the cognitive processing strategies used in question-answering (see Chapter 2, Chapter 3). Reviews of extant literature have called for more explicit instruction and longer interventions (see Chapter 3). The current study addresses these issues. Therefore, it is hypothesised that this study will report, for the first time, significant performance differences in a standardised measure of reading comprehension following completion of the intervention program.

Hypotheses 1.2

The intervention program provides explicit instruction in how to answer a question and in the range of questions that might be asked. Explicit instruction has been shown to have a significant effect on student performance in a range of curriculum areas (see Chapter 3). Narrative text passages were included for instruction in the intervention. Previous research in question-answering instruction has documented improvements in student performance on question-answering with
narrative text (see Chapter 3). Therefore, it is hypothesised that greater improvements in question-answering for narrative text will occur for students who complete the intervention when they are compared to students who participate in regular classroom reading instruction.

Hypothesis 1.3

Previous research has also documented improvements in student performance resulting from question-answering instruction with expository text passages, namely social studies passages (see Chapter 3). The intervention provided explicit instruction using expository text. Year 5 classrooms include expository text as part of their instruction in specific content areas, for example Social Studies and Science. Previous research has included both instruction and measures using expository text (Social Studies), with positive results (see Chapter 3). Therefore, with a longer and more explicit intervention in the current study compared to previous research, it is hypothesised that there will be significant differences on question-answering scores for a factual passage for students who participated in the intervention compared to students who participate in regular classroom reading instruction.

2. Rationale for Effects on Measures of Vocabulary and Oral Reading Fluency

Research Question 2.1

The strong relationship between reading and vocabulary has been demonstrated by previous research (see Chapter 3). Consistent with information processing models, detailed analysis of the information to be taught in the intervention program included a focus on the meanings of the words used in questions and in passages of text. Previous studies using question-answering
instruction have not documented reading vocabulary performance (see Chapter 3). Therefore, the effects of the question-answering program on standardised reading vocabulary performance cannot be predicted based on previous research. Hence, a research question was posed to elucidate whether or not the question-answering program impacted on reading vocabulary.

Research Question 2.2

Previous research has demonstrated that reading fluency is highly correlated with reading comprehension (see Chapter 3). Therefore, if significant improvements in reading comprehension are predicted, then improvements in oral reading fluency may be likely. However, the intervention does not explicitly provide instruction focussed on improving reading fluency. Previous research in question-answering has not explicitly examined reading fluency (see Chapter 3). Therefore, following completion of the question-answering program, it was not known whether there would be differences in reading fluency between students who participated in the question-answering program and students who participated in regular classroom reading instruction. Hence a research question was posed to elucidate whether effects of the question-answering program were evident on reading fluency measures.

3. Rationale for Effects of Pre-existing Skills on Intervention

Research Question 3.1

The intervention was purposefully designed to improve the performance of all students in reading comprehension and question-answering. Research has shown that learning and improvements are dependent upon pre-existing performance (see Chapter 2, Chapter 3). The pressure on classroom teachers to meet the needs of an
increasingly wide range students in their classrooms has been documented (see Chapter 1). Some question-answering intervention research has suggested interaction effects based on pre-existing performance (see Chapter 3). However, there is a lack of empirical evidence in question-answering research to determine whether the intervention will have similar effects for students performing at relatively high and relatively low levels at pretest, prior to implementation of the intervention. Some previous question-answering studies have focussed mostly on students with learning difficulties, where regression to the mean effects may have affected results (see Chapter 3). The current study examines the effects of an intervention designed for teachers to implement with all of the students in their class. To determine whether the intervention is equally successful for all students is one of the aims of the study. Few previous studies have implemented their question-answering program across a full class of students (see Chapter 3). Therefore, no clear direction from previous work provides a basis for a prediction on any measures in the present investigation. Hence, this research question is posed to elucidate whether differential effects for the intervention on measures of reading comprehension, question-answering, vocabulary or oral reading fluency are evident for Year 5 students with different prior performance scores in the respective dependent variable.

Chapter Summary

The current chapter has clearly outlined the present investigation’s aims, hypotheses, research questions and their rationale. Hypotheses have been developed where clear predictions can be made based on theory or previous research. Research
questions were posed where there was a lack of evidence supporting any predictions or where there appeared to be conflicting, potential effects of the intervention. The following chapter outlines the methodology designed to address the hypotheses and research questions and to allow valid and reliable conclusions to be drawn from the data.
CHAPTER SIX:

METHODOLOGY

In the current chapter the methods and procedures used to examine the hypotheses and research questions formulated for the present investigation are presented. Firstly, the characteristics of the participants are described. Secondly, the instrumentation to be employed is described. Next, an overview is provided of the research design and intervention procedures. Finally, a detailed description of the powerful statistical analyses used to examine the results is presented. Hence, the current chapter provides evidence for the validity and reliability of the methods, procedures and statistical analyses, and, therefore, the empirical data upon which the results and discussion are based.

Participants

Participants were predominantly middle class suburban school students (n = 288) in Year 5 classes (n = 10) who attended three schools in metropolitan Sydney. A total of 288 students were enrolled in ten Year 5 classes in three schools, with 5 classes from School 1, 3 classes from School 2 and 2 classes from School 3. Twenty one students were excluded from data analyses. Reasons for exclusion included leaving the school, either permanently or for holidays, students absent for more than one week and special education students on individual programs provided outside the regular classroom.

The final sample comprised 267 students, 92.7% of the enrolled students, which included 144 males and 123 females. The ten classes had an average of almost 27 students in each class (sd = 2.2), with class sizes ranging between 22 and 31 students. The mean chronological age of these students was 10 years 2 months (sd = 4.9 months) with class averages ranging from 10 years, 1 month to 10 years 5
months. The ten classes included, on average, 14 boys and 12 girls in each class of almost 27. Detailed class data are reported (see Appendix C).

Two schools, Schools 1 and 3, were primary schools in the New South Wales state education system (Kindergarten to Year 6) with similar sized school populations (approximately 500 students). School 2 was an independent comprehensive (Kindergarten to Year 12) and was, therefore, much larger in size (approximately 1200 students). All students were allocated by schools to the 10 existing Year 5 classes prior to the study, based on resource allocation formulae for class sizes (students per class, teachers per school). Policy in each school attempted to equalise the allocation of students to classes in relation to prior ability, student numbers and gender. Resource allocation formulae aimed at creating parallel classes. Existing table and seating arrangements in classrooms were used for the study.

Research Design

Assignment to Treatment Groups

Classes were assigned to one of two treatment groups: an experimental group \( n = 6 \) who received the intervention (question-answering program) and a control group \( n = 4 \) who continued with their regular classroom reading program. Teachers of Year 5 classes in each school volunteered to be involved in the study. Each teacher nominated whether they wished their class to be allocated to the experimental or the control group, within the constraint that there needed to be at least one class in each treatment group at each school. Hence, assignment to treatment groups was not determined by the researcher. This assignment procedure resulted in a total of 167 students (92 males or 55%, 75 females or 45%) being assigned to the intervention group and 100 students (52 males or 52%, 48 females or 48%) assigned to the control group. The mean age of the experimental group was 10 years 2 months while the mean age for the control group was 10 years 1.7 months.
Pretest differences between the two treatment groups on outcome measures are considered subsequently (see Chapter 7).

**Intervention Treatment**

The intervention treatment comprised classroom teacher implementation of 30 lessons of student materials designed to teach students how to write answers to questions (see Chapter 4, and Appendix A). Classroom teachers implemented the intervention to their whole class, during their regular reading time, at least three times per week. While trained to implement the intervention for no longer than 45 minutes for each lesson, treatment integrity data showed that experimental classroom teachers implemented the intervention for an average of 48 minutes per lesson, with a range from 35 minutes to 75 minutes (see Appendix D). Detailed description of the intervention was reported (see Chapter 4).

Implementation integrity data were collected using classroom observations and through examining each student’s completed intervention materials. Student workbooks were collected regularly from the experimental treatment group and teachers were provided feedback on the number of examples completed independently by all students in each workbook. This ensured that students completed the number of examples included in the materials. Integrity of implementation of the instructional program was ensured by these data, along with informal classroom observations and teacher diaries. Summary data for work completed has been included (Appendix D), documenting that, on average, students completed 225 answers to 57 passages, that comprised 90% of the 247 questions included in the intervention program (see Appendix E). Informal classroom observations and teacher diaries documented that lesson times were approximately 50 minutes in length and occurred three times each week.

**Control Group Treatment**

All control teachers completed their usual classroom program in reading as they would have as if the research had not been occurring in their school. Aside
from completing their classroom reading program, control classes completed pretesting and posttesting at the same time and in the same way as experimental classes. In all control classes, classroom teachers selected six students from whom work samples of all reading activities were copied by the researcher. The six students were selected by the teachers as very competent, average competence and struggling readers in each control class. Descriptions of these work samples that comprised the control group reading programs are reported (see Appendix E). In summary, control group teachers taught a wide range of comprehension skills over the 30 lessons. A wide range of responses were documented across the four control classes. Students with poor reading skills, as judged by their teachers, completed between 64 and 82 responses on average. Students with average reading skills completed between 88 and 234 responses, while students with good reading skills completed between 94 and 273 responses during the 30 lessons. Only in one class, Class 2, did students complete more than 200 responses, where average and good readers completed 234 and 273 responses respectively. Across the remaining three classes, student responses ranged between 69 and 163 responses (see Appendix E).

Instrumentation

This section outlines all measures used in the study. Measures of reading comprehension are followed by other reading measures. Firstly, measures of reading comprehension included one standardised measure of reading comprehension and two curriculum-based measures of written question-answering. The two curriculum-based written question-answering measures involved a narrative passage and a factual passage. Secondly, measures of reading vocabulary and reading fluency are outlined. The measure of reading vocabulary was standardised and normed with the
standardised measure of reading comprehension. The two measures of reading fluency corresponded to the two measures of written question-answering for the two passages of text, narrative and factual. Discussion of all measures focuses on the validity and reliability of each measure used in the study.

*Reading Comprehension Measures*

The reading comprehension measures used in the current study were used to address the research hypotheses (see Chapter 5). The standardised reading comprehension measure addressed Hypothesis 1.1. The curriculum based reading comprehension measures, in written question-answering, addressed Hypothesis 1.2 and 1.3 for the narrative and factual passages respectively.

*Standardised Reading Comprehension Measure*

Reading comprehension was measured by one standardised measure: "Progressive Achievement Tests in Reading: Comprehension" (Australian Council for Educational Research, 1986, p. 1). This measure provided normative data measured in percentiles. The test was standardised for Years 3 through 9. Two parallel forms of the test were available (Form A and Form B). Form B was selected for the current investigation. Students were asked to read a series of short passages and, as each passage was read, to respond to multiple choice reading comprehension questions for that passage. The Year 5 test included eight prose passages (between 200 and 300 words long), with two narrative passages, two descriptive passages and four expository passages. Passage features were reported for length, and number and types of questions for each passage, ranging from 175 to 352 words in length with five or six questions (see Appendix F).

The Year 5 test comprised 41 multiple choice questions, 21 of which were factual and 20 of which were inferential as defined in the manual. Question categorisation as either factual and inferential was defined in the manual: “Factual items test comprehension of the facts and ideas explicitly stated in the passage ...
Inferential items demand a level of cognition beyond word recognition and recall of facts ... to make inferences ... to establish the main point ... to draw conclusions” (Australian Council for Educational Research, 1986, p. 2). All 41 items were multiple choice format and participants selected the best answer from five multiple choice items.

*Rationale for instrumentation selection.* The test was selected for the current study for several reasons. Firstly, resource limitations required a group administered test. In addition, group administration was completed by classroom teachers, which therefore minimised contact between the researcher and participants. Secondly, the test was normed in Australia, albeit some time ago. The tests were developed in New Zealand and renormed in Australia in November 1984 (Australian Council for Educational Research, 1986). Although dated by almost 14 years, these were the most recent norms at the time of the study. Thirdly, this test required students to select multiple choice answers to questions and question-answering was the skill of interest in this study. Fourthly, concurrent validity of the tests was supported by high correlations (0.73) with other reading tests for New South Wales samples at the time of norming (Australian Council for Educational Research, 1973). Finally, reliability for the test was established with a Kuder Richardson index (KR-20) of 0.94 (Australian Council for Educational Research, 1986, p.31).

Therefore, the PAT Reading Comprehension was the most appropriate measure of reading comprehension for group administration at the time of the current study as it provided valid and reliable normative data.

*Written Question-Answering Measures*

Reading comprehension was also measured by two sets of written answers to questions about two text passages, one narrative and one factual. The two sets of written question-answering provided a direct measure of the effects of the intervention and addressed Hypotheses 1.2 and 1.3. The narrative passage, titled “Tropical”, which was used as part of the Year 3 state-wide testing program (NSW Department of Education and Training, 1996), was selected as the narrative passage
(see Appendix G). A passage designed as challenging for Year 3 students was deliberately selected for the current investigation focussing on Year 5 students in order to ensure that the passage could be readily decoded by the older students participating in the present study. Therefore, decoding skills were likely to have minimal impact on written answers to questions.

The passage, titled “Whales”, was selected as the factual passage (see Appendix G). Previous research examining “think aloud” protocols had demonstrated this passage was readily decoded by Year 4 students (Kucan & Beck, 1996, p.259). Hence this passage was deemed suitable for Year 5 students and for application to question-answering research, given this area of research constituted another area of reading comprehension research. In addition, during a pilot study, classroom teachers agreed that both passages were at approximately Year 5 difficulty level and similar to what they would have used with their students during classroom reading instruction.

The readability of both passages was examined. The Flesch Reading Ease Score was calculated for each passage (Neibauer, 1998). This formula used average words per sentence and average syllables per word. Both passages were similar, with about 1.3 syllables per word and about 13 words per sentence (see Appendix H), although the factual passage was about 100 words longer. Calculations resulted in a Flesch Reading Ease Score of 82 for the narrative passage and 74 for the factual passage. A score within the range of 70 - 80 was claimed to be graded fairly easily in relation to reading difficulty, hence both passages were deemed to be of minimal reading difficulty (Neibauer, 1998). Therefore, both passages were considered to be at an appropriate level of difficulty for Year 5 students and approximately at a similar level of difficulty.

For each passage, a set of questions was written to correspond to the question types taught in the intervention program in this study (see Chapter 4). The questions were of three types defined in previous research (see Chapter 3). Two question types were found in the passage, either directly in one sentence or in more than one sentence. The third question type required information in the passage to be
combined with either topic knowledge or personal experience to provide an answer.

For the narrative passage, four questions for each question type were written, resulting in a total of twelve questions, four of which were answered using one sentence from the passage, four others answered using more than one sentence and another four answered using background knowledge (see Appendix G). For the factual passage ten questions were written, which included three questions answered directly from the passage, four questions answered using more than one sentence from the passage, and three questions answered using background knowledge (see Appendix G).

All students completed both passages within the same amount of time. Written student responses were marked by the researcher. A standard marking guide was created against which all student written answers were marked (see Appendix I). This guide provided samples for written answers to be judged as correct, half correct, or incorrect. Secondly, a second marker, a trained research assistant, marked a randomly selected sample of 53 student written answers (20% of the total sample) against the standard marking guide. The ratio of inter-rater agreement for narrative answers and factual answers was calculated at 91.9% and 91.5% respectively (see Appendix J).

Therefore, the passages and questions were considered to be typical of the content that might be used in Year 5 classrooms. The standardised administration (see Appendix K) and scoring of the answers, supported by inter-rater reliability data, ensured the reliability of the scores for written question-answering for all participants.

Reading Vocabulary and Oral Reading Fluency Measures

Standardised Reading Vocabulary Measure

Reading vocabulary was measured using “Progressive Achievement Tests in Reading: Vocabulary” (Australian Council for Educational Research, 1986, p. 1).
This measure addressed Research Question 2.1 and provided normative performance, in percentiles standardised for Years 3 through 9. Two parallel forms of the test were available (Form A and Form B). Form B was selected for the current investigation. Students were asked to read a sentence and then respond by selecting the best synonym for the underlined word in each sentence. Students selected "the one answer which has the same or nearly the same meaning as the underlined word" (Australian Council for Educational Research, 1986, Student Booklet, p. 2). The Year 5 test comprised 53 items arranged in increasing order of difficulty. Students selected multiple choice answers from five alternatives for all questions using a standardised answer sheet. Norms for this measure were completed with the reading comprehension measure and were the most recent norms available at the time of the study.

*Reading Fluency Measures*

Oral reading fluency was measured using one minute oral readings of both the narrative and factual passages used for written question-answering. Oral reading fluency measures addressed Research Question 2.2. Oral reading fluency was measured individually by the researcher or one of two trained research assistants. Standardised directions for administration and scoring were used, as adapted from Shinn (Shinn, 1989, p. 239; see Appendix L). Oral reading fluency scores were the total number of words read correctly per minute. Inter-observer reliability checks were completed for 53 students, comprising 20% of the sample of 267 participants. Reliability data included both pretest and posttest measures of oral reading fluency. Reliability checks, which involved two trained research assistants as second markers, were reported at 95.1% and 94.2% agreement between the two markers and the researcher for narrative and factual passages, respectively (see Appendix J).
Procedure

The study was approved by both the University of Western Sydney Ethics Committee and the New South Wales Department of Education Research Approvals Committee, as well as by the principal in the independent school, to ensure ethical standards were upheld. Written approval from both was required prior to commencing any part of the formal research project. Informed written consent was obtained from parents or guardians of participants in all schools (See Appendix M). Part of the process of obtaining informed consent included general information presented at a parent information night in one school and a short, general statement about the study in a school newsletter at a second school.

The schools involved were selected on the basis of their willingness to participate. The researcher had not been involved in any school prior to the study. In School 1, the researcher approached an executive teacher to request the involvement of Year 5 teachers. In both School 2 and School 3, the researcher was approached by the special education teacher who subsequently approached Year 5 teachers. In all schools, the researcher presented a general overview of the aims of the study, the instrumentation and the procedures at an initial meeting with Year 5 teachers and school executive. Discussion with teachers included that the researcher would observe lessons in all classrooms. All teachers agreed to be involved under these conditions. One school had recently used the PAT Reading Comprehension Form A test. To ensure consistency across all schools and to eliminate possible practice effects, Form B tests for both reading comprehension and reading vocabulary were used for all participants for both pretests and posttests.

The procedure for the study required all testing to be completed before lunchtime, in order to maximise the performance of all students. Wherever possible, testing occurred within the regular times allocated for reading instruction. The researcher offered to provide the comparison teacher with the intervention program
at the conclusion of posttesting. This meant that all classes had the opportunity of access to the intervention program. In all teacher discussions, the researcher indicated confidence in current classroom instruction and the need to document control classroom reading programs.

**Pretesting & Posttesting**

Pretesting and posttesting in all schools began with individual testing of all students on oral reading fluency, completed by the researcher or one of two trained research assistants. Group tests administered by classroom teachers began as soon as individual testing was completed. All group tests were administered using standardised directions (see Appendix K) and the same testing schedule (see Appendix N). During pretesting and posttesting, the researcher made regular visits to schools to collect completed student tests and to administer group tests to students who had been absent. Small groups of students were seated in nearby classrooms or annexes, where the researcher administered any tests that had been missed using standardised directions.

On completion of pretests, the researcher negotiated for the commencement of the intervention to begin as soon as possible. Discussions with all teachers included organising classroom observations, collection of completed student booklets from experimental classes and collection of student work samples from control classes.

Posttesting was commenced as soon as possible after completion of the intervention and was as similar as possible to pretesting. Posttesting began with oral reading fluency testing. The same testing schedule and standardised directions were used by all teachers for the group administered tests. Absent students were tested by the researcher using the same process from pretesting. At the conclusion of posttesting, a final meeting was organised in each school where results were discussed. During this meeting, the researcher, as previously agreed, offered the intervention program to all comparison teachers. This meeting completed the formal data collection and study within each school. All classroom teachers and schools
were thanked for their participation in the study and the researcher had no further contact with the school.

Prior to posttesting the independent variable, the question-answering instructional program, was implemented in all experimental classrooms (see Chapter 4 and Appendix A). A brief description of this is included earlier in the current chapter, under Intervention Treatment.

**Summary: Procedure**

These procedures ensured that data were collected from participants without threatening validity or reliability. Contact between all classroom teachers and the researcher ensured that interactions were minimised and the researcher presented the purpose of the research was to determine effects, rather than predict positive performance changes would result from the intervention. Contact between the participants and the researcher was minimised to less than five minutes involved in individual testing of oral reading fluency. Pretesting and posttesting procedures were identical for both experimental and control groups. Using these procedures ensured that valid and reliable performance data for all participants were analysed.

**Data Analyses**

The current study used multilevel modelling for most of the statistical analyses. Mean pretest and posttest treatment group scores provided descriptive statistics and were an advance organiser prior to the completion of more sophisticated analyses. The complex nature of the variables and data required multilevel modelling in order to take into account both the hierarchical nature of the sample data and the number of interdependent variables. Statistical analyses used Multilevel Modelling Software, namely MlwiN, (Rasbash et al., 2002). This
approach (also termed hierarchical linear modelling) has been outlined in detail elsewhere (Bryk & Raudenbush, 1992; Goldstein, 1995). Multilevel procedures allowed detailed examination of the results for all hypotheses and research questions. Put simply, multilevel analyses used coefficients from regression equations to provide measures of effects, somewhat similar to \( t \) tests with statistical adjustments that controlled for data organised in successively larger groups (e.g., classes within schools).

**Descriptive Statistics**

For each dependent variable, treatment group means and standard deviations were used to provide a preliminary description of the data. As an advance organiser, these data provided an overall view of mean changes in performance for the two treatment groups. Typically, traditional statistical analyses reported group mean data, which were then analysed using more sophisticated procedures such as multiple regression or analyses of variance or covariance. However, data analyses using analyses of variance or covariance ignored potential confounding effects due to the hierarchical organisation of the data within classes within each treatment group. Multilevel modelling provided more sophisticated analyses that adjusted for the hierarchical (nested) nature of the data.

**Background for Multilevel Modelling**

In most research conducted in school settings, individual student characteristics and those associated with groups (e.g., classes, schools) are confounded because groups are typically not established according to random assignment. Students within the same group (e.g., class or school) are typically more similar to other students in that same group than they are to students in other groups.
Even when students are initially assigned at random, they tend to become more similar to students within their group over time. In general, it is inappropriate to pool responses of individual students without regard to classes unless it can be shown that classes do not differ significantly from each other.

Traditional analyses (e.g., analysis of variance, analysis of covariance, multiple regression) are based on the assumption that measurements at different levels are independent. This assumption infers that the results for any individual student within the same class are independent of those for other students within that class. Typically, this assumption is violated in that students within one particular class tend to be more similar to each other than they are to students in other classes. Many factors that affect students occur at the classroom level. In particular, as in the current investigation, differences in instructional programs tend to occur at the class level. When this assumption is violated, traditional tests of statistical significance ignore the hierarchical (nested) nature of the data and are no longer valid. If, for example, there are systematic differences between classes, then the typical single-level analyses that ignore this clustering of students into classes (or schools) are likely to be invalid. Specifically, a violation of statistical assumptions increases the likelihood of finding a significant effect when there is none (Type 1 error). In contrast to traditional analyses, multilevel modelling does not make this assumption. Because of these problems, multilevel modelling (also known as hierarchical linear modelling) was used to analyse hierarchically structured data as in the current study (for further details of multilevel modelling, see Bryk & Raudenbush, 1992; Goldstein, 1995; Marsh, Hau & Kong, 2002; 2000; Marsh, Koeller & Baumart, 2001; Rasbash et al., 2002; Raudenbush & Bryk, 2002; Snijders, & Bosker, 1999.)
In addition, unlike constraints in traditional statistical analyses, multilevel modelling procedures did not require the same number of lower level units within each higher level unit (Goldstein, 1995). Therefore, in the current study, where the number of students varied from class to class, traditional statistical analyses were problematic. Hence, another major advantage of multilevel modelling procedures was the ability to handle unbalanced data. This stood in contrast to traditional repeated measures multivariate analysis of variance, which required balanced data. Therefore, multilevel modelling statistical analyses were conducted in the current study, using MLwiN (Rasbash et al., 2002).

The raw scores for all measures were used except for the standardised measures. The percentile scores for standardised measures were used. Percentile scores, rather than raw scores, provided the normative comparison. Therefore, percentile scores were used for analyses of reading comprehension (PAT Reading Comprehension) and reading vocabulary (PAT Reading Vocabulary). The translation between the statistical results and predictions of posttest performance was facilitated by using raw scores. For example, the coefficient for a variable in the regression equation represented the change in performance in the scale of measurement used in the statistical analyses for that variable. Using percentile scores for normative measures, the coefficient showed the amount of change, in terms of percentiles, that had resulted from the intervention.

Models used for Multilevel Analyses

Rasbash et al. (2002) recommended starting with simple models and, with the addition of variables, to slowly increase the complexity of modelling. The approach in the current study was to separately analyse each dependent variable
using the same five models for each variable. The same series of two-level models (student level and class level) was used for each dependent variable. Therefore, in the current study, each dependent variable was analysed with the increasing addition of a series of variables into each successive model. The purpose of including each model separately was to enable examination of the effects of additional variables on the error variance term at each level of the model: student level and class level. The reduction in total variance for each equation supported the inclusion of additional variables. The models used in the analyses have been outlined (see Table 4) and discussed, in detail, in the following sections.

Preliminary analyses occurred for all pretest dependent variables using two models, Model 1 and Model 2 (see Table 4). With all pretest data, analyses for each dependent variable began with Model 1, the “basic variance components model” (Rasbash et al., 2002, p.98) which examined the variance at both student and class levels. Model 2 introduced the treatment group variable into the equation. The overarching purpose of these models was to determine whether there were pre-existing, systematic differences between the ten classes and between the experimental and control groups prior to the start of the intervention.
Table 4

*Models used in MiwiN Analyses*

<table>
<thead>
<tr>
<th>Model</th>
<th>Analyses</th>
<th>Variables</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>Basic Variance</td>
<td>None</td>
<td>Examine potential pretest student level and class level differences</td>
</tr>
<tr>
<td></td>
<td>Components Model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 2</td>
<td>Treatment Group as a fixed effect</td>
<td>Group</td>
<td>Examine potential pretest treatment group differences</td>
</tr>
<tr>
<td>Model 3</td>
<td>Treatment Group as a fixed effect</td>
<td>Group</td>
<td>Examine potential posttest treatment group differences</td>
</tr>
<tr>
<td>Model 4</td>
<td>Related Dependent Variables added</td>
<td>Pretest</td>
<td>Adjustment for pretest variables’ effects on posttest performance</td>
</tr>
<tr>
<td></td>
<td>Variables</td>
<td>Variables</td>
<td></td>
</tr>
<tr>
<td>Model 5</td>
<td>Interaction Term for pretest and treatment group added</td>
<td>Interaction Term</td>
<td>Examine potential posttest treatment group differences, after controlling for pretest treatment group differences</td>
</tr>
</tbody>
</table>

The main statistical analyses of intervention effects included three models, Model 3, Model 4 and Model 5 (see Table 4). Model 3 analysed the posttest differences between the treatment groups. Model 3 was identical to Model 2, except that Model 3 analysed posttest data. Model 4 introduced pretest performance of related variables, including the matching pretest variable, into the equation. Model 5 included interactions between the treatment group and the pretest variable corresponding to the outcome variable. This series of five models was used for all variables. Similar analyses have been reported previously for students in Year 5 in
reading comprehension research (DeCorte et al., 2001). Analyses calculated
parameter estimates using restricted iterative generalised least square estimation
(Rasbash et al., 2002).

*Interpreting Multilevel Software Results*

Model 1, the variance component model outlined below (Figure 1), provided
a baseline with which to compare more complex models. The subscript "i" referred
to the student, and the subscript "j" to the class. Subscript "ij" indicated variables
varied from student to student within a class. If a variable had a subscript "j" only,
it varied across classes but had the same value for all students within a class.
Variables with no subscripts were constant across all students and classes.
The output from the software for this simplest model is presented (see Figure 1).
The gradual introduction of additional variables to the regression equation
corresponded to the five models outlined above (Table 4). Model 1 is presented in
general terms, with detailed explanations (see Figure 1). Model 4 is presented with
explanations of the interpretations of the explanatory variables linked specifically to
the reading comprehension measure. Model 5 is discussed in relation to the addition
of the interaction term.
\[ y_{ij} \sim N(XB, \Omega) \]
\[ y_{ij} = \beta_0 x_0 + u_{0j} + e_{0j} \]
\[ \begin{bmatrix} u_{0j} \\ e_{0j} \end{bmatrix} \sim N(0, \begin{bmatrix} \Omega_u & 0 \\ 0 & \Omega_e \end{bmatrix}) : \begin{bmatrix} \Omega_u & 0 \\ 0 & \Omega_e \end{bmatrix} = \begin{bmatrix} \sigma_u^2 & 0 \\ 0 & \sigma_e^2 \end{bmatrix} \]

-2*\text{loglikelihood(IQLS Deviance)} = 2475.548 (267 of 267 cases in use)

*Figure 1. Model 1 basic variance components model*

Note: \( y_{ij} \sim N(XB_{ij}) \) was the standard notation for a normally distributed response variable with the fixed part of the model XB and variances and covariances of the random terms over all the levels of the model. For instance, \( y_{ij} \) in the current study, was the dependent variable given by \( ith \) student in the \( jth \) class.

\( B_0 \) was the mean \( y \) performance for students in all classes. For example, if \( y \) was PAT Reading Comprehension, \( B_0 \) was the overall mean of student performance for the PAT Reading Comprehension for all participants.

\( x_0 \) was a constant column or a vector of ones and was typically denoted as "cons" (\( x_0 \) is a special explanatory variable, which takes the value 1 for all cases). \( U_{0j} \) was a residual which varied randomly between classes and which was the same for all
students in class j (the subscript 0 indicated that it was attached to \( B_0 \)). Also, \( U_{oj} \) was the departure of the jth class’s intercept from the overall value \( B_0 \).

\( e_{ij} \) was a random variable with zero mean and represented the sum of all other influences on student \( ij \). The term \( B_0 \) constituted the “fixed” part of the model, \( U_{oj} \) and \( e_{ij} \) the “random” parts of the model. Fixed effects were assumed to be “constant” and without measurement error. Random effects were not assumed to be constant and were measured with sampling error, for example where a sample of classes was used and the results were generalised to the population. Random variables were from a probability distribution and had a mean and a variance.

It was assumed that:

1. \( U_{oj} \sim N(0, S_{w0}^2) \), \( S_{w0}^2 \) was the variance of level 2 residuals \( U_{oj} \) (class level variance).
2. \( e_{ij} \sim N(0, S_e^2) \), \( S_e^2 \) was the variance of level 1 residuals \( U_{oj} \) (student level variance).
3. \( U_{oj} \) and \( e_{ij} \) were independent.

The variances \( S_{w0}^2 \) and \( S_e^2 \) were referred to as random parameters and \( B_0 \) as the fixed parameter of the model. Standard errors of fixed and random parameters were given in parentheses for all models. The likelihood ratio statistic (-2*\( \log(\text{like}) \) or -2loglikelihood) was used to test the significance of subsequent models (Rasbash et al., 1999).

Subsequent multilevel models introduced explanatory variables as outlined above (see Table 4). Model 4 introduced fixed parameters for pretest variables and examined the effects of these variables, together, on the dependent variable. The effects of these variables, which may have differed across students and classes, were determined by examining their respective coefficients and the difference between
the log-likelihoods. Model 4 is presented to outline the interpretation of the
effects of explanatory variables on the dependent variable, PAT Comprehension
Posttest in the presented example (see Figure 2).

The significance of explanatory variables was tested by comparing the
parameter estimate with its standard error, presented as the coefficients in the
regression equation as shown in Figure 2. For a large random sample, the ratio of a
fixed parameter to its standard error was approximately normally distributed with
mean 0 and variance 1. The ratio of the parameter estimate to its standard error
provided a critical “t” value to test the significance of the parameter estimate. If
this ratio was greater than 1.96 (critical value under normal distribution) then the
parameter estimate was significantly different from zero. Significant effects were,
therefore, determined by examining these coefficient ratios in the regression
equation. For example, in this illustration, three coefficients (for Treatment Group,
Pretest PAT Comprehension, and Pretest PAT Vocabulary) were significant (see
Figure 2). The coefficient ratios for the two reading fluency pretest variables were
not significant.
COMPOP_{\text{STUDNO, NCLASS}} \sim \mathcal{N}(\gamma \mathbf{E}, \Omega)

\text{COMPOP}_{\text{STUDNO, NCLASS}} = \beta_{0\text{STUDNO, NCLASS}} \cdot \text{CONS} + 11.758(1.622) \cdot \text{GROUP}_{\text{NCLASS}} + \\
0.531(0.045) \cdot \text{COMPREP}_{\text{STUDNO, NCLASS}} + \\
0.222(0.046) \cdot \text{VOCPREP}_{\text{STUDNO, NCLASS}} + \\
0.038(0.055) \cdot \text{TPREWRRC}_{\text{STUDNO, NCLASS}} + \\
0.044(0.060) \cdot \text{WPREWRC}_{\text{STUDNO, NCLASS}}

\beta_{0\text{STUDNO, NCLASS}} = 6.838(2.808) + \mu_{0\text{NCLASS}} + \epsilon_{0\text{STUDNO, NCLASS}}

\begin{bmatrix} \mu_{0\text{NCLASS}} \end{bmatrix} \sim \mathcal{N}(0, \Omega_u) : \Omega_u = \begin{bmatrix} 0.000(0.000) \end{bmatrix}

\begin{bmatrix} \epsilon_{0\text{STUDNO, NCLASS}} \end{bmatrix} \sim \mathcal{N}(0, \Omega_e) : \Omega_e = \begin{bmatrix} 162.293(14.058) \end{bmatrix}

-2 \cdot \text{loglikelihood(IGLS Deviance)} = 2116.583 (267 of 267 cases in use)

\text{Figure 2. Model 4 pretest explanatory variables model with estimates}

\text{Note:}

COMPOP = Posttest PAT Comprehension;

GROUP = Treatment Group as fixed variable;

COMPREP = Pretest PAT Comprehension;

VOCPREP = Pretest PAT Vocabulary;

TPREWRRC = Pretest Tropical (Narrative) Oral Reading Fluency; and

WPREWRC = Pretest Whale (Factual) Oral Reading Fluency.
Model 2 and Model 3 were simplified versions of Model 4, with Treatment Group as the only fixed variable included in the regression equation. Model 2 examined pretest data and Model 3 examined posttest data. Extending Model 4, Model 5 examined the question of whether interaction effects existed between pretest performance on each explanatory variable and the treatment group variable. Model 5 included addition of the interaction term as a fixed variable. For the presented example of Model 5, the interaction term was Group.COMPREP that representing the interaction between treatment group and pretest reading comprehension and likely effects on posttest reading comprehension.

Potential interaction effects were determined by examining the coefficient of the interaction term for treatment group and pretest performance on the dependent variable. Statistically significant interaction effects involved calculating predicted posttest estimates based on pretest performance for each treatment group. Significant interaction effects were reported graphically by plotting pretest performance for each treatment group against predicted posttest performance at representative levels (see Appendix O). Interpretation of the significance of the interaction effect was the same as for other explanatory variables, using ratio comparisons of parameter estimates. Significant effects were confirmed graphically when the plots for the treatment groups were not parallel (see Chapter 7).

Chapter Summary

Therefore, the current study involved a quasi-experimental design with replications across classes and schools, and where each replication included at least
one experimental class and one control class. Assignment to treatment groups was through self selection by teachers, and pretesting and posttesting followed standardised administration and testing schedules in all schools. The use of valid and reliable instruments and complex statistical analyses, using multilevel modelling, supported the design. The following chapter presents detailed results from this design.
RESULTS

The purpose of the present chapter is to report the results of the current study that tested the impact of the question-answering program, the independent variable, on the performance of Year 5 participants on measures of reading comprehension, question-answering, vocabulary and oral reading fluency (see Chapter 6 for instrumentation). Statistical analyses included descriptive statistics (e.g. means and standard deviations) and, in particular, multilevel modelling, using MLwiN software (Rasbash et al., 2002) as described in Chapter 6. The current chapter is divided into two sections. In the first section, preliminary analyses are presented, demonstrating that there were no statistically significant pretest differences between treatment groups or classes for any dependent variables examined in the current study. In the second section, the statistical analyses undertaken to evaluate the effects of the independent variable (question-answering program) are presented. Results for each measure are reported, corresponding to the numbering of hypotheses and research questions presented in Chapter 5. Interaction effects, relevant to Research Question 3.1, are reported with the results for the two relevant measures where significant interaction effects occurred. A summary of interaction effects for all measures, addressing Research Question 3.1, is presented immediately prior to the chapter summary.

Preliminary Analyses: Tests of Pre-Existing Differences

Preliminary results reported pretest data for all dependent variables. Pretest measures included: reading comprehension (including a standardised measure and two written question-answering measures), reading vocabulary (standardised measure), and two oral reading fluency measures (see Chapter 6 for detailed descriptions). Statistical analyses were undertaken to determine if pre-existing differences between the treatment groups (experimental and control groups) on
dependent variables were present. Firstly, pretest means and standard deviations for the experimental and control groups are presented. Secondly, statistical analyses, using multilevel modelling are reported (see Chapter 6).

*Descriptive Statistics for Treatment Groups*

The pretest means and standard deviations for the two treatment groups for all dependent variables are presented (see Table 5). Further analyses, using multilevel modelling procedures, were undertaken to examine more closely pretest differences between treatment groups and classes on all dependent variables.

*Multilevel Results: Model 1*

Results for Model 1 (see Table 6) indicated that there were no statistically significant differences between classes on any of the dependent variables at pretest. The lack of difference between classes was evident from the non-significant standard $t$ values (see Table 6, fourth column). Hence, results based upon Model 1 confirmed that there were no statistically significant pretest differences between classes on any of the six dependent variables reported in the treatment group summary data (see Table 5). Tables of class means and standard deviations for all dependent variables have been included in Appendix P. More specifically, the six $t$ values (under the column “$t$ score” for “class level differences”, see Table 6) corresponding to the six dependent variables were all non-significant (all $p_s < 0.05$). Hence, there were no significant differences between the 10 classes on pretest data collected prior to the start of the intervention. Model 2 analyses were completed to evaluate potential significant pretest differences between the treatment groups.
Table 5

*Pretest Means and Standard Deviations of Treatment Groups*

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Pretest mean</th>
<th>Pretest standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Exper.</td>
</tr>
<tr>
<td></td>
<td>n = 100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>167</td>
<td></td>
</tr>
</tbody>
</table>

Reading comprehension measures

| Reading comprehension \(^a\) | 59.3       | 62.9     | 60.7   | 26.9   | 27.8   | 27.3   |
| Narrative written answers \(^b\) | 8.5       | 8.4      | 8.5    | 2.1    | 2.0    | 2.1    |
| Factual written answers \(^b\) | 6.0       | 6.0      | 6.0    | 1.5    | 1.6    | 1.5    |

Other reading measures

| Reading vocabulary \(^a\) | 58.3       | 62.9     | 60.0   | 25.7   | 25.5   | 25.6   |
| Narrative reading fluency \(^c\) | 130.0  | 131.0    | 130.0  | 41.7   | 42.5   | 42.0   |
| Factual reading fluency \(^c\) | 112.0  | 115.0    | 113.0  | 37.7   | 37.7   | 37.7   |

Note: \(^a\) Measured in percentiles. \(^b\) Measured in correct answers according to standard marking frame. Maximum scores, 12 for written narrative answers and 10 for written factual answers. \(^c\) Measured in words read correctly per minute.
Table 6

*Model 1: Basic Variance Components Model for Dependent Variables*

<table>
<thead>
<tr>
<th>Pretest Dependent Variables</th>
<th>Class Level Differences ($u_{ij}$)</th>
<th>Student Level Differences ($e_{ij}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Variance</td>
<td>Standard error</td>
</tr>
<tr>
<td>Reading Comprehension</td>
<td>23.627</td>
<td>22.704</td>
</tr>
<tr>
<td>Narrative written answers</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Factual written answers</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Reading vocabulary</td>
<td>0.12</td>
<td>11.18</td>
</tr>
<tr>
<td>Narrative reading fluency</td>
<td>71.07</td>
<td>60.22</td>
</tr>
<tr>
<td>Factual reading fluency</td>
<td>33.52</td>
<td>38.27</td>
</tr>
</tbody>
</table>

Note: * = significant at $p < 0.05$. 
Multilevel Results: Model 2

Model 2 extended Model 1 by including the experimental grouping variable (1 = experimental, 0 = control). This was accomplished by introducing a fixed variable for treatment group into the model for each of the six dependent pretest variables (see Chapter 6). The purpose of this model was to test more explicitly the assumption that there were no systematic pretest differences between the experimental and control groups, taking into account the hierarchical nature of the data. Standard t scores were calculated by comparing the fixed effects of the dichotomous experimental grouping variable with the corresponding standard error term. Consistent with the results of Model 1, there were no statistically significant differences between the experimental and control groups on any of the six pretest variables. All six t values (under the column “standard t score” for “class level differences”, see Table 7) corresponding to the six dependent variables were non-significant (all ps < 0.05). Hence, there were no significant differences between the experimental and control groups on pretest data collected prior to the start of the intervention (for a more detailed presentation of the results based on Model 2, see Appendix Q).
Table 7

*Model 2 Pretest Multilevel Results for Dependent Variables*

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Group Variance</th>
<th>Standard Error</th>
<th>Standard t score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading Comprehension</td>
<td>-3.703</td>
<td>4.488</td>
<td>0.825</td>
</tr>
<tr>
<td>Narrative written answers</td>
<td>0.034</td>
<td>0.26</td>
<td>0.131</td>
</tr>
<tr>
<td>Factual written answers</td>
<td>0.02</td>
<td>0.192</td>
<td>0.104</td>
</tr>
<tr>
<td>Reading vocabulary</td>
<td>-4.591</td>
<td>3.225</td>
<td>1.424</td>
</tr>
<tr>
<td>Narrative reading fluency</td>
<td>-1.737</td>
<td>7.521</td>
<td>0.231</td>
</tr>
<tr>
<td>Factual reading fluency</td>
<td>-2.792</td>
<td>5.971</td>
<td>0.468</td>
</tr>
</tbody>
</table>

Note: * = p < 0.05.
Summary: Tests for Pre-Existing Differences

In summary, there were no statistically significant pretest differences between the experimental group and the control group on any of the dependent variables. No statistically significant pretest differences between classes were present for any of the dependent variables. The next section of the results chapter outlines the results for the main statistical analyses that examined the effects of the intervention program.

Main Statistical Analyses of Intervention Effects

In this section of the chapter, the effects of the intervention on all dependent variables are reported in the context of the hypotheses and research questions posed (see Chapter 5). Firstly, results for reading comprehension measures, including interaction effects for these measures, are presented. Secondly, results for vocabulary, oral reading fluency measures and interaction effects for reading vocabulary are presented. For each hypothesis and research question, multilevel modelling analyses are reported (see Chapter 6 for a more detailed description of the analyses that are reported). Analyses examined each dependent variable separately and compared the posttest performance of the treatment groups.

Detailed explanations for each of the set of three multilevel models (Models 3, 4 and 5; see Chapter 6) for the standardised reading comprehension measure are presented. The intention of this material is to serve as an advance organiser for the nature of materials to be presented for the remaining analyses. The remaining five dependent variables were each analysed using the same set of three models. The analyses for these remaining dependent variables are reported in this chapter, along with a summary table format and discussed. Finally, a table summarising the intervention effects in relation to all dependent variable concludes this chapter.
Intervention Effects on Measures of Reading Comprehension

The effects of the question-answering program on reading comprehension measures included one standardised reading comprehension measure and two measures of question-answering. These three measures were the focus of three corresponding hypotheses (see Chapter 5).

Results Hypothesis 1.1: Intervention Effects on Standardised Reading Comprehension

Hypothesis 1.1 predicted that posttest performance of the Year 5 students who completed the question-answering program, would be significantly higher on a standardised measure of reading comprehension than the control group who completed their regular classroom reading programs. Statistical analyses, reported previously (see Tables 5, 6 and 7), established a lack of pretest differences on all dependent variables, including standardised reading comprehension. The following sections report all analyses for three multilevel models: Model 3, Model 4, and Model 5 (see Chapter 6) used to determine the effects of the intervention (question-answering program).

Pretest and posttest means and standard deviations for treatment groups are presented (see Table 8 and Figure 3). Preliminary results indicated mean pretest reading comprehension performances for the experimental group and the control group of 59.3 percentiles and 62.9 percentiles, respectively. As noted previously this difference was not statistically significant (see Table 5). Posttest mean reading comprehension performances for the experimental and control groups were 73.0 percentiles and 64.3 percentiles, respectively. Therefore, there was an increase in mean reading comprehension by 13.7 percentiles for the experimental group, compared to an increase of 1.4 percentiles for the control group. The purpose of the multilevel analyses is to evaluate the statistical significance of differences between the two groups, controlling for pretest differences and taking into account the multilevel nature of the data.
Table 8

**Treatment Group Mean Pretest and Posttest Scores for Standardised Reading**

**Comprehension**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pretest*</th>
<th></th>
<th>Posttest*</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
<td>Experimental</td>
<td>Control</td>
</tr>
<tr>
<td>Mean</td>
<td>59.3</td>
<td>62.9</td>
<td>73.0</td>
<td>64.3</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>26.9</td>
<td>27.8</td>
<td>23.2</td>
<td>27.4</td>
</tr>
</tbody>
</table>

Note: * All data were percentiles.

*Figure 3.* Mean treatment group pretest and posttest scores for standardised reading comprehension.
Multilevel Results Hypothesis 1.1 Standardised Reading Comprehension

Standardised reading comprehension results for multilevel models (Model 3, Model 4 and Model 5) are reported in this section followed by a summary table of results for all three models. As previously outlined, statistically significant effects involved a \( t \) test based on the coefficient of the regression equation from the multilevel modelling analyses. These were summarised for each measure and are presented for reading comprehension (see Table 9).

Model 3 included a fixed effect variable for treatment group (\( \text{GROUP}_j \); see Figure 4) and analysed data at the class level and student level (see Chapter 6 for more detailed explanation). The standard \( t \) score was calculated by comparing the "group" (1 = experimental, 0 = control) effect to its standard error. The calculated values were taken directly from the equation as the coefficients of the \( \text{GROUP}_j \) term (8.619 compared to 3.640, equation in second line, see Figure 4), and resulted in a significant standard \( t \) score \( (t = 2.37, p < 0.05) \). Therefore, Model 3 reported a statistically significant effect for the treatment group.
COMPOP\textsubscript{ij} \sim N(\mu \beta \text{CONS} + 8.619(3.640)\text{GROUP}_j,\Omega)

\beta_{0ij} = 64.319(2.864) + u_{0ij} + e_{0ij}

\begin{bmatrix} u_{0ij} \\ e_{0ij} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 8.499(14.074) \end{bmatrix}

\begin{bmatrix} e_{0ij} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 605.260(53.387) \end{bmatrix}

-2 * \text{loglikelihood (IGLS Deviance)} = 2471.203 (267 of 267 cases in use)

\textbf{Figure 4.} Model 3 MlwiN results for standardised reading comprehension

Note: COMPOP\textsubscript{ij} is Posttest performance on standardised reading comprehension for students (j) in classes (i).
Model 4 introduced four pretest covariates into the equation: standardised reading comprehension (COMPREP $y$), reading vocabulary (VOCREP $y$), narrative reading fluency (TPREWRC $y$) and factual reading fluency (WPREWRC $y$; see Figure 5). The most important test of statistical significance in Model 4 was that associated with differences between the experimental and control groups, controlling for pretest variables and taking into account the multilevel nature of the data. The \text{GROUP}$_{j}$ effect (11.758) was highly significant in relation to its standard error (1.622), resulting in standard $t$ score ($t = 7.249, p < 0.001$) (see Figure 5). It is interesting to note that the main effect in favour of the experimental group over the control group is slightly larger in Model 4 than Model 3, indicating that the control group was slightly higher than the experimental group based on the combined multivariate effects of the set of pretest variables. This difference, however, was not very large and there were no differences between groups on any of the pretest variables. Importantly, the standard error of the group effect was substantially smaller in Model 4 than in Model 3. This substantial difference is due to the fact that much of the residual variance in the post-test reading comprehension scores of individual students could be explained in terms of the pretest variables (described below). Hence, the standard $t$ value reflecting the group effect, the difference between the experimental and control group, was substantially larger in Model 4 than in Model 3.

An evaluation of other components of Model 4 is also relevant, particularly the effects of the pretest variables. For pretest standardised reading comprehension and reading vocabulary, the effects were statistically significant for the COMPREP $y$ and VOCREP $y$ terms. The effects for pretest reading comprehension and pretest reading vocabulary were 0.531 and 0.222, for the COMPREP $y$ term and VOCREP $y$ term, respectively (see Figure 5) and were statistically significant ($t = 11.8, p < 0.05$, and $t = 4.8, p < 0.05$, respectively). These results indicate that pretest
performance on both these variables (reading comprehension and reading vocabulary) significantly affected posttest standardised reading comprehension.

For reading fluency variables, pretest effects were examined in the coefficients of the TPREWRC \( y \) term for the narrative passage and the WPREWRC \( y \) term for the factual passage (0.038 and 0.044 for effects, and 0.055 and 0.060 for the standard errors, respectively; see Figure 5). Neither of these resulted in a significant standard t score. Therefore, after controlling for the effects of the two other pretest variables, neither of the two pretest reading fluency variables had a significant effect on standardised reading comprehension performance.
COMPOP\textsubscript{ij} \sim N(X\beta, \Omega)

\begin{align*}
\text{COMPOP}_{ij} &= \beta_{0ij} \text{CONS} + 11.758(1.622)\text{GROUP}_j + 0.531(0.045)\text{COMPREP}_{ij} + \\
&\quad 0.222(0.046)\text{VOCREP}_{ij} + 0.038(0.055)\text{TPREWRC}_{ij} + \\
&\quad 0.044(0.060)\text{WPREWRC}_{ij} \\
\beta_{0ij} &= 6.837(2.808) + u_{0j} + e_{0ij}
\end{align*}

\begin{align*}
[u_{0j}] &\sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 0.000(0.000) \end{bmatrix} \\
[e_{0ij}] &\sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 162.293(14.068) \end{bmatrix}
\end{align*}

-2*loglikelihood(IGLS Deviance) = 2116.583 (267 of 267 cases in use)

*Figure 5. Model 4 MlwiN results for standardised reading comprehension*

Model 4 also examined the class level and student level residual variance. The class level variance was calculated to be zero. It is not theoretically or mathematically possible to have a negative variance in any model. However, MlwiN has a constraint that sets the variance at zero when the estimated variance component is not positive. This result indicated that there was no residual variance at the class level that could not be explained in terms of the other variables in the model. Therefore, the variables included in Model 4 equation explained posttest performance on standardised reading comprehension completely at the class level. There was no statistically significant variation at the class level and all of the residual variance was at the level of the individual student level.

In addition, the inclusion of the pretest covariates into the equation resulted in one other notable difference. The Model 4 equation had reduced unexplained variance in the model. The amount of residual variance at the student level was
substantially smaller in Model 4 (2116.583 for $-2\log\text{likelihood}$) than in Model 3 (2471.203 for $-2\log\text{likelihood}$) because much of the residual variance in Model 4 could be explained in terms of the pretest covariates that were added in Model 4. In summary, Model 4 confirmed the highly significant effect of the treatment reported for Model 3.

Model 5 evaluated whether the difference between the experimental and control groups on posttest reading comprehension varied as a function of pretest levels of reading comprehension by introducing a term that represented the interaction between treatment group and pretest reading comprehension (see Figure 6). A statistically significant standard $t$ score was found for the interaction effect between treatment group and pretest reading comprehension performance ($t = 2.7, p < 0.01$). The nature of the interaction was analysed by calculating the posttest performance scores (controlling for pretest variables) and graphing these against the pretest performance at three representative levels of performance for each treatment group (see Chapter 6 for more discussion). Mean performance levels on all measures were used in calculations, for both treatment groups, along with performance one standard deviation above and one standard deviation below the mean performance. Results of these calculations were graphically reported (see Figure 6). This confirmed the interaction effect for treatment groups since the lines were not parallel.

More specifically, at one standard deviation below mean performance for both treatment groups, the difference in Posttest performance (in $y$ values) was substantially higher for the Experimental Group. The difference between the two treatment groups was smaller at the mean performance and was negligible at one standard deviation above mean performance. Therefore, the effect of the intervention was moderated to some extent by pretest levels of reading comprehension. Students with lower pretest reading comprehension performance
showed greater improvements in reading comprehension in response to the treatment than students with higher pretest reading comprehension.
\[ \text{COMPOP}_{ij} \sim N(XB, \Omega) \]
\[ \text{COMPOP}_{ij} = \beta_{0ij} \text{CONS} + 21.463(3.925)\text{GROUP}_{j} + 0.632(0.058)\text{COMPREP}_{ij} + 0.216(0.046)\text{VOCPREP}_{ij} + 0.032(0.054)\text{TPREWRC}_{ij} + 0.050(0.059)\text{WPREWRC}_{ij} + -0.158(0.058)\text{GROUP .COMPREP}_{ij} \]
\[ \beta_{0ij} = 0.973(3.516) + \nu_{0ij} + \epsilon_{0ij} \]
\[
\begin{bmatrix} \nu_{0ij} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 0.000(0.000) \end{bmatrix}
\]
\[
\begin{bmatrix} \epsilon_{0ij} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 157.955(13.671) \end{bmatrix}
\]

-2*loglikelihood(IGLS Deviance) = 2109.350 (267 of 267 cases in use)

*Figure 6. Model 5 MlwiN results for standardised reading comprehension*

Note: New term added to the equation was the term for the interaction between treatment group and pretest reading comprehension (GROUP, COMPREP) for students \((j)\) in classes \((i)\).
Figure 7. Interaction effect: treatment group and pretest standardised reading comprehension
Summary for Hypothesis 1.1: Standardised Reading Comprehension

Hypothesis 1.1 was supported by a statistically significant posttest difference in standardised reading comprehension performance favouring the experimental group over the control group. While mean pretest performance of the control group was slightly, but non-significantly higher than the experimental group (3.6 percentile points), mean posttest performance of the experimental group was 8.7 percentile points higher than the control group. In addition, there was a significant interaction between treatment group and pretest reading comprehension. Results for Hypothesis 1.1 are summarised and presented as an overview of the results from all MlwiN models (see Table 9). For reading comprehension, detailed discussion directly linked multilevel results to the terms in the equation for each multilevel model.

The next subsections report results for remaining dependent variables for reading comprehension, namely written question-answering for the narrative and factual passages. The following sections report results for other reading measures, namely reading vocabulary and reading fluency.
<table>
<thead>
<tr>
<th>Model</th>
<th>Effects</th>
<th>Relevant Term in MlwiN Equation</th>
<th>$t$ test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 3</td>
<td>Fixed</td>
<td>Group effect $8.619 (3.639)$ GROUP$_j$</td>
<td>2.37*</td>
</tr>
<tr>
<td>Effect</td>
<td></td>
<td>(8.619 / 3.639 = 2.37)</td>
<td></td>
</tr>
<tr>
<td>Model 4</td>
<td>Pretest</td>
<td>Group effect $11.758 (1.622)$ GROUP$_j$</td>
<td>7.3*</td>
</tr>
<tr>
<td>Effects</td>
<td></td>
<td>Pretest Reading comprehension</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$0.531 (0.045)$ COMPREP$_{ij}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading Vocab $0.222 (0.046)$ VOCPREP$_{ij}$</td>
<td>4.8*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narrative Fluency $0.038 (0.055)$ TPREWRC$_{ij}$</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factual Fluency $0.044 (0.060)$ WPREWRC$_{ij}$</td>
<td>0.7</td>
</tr>
<tr>
<td>Model 5</td>
<td>Interaction</td>
<td>Group effect $21.463 (3.925)$ GROUP$_j$</td>
<td>5.5*</td>
</tr>
<tr>
<td>Effect</td>
<td></td>
<td>Reading comprehension</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$0.632 (0.058)$ COMPREP$_{ij}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading Vocab $0.216 (0.046)$ VOCPREP$_{ij}$</td>
<td>4.7*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narrative Fluency $0.032 (0.054)$ TPREWRC$_{ij}$</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factual Fluency $0.050 (0.059)$ WPREWRC$_{ij}$</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interaction (Group &amp; Pretest Reading Comprehension)</td>
<td>2.7**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$0.158 (0.058)$ GROUP.COMPREP$_{ij}$</td>
<td></td>
</tr>
</tbody>
</table>

Note: * = significant effect, $p < 0.05$, ** = significant effect, $p < 0.01$. 
Results Hypothesis 1.2: Intervention Effects on Narrative Written Answers

Hypothesis 1.2 predicted that, following intervention implementation, the experimental group would display significantly higher scores on measures of written question-answering on a narrative passage compared to the control group, who completed their regular classroom reading programs. Using similar analyses to those used with reading comprehension, analyses included descriptive statistics for the two treatment groups followed by multilevel results.

Data for mean pretest performance confirmed a lack of difference in pretest means between the experimental group and control group of 0.03 answers correct (see Table 10 and Figure 8). Mean posttest reading comprehension performance for the experimental group was 9.87 answers compared to 8.8 answers correct for the control group. The increase in mean group performance from pretest to posttest was 1.41 answers correct for the experimental group compared to an increase in mean performance of 0.37 answers correct for the control group.
Table 10

_Treatment Group Mean Pretest and Posttest Scores for Narrative Question-Answering_

<table>
<thead>
<tr>
<th></th>
<th>Pretest a</th>
<th></th>
<th>Posttest a</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
<td>Experimental</td>
<td>Control</td>
</tr>
<tr>
<td>Mean</td>
<td>8.46</td>
<td>8.43</td>
<td>9.87</td>
<td>8.8</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>2.11</td>
<td>1.98</td>
<td>1.59</td>
<td>2.04</td>
</tr>
</tbody>
</table>

Note: a All data were correct written answers according to standard marking frame, maximum possible score was 12.

*Figure 8. Mean treatment group pretest and posttest scores for narrative question-answering*
Multilevel Results for Hypothesis 1.2: Intervention Effects on Narrative Written Question-Answering

Statistical significance of posttest differences was determined using multilevel analyses. Model 3 introduced treatment group as a fixed variable into the equation and reported a statistically significant effect ($t = 4.803, p < 0.001$, see Table 11 and Figure 9).

\[
\text{TROPOQ}_{ij} \sim N(X\beta, \Omega)
\]
\[
\text{TROPOQ}_{ij} = \beta_{00} \text{CONS} + 1.071(0.223)\text{GROUP}_j
\]
\[
\beta_{00} = 8.800(0.177) + \mu_{0j} + e_{0ij}
\]

\[
\begin{bmatrix}
\mu_{0j} \\
e_{0ij}
\end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 0.000(0.000) \end{bmatrix}
\]

\[
\begin{bmatrix}
\mu_{0j} \\
e_{0ij}
\end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 3.116(0.270) \end{bmatrix}
\]

\[-2*\text{loglikelihood(IGLS Deviance)} = 1061.175(267 \text{ of 267 cases in use})
\]

Figure 9. Model 3 multilevel results narrative question-answering

Note: TROPOQ$_{ij}$ is Posttest narrative written answers for students $(j)$ in classes $(i)$.

The inclusion of pretest variables in Model 4 confirmed the statistically significant effect for treatment group ($t = 6.392, p < 0.05$, see Figure 7.8 and Table 7.7). Significant effects for pretest narrative answers and reading comprehension were reported ($t = 8.66, p < 0.05$ and $t = 2.0, p < 0.05$, see Figure 7.8 and Table 7.7). The effects of reading vocabulary and narrative fluency were not significant.
TROPPQ\(_{ij}\) \sim N(\mu, \Omega)

TROPPQ\(_{ij}\) = \beta_{0ij} \text{CONS} + 1.104(0.164) \text{GROUP}_j + 0.459(0.053) \text{TROPPREQ}\(_{ij}\) + 0.002(0.003) \text{TPREWRC}\(_{ij}\) + 0.010(0.005) \text{COMPREP}\(_{ij}\) + 0.002(0.005) \text{VOCPREP}\(_{ij}\)

\beta_{0ij} = 3.931(0.353) + u_{0j} + e_{0ij}

\left[ u_{0j} \right] \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 0.000(0.000) \end{bmatrix}

\left[ e_{0ij} \right] \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 1.659(0.144) \end{bmatrix}

-2 * \text{loglikelihood(IGLS Deviance)} = 892.837 (267 of 267 cases in use)

\text{Figure 10. Model 4 multilevel results narrative question-answering}

Note: New pretest variables introduced into the equation were narrative written answers (TROPPREQ\(_{ij}\)), narrative reading fluency (TPREWRC\(_{ij}\)), reading comprehension (COMPREP\(_{ij}\)), and reading vocabulary (VOCPREP\(_{ij}\)), and all variables for students (j) in classes (i).

A statistically significant interaction effect between treatment group and pretest narrative answers was evident in Model 5 (t = 4.25, p < 0.05). The nature of the interaction effect was examined in the same way as for reading comprehension, using values of the dependent variable (narrative answers) and calculating posttest values at representative levels using the regression equation for Model 5 (see Figure 11 and Appendix O). These results were presented graphically (see Figure 12). As for reading comprehension, the interaction between group and pretest narrative
answers showed that, at lower pretest levels, student posttest performance was higher for the experimental treatment group than for the control treatment group. The interaction is the juxtaposition between the two intervention effects which was much smaller for students performing at relatively higher pretest levels. This can be clearly seen in the differences (in y values) shown on the graph between the experimental and control groups (see Figure 12) that are somewhat larger at one standard deviation below the mean than at one standard deviation above the mean.

Summary for Hypothesis 1.2: Narrative Written Answers

Hypothesis 1.2 was supported by the significant posttest differences between the treatment groups on narrative written answers in all multilevel models. The effect was confounded by the interaction effect of treatment group and pretest performance on narrative answers. The interaction effect will be discussed further in the following chapter (see Chapter 8).
\[
TROPPOQ_{ij} \sim N(\alpha_{ij}, \Omega) \\
TROPPOQ_{ij} = \beta_{0ij}\text{CONS} + 2.818(0.696)\text{GROUP}_{ij} + 0.601(0.076)\text{TROPPREQ}_{ij} + \\
0.002(0.003)\text{TPREWRC}_{ij} + 0.009(0.004)\text{COMPREP}_{ij} + \\
0.002(0.005)\text{VOCREP}_{ij} - 0.204(0.080)\text{GROUP} \cdot \text{TROPPREQ}_{ij} \\
\beta_{0ij} = 2.806(0.565) + u_{0ij} + e_{0ij}
\]

\[
\begin{bmatrix}
\mu_{0ij} \\
\mu_{ij}
\end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix}
0.000(0.000)
\end{bmatrix}
\]

\[
\begin{bmatrix}
e_{0ij}
\end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix}
1.620(0.140)
\end{bmatrix}
\]

\(-2\times\text{loglikelihood(IgLs Deviance)} = 886.500\)

Figure 11. Model 5 multilevel results narrative question-answering

Note: New term added to the equation was the term for the interaction between treatment group and pretest reading comprehension (\text{GROUP} \cdot \text{TROPPREQ}_{ij}) for students \((j)\) in classes \((i)\).
Figure 12. Interaction effect between pretest narrative question-answering and posttest narrative question-answering by treatment group
Table 11

Narrative Question-Answering Multilevel Results Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>Effects</th>
<th>Relevant Term in MLwiN Equation</th>
<th>t test</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Fixed Effect</td>
<td>Group effect 1.071 (0.223) GROUP_{ij}</td>
<td>4.803*</td>
</tr>
<tr>
<td>4</td>
<td>Pretest Effects</td>
<td>Group effect 1.104 (0.164) GROUP_{ij}</td>
<td>6.392**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narrative Answers 0.459(0.053) TPREPREQ_{ij}</td>
<td>8.66**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narrative Fluency 0.002 (0.003) TPREWRC_{ij}</td>
<td>0.667</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading comprehension 0.010 (0.005)</td>
<td>2.0*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>COMPREP_{ij}</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading Vocabulary 0.002(0.005) VOCPREP_{ij}</td>
<td>0.4</td>
</tr>
<tr>
<td>5</td>
<td>Interaction Effect</td>
<td>Group effect 2.818 (0.696) GROUP_{ij}</td>
<td>4.048**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narrative Answers 0.601(0.076) TPREPREQ_{ij}</td>
<td>7.907**</td>
</tr>
<tr>
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<td></td>
<td>Narrative Fluency 0.002 (0.003) TPREWRC_{ij}</td>
<td>0.667</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading Comprehension 0.009(0.004)</td>
<td>2.25*</td>
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<tr>
<td></td>
<td></td>
<td>COMPREP_{ij}</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading Vocabulary 0.002(0.005) VOCPREP_{ij}</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>Interaction (Group &amp; Pretest Narrative answers) 0.259 (0.061)GROUP_{ij} \cdot TROPPREQ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * = p < 0.05, ** = p < 0.01.
Results Hypothesis 1.3: Intervention Effects on Factual Written Answers

Hypothesis 1.3 predicted that the experimental group would display significantly higher scores on measures of written question-answering on a factual passage than the control group who completed their regular classroom reading programs. Using similar analyses for previous measures, results included descriptive statistics for pretest and posttest mean performance for the two treatment groups, followed by multilevel analyses.

Comparisons of pretest mean scores confirmed a lack of difference between the treatment groups of 0.02 questions (see Table 12 and Figure 13). Posttest mean performance for the two treatment groups reported a difference of 0.67 answers. The posttest experimental group mean was 7.09 answers correct and posttest control group mean was 6.42 answers correct. Analyses using multilevel models were used to determine the statistical significance of this result (see Figures 14, 15 and 16 and Table 13).
Table 12

*Treatment Group Mean Pretest and Posttest Scores for Factual Question-Answering*

<table>
<thead>
<tr>
<th></th>
<th>Pretest <em>a</em></th>
<th>Posttest <em>a</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
</tr>
<tr>
<td>Mean</td>
<td>5.97</td>
<td>5.95</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>1.5</td>
<td>1.56</td>
</tr>
</tbody>
</table>

Note: *a* All data were correct answers according to standard marking frame, Maximum possible score was 10.

*Figure 13.* Mean treatment group pretest and posttest scores for factual question-answering
Multilevel Results Hypothesis 1.3 Factual Written Answers

Treatment group effects from all three models were statistically significant based on coefficients of the terms in the multilevel equations (see Figure 14, Figure 15 and Figure 16). Results were reported in the summary table as treatment group effects with significant t tests for Model 3, Model 4 and Model 5 (see Table 13). The introduction of the pretest variables into the multilevel equation in Model 4 led to a significant reduction in unexplained variance shown by the difference in the two "-2*loglikelihood (IGLS Deviance)" values from 986.058 (see bottom line of Figure 14) reduced to 802.188 (see bottom line of Figure 15). Significant effects were evident for three of the four pretest variables, namely factual written answers, factual reading fluency and reading vocabulary (see Figure 15 and Table 13). Pretest reading comprehension did not have a significant effect on posttest factual written answers, once the effects of the other pretest variables were controlled. Model 5 confirmed significant effects for treatment group and these three pretest variables. In addition, the interaction between treatment group (the experimental intervention) and pretest levels of factual written answers was not statistically significant (see Figure 16 and Table 13, bottom line). For completeness, the non-significant interaction effect (t =1.7, p > .05) was examined graphically (see Figure 17) in the same way as other interaction effects. As with previous statistically significant interactions for the other measures, the interaction for factual answers showed differences in the changes in performance between the two treatment groups at lower and higher pretest levels. However, unlike the statistically significant interaction effects for previous measures, this non-significant interaction was confirmed, as the lines for the two treatment groups were approximately parallel (see Figure 17). Therefore, interaction effects indicated that the effects of the intervention were similar at different levels of pretest factual question-answering.
Summary for Hypothesis 1.3: Factual Written Answers

Hypothesis 1.3 was supported by multilevel analyses that reported statistically significant posttest differences between the two treatment groups on factual written answers (see Table 13). In addition, posttest performance was significantly affected by pretest factual written answers, pretest factual reading fluency and pretest reading vocabulary. Thirdly, the interaction effect between treatment group and pretest factual written answers was not statistically significant.
WHPOQ_{ij} \sim N(XB, \Omega)
WHPOQ_{ij} = \beta_{0ij} \text{CONS} + 0.670(0.240)\text{GROUP}_i \\
\beta_{0ij} = 6.417(0.189) + u_{0j} + e_{0ij}

\begin{bmatrix} u_{0j} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 0.050(0.061) \end{bmatrix}

\begin{bmatrix} e_{0ij} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 2.312(0.204) \end{bmatrix}

-2*\text{loglikelihood(IGLS Deviance)} = 986.058(267 of 267 cases in use)

---

*Figure 14.* Model 3 multilevel results for factual question-answering

Note: WHPOQ_{ij} is Posttest factual answers for students (j) in classes (i).
\[ WHPOQ_{ij} \sim N(\lambda E; \Omega) \]

\[ WHPOQ_{ij} = \beta_{0ij} \text{CONS} + 0.777(0.249)\text{GROUP}_j + 0.349(0.061)\text{WHPREQ}_{ij} + \\
0.008(0.002)\text{WPREWR}_{ij} + 0.002(0.004)\text{COMPREP}_{ij} + \\
0.015(0.004)\text{VOCPREP}_{ij} \]

\[ \beta_{0ij} = 2.372(0.333) + \mu_{0j} + \varepsilon_{0ij} \]

\[
\begin{bmatrix}
\mu_{0j} \\
\varepsilon_{0ij}
\end{bmatrix} \sim N(0, \Omega_{\mu}) : \Omega_{\mu} = \begin{bmatrix} 0.104(0.066) \end{bmatrix}
\]

\[
\begin{bmatrix}
\varepsilon_{0ij}
\end{bmatrix} \sim N(0, \Omega_{\varepsilon}) : \Omega_{\varepsilon} = \begin{bmatrix} 1.128(0.099) \end{bmatrix}
\]

\[-2*\text{loglikelihood (IGLS Deviance)} = 802.188 (267 of 267 cases in use)\]

*Figure 15. Model 4 multilevel results for factual question-answering*

Note: New pretest variables introduced into the equation were factual written answers (WHPREQ\(_{ij}\)), factual reading fluency (WPREWR\(_{ij}\)), reading comprehension (COMPREP\(_{ij}\)), and reading vocabulary (VOCPREP\(_{ij}\)), and all variables were for students \((j)\) in classes \((i)\).
WHPOQ_{ij} \sim \mathcal{N}(\mu, \Sigma)

WHPOQ_{ij} = \beta_{0ij} \text{CONS} + 1.699(0.578)\text{GROUP}_j + 0.448(0.083)\text{WHPREQ}_q + \\
0.008(0.002)\text{WPREWRC}_q + 0.002(0.004)\text{COMPREP}_q + \\
0.015(0.004)\text{VOCPREP}_q + -0.155(0.088)\text{GROUP}_j \text{WHPREQ}_{ij}

\beta_{0ij} = 1.819(0.455) + u_{0j} + e_{0ij}

\begin{bmatrix} u_{0j} \\ e_{0ij} \end{bmatrix} \sim \mathcal{N}(0, \Sigma_u) ; \quad \Sigma_u = \begin{bmatrix} 0.097(0.062) \\ 1.117(0.099) \end{bmatrix}

\text{Figure 16. Model 5 multilevel results for factual question-answering}

Note: New term added to the equation was the term for the interaction between treatment group and pretest reading comprehension (GROUP. WHPREQ_{ij}) for students (j) in classes (i).
Figure 17. Interaction between group and pretest factual question-answering
### Table 13

**Factual Answers Multilevel Results Summary**

<table>
<thead>
<tr>
<th>Model</th>
<th>Effect</th>
<th>Relevant Term in MlwiN Equation</th>
<th>$t$ test</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Fixed Effect</td>
<td>Treatment group effect 0.670 (0.240) GROUP$_{ij}$</td>
<td>2.792**</td>
</tr>
<tr>
<td>4</td>
<td>Pretest Effects</td>
<td>Group effect 0.777 (0.249) GROUP$_{ij}$</td>
<td>3.121**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factual Answers 0.349 (0.061) WHPREQ$_{ij}$</td>
<td>5.721**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factual Fluency 0.008 (0.002) WPREWRCP$_{ij}$</td>
<td>4.0 **</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading comprehension 0.002 (0.004) COMPREP$_{ij}$</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading vocabulary 0.015 (0.004) VOCPREP$_{ij}$</td>
<td>3.75**</td>
</tr>
<tr>
<td>5</td>
<td>Interaction Effect</td>
<td>Group effect 1.699 (0.578) GROUP$_{ij}$</td>
<td>2.939**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factual Answers 0.448 (0.083) WHPREQ$_{ij}$</td>
<td>5.40**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factual Fluency 0.008 (0.002) WPREWRCP$_{ij}$</td>
<td>4.0**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading comprehension 0.002 (0.004) COMPREP$_{ij}$</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading vocabulary 0.015 (0.004) VOCPREP$_{ij}$</td>
<td>3.75**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interaction (Group &amp; Factual Answers) 0.155 (0.088) COMPREP$_{ij}$</td>
<td>1.761</td>
</tr>
</tbody>
</table>

Note: * = $p < 0.05$, ** = $p < 0.01$. 
Summary: Intervention Effects on Reading Comprehension

All three hypotheses (Hypothesis 1.1, Hypothesis 1.2 and Hypothesis 1.3) were supported. Statistically significant posttest differences favouring the experimental group over the control group were reported for reading comprehension, narrative answers and factual answers for all multilevel models. In addition, significant interaction effects were reported for treatment group and pretest performance on reading comprehension, narrative answer and factual answer measures. Significant differences in posttest reading comprehension were affected by pretest reading comprehension and reading vocabulary and not by either narrative or factual reading fluency. Significant differences in posttest narrative written answers were affected by pretest narrative answers and reading comprehension and not by reading vocabulary nor narrative reading fluency. Significant differences in posttest factual answers were affected by pretest factual answers, pretest factual reading fluency and pretest reading vocabulary. Factual answers were not affected by pretest reading comprehension. These results and their implications are discussed in the following chapter (Chapter 8).

Intervention Effects on Reading Vocabulary and Reading Fluency

Results Research Question 2.1: Intervention Effects on Reading Vocabulary

This research question was concerned with potential intervention effects on reading vocabulary. As with previous measures, pretest treatment group results reporting means and standard deviations are followed by multilevel analyses.

Treatment group pretest and posttest group mean scores for reading vocabulary in percentiles are reported (see Table 14 and Figure 18). Inspection of
means indicated pretest and posttest differences between treatment groups. Improvement was 9.4 percentiles in experimental group mean from 58.3 percentiles at pretest to 67.7 percentiles at posttest. Improvement in the control group mean was 3.4 percentiles, from 62.9 percentiles at pretest to 66.3 percentiles at posttest (see Table 14). Multilevel analyses provided a clearer picture of changes in performance of the treatment groups.
Table 14
*Treatment Group Mean Pretest and Posttest Scores for Reading Vocabulary*

<table>
<thead>
<tr>
<th></th>
<th>Pretest a</th>
<th></th>
<th>Posttest a</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
<td>Experimental</td>
<td>Control</td>
</tr>
<tr>
<td>Mean</td>
<td>58.3</td>
<td>62.9</td>
<td>67.7</td>
<td>66.3</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>25.7</td>
<td>25.5</td>
<td>23.5</td>
<td>24.8</td>
</tr>
</tbody>
</table>

Note: a All data were percentile scores.

*Figure 18.* Mean treatment group pretest and posttest scores for reading vocabulary
Multilevel Results for Research Question 2.1 Intervention Effects on Reading

Vocabulary

Model 3 introduced treatment group as a fixed effect variable into the equation, and there were no significant differences between the treatment groups (first line of Figure 19 and see Table 15). However, when Model 4 introduced the pretest variables into the multilevel equation, analyses reported a significant effect for treatment group \( t = 2.264, p < 0.05 \), below. Significant effects were reported for three pretest variables, reading comprehension, reading vocabulary and narrative reading fluency \( t = 12.833, p < 0.05, t = 6.048, p < 0.05, t = 2.157, p < 0.05 \), respectively, see Table 15). Model 5 introduced the interaction effect for treatment group and pretest reading vocabulary that was not significant. Multilevel results for the effects of the intervention on reading vocabulary are summarised (see Table 15).

Summary for Research Question 2.1: Reading Vocabulary

The effects of the intervention on reading vocabulary were mixed. Initial analyses (using Model 3) revealed no significant posttest differences between the treatment groups. However, the introduction of pretest variables of reading comprehension, reading vocabulary and narrative reading fluency in Model 4, resulted in a statistically significant treatment group difference. In Model 5, the introduction of an interaction term resulted in a nonsignificant interaction between treatment group and pretest reading vocabulary. The intervention effect was significant in Model 4 but not in Model 3 because Model 4 provided a stronger, more powerful test of the intervention. Significant effects were maintained in Model 5 for treatment group, pretest reading vocabulary, pretest reading comprehension and pretest narrative reading fluency.
VOCPOP\textsubscript{ij} \sim N(XB, \Omega)

\text{VOCPOP}\textsubscript{ij} = \beta_{0ij} \text{CONS} + 1.404(3.094) \text{GROUP}_j

\beta_{0ij} = 66.283(2.444) + u_{0ij} + e_{0ij}

\begin{bmatrix} u_{0ij} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 1.124(10.160) \end{bmatrix}

\begin{bmatrix} e_{0ij} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 568.944(50.180) \end{bmatrix}

-2^{*}\text{loglikelihood}(IGLS Deviance) = 2452.017(267\text{ of 267 cases in use})

\textbf{Figure 19.} Model 3 multilevel results for reading vocabulary

Note: VOCPOP\textsubscript{ij} is Posttest reading vocabulary for students (j) in classes (i) in percentiles.
VOCPOP\(y\) \sim N(XB, \Omega)

\[
\begin{align*}
\text{VOCPOP}_{y} &= \beta_{0ij}\text{CONS} + 4.802(2.121)\text{GROUP}_{y} + 0.539(0.042)\text{VOCPREP}_{y} + \\
&\quad 0.254(0.042)\text{COMPREP}_{y} + 0.110(0.051)\text{TPREWRC}_{y} + \\
&\quad -0.069(0.056)\text{WPREWRC}_{y} \\
\beta_{0ij} &= 9.855(2.858) + u_{0j} + e_{0ij}
\end{align*}
\]

\[
\begin{bmatrix}
u_{0j} \\
e_{0ij}
\end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 5.515(4.756) \end{bmatrix}
\]

\[
\begin{bmatrix}
u_{0j} \\
e_{0ij}
\end{bmatrix} \sim N(0, \Omega_\varepsilon) : \Omega_\varepsilon = \begin{bmatrix} 135.174(11.924) \end{bmatrix}
\]

-2*loglikelihood(IGLS Deviance) = 2075.119 (267 of 267 cases in use)

Figure 20. Model 4 multilevel results for reading vocabulary

Note: New pretest variables introduced into the equation were reading comprehension (COMPREP\(y\)), reading vocabulary (VOCPREP\(y\)), narrative reading fluency (TPREWRC\(y\)) and factual reading fluency (WPREWRC\(y\)) all variables were for students \((j)\) in classes \((i)\).
\[ \text{VOCPOP}_{ij} \sim \mathcal{N}(\mu, \Omega) \]
\[ \text{VOCPOP}_{ij} = \beta_0 + \text{CONS} + 9.360(4.151)\text{GROUP}_j + 0.588(0.057)\text{VOCREP}_{ij} + \\
0.250(0.042)\text{COMPREP}_{ij} + 0.112(0.051)\text{TPREWRC}_{ij} + \\
-0.071(0.056)\text{WPREWRC}_{ij} + \\
-0.075(0.058)\text{GROUP} \cdot \text{VOCREP}_{ij} \]
\[ \beta_0 = 6.938(3.654) + \pi_0 + e_{0ij} \]

\[ \begin{bmatrix} \pi_0 \end{bmatrix} \sim \mathcal{N}(0, \Omega_{\pi}) : \Omega_{\pi} = \begin{bmatrix} 5.809(4.862) \end{bmatrix} \]

\[ \begin{bmatrix} e_{0ij} \end{bmatrix} \sim \mathcal{N}(0, \Omega_e) : \Omega_e = \begin{bmatrix} 134.192(11.838) \end{bmatrix} \]

\[-2\text{loglikelihood(IGLS Deviance)} = 2073.484\text{ (267 of 267 cases in use)}\]

*Figure 21. Model 5 multilevel results for reading vocabulary*
<table>
<thead>
<tr>
<th>Model</th>
<th>Effect</th>
<th>Relevant Term in MlwiN Equation</th>
<th>$t$ test</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Group</td>
<td>$\text{GROUP}_{ij}$</td>
<td>0.454</td>
</tr>
<tr>
<td></td>
<td>Effect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Pretest Effects</td>
<td>Group effect $4.802 (2.121) \text{GROUP}_{ij}$</td>
<td>2.264*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading vocabulary $0.539 (0.042) \text{VOCPREP}_{ij}$</td>
<td>6.048*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading comprehension $0.254 (0.042)$</td>
<td>12.833*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\text{COMPREP}_{ij}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narrative fluency $0.110 (0.051) \text{TPREWRC}_{ij}$</td>
<td>2.157*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factual fluency $0.069 (0.056) \text{WPREWRC}_{ij}$</td>
<td>1.232</td>
</tr>
<tr>
<td>5</td>
<td>Interaction Effect</td>
<td>Treatment group effect $9.360 (4.141) \text{GROUP}_{ij}$</td>
<td>2.26*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading vocabulary $0.588 (0.057) \text{VOCPREP}_{ij}$</td>
<td>10.316**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reading comprehension $0.250 (0.042)$</td>
<td>5.952**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\text{COMPREP}_{ij}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narrative Fluency $0.112 (0.051) \text{TPREWRC}_{ij}$</td>
<td>2.196**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factual Fluency $0.071 (0.056) \text{WPREWRC}_{ij}$</td>
<td>1.268</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interaction (Group &amp; Pretest Reading Vocabulary)</td>
<td>1.293</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$0.075 (0.058) \text{GROUP. VOCPREP}_{ij}$</td>
<td></td>
</tr>
</tbody>
</table>

Note: * = $p < 0.05$
Results Research Question 2.2: Intervention Effects on Reading Fluency

Research Question 2.2 was concerned with whether potential intervention effects in relation to oral reading fluency were present for the experimental group compared to the control group. Two measures of reading fluency were analysed separately, one for the narrative passage (narrative reading fluency) and one for the factual passage (factual reading fluency). Results for narrative reading fluency are followed by results for factual reading fluency. As for all measures, analyses of fluency measures reported pretest and posttest treatment group scores for means and standard deviations followed by multilevel analyses.

Treatment Group Pretest Posttest Scores for Narrative Reading Fluency

Treatment group summary data for mean pretest and posttest treatment group performance for narrative reading fluency reported minimal differences (see Table 16 and Figure 22). Inspection of group means and standard deviations suggested that both treatment groups made similar improvements from pretest to posttest. Mean experimental group performance improved by 21.3 words read correctly per minute compared to mean control group performance improvement of 18.5 words read correctly per minute. Multilevel analyses were undertaken to determine potential statistical significance of these results.
Table 16

*Treatment Group Mean Pretest and Posttest Scores for Narrative Fluency*

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
</tr>
<tr>
<td>Mean</td>
<td>129.62</td>
<td>130.59</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>41.7</td>
<td>42.5</td>
</tr>
</tbody>
</table>

Note: a All data reported in words read correctly per minute.

*Figure 22. Mean treatment group pretest and posttest scores for narrative fluency*
Multilevel Results for Narrative Fluency

Multilevel results confirmed there were no significant differences between the two treatment groups for narrative fluency for Models 3, 4, and 5 (Table 17). Model 4 and Model 5 results reported significant effects of pretest narrative fluency on posttest narrative fluency (Model 4, $t = 42.182, p < 0.05$, and Model 5, $t = 26.03, p < 0.05$, Table 17). Therefore, the intervention had no significant effects on narrative fluency.
\[ TPOWRC_{ij} \sim N(XB, \Omega) \]

\[ TPOWRC_{ij} = \beta_{0ij} \text{CONS} + 1.866(5.110)\text{GROUP}_i \]

\[ \beta_{0ij} = 149.050(4.042) + u_{0j} + e_{0ij} \]

\[
\begin{bmatrix}
  u_{0j} \\
  e_{0ij}
\end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix}
  0.000(0.000)
\end{bmatrix}
\]

\[
\begin{bmatrix}
  e_{0ij}
\end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix}
  1633.542(141.381)
\end{bmatrix}
\]

-2*loglikelihood(IGLS Deviance) = 2733.114 (267 of 267 cases in use)

*Figure 23. Model 3 multilevel results narrative reading fluency*

Note: TPOPWRC \( ij \) is Posttest narrative reading fluency for students \( j \) in classes \( i \) measured in words read correctly per minute.
TPOWRC_{ij} \sim N(\mu_i, \Omega_i)

TPOWRC_{ij} = \beta_{0j} \text{CONS} + 3.388(4.937)\text{GROUP}_j + 0.928(0.022)\text{TPREWRC}_{ij}

\beta_{0j} = 27.380(4.797) + u_{0j} + e_{0j}

\begin{bmatrix} u_{0j} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 50.361 & (26.073) \end{bmatrix}

\begin{bmatrix} e_{0j} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 209.776 & (18.506) \end{bmatrix}

-2\times \log \text{likelihood(IGLS Deviance)} = 2205.091 \text{(267 of 267 cases in use)}

Figure 24. Model 4 multilevel results narrative reading fluency

Note: New pretest variable introduced into the equation was narrative reading fluency (TPREWRC_{ij}). All variables were for students (j) in classes (i).
TPOWRC_{ij} \sim N(XB, \Omega)

TPOWRC_{ij} = \beta_{0ij} \text{CONS} + -0.312(7.677)\text{GROUP}_j + 0.911(0.035)\text{TPREWRC}_{ij} + 0.028(0.045)\text{GROUP} \cdot \text{TPREWRC}_{ij}

\beta_{0ij} = 29.639(6.005) + u_{0ij} + e_{0ij}

\begin{bmatrix} u_{0ij} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 50.898(26.310) \end{bmatrix}

\begin{bmatrix} e_{0ij} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 209.379(18.471) \end{bmatrix}

-2*\text{loglikelihood(IGLS Deviance)} = 2204.693(267 \text{ of } 267 \text{ cases in use})

\text{Figure 25. Model 5 multilevel results narrative reading fluency}

Note: New term added to the equation was the term for the interaction between treatment group and pretest reading comprehension (\text{GROUP} \cdot \text{TPREWRC}_{ij}) for students \((j)\) in classes \((i)\).
Table 17

Narrative Reading Fluency Multilevel Results Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>Effect Examined</th>
<th>Relevant Term in MLwiN Equation</th>
<th>t test</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Group Effect</td>
<td>Group effect 1.866 (5.110) GROUP_j</td>
<td>0.365</td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>Group effect 3.388 (4.937) GROUP_j</td>
<td>0.686</td>
</tr>
<tr>
<td>4</td>
<td>Effects</td>
<td>Narrative Fluency 0.928 (0.022) TPREWRC_ij</td>
<td>42.182*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group effect 0.312 (7.677) GROUP_j</td>
<td>0.041</td>
</tr>
<tr>
<td>5</td>
<td>Interaction</td>
<td>Narrative Fluency 0.911 (0.035) TPREWRC_ij</td>
<td>26.029*</td>
</tr>
<tr>
<td></td>
<td>Effect</td>
<td>Interaction (Group &amp; Pretest Narrative Fluency) 0.028 (0.045) GROUP_j, TPREWRC_ij</td>
<td>0.622</td>
</tr>
</tbody>
</table>

Note: * = p < 0.05, ** = p < 0.01.

Treatment Group Pretest Posttest Scores for Factual Fluency

Treatment group summary data of mean pretest and posttest performance for factual reading fluency showed minimal differences between treatment groups (see Table 18 and Figure 26). Improvements in factual reading fluency were 21.1 words read correctly per minute for the experimental group and 16.5 words read correctly per minute for the control group. Therefore, similar improvements occurred from pretest to posttest, for both treatment groups. Multilevel analyses were completed to determine if treatment group improvements were significantly different.
Table 18

Treatment Group Mean Pretest and Posttest Scores for Factual Fluency

<table>
<thead>
<tr>
<th></th>
<th>Pretest (^a)</th>
<th>Posttest (^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
</tr>
<tr>
<td>Mean</td>
<td>112.5</td>
<td>115.0</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>37.7</td>
<td>37.7</td>
</tr>
</tbody>
</table>

Note: \(^a\) All data reported in words read correctly per minute.

Figure 26. Mean treatment group pretest and posttest scores for factual fluency
Multilevel Results for Factual Fluency

As for narrative fluency, multilevel results confirmed a lack of significant differences between the treatment groups for factual fluency for Models 3, 4 and 5 (see Table 19, Figures 27, Figure 28, and Figure 29). Model 3 results confirmed a lack of treatment group effect with a nonsignificant $t$ test ($t = 0.447, p > 0.05$, Figure 27, and Table 19, below) The results found significant effects for pretest factual fluency (Model 4, $t = 41.522, p < 0.05$, and Model 5, $t = 26.162, p < 0.05$, see Table 19). Therefore, the intervention had no significant effects on factual fluency.
WPOWRC_{ij} \sim N(XB, \Omega)

WPOWRC_{ij} = \beta_{0j} \text{CONS} + 2.139(4.788)\text{GROUP}_j

\beta_{0j} = 131.490(3.787) + u_{0j} + e_{0j}

\begin{bmatrix} u_{0j} \\ e_{0j} \end{bmatrix} \sim N(0, \Omega_{\omega}) : \Omega_{\omega} = \begin{bmatrix} 0.000(0.000) \end{bmatrix}

\begin{bmatrix} e_{0j} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 1434.150(124.123) \end{bmatrix}

-2^{*}\log\text{likelihood} (IGLS Deviance) = 2698.357 (267 of 267 cases in use)

Figure 27. Model 3 multilevel results factual fluency

Note: WPOWRC_{ij} = Posttest factual reading fluency for students (j) in classes (i) reported in words read correctly per minute.
WPOWR_C_g ~ N(XB, \Omega)
WPOWR_C_g = \beta_{0ij} \text{CONS} + 4.963(3.680) \text{GROUP}_j + 0.955(0.023) WPREWRC_{gj}
\beta_{0ij} = 21.353(3.897) + \mu_{0j} + e_{0ij}

\begin{bmatrix} \mu_{0j} \\ e_{0ij} \end{bmatrix} \sim N(0, \Omega_{0j}) \quad : \quad \Omega_{0j} = \begin{bmatrix} 25.191(14.453) \end{bmatrix}

\begin{bmatrix} \mu_{0ij} \\ e_{0ij} \end{bmatrix} \sim N(0, \Omega_{e}) \quad : \quad \Omega_{e} = \begin{bmatrix} 188.499(16.629) \end{bmatrix}

-2*log likelihood(IGLS Deviance) = 2171.707 (267 of 267 cases in use)

Figure 28. Model 4 multilevel results factual fluency

Note: New pretest variable introduced into the equation was factual reading fluency (WPREWRC_y). All variables were for students (j) in classes (i).
WPOWR\textsubscript{C\_i\_j} \sim N(XB, \Omega)

WPOWR\textsubscript{C\_i\_j} = \beta_{0ij} \text{CONS} + 7.413(6.513)\text{GROUP}\_i + 0.968(0.037)\text{WPREWR}\textsubscript{C\_i\_j} + \phantom{0} -0.021(0.047)\text{GROUP} \cdot \text{WPREWR}\textsubscript{C\_i\_j}

\beta_{0ij} = 19.827(5.143) + u_{0ij} + e_{0ij}

\begin{bmatrix} u_{0ij} \\ e_{0ij} \end{bmatrix} \sim N(0, \Omega_{u}) : \Omega_{u} = \begin{bmatrix} 24.927(14.340) \\ 188.408(16.621) \end{bmatrix}

-2^*\text{loglikelihood}(IGLS Deviance) = 2171.500(267 of 267 cases in use)

\textit{Figure 29.} Model 5 multilevel results factual fluency

Note: New term added to the equation was the term for the interaction between treatment group and pretest reading comprehension (GROUP. WPREWR\textsubscript{C\_i\_j}) for students (j) in classes (i).
Table 19

**Factual Fluency Multilevel Results Summary**

<table>
<thead>
<tr>
<th>Model</th>
<th>Effect Examined</th>
<th>Relevant Term in MlwiN Equation</th>
<th>t test</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Group Effect</td>
<td>Group effect 2.139 (4.788) GROUP$_j$</td>
<td>0.455</td>
</tr>
<tr>
<td>4</td>
<td>Pretest</td>
<td>Group effect 4.963 (3.680) GROUP$_j$</td>
<td>1.349</td>
</tr>
<tr>
<td>4</td>
<td>Effects</td>
<td>Factual Fluency 0.955 (0.023) WPREWRC$_ij$</td>
<td>41.522*</td>
</tr>
<tr>
<td>4</td>
<td>Effects</td>
<td>Group effect 7.413 (6.513) GROUP$_j$</td>
<td>1.138</td>
</tr>
<tr>
<td>5</td>
<td>Interaction</td>
<td>Factual Fluency 0.968 (0.037) WPREWRC$_ij$</td>
<td>26.162*</td>
</tr>
<tr>
<td>5</td>
<td>Effect</td>
<td>Interaction (Group &amp; Pretest Factual Fluency)</td>
<td>0.447</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>0.021 (0.047) GROUP$_j$, WPREWRC$_ij$</td>
<td></td>
</tr>
</tbody>
</table>

Note: * = $p < 0.05$.

**Summary Research Question 2.2: Narrative and Factual Fluency**

For both reading fluency measures, there were no significant group effects for any analyses, treatment group summary data or multilevel models. Therefore, the intervention had no significant group effects on performance on oral reading fluency measures. Significant effects of pretest oral reading fluency on posttest oral reading fluency were reported for both treatment groups, for both narrative and factual passage.

**Summary: Effects on Reading Vocabulary and Reading Fluency**

The effects of the intervention on reading vocabulary and reading fluency were mixed. For reading vocabulary, posttest treatment group differences were statistically significant after controlling for pretest reading vocabulary, pretest reading comprehension and pretest narrative reading fluency. No significant interaction effects were reported for reading vocabulary. There were no significant posttest treatment group differences for either narrative or factual reading fluency. Significant
effects were found for pretest narrative and factual reading fluency on posttest performance on narrative reading fluency and factual reading fluency for both treatment groups.

Interaction Effects Overview: Research Question 3.1

Interaction effects were significant for two measures: standardised reading comprehension and narrative question-answering. These effects were discussed within the discussion of each relevant measure. For all other measures, Model 5 results reported interaction effects and have been presented with the analyses and results for each measure. This section summarises the results for all measures (see Table 20).

Table 20

Summary of Interaction Effects

<table>
<thead>
<tr>
<th>Measures</th>
<th>Model 5 MlwiN Result</th>
<th>Interaction Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction Term</td>
<td></td>
<td>Significant, ( t = 2.7 ) *</td>
</tr>
<tr>
<td>Coefficient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading Comprehension</td>
<td>21.463 (3.925)</td>
<td>Significant, ( t = 2.25 ) *</td>
</tr>
<tr>
<td>Narrative Answers</td>
<td>2.818 (0.696)</td>
<td>Not significant, ( t = 1.761 )</td>
</tr>
<tr>
<td>Factual Answers</td>
<td>1.699 (0.578)</td>
<td></td>
</tr>
<tr>
<td>Reading Vocabulary</td>
<td>9.360 (14.141)</td>
<td>Not significant, ( t = 1.293 )</td>
</tr>
<tr>
<td>Narrative Fluency</td>
<td>0.312 (7.677)</td>
<td>Not significant, ( t = 0.622 )</td>
</tr>
<tr>
<td>Factual Fluency</td>
<td>7.413 (6.513)</td>
<td>Not significant, ( t = 0.447 )</td>
</tr>
</tbody>
</table>

Note: * = \( p < 0.05 \).
The interaction effects can be summarised as significant for reading comprehension and narrative question-answering. The interaction effects were not significant for factual question-answering, reading vocabulary, narrative reading fluency and factual reading fluency measures. Interaction effects were, therefore, significant across two measures where there were significant posttest performance differences that favoured the experimental group. For all statistically significant interactions, the intervention was somewhat more effective for students who initially had lower pretest scores.

Chapter Summary: Intervention Effects

Multilevel results for all variables have been summarised (see Table 21). These results support statistically significant performance differences favouring the experimental group on three reading comprehension measures—standardised reading comprehension and two written question-answering measures. Statistically significant interaction effects, between treatment group and pretest performance, were reported for reading comprehension and narrative answers, but not for factual answers, reading vocabulary measures, narrative reading fluency and factual reading fluency measures.

Experimental posttest vocabulary performance was significantly higher than control group performance only after controlling for pretest differences on reading vocabulary. There were no statistically significant posttest performance differences on two measures of reading fluency. These results and their implications for theory, future research and classroom practice are discussed in the following chapter (Chapter 8).
Table 21

*Summary of Intervention Effects*

<table>
<thead>
<tr>
<th>Measures</th>
<th>Intervention Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading Comprehension</td>
<td>Statistically Significant Posttest Group Effect and Significant Interaction Effect with Pretest</td>
</tr>
<tr>
<td>Narrative Answers</td>
<td>Statistically Significant Group Effect</td>
</tr>
<tr>
<td>Factual Answers</td>
<td>Statistically Significant Posttest Group Effect</td>
</tr>
<tr>
<td>Reading Vocabulary</td>
<td>Statistically Significant Posttest Group Effect after adjustment for Pretest Performance</td>
</tr>
<tr>
<td>Narrative Fluency</td>
<td>No Statistically Significant Posttest Group</td>
</tr>
<tr>
<td>Factual Fluency</td>
<td>Effects</td>
</tr>
</tbody>
</table>
CHAPTER EIGHT:
DISCUSSION, LIMITATIONS AND IMPLICATIONS

This chapter discusses the results of the current study in the context of the research literature in information processing, reading comprehension and question-answering. Firstly, a brief overview of the main findings pertaining to each of the hypotheses and research questions is systematically presented and discussed in the context of previous research findings. Secondly, the strengths and limitations of the present investigation are summarised. This section includes comparisons between the question-answering intervention and control group reading instruction. Finally, future implications of the findings for theory, research and classroom instruction in question-answering and reading comprehension are discussed.

Intervention Effects on Reading Comprehension

The first aim of the current study was to determine the efficacy of a newly-developed question-answering intervention for improving reading comprehension performance by comparing experimental group performance to the control group who completed their regular classroom reading instruction. The second aim was to examine potential difference in intervention effects for participants with different levels of reading achievement prior to completion of the question-answering program.

_Hypothesis 1.1: Effects on Standardised Reading Comprehension_

Extending beyond previous research, the current study documented statistically significant improvements on a standardised reading comprehension measure following question-answering instruction. Given the lack of pretest treatment group differences, the strong research design and sophisticated statistical analyses,
posttest performance differences favoring the experimental group were attributed to differences between the reading instruction of the two treatment groups. Significant interaction effects between pretest performance and treatment group were also reported for reading comprehension. Hypothesis 1.1 predicted standardized reading comprehension performance would significantly favor the experimental group following implementation of the intervention. Posttest performance differences in standardized reading comprehension were statistically significant. Differences favored the experimental group in that experimental participants displayed higher scores (73.0 percentiles) in comparison to the control group (64.3 percentiles). Experimental group mean performance increased by 13.7 percentiles while the control group mean performance increased by 1.4 percentiles over the same period of time. These results supported the efficacy of the question-answering intervention to enhance reading comprehension performance and the saliency of theory and research on which the intervention is based.

Statistically significant interaction effects were also documented whereby the intervention had larger effects on experimental participants with lower levels of pretest performance in standardized reading comprehension compared to participants with higher levels of pretest performance. Significant interaction effects related to treatment groups added support to the contention that improvements were linked to the intervention. The significant interaction effects for the experimental group further supported the efficacy of the intervention because these effects demonstrated greater improvements for students with lower pretest performance that were not evident for the control group. Therefore, there was no support for regression to the mean effects that suggested any instructional program might lead to improvements in performance of students with lower pretest scores. Similar interaction effects have been reported in
earlier question-answering intervention research (Benito, et al., 1993), and graphically (Raphael, 1984). However, these studies did not evaluate interaction effects using statistical analyses that adjusted for pretest differences as used in the current study (Graham, 1995; Raphael & McKinney, 1983; Raphael & Wonnacott, 1985). In addition, similar interaction effects favouring experimental groups have been documented for comprehension strategy instruction (DeCorte et al., 2001). Similarly to the De Corte et al. study, the current study reported statistical evidence for interaction effects and extended interaction evidence beyond question-answering achievement to standardised reading achievement. Hence, the findings of the present investigation suggest that the intervention developed for the present investigation is of practical significance to students who are most likely to benefit from such an intervention through increases in reading comprehension.

Interaction effects documented that students with lower pretest performance made significantly greater improvements in the experimental group than in the comparison group and that these improvements were significantly greater than students with higher pretest performance. The question-answering intervention utilised in the current investigation used information processing models to present concepts to students in a format that included small amounts of information, repeated presentations over time and gradual increases in task difficulty. These instructional features have been shown to be effective with students with learning disabilities (Gersten, et al., 2001; Mastropieri & Scruggs, 1997; Swanson, 2001; Weisberg, 1988) and, therefore, expected improvements in reading comprehension were significant. The practical significance of the current intervention lies in the extension of principles recommended for students with learning disabilities to standardised reading comprehension measures and the confirmation that these strategies are effective for
enhancing reading comprehension of these students within regular classroom instruction.

The ultimate goal of all reading comprehension instruction is to improve the performance of all students on standardised reading comprehension measures. To date, the null results of previous research have suggested that this goal would remain elusive. Previous question-answering research has documented a lack of statistically significant effects of instruction as measured by standardised reading comprehension measures (Benito et al., 1993; Ezell et al., 1992; Graham, 1995; Graham & Wong, 1993; Raphael, 1982; Raphael, 1984, 1986; Raphael & McKinney, 1983; Raphael & Wonnacott, 1985). In addition, methodological weaknesses and lack of sophisticated statistical methods had plagued previous research (see Chapter 3). In contrast, the current study found that question-answering instruction impacted positively and significantly on reading comprehension. The current study was designed to avoid the pitfalls of previous research by implementing a sound research design and utilising reliable measurement instruments and strong statistical tools. These results suggested that attention to addressing previous methodological issues and the development of a question-answering intervention based upon the best available theory and research can result in a statistically significant impact on reading comprehension scores. Through using scientific method, the current study ruled out many competing causes of reading comprehension improvements and, therefore, supported the link between the intervention and performance improvements in the experimental group.

In the current study, the extension to statistically significant improvements in reading comprehension performance is attributed to the theory-driven aspects of instructional design used for the question-answering intervention. Previous recommendations from strategy instruction (De Corte et al., 2001; NICHHD, 2000a),
and from question-answering intervention studies (Benito et al., 1993; Ezell et al., 1992; Graham, 1995; Graham & Wong, 1993; Raphael, 1982, 1984, 1986; Raphael & McKinney, 1983; Raphael & Wonnacott, 1985) provided an incomplete analysis of the information and cognitive processing for designing classroom instructional programs that would lead to significant improvements in reading comprehension. Hence, the critical weakness of previous research was the lack of application of theory, specifically information processing models, to the design of question-answering instruction. In applying information processing models to question-answering instruction, two broad principles were synthesised: inclusion of a strategic goal-directed strategy for question-answering, and presentation of controlled and sequenced teaching examples that supported the strategic goal (see Chapter 2). These principles were not reported in previous studies of question-answering instruction (see Chapter 3), nor in the control programs in the current study, and hence seem to be unique to the current intervention.

In addition, the demands for research-based and effective classroom reading instruction for all participants have never been stronger (De Corte, 2003; van Merriënboer & Paas, 2003). Focussed on improving reading instruction for all participants, recommendations have included both instruction in decoding skills and in reading comprehension skills (Denton et al., 2003; Gorman, 2003; Johnson et al., 2002; NICHHD, 2000b). While question-answering instruction has been included within these general recommendations, the author is not aware of any previous classroom instructional program in question-answering that has empirically documented statistically significant improvements in standardised reading comprehension. The current study has reported such improvements and thereby offers an exciting and promising beginning for the development of effective intervention for
the regular classroom.

*Hypothesis 1.2 and Hypothesis 1.3: Effects on Written Question-answering*

Hypotheses 1.2 and 1.3 predicted that experimental participants would significantly outperform control participants in written question-answering measures, using narrative and factual passages. Both hypotheses were supported by statistically significant posttest differences favouring the experimental group, and confirmed results from previous question-answering intervention studies (see Chapter 3). These results support the strength of the intervention and the theory and research on which it was based.

For Hypothesis 1.2 regarding the narrative passage, the experimental group mean increased from 8.5 answers correct at pretest to 9.9 answers correct at posttest, an increase of 1.4 answers out of 12 questions asked. For the same narrative passage, the control group mean increased from 8.4 answers correct at pretest to 8.8 answers correct at posttest, an increase of 0.4 answers out of 12 questions. In percentage terms, the experimental participants showed an increase of almost 12% compared to a 3% increase for the control participants, after one term of classroom instruction.

Following the intervention, experimental participants were able to write, on average, one more correct answer (out of twelve questions) than the control participants. However, examination of the posttest means and standard deviations suggested that experimental group performance on this measure might have been affected by ceiling effects. Potential ceiling effects on performance of the experimental group suggests that, on this measure, improvements in experimental group performance may have been limited due to ceiling effects. Hence ceiling effects may have also contributed to the interaction effects by effectively reducing performance improvements for students with higher pretest performance levels.
For Hypothesis 1.3 the mean pretest performance on the factual passage was 6 answers correct from 10 questions for both treatment groups. Results for posttest performance reported an experimental mean of 7.1 answers correct and a control group mean of 6.4 answers correct. This corresponded to an increase in performance of 11% for experimental participants compared to a difference of 4% for the control participants. Therefore, following the intervention, the experimental group wrote, on average, 0.6 more questions correct than the control group.

Interaction effects were documented in relation to Hypothesis 1.2 for written answers to the narrative passage. These effects suggest, as for standardised reading comprehension, that those experimental participants performing at lower pretest levels improved by significantly more than experimental participants performing at higher pretest levels. However, similar interaction effects were not evident for Hypothesis 1.3 for written answers to the factual passage. This difference may have been due to the inherent differences between the two types of passages or may have been due to a larger number of narrative practice passages in the instructional program. The factual passage, on the topic of whales, contained some words that may have been unfamiliar to some students, whereas the narrative passage was written in language that may have been more familiar to students. As a result, students may have found answering questions easier with the narrative passage than with the factual passage.

However, the standardised reading comprehension measure included both narrative and factual passages and a significant interaction effect was reported. Statistical analyses reported differences in the significance effects of pretest measures on posttest narrative question-answering and factual question-answering, despite the lack of difference in pretest performance between the two treatment groups. For narrative question-answering, significant group and interaction effects were
accompanied by significant effects of pretest reading comprehension and pretest narrative question-answering. These results support the finding of similar interaction effects for reading comprehension during comprehension strategy instruction (De Corte et al., 2001).

In contrast, for factual question-answering, significant group effects were accompanied by significant effects of pretest factual question-answering, pretest reading vocabulary and pretest factual fluency. These results, as distinct from narrative question-answering and reading comprehension, suggested that factual question-answering might have been affected by the vocabulary in the passage and reading fluency. The factual passage was slightly longer than the narrative passage (361 words compared to 291 words) and this may have been a factor affecting improvements in participants with lower pretest performance who would have been likely to have had lower pretest reading fluency.

A further factor affecting performance on the factual passage may have been suggested by the significant effects on factual question-answering of both reading vocabulary and factual reading fluency in posttest question-answering performance. (see Chapter 7, Multilevel Results for Hypothesis 1.3). This stood in contrast to both narrative question-answering and standardised reading comprehension, where pretest performance significantly contributed to posttest performance on both measures (see Chapter 7). Therefore, these results suggest that vocabulary knowledge and reading fluency have potentially stronger effects during factual question-answering than during narrative question-answering or standardised reading comprehension. These differences remain to be further investigated by future research and support the use of measures in different text types as part of reading comprehension research. One possible implication of this result might be to suggest that classroom instruction in
reading vocabulary and reading fluency may lead to some improvements of student performance in understanding factual passages.

Effects on Other Reading Measures

Related reading measures reported in the current study included reading vocabulary and reading fluency. Strong correlations have been documented in the research literature between reading comprehension, reading vocabulary and reading fluency (Fuchs et al., 1988; Hirsch Jr, 2003; NICHD, 2000a; Stahl, 2003; Wolf & Katzir-Cohen, 2001). As these measures had not been directly examined in previous question-answering research, the impact of the intervention on the related constructs of reading vocabulary and fluency was examined in the context of two research questions.

Research Question 2.1: Intervention Effects on Reading Vocabulary

Research Question 2.1 considered potential effects on reading vocabulary performance of the experimental group compared to performance of the control group. There were statistically significant differences reported on reading vocabulary favouring the experimental group. Statistical analyses confirmed a lack of pretest differences between the treatment groups. Pretest reading vocabulary performance slightly and non-significantly favoured the control group over the experimental group (62.9 percentiles and 58.3 percentiles, respectively). Changes from pretest to posttest differed between the two treatment groups: Experimental group performance improved by 9.4 percentiles, whereas the control group performance changed by 3.4 percentiles. Following adjustment for pretest differences, statistical analyses supported significantly larger improvements that favoured the experimental group. Interaction effects for treatment groups were not significant and, therefore, the
intervention effect on reading vocabulary performance was similar at all levels of pretest performance.

The focus of the intervention included instruction in words involved in questions and in strategies for finding the meanings of difficult words. While this was expected to improve participant performance on reading comprehension measures, there was no basis for predicting effects on reading vocabulary, using a standardised measure. In addition, control classes included incidental instruction in word meanings during classroom reading activities. However, the wider range of reading activities in the control group meant that instruction in word meanings was less systematic, varied across participants, and arose incidentally during reading activities.

In contrast, the intervention presented repeated, multiple examples of a small number of word meanings in questions and of strategies for independently finding out word meanings. By teaching fewer word meanings, the intervention program provided increased opportunities for all participants to learn and maintain the knowledge of the examples that were presented. This result is supported by recommendations for reading vocabulary instruction that focus on multiple, repeated presentations of words and their meanings for all students (Stahl, 2003). Similar recommendations from information processing models confirmed the importance of repeated, deliberate practice to improving skills over time (see Chapter 2). In particular, a recent review of the positive effects of practice in reading vocabulary for students with learning disabilities supports this significant effect (Jitendra, et al., 2004). In light of this review, while students with learning disabilities defined by Jitendra et al. were not equivalent to students with lower pretest performance in the current study, the significant interaction results following statistical adjustment for pretest performance are supported (Jitendra et al., 2004). The results of the present investigation support
the use of reading vocabulary instruction as a promising strategy for students in regular classrooms.

Research Question 2.2: Intervention Effects on Reading Fluency

Research Question 2.2 involved examining the potential effects of the intervention on reading fluency measures that included one narrative and one factual passage of text. The relation between reading fluency and reading comprehension has been strongly and repeatedly reported in research literature (NICHD, 2000a; Wolf & Katzir-Cohen, 2001). However, correlational evidence seems to have predominated this area of research, as the author is unaware of any causal modelling studies involving Year 5 students. Some studies have reported predictive results for beginning reading that linked reading fluency to predicted comprehension measures used in statewide testing (Kaminski & Good III, 1998). With the intensive instructional focus on one reading comprehension skill, the skill of question-answering targeted in the present investigation, potential direct or indirect effects on reading fluency were unknown. Therefore, the additional impact of text type, narrative or factual, on reading fluency was also unknown.

Intervention effects on reading fluency measures were not statistically significant. Statistical analyses confirmed that pretest reading fluency performance, on both narrative and factual texts, was similar for the two treatment groups. For both treatment groups, mean pretest reading fluency was about 130 words read correctly per minute on the narrative passage, and about 114 words read correctly per minute for the factual passage. This rate was within the benchmark suggested for Year 5 students by state authorities (NSW Board of Studies, 1997). Similar standard deviations were reported for both treatment groups. Most of the participants in both treatment groups were reading both passages above this level. Therefore, for most
participants, reading comprehension performance at both pretest and posttest was not likely to be adversely affected by low decoding fluency. Hence, as suggested by information processing models, working memory capacity limitations resulting from difficulties with decoding skills (see Chapter 2) were likely to have had minimal impact on reading comprehension performance for both treatment groups.

Significant treatment group differences were reported for reading vocabulary, after statistically controlling for pretest scores. Effects on reading fluency were not statistically significant. As the intervention implemented in the present investigation was not explicitly designed to enhance either reading vocabulary or reading fluency, these results are not, perhaps, surprising. Hence whilst previous research has proposed some correlation between these constructs, the results of the present investigation suggest that the causal mechanisms underlying these relations require further investigation. The current study’s results lend support to the need for explicit instruction in both decoding and comprehension within the simple view of reading (Hoover & Gough, 1990; Hoover & Tunmer, 1993). Nevertheless these results suggest that future research may be strengthened by disentangling further the relation between reading comprehension, reading vocabulary, question-answering and reading fluency variables. The latter could be advanced by implementing a sophisticated longitudinal causal modelling research design to overcome previous research limitations based upon correlational research designs. In addition, given the correlational relations between reading vocabulary, reading fluency and reading comprehension, the effects of the current intervention may be further strengthened by incorporating instruction in reading fluency and reading vocabulary prior to question-answering instruction.

In summary, statistically significant intervention effects were limited to
reading comprehension measures, and documented clear differences between the experimental participants and control participants following implementation of question-answering instructional program and regular reading instruction, respectively. The research design included classes within the same school and year, and documented high levels of research control that suggested that posttest differences were a result of differences between the instructional programs, rather than other variables. Both the similarities and differences between the experimental and control instructional programs are discussed in the following section.

Features of Reading Instruction And Treatment Group Differences

Given the lack of pretest treatment group differences, and high internal validity of the research design, posttest differences were attributed to differences between classroom reading instruction in the experimental and control groups. Both treatment groups contained classes in the same schools, and consisted of students who were of similar ages and with similar ratios of male and female participants. Classroom teachers were self selected to participate in treatment and control conditions. This provided limited research control for threats to internal validity and, importantly, controlled for practice effects of repetition of the same assessments. As a result, the results of the present study strongly suggest that differences in classroom reading instruction, namely the intervention materials used in experimental classes, resulted in significant differences in posttest performance favouring the experimental group. The lack of posttest difference in reading fluency measures between treatment groups provided strong discriminant validity supporting the causal link between the intervention and performance increases in reading comprehension measures for the experimental group. Similarities and differences in reading instruction between the
two treatment groups are presented below.

**Similarities in Reading Instruction Across Treatment Groups**

In both experimental and control classes, whole class lessons predominated in classroom reading instruction. Classroom teachers provided all participants in their class with the same materials or activities and participants were provided with examples completed by the teacher. Control teachers presented lesson content to their class and instructed participants to complete activities independently for the majority of reading lessons. Anecdotal evidence suggested that control teachers presented one or two examples of concepts taught and then requested participants to work independently and individually to complete further examples. While experimental teachers also presented examples, features of the intervention materials resulted in teacher modelling that involved presentation of a larger number of worked examples than in control classes. In addition, intervention materials ensured that experimental teachers provided multiple, additional worked examples that were completed jointly by experimental teachers with their students prior to the commencement of independent examples by students.

Across all classes, on average, similar lesson times were documented. In control classes, average reading lessons lasted a little over 52 minutes, with a range of 30 - 85 minutes reported or timetabled by control teachers. Three control class teachers documented average lesson times of around 48 minutes and one control teacher’s average lesson time was 61 minutes. In experimental classes, average reading lessons lasted for around 48 minutes, with a range between 35 - 90 minutes. Across the six experimental class teachers, average lesson times for the thirty lessons ranged between 45 and 52 minutes. Similarities between instructional times in the experimental and control groups offer support for the contention that differences in
instructional time were minimal, and had little effect on posttest performance differences. Hence, posttest performance differences were more likely attributed to differences in the features of the instructional programs.

**Instructional Differences Between Treatment Groups**

Differences were documented between the two treatment groups in relation to the type of classroom reading instruction. The experimental group was presented with intervention materials that focussed explicitly and directly on written question-answering. The materials were designed using theoretical principles from information processing models, reviews of reading comprehension research, and specific research on question types. Features of the materials included explicit cognitive steps for completing question-answering, multiple positive and negative examples of concepts at multiple levels, a comprehensive framework of question types that reflected answer sources, and repeated opportunities for independent participant practice. The structured lesson format that was presented within the intervention materials included corrective feedback and repeated review of presented information. During the intervention, experimental participants were presented with 57 passages of text of various lengths and had the opportunity to write answers to 343 questions, some with teacher support. Integrity data showed that participants independently completed about 90% of these questions. Experimental participants, therefore, were provided with an intervention based on a well-established theoretical base that specifically targeted question-answering.

In contrast, the control group continued with classroom reading programs planned and implemented by each control classroom teacher. The content of control classroom reading programs varied greatly across classes. Rather than focussing on a single comprehension skill, control teachers presented their classes with a wide
variety of comprehension skills that included question-answering, advertisements, written chapter summaries, letter writing, descriptions, maze activities, cloze passages, story maps, plot profiles, directions, retelling, vocabulary instruction, listening comprehension, illustrations, poetry, research, grammar, character and cause and effect sequences. Consequently, there were fewer opportunities to practise any single comprehension skill to the same level as experimental participants had practised written question-answering.

Details of control programs documented that control teachers, in fact, had continued with their planned classroom reading programs and had not altered their instruction significantly during the current study. The four control teachers presented whole class lesson instruction, and the same tasks were required of all participants. Selection of participants as low, average and high reading skills may have suggested (and confirmed) teacher expectations of those participants and indirectly affected student work completion. Differences in completion rates across participants were not discussed with control teachers during the current study, so there is no information about whether teachers were aware of these differences between participants. These data confirmed the lack of interference in control classes during the study and ruled out possible threats to external validity due to experimental arrangements, such as Hawthorne effects (Tuckman, 1999), and the compensatory rivalry of John Henry Effects (Gall, Borg, & Gall, 1996). The lack of instruction specific to written question-answering in control classrooms confirmed “experimental treatment diffusion” was not a threat to internal validity (Gall et al., 1996, p. 471).

In addition, data were reported for control classes for a small sample of participants from each control class, selected by classroom teachers as participants of low, average and high reading skills. These data documented a wide variation in the
number of examples completed across classes and between participants of different
teacher-determined reading ability levels (see Appendix E). Therefore, control
participants with high reading skills completed similar amounts of responses
compared to experimental participants in only one of the four control classes and
control participants with lower reading skills completed substantially fewer examples
than experimental participants. In contrast, the intervention presented similar amounts
of work to all participants and treatment integrity procedures ensured that all
participants in the experimental groups completed similar numbers of examples. In
contrast, low performing control participants completed considerably fewer examples
compared to low performing experimental participants. These differences in
completed examples may have contributed to the statistically significant posttest
performance differences and to the significant interaction effects documented in the
current study.

Strengths of the Current Study

The strengths of the present investigation included the high internal and
external validity of the study, whereby statistically significant improvements in
reading comprehension resulted from implementation of the question-answering
intervention for Year 5 participants. In contrast to previous intervention studies, the
current investigation used instruments with sound psychometric properties and
sophisticated statistical analyses. The current study also verified the relevance of
information processing models for the design of effective instruction in question-
answering, the models being found to be sufficiently powerful for significant effects
to be reported in standardised reading comprehension. Theoretically, information
processing models suggested that presentation of a complete specification of the
cognitive system would lead to the development of expertise (Anderson, 2002; Newell, 1990). The analysis and synthesis of knowledge structures and cognitive processing used in the intervention proved to be sufficiently wide in the types of examples that increases in reading comprehension skills were documented within the context of intensive instruction in question-answering.

A major strength of the current investigation was the establishment of an intervention that was effective in improving reading comprehension without a long period of teacher training. This was achieved through the reliance on the selection and sequencing of the teaching examples presented in the materials. The teaching examples not only established and controlled appropriate participant responses, but may have also provided scaffolding for classroom teachers where their knowledge of comprehension instruction may have been lacking. Hence, an important component of the current intervention was its presentation by classroom teachers, without the intrusion of scripted lesson presentations. This increases the external validity of the intervention and the likelihood of teacher acceptance of the current intervention in the longer term.

A clear change the present investigation is the introduction of multilevel modelling approaches to evaluate the statistical significance of the effects of a question-answering intervention. Multilevel modelling has been applied to comprehension strategy instruction (DeCorte et al., 2001). However, in previous question-answering intervention studies, the multilevel, hierarchical nature of classroom data (i.e., students nested within classes) has been ignored. This failure of the existing question-answering research introduces a potentially large bias in tests of statistical significance in the direction of reporting differences to be statistically significant when they are not. The use of multilevel modelling approaches also has the
potential to determine whether intervention effects vary significantly across different classrooms and to evaluate classroom variables (e.g., teacher characteristics or aggregated measures of students within each classroom) that explain such differences. The present investigation is one of the first to apply multilevel modelling to an intervention study, and the primary focus of statistical analyses was on treatment group effects. However, one contribution of the current study was to highlight the use of sophisticated multilevel modelling statistics for determining intervention efficacy. Potential applications of multilevel modelling procedures might examine other reading comprehension interventions and more detailed effects of specific classroom variables. No doubt this will be of interest to researchers in the future.

Limitations of the Current Study

Conclusions from the current study were limited to Year 5 students enrolled in regular classrooms in Sydney metropolitan schools. Whether similar differences in posttest performance would have resulted for students in other grades or in other schools was not investigated. In addition, conclusions were limited to the reading measures used in the current study that reflected the question-answering, reading fluency, standardised reading comprehension and reading vocabulary skills sampled in the measures that were used. Whether similar performance differences would have been reported on alternative standardised measures, sampling cloze passage, retelling or other comprehension skills, remains unknown. Posttest performance differences were limited to measures tested on completion of the intervention program. Therefore, long term maintenance of skills and knowledge was not documented. Effects of additional practice were documented particularly for students with low reading skills through integrity of implementation data and interaction effects in reading
comprehension and narrative question-answering. Such additional practice—rather than the specific content of the intervention—cannot be ruled out as a cause of interaction effects, and of performance differences between the treatment groups.

The question of which single component or combination of components of the intervention was more effective than other components cannot be determined in the current investigation. The intervention focussed on a synthesis of knowledge and cognitive processing that led to a complex set of materials and teaching strategies and changed the classroom environments during reading comprehension lessons. As with De Corte et al. (2001), there was no way to determine which specific components of the new classroom environment were effective. In addition, the purpose of the current study did not include examination of the complex interrelations between the reading measures used in reading comprehension, reading vocabulary, question-answering and reading fluency. However, none of these limitations detract from the power of the intervention for improving student performance in the reading comprehension measures used in the current study.

Theoretical Implications from the Current Study

The efficacy of the question-answering intervention based on information processing models, in the context of a strong research design, was strongly supported. The gradual increase in task difficulty and range of examples presented minimised working memory limitations. Deliberate practice of cognitive strategy steps applied multiple examples across the thirty-lesson sequence. Therefore, over time, the intervention led to the development of automaticity in lower level knowledge and skills, at the word and sentence level, and hence, skill development in question-answering at the passage level.
The features of the intervention operationalised a gradual release of responsibility for completing the cognitive processing used in question-answering from the teaching examples and selection responses, to the experimental participants. The intervention enabled participants to both attend to and process particular features of questions and passages (environmental stimuli) that, to this point, had gone unnoticed. Therefore, the critical intervention features included the gradual increase in the difficulty level of examples, the range of example features and gradual change in required responses, from selection to production, within the context of cognitive strategy steps. The intervention materials focussed participant attention on essential knowledge and cognitive processing required for question-answering and, hence reduced the effects of working memory capacity limitations on the completion of the complex task. In contrast, the lack of selection and sequencing of teaching examples presented in control reading instruction failed to lead to similar improvements in control group performance.

Working memory limitations appeared to be a major barrier to enabling participants to successfully complete reading comprehension tasks, including question-answering (see Chapter 2). Working memory limitations hampered completion of simultaneous storage and processing of information while completing complex cognitive skills (Miyake & Shah, 1999b). The features of the materials reduced the cognitive load on working memory and enabled participants to complete a simplified version of the complex task with multiple examples (De Corte et al., 2003; Sweller et al., 1998). Gradual increases in the complexity of teaching examples enabled experimental participants to apply the cognitive strategy steps to novel examples and to demonstrate improvements in reading comprehension. In contrast, the control participants were presented with materials, from published textbooks, that
covered a range of complex, comprehension tasks at a grade-appropriate level of
difficulty. As a result, improvements in experimental group performance in question-
answering and in reading comprehension were significantly greater than
improvements in control group performance.

The larger amounts of deliberate practice provided within the intervention also
contributed to performance improvements. The intervention presented one
comprehension skill, question-answering, provided in the experimental materials
compared to smaller amounts of practice for several comprehension skills in the
control classroom reading programs. Hence, the implication of these results is that
instruction in fewer skills, presented with control of examples and with more
examples, led to significantly greater improvements than instruction in a large number
of skills with less detail and control of examples (Engelmann & Carnine, 1982;
Thorley et al., 1991). This parallels conclusions about teaching reading vocabulary
that suggested repeated presentations of fewer words are more effective for improving
reading vocabulary knowledge than single presentations of a larger number of words
(Stahl, 2003).

In summary, the empirical results suggest that experimental participants
experienced significant changes in cognitive representations of information and
cognitive processing in comparison to the control participants. Hence, differences in
classroom instruction between the two treatment groups resulted in significant
differences in posttest performance that significantly favoured experimental
participants in reading comprehension measures and supported the application of
information processing models.
Instructional Implications from the Current Study

The current study has confirmed the importance of proven aspects of effective classroom instruction and made an important contribution to current knowledge about both question-answering and reading comprehension. The application of theoretically designed materials to classroom instruction led to significant improvements in question-answering that generalised to reading comprehension performance and reading vocabulary. In particular, the current study strongly suggests that effective instruction should focus on both specific teaching examples and the strategic goal of the lesson or skill being taught. The nature of the correlational relationship between reading comprehension and reading fluency may be more complex than originally presented and the specific nature of the relationship, whether causal or correlational or interactive, remains to be further examined. The findings with regard to reading fluency challenge existing literature and present a challenge for future research.

Reviews of reading comprehension have repeatedly called for more explicit instruction (Dole et al., 1991; Fielding & Pearson, 1994) and for the gradual release of responsibility for completing comprehension activities from teachers to students (Pearson, 1985; Pearson & Dole, 1987). The National Reading Panel reinforced this call, and yet, few specific directions for classroom teachers were evident (NICHHD, 2000a). The current study operationalised this call through the design of the intervention materials. Using the intervention in the present investigation, classroom teachers were capable of providing the explicit instruction and the gradual release of responsibility called for in the literature.

More specifically, using the intervention materials, experimental classroom teachers used the effective teaching cycle, originally proposed by Rosenshine and Stevens (1986) and presented again by the National Reading Panel (NICHHD,
2000a). Time and effort spent in designing the intervention and controlling features of teaching examples in the intervention led directly to correct participant responses that enabled classroom teachers to praise students. In this way, the materials provided a social context that promoted successful completion of work supported by positive social consequences (Luria, 1982).

Previous question-answering research has reported significant increases in question-answering measures, without significant increases in reading comprehension. In contrast, the intervention in the present investigation resulted in significant increases in both question-answering and reading comprehension measures. The conclusion that the intervention mediated improvements in performance places significant emphasis on the importance of the materials used in classrooms. Control teachers in the current study relied on materials produced by publishers as a foundation for their classroom reading programs. These materials, as implemented by control teachers experienced in classroom reading instruction, led to minimal improvements in question-answering and reading comprehension performance over a school term. Theoretically designed materials, using a structured lesson format such as the current intervention, provided an environment during reading lessons that was familiar to teachers and students, and focussed attention on specific features of examples within the context of general strategy instruction. The structured lesson format established a schema for reading comprehension lessons and provided opportunities for teacher modelling followed by independent student practice.

"Changing the face of reading comprehension instruction" (Pearson, 1985, p. 724) was achieved, not by intensive or time consuming teacher training, but through the provision of theory-designed student materials that classroom teachers were able to implement. This was supported by a short session of training and strategies to
ensure implementation integrity. Anecdotally, classroom teachers commented favourably on what they had learned during implementation of the thirty lessons. While no empirical data on classroom teachers or specific teaching behaviours were collected, implementation integrity confirmed teacher anecdotal support for the positive effects on their classroom instruction and improvements in teacher knowledge about reading comprehension.

Differences between definitions of Pearson and Johnson’s (1978) question taxonomy posed potential problems during the design of the materials. A major issue in clarifying the question type definitions arose in the distinction between text explicit and text implicit questions, in particular with reference to anaphora. Examples of anaphora (using pronouns and noun referents) that were reported in the study validating the question types, confused these two types (Thompson & Gipe, 1985). Even the same researchers used different definitions across studies (Raphael, 1982; Raphael, 1984, 1986; Raphael & Wonnacott, 1985) and only once were changes in definitions acknowledged (Raphael, 1986). The implication of this problem is that the inability of researchers to clearly and consistently define question types might have contributed to the difficulty of implementing the strategy within classroom instruction. The definition problem of an abstract higher-order category, like question types, reinforced the hierarchical nature of the strategy and concepts involved in question-answering. When teaching complex, abstract concepts, the current intervention reinforced the critical importance of focussing on all levels of concepts and strategy steps in order to communicate a single interpretation of the full range of concepts involved in question-answering (Engelmann & Carnine, 1982).

One of the critical features that differentiates the intervention in the current study from previous question-answering instruction is the synthesis of specific
teaching examples within the context of the strategic goal of the instruction. This synthesis provides a way forward for classroom teachers to operationalise the calls for explicit instruction and provides potential for improvements to be generalised beyond the current lesson being taught. To date, reading comprehension instruction in the classroom may not have changed in response to research reviews, and teachers appear to require considerable training in reading comprehension strategies (NICHD, 2000a). The current study provides an effective alternative to costly teacher training. That alternative focusses on designing materials with specifically selected teaching examples that reflect the cognitive processes for strategic goals in reading comprehension and reading (Carnine et al., 1997; Kameenui & Simmons, 1990).

In summary, the current investigation documents the first reported statistically significant improvements in a standardised reading comprehension measure resulting from question-answering instruction. The importance of the design of classroom interventions based on a sound theoretical foundation in information processing models has been supported. Rather than a sole focus on general strategy instruction, the current investigation strongly supports the need for specially designed classroom materials that will firstly, foster the generalised use of effective reading comprehension strategies by all students, and secondly, be received and implemented by classroom teachers. The theoretical principles outlined in the current investigation, therefore, provide a clear direction for textbook designers that could have profound implications for classroom practice in reading comprehension.

Future Directions

The current investigation has supported the efficacy of theoretically designed instructional materials in question-answering for whole class instruction resulting in
statistically significant improvements in reading comprehension in Year 5. Further applications of theoretical principles from information processing models remain to be explored. Any complex cognitive skill, including a number of other reading comprehension skills, may potentially be presented to students using an intervention based on the principles applied in the current study. Beyond reading, complex mathematical skills (including math story-problem instruction) and complex mapping and graphing skills are also potential candidates for instruction based on these theoretical principles.

An application of these theoretical principles to similar comprehension skills, like finding the main idea, sequencing and making inferences, would be the most immediate future research direction. The well documented slump at Year 4 in reading comprehension has increased demand for effective instructional programs in reading comprehension (Chall & Jacobs, 2003). With students in Year 5, where some existing reading skills in decoding are more likely to be found, reading comprehension materials using example features and a similar type of goal-directed framework may be a realistic option. This would require an examination of previous research focussed on the specific skill to be taught (for example, finding the main idea) to determine both teaching exemplar features and a goal-directed framework with some existing empirical support.

The current study did not evaluate maintenance of performance changes in the longer term, or potential effects of the current instructional materials on other comprehension skills, like summarisation or cloze passage. Resources within the current study prevented such investigation. Replications of the current study with additional measures of reading comprehension would provide vital information about the complex relationships in knowledge and skills that underpin a range of
comprehension skills, including question-answering.

In addition, the challenge awaits researchers to apply these theoretical principles to similarly designed materials for younger students in question-answering or other comprehension skills. Such materials may require a focus on oral and aural skills, rather than written performance used in the current study. The design of materials for younger students, particularly students with few reading skills, would rely more heavily on oral teacher presentation skills than the materials used in the current investigation. Whether this reliance would require the scripted teacher presentations used in some commercially available programs (for example, direct instruction materials, Engelmann & Carnine, 1982; Carnine, et al., 1997) remains unknown.

Potential applications of these theoretical principles of instructional design to higher order skills and knowledge, perhaps with older students and in secondary classrooms also remains to be investigated. In secondary classrooms, the challenge to provide strategy instruction has been taken up by previous researchers (Deschler & Schumaker, 1986; Deschler & Schumaker, 1993) with some success. However, the presentation of generic strategy instruction that might apply, in various formats and permutations, across a range of content areas, is yet to be undertaken.

The National Reading Panel emphasised the importance of teacher training for the future of comprehension instruction (NICHHD, 2000a). There is clear potential for providing preservice and in-service training for classroom teachers in the theoretical principles underpinning the current investigation. Given the success of the intervention in the current investigation, teacher training in reading comprehension instruction may be more likely to be effective if accompanied by similar intervention materials based on information processing models. The current investigation provided
one example where the provision of a theoretically-based intervention led to significant improvements in student performance in reading comprehension and question-answering and was accompanied by a small amount of teacher training.

Further research is required to examine more closely the relations between the multiple variables involved in specific reading comprehension skills. General relations between constructs, such as the high correlations between reading fluency, reading vocabulary and reading comprehension, have been established. However, the current study has suggested more specific relations may underpin the general relations and that instructional factors can significantly impact on those relations. For example, in the current study, vocabulary effects and reading fluency effects were found to be significantly correlated in the factual passage of text, but were not significantly correlated for the narrative passage. This finding is more specific than previous general conclusions and raises questions about the relations between passage types and comprehension variables.

A common finding across all reading measures was the importance of pretest performance as a predictor of posttest performance. For some reading measures, the interaction between pretest performance and instructional effects was significant on the same measure. Theoretically, these findings support a preventative approach rather than remediation for students with special education needs in regular classrooms, and the impact of instructional factors on this preventative approach is yet to be determined.

Finally, research in reading comprehension has remained enigmatic. While detailed scope and sequence charts exist for decoding instruction, similar specifications for scope and sequence recommendations for reading comprehension skills have remained elusive. Researchers, as in the current study, have investigated
specific component comprehension skills. Some work has occurred on combinations of comprehension skills and combined strategy instruction and, as would logically be expected, more significant gains occurred for combined strategy instruction than for instruction in a single strategy (NICHHD, 2000a). However, there has been limited work on the sequence of instruction in specific strategies, in terms of the cumulative benefits of providing one particular strategy prior to another. In addition, a major problem with multiple strategy instruction has been the maintenance of strategies and difficulties that students with disabilities have when deciding which strategy is appropriate (Deschler & Schumaker, 1993). Therefore, a future direction from the current study would be to determine whether completion of the question-answering materials has cumulative effects as students begin instruction in another comprehension skill.

Chapter Summary

The current chapter has discussed the implications for theory and practice of the results in the current investigation. The application of information processing models to the question-answering intervention used in the current study has been supported. The implications of significant improvements that have extended to reading comprehension have been explained in terms of information processing models. The implications of these results have the potential to impact on theory, research and classroom instruction in reading comprehension and other skills. Within the context of extant research and literature, the current study has provided some clear directions for effective classroom instructional practices.
CHAPTER NINE:
SUMMARY AND CONCLUSIONS

The current investigation sought to determine the efficacy of an instructional program in question-answering for improving reading comprehension performance of Year 5 students. A review of research in reading comprehension and question-answering revealed the lack of clear direction provided for classroom teachers when designing effective classroom instruction in reading comprehension or question-answering. Reviews of research in reading comprehension and intervention studies in question-answering provided general directions for intervention strategies, yet failed to outline both the specifics required for effective classroom instructional programs and a theoretical foundation. Synthesis of current theoretical models in information processing and empirical evidence from reading comprehension research underpinned the design of the materials that comprised the intervention.

Using information processing models, the knowledge structures and cognitive processing required for the complex skill of question-answering were elucidated. The resultant intervention included materials and classroom implementation methods that synthesised both the information presented and cognitive processing across thirty classroom lessons. Reading measures used in the current study took account of decoding and vocabulary knowledge confirmed to be critical components within reading comprehension processes (NICHHD, 2000a). Analyses focused on reading comprehension and question-answering measures of most relevance to the intervention to determine the effectiveness of the intervention materials.

A quasi-experimental research design was developed to test the efficacy of the newly developed intervention. A hallmark of this design, rare in current research
literature, was that the intervention was replicated across classrooms and across
schools. Teachers presented the intervention to six Year 5 classes in three schools.
Internal validity was ensured through the use of valid, reliable instruments,
standardised procedures for administration of instrumentation and the intervention,
calculations of inter-rater reliability of achievement measures, and measurement of
the integrity of intervention implementation. Sophisticated statistical analyses were
utilised to take into account the hierarchical nature of the data that arose out of this
design—students within classes—to ensure valid and reliable conclusions resulted.

Consistent with the design of the intervention and a priori hypotheses, the
current study reported—for the first time to the author's knowledge—statistically
significant improvements in a standardised reading comprehension measure as a result
of question-answering intervention. Pretest differences between treatment groups
were non-significant on reading measures. Following teacher implementation of the
intervention, statistically significant differences between the treatment groups were
documented for three measures of reading comprehension: standardised reading
comprehension, written question-answering using narrative text and written question-
answering using factual text. After controlling for pretest performance, significant
differences in reading vocabulary favoured the experimental group. Significant
interaction effects were reported for reading comprehension and written answers to
questions from a narrative passage. Examination of these effects demonstrated that
students with lower pretest performance improved their performance by significantly
more than students with higher pretest performance in the respective measure. That is,
the intervention was more effective in improving performance for students initially
performing at lower pretest levels.

Empirical data supported the efficacy of the intervention and the saliency of
information processing models to question-answering and reading comprehension. Specification of a wide range of examples and cognitive processes in the question-answering intervention provided participants with a detailed knowledge base that resulted in significant improvements in reading performance in comparison to control participants. No similar specification was provided for the skills involved in reading fluency and reading fluency, did not improve as an outcome of the intervention. The latter findings support the simple view of reading whereby decoding skills and comprehension skills are confirmed to be separate, yet related, components of reading. Previous reading research has documented significant correlational evidence supporting strong relations between reading comprehension, reading vocabulary and reading fluency (NICHD, 2000a). In this study, some relations between reading comprehension, question answering, reading fluency, and reading vocabulary, were supported. However, the improvements in reading comprehension measures that were the key focus of the intervention occurred without concomitant improvements in reading fluency. The full complexity of these inter-relations remains to be addressed more fully by future research.

Previous research in question-answering and reading comprehension strategy instruction has been fraught with low internal and external validity. Problems have included researcher implementation of interventions, lack of pretest empirical data, the use of researcher-devised measures without demonstrating the psychometric properties of instrumentation, and a resulting lack of statistically significant improvements in standardised reading comprehension performance. Replication of previous research has also been limited by the lack of detail reported for intervention design, and participants’ prior skills and knowledge. This study has avoided this limitation of previous research by fully documenting the intervention procedures to
readily allow for replication, and by measuring participants’ prior knowledge and skills with psychometrically sound measures.

Directions from theoretical models and empirical evidence suggested a dual focus on declarative and procedural knowledge (Anderson, 2002). Controlling the learning environment demonstrated a potent method for ensuring effective learning (De Corte et al., 2003; Engelmann & Carnine, 1982; Mackintosh, 1997; Thorley et al., 1991; van Merrienboer & Paas, 2003). The selection and sequencing of teaching examples along with gradual increases in cognitive processing demands dominated the design of the materials and combined De Corte et al.’s (2003) concept of powerful learning environments with Engelmann and Carnine’s (1982) structural basis for generalisation. Synthesis of the wide range of specific examples with the strategic goal of question-answering sets the intervention in the current study apart from previous question-answering interventions. The efficacy of the current intervention supported the potential application of theory and research in capacity limitations (Halford et al., 1998; Miyake and Shah, 1999b; Sweller et al., 1998), skill development (Bransford et al., 2000) and deliberate practice (De Corte et al., 2003; Ericsson & Charness, 1994).

The study limits conclusions to Year 5 students receiving reading instruction in classrooms in the Sydney metropolitan area, with similar pre-existing reading skills to participants in the current study. In addition, the scope of the study did not allow for tests of the long-term maintenance of effects. Hence, future research could benefit from more fully investigating the impact of this type of intervention on a wider age range, by elucidating the extent of maintenance of effects longitudinally, and incorporating a wider range of reading achievement domains and measures. In addition, given the results of the study, it may be useful for researchers to consider
extending and applying the theoretical principles of instructional design based on information processing models to a more extended range of skills and knowledge taught in classrooms, beyond reading and reading comprehension. Furthermore, researchers may consider applying the theoretical principles of instructional design based on information processing models to a range of skills and knowledge taught in classrooms, beyond reading and reading comprehension, to further test the salience of information processing models.

The current study has documented the efficacy of a question-answering intervention through rigorous research that produced significant tangible outcomes. Given the success of the intervention it might also be useful for educators to consider developing further age-specific interventions grounded in the intervention strategies utilised in this study, to benefit a wider range of age groups than those considered in this study. In addition, educators may also consider similar applications of information processing models to interventions involving a broader range of reading skills.

In summary, the intervention utilised in this study and the theoretical principles on which it was based provide promising directions for strengthening reading comprehension theory, research and practice. These new understandings suggest that successful interventions need to be firmly grounded in the best available theory and research to result in effective practice in classrooms. Theory, research and practice are inextricably linked such that neglecting any one area may lead to less than desired results. The conclusions emanating from this study suggest that the time is ripe for developing stronger links between theory, research and practice in relation to reading comprehension interventions that can make a real difference to children’s lives within and beyond the classroom.
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Appendix A: Question-Answering Intervention

The intervention used in the current investigation was published, in response to teacher demand, in January 2002. The intervention was self-published by the author, using a consultancy company, Designed Learning Consultancy, and has an ISBN (0-9580372-0-5).

The package included in this thesis is the original intervention program as implemented in the current investigation.

Prior to formal publication, two changes were made to the original intervention program.

Firstly, a small number of stories had been adapted from commercially published reading programs. To avoid copyright issues, these stories were replaced with original stories written by the author, with the same features and length as the published stories and using different topics.

Secondly, in response to teacher feedback, additional strategies for generalisation were included in a scope and sequence that were planned for implementation between each set of student books.

The teacher manual was rewritten to include scripted demonstration lessons for the generalisation strategies. The original teacher manual, as presented to classroom teachers in the current study, has been published in this thesis.

For further details about the revised teacher manual, the generalisation strategies and the published program, please contact the author.
PRIMARY COMPREHENSION RESEARCH

OVERVIEW

The research and intervention program will focus on the development of a program to teach written comprehension skills to students in primary school who already have some decoding skills. The minimal level of decoding skills required for this program is not known at this stage - this is one of the questions that will, hopefully, be answered in some way during the course of implementing the program. The reading fluency samples that were taken earlier will form part of the data to determine this.

The written tests of question answering with short passages and the PAT test, a normative test of Reading Comprehension will be used to evaluate the program. These measure several aspects of comprehension. Previous implementations of this program have resulted in gains for students in both these measures.

A couple of points are critical to ensuring that the program has resulted in the student gains in skills. Firstly, teachers need to document the instruction for reading and reading comprehension that is occurring during the period of time. Secondly, it is also important that teachers document the amount of instruction given - if an excursion, or whatever, is on then this needs to be briefly noted in the diary of the teacher(s) concerned.

THE PROGRAM ITSELF

Whether there is an appropriate amount of activities or too much work to be completed in one approximately thirty minute lesson is unknown. Whether the work is at an appropriate level of reading difficulty is unknown for this grade of students. Further development has been possible as a result of feedback from previous implementations of the program. (My home phone number is 02 - 9484 - 1764 - please don't hesitate to ring me with feedback or problems at any time).
Each lesson has been written with a specific lesson plan in mind:
{Based on the Effective Teaching Cycle (Rosenshine & Stevens;1986)}

GENERAL LESSON PLAN

REVIEW - of previous teaching of the concepts and skills

PRESENTATION - DIRECT TEACHING of new concepts or types of examples - direct teaching and explanation, including modelling of the process is required with more than one example. This involves a lot of teacher input and explicit modelling of how to work through the steps of finding answers to questions.

GUIDED PRACTICE - where students complete some part(s) on their own but teachers still closely monitor for errors and correct where necessary. Error correction should be immediate at this stage and should involve some explanation

INDEPENDENT PRACTICE - where students complete the work virtually independently. This section should involve very few errors, and explanations should be given only where necessary

**If students are making more than one or two errors in a passage please note this down and ring me if you feel you need to**

Some students may have some difficulties in completing the required work during the time allowed. Lesson presentation should be fairly fast paced - this is essential or the more capable students will be bored. Where problems arise due to the wide range of skills in the class, this will need to be discussed as soon as possible so that some solution can be worked out.

**Students who are competent and complete work before most of the class should be given extension activities including:
- writing their own right there questions using passages from books
- writing the answers to these questions
(Students can swap and answer each others)
- other activities like marking other students' work or helping others (need to monitor)

IT IS ESSENTIAL THAT ALL STUDENTS BE KEPT ON THE ONE LESSON
Feedback on the program is essential to further development. This feedback should also include comments on specific tasks, words in passages and the amount of work that has been included.

THE PROGRAM
This program gives students some useful ways of finding answers to questions by using a simple system of grouping all questions.

This system looks at both questions and answers.
Questions are grouped together if their answer comes from the same source.

This system includes three broad sources for answers:

<table>
<thead>
<tr>
<th>SOURCE 1: RIGHT THERE QUESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right There Questions are those where the answer is right there in one sentence.</td>
</tr>
<tr>
<td>There is only one correct answer to a Right There Question.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SOURCE 2: THINK &amp; SEARCH QUESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Think &amp; Search Questions are where the answer is in more than one sentence or the answer uses the story &amp; your thinking together to give a complete answer</td>
</tr>
<tr>
<td>There might be more than one complete and correct answer to a Think &amp; Search question.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SOURCE 3: ON MY OWN QUESTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>On My Own Questions are where the answer requires you to think of the answer on your own - there are few (sometimes no) clues in the story.</td>
</tr>
<tr>
<td>You need to think about what you already know about the topic and the story, and write an answer that fits in with both the story and what you already knew.</td>
</tr>
<tr>
<td>There can be more than one answer to On My Own questions</td>
</tr>
</tbody>
</table>

Even though there are these three sources of answers, sometimes it is difficult to tell which source you need to use to get the best answer. If you are good at finding answers, you can use all these sources to write
great answers and you can tell them apart easily.

The Question-Answer Relationship (QAR) Framework presented above describes the three basic types of QAR that are taught within the program.

While these are taught as separate and distinct entities initially, in reality, it can be difficult to determine exactly where a particular question should be placed in this framework.

Ultimately, this discrimination is NOT what the program is about - but initially, to get kids to use these three sources of information for answers, this is critical.

Upon beginning to write the program, it became evident that there were several subtypes for each of the QAR above. Different subtypes might ask the same question, be of the same "type" but be more or less difficult because of the words included in the actual question or the source used for arriving at the answer:

For example:

1. What was John holding?
2. Initially, what was John holding?
3. Before dinner, what was John holding?
4. What was John holding when he arrived?
5. When he arrived, what was John holding?
6. While he was standing in the pouring rain what was John holding?
7. Describe the item John was holding.
8. Outline the features of what John was holding.

In fact, all these questions may be asking the same thing - or they may be asking different things depending on what the story/passage includes. Positioning of the "wh____" word, the number of other words around it, the presence of another "wh____" word, may all distract the student from the question being asked and therefore affect the difficulty of the question. The program presents different QAR with what is considered to be the simplest form, (No. 1 above) through to more difficult forms.

Basically, it has been presumed that questions like No. 1 which are Right There in the one sentence (direct literal restatements) are the easiest types
of questions to answer and these are presented first in the program. Next, totally inferential questions are taught, using familiar topics that, it is hoped, students have substantial background knowledge in (Lesson 3).

Initially, students are provided with both the question and the inferential answer. All the student is required to do is to discriminate whether the answer is directly in one sentence of the story or whether the answer has come from the background knowledge of the reader/teacher.

In addition, the acceptability of multiple correct answers is introduced at this point. Within this lesson, it is critical that the teacher clearly specify for the students the "reasonableness" or "acceptability" of answers - this is done by providing answers that are and are not acceptable - rather than correct or incorrect, the use of terminology like "acceptable" or "unacceptable" means that answers are judged with reference to the passage/story rather than with reference to the correct answer that might be in the teacher's head. Students can be asked to justify their answer with reference to the story.

Often, students can give an answer that is partially correct - either they have used background knowledge (and the answer doesn't fit in with the story) OR they have used the story (and the answer doesn't fit in with background knowledge - what might usually happen). Rather than just marking this as an error - this is an important opportunity to teach - the teacher acknowledges the part of the answer that is acceptable, the student would receive a "half mark" but then the teacher should elaborate what the "better" answer would be.

On this basis, marking of answers to questions completed in Independent Practice is one of the most critical components of the program. It is important that the teacher "thinks aloud" their justification for giving a student full marks for an acceptable answer or no marks for an unacceptable answer (followed by modelling of a correct answer) or half marks for an answer that could be improved upon (followed by modelling of how this could be improved) - other students, not just the teacher, might provide this modelling of the improved answer and the justification as to why it is improved. Alternately, the student him/herself might be able to improve the answer with some prompting about the information source to use.
At each point where a new QAR type is introduced, students are given full and explicit demonstrations and examples and may only need to discriminate the QAR initially.

APPROPRIATE ADAPTATIONS
All instruction must be fast paced - for both oral and written tasks.

Despite this, there may be some lessons where too much work has been set for the time allowed. Teachers should note down which lessons are particularly long so that these can be shortened.

Alternately, it would be appropriate to work through some questions and answers orally rather than requesting students to write answers. Teachers must still include a reasonable amount of written practice or students will not improve on these skills.

PLEASE DON'T HESITATE TO RING ME AT ANY TIME - I WOULD REALLY LIKE THE FEEDBACK (02 - 9484 - 1764)

GOOD LUCK WITH THE PROGRAM
CONSTRAINTS ON IMPLEMENTATION

1. The program must be taught at least three times per week, hopefully four to five times per week. Unless students receive repeated instruction and practice at the rate of at least three lessons per week, gains in comprehension skills cannot be expected to occur.

2. Each lesson should not be continued for more than forty minutes maximum - hopefully, as teachers and students become familiar with the program, 30 minutes may be a reasonable time limit.

3. More competent students can be allowed to complete the independent practice section of the lesson without detailed teacher instruction, and can then move onto individual contract work, provided by the classroom teacher. Some examples of extension activities have been suggested above.

If students make more than one error on the independent practice questions, they may need to participate in explicit modelling of examples by the classroom teacher. Teachers should monitor closely the error rate of these more competent students.

4. Students experiencing difficulties with independent practice may require additional instruction and error correction, through additional lessons. If students make more than one error on independent practice please ring me for these additional examples.

5. Some students may require instruction to improve reading fluency accompanying this program. Again ring me for input and resources. strategies for this.

6. Keep all students on the same lesson each day.

7. Try to complete marking of independent story within the lesson, and at a fast pace. This can be used for correction and additional instruction.
READING COMPREHENSION PACKAGE

Gail Brown

A program for improving reading comprehension for use by classroom teachers.

Strategy Instruction and Techniques for Generalised Use in a range of curriculum areas and classrooms.
Acknowledgements

The development of the package would not have been possible without the support and advice of Greg and David. Additional thanks should go to Susan for her invaluable feedback on drafts of the strategies taught within the package and to the classroom teachers in Sydney primary schools involved in the doctoral research on which this package is based.

Designed Learning
Tailored Consultancy Support

This package provides detailed instructions and student workbooks for improving student performance in reading comprehension and reading fluency. These strategies are unique to this package and quite different from the type of instruction teachers have been using prior to this package. It is highly unlikely that teachers would have encountered these strategies in previous teacher training courses or courses in reading.

As a result, there may be experienced and effective classroom teachers who initially may need some additional support and advice in practical modifications of the package. This support will enable all teachers to better meet the individual needs of their students, and to tailor the package to fit their existing teaching philosophy, the their current classroom program and their school context.

Through a consultancy business, Designed Learning, the author provides this consultancy support to individual teachers, small groups of teachers or for schools.

Further information about consultancy support can be negotiated by contacting the author, through Designed Learning, on the following numbers:

Phone: 02 9484 - 1764 Fax: 02 9484 9602
(Leave a message if unattended)

ORDERING INFORMATION: An order form has been included in this second print run of this package. It is at the back of the final Student Workbook.

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**LESSON 1**

**PART 1 - FINDING WHAT TO LOOK FOR USING CLUE WORDS FROM THE QUESTION**

<table>
<thead>
<tr>
<th>CLUE WORD</th>
<th>SAMPLE QUESTION</th>
<th>WHAT TO LOOK FOR</th>
<th>ANSWERS (SAMPLES TO LOOK FOR)</th>
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</thead>
<tbody>
<tr>
<td>WHAT</td>
<td><em>What is Tim holding?</em></td>
<td>NAME (S)</td>
<td><em>Tim is holding a book.</em> (the cats, mum, a cake, toy, people, a house, the world, the men)</td>
</tr>
<tr>
<td>WHERE</td>
<td><em>Where is mum going? Where is the cat sitting?</em></td>
<td>NAME (S) OF A PLACE (S)</td>
<td><em>Mum is going home.</em> <em>(the river, Dubbo, the moon, Japan, floor, on the chair)</em></td>
</tr>
<tr>
<td>WHEN</td>
<td><em>When will we be going? When will dad be home?</em></td>
<td>TIME</td>
<td><em>We will be going at ten o'clock.</em> <em>(later, morning, soon, midnight, in a while, evening... till lunch, till one o'clock, till late)</em></td>
</tr>
<tr>
<td>WHY</td>
<td><em>Why is mum here? Why is Tim crying?</em></td>
<td>REASON(S) &amp; because</td>
<td><em>Mum is here because she has to pick me up.</em> <em>Tim is crying because he is sad.</em> <em>(because my eyes hurt, because I did the wrong thing, because I asked my friend)</em></td>
</tr>
</tbody>
</table>
Some questions are questions where the answer is **RIGHT THERE** in the story **In one sentence**. Most of the words in the question can be found in one sentence in the story. This sentence is the **whole answer to the question**. Other questions need more than one sentence in the story for the **whole** answer. We'll learn about these questions later.

**STEPS FOR FINDING A RIGHT THERE ANSWER**

1. Underline the words you need from the question. These words will be a part of your answer.

2. Circle the clue word that tells you what to look for. (Use the table to help you eg "What", "Where")

3. Find a sentence in the story that has the words from the question. The sentence might be anywhere in the story.

4. Underline these words & the rest of the sentence.

5. Read the question and read the underlined sentence again.

6. Ask yourself: Does the sentence answer the question? **AND** Is this the whole answer?
   * If YES, then go on to the next step.
   * If NO, look for information in another sentence(s).

7. **CHECK**: Ask yourself: Is this the whole answer? For **RIGHT THERE** questions, this will be **YES**.

8. Write the sentence for your answer.

9. **CHECK AGAIN**: Read your answer and question again: **THINK**: Is this the whole answer?
The mother cat is covered with soft, black and white fur.
The mother cat sits in the sun in the morning.
The mother cat is sitting on the mat.

**QUESTIONS AND ANSWERS**

Q1. What is the mother cat covered with?
A1. The mother cat is covered with soft, black and white fur.
   (Does this answer the question?)
   (Is this the whole answer?)

Q2. When does the mother cat sit in the sun?
A2. The mother cat sits in the sun in the morning.
   (Does this answer the question?)
   (Is this the whole answer?)

Q3. Where is the mother cat sitting?
A3. The mother cat is sitting on the mat.
   (Does this answer the question?)
   (Is this the whole answer?)
PART 3
Jane was getting out all her winter clothes. Jane was wearing lots of warm clothes in the cold weather. On her feet Jane was wearing warm woollen socks. Jane was wearing a red hat on her head. On top of her clothes Jane was wearing a thick black overcoat. Jane likes to put her hands into the coat pockets because it keeps them warm.

Questions and Answers
Q1. What was Jane getting out?
A1. Jane was getting out all her winter clothes.
(Does this answer the question?)____
(Is this the whole answer?)____

Q2. What was Jane wearing in the cold weather?
A2. Jane was getting out all her winter clothes.
(Does this answer the question?)____
(Is this the whole answer?)____

Q3. What was Jane wearing in the cold weather?
A3. Jane was wearing lots of warm clothes in the cold weather.
(Does this answer the question?)____
(Is this the whole answer?)____

Q4. What was Jane wearing on her feet?
A4. Jane was wearing black boots on her feet.
(Does this answer the question?)____
(Is this the whole answer?)____

Q5. What was Jane wearing on her feet?
A5. Jane was wearing warm woollen socks on her feet.
(Does this answer the question?)____
(Is this the whole answer?)____

Q6. What was Jane wearing on her head?
A6. Jane was wearing warm woollen socks on her head.
(Does this answer the question?)____
(Is this the whole answer?)____

Q7. What was Jane wearing on her head?
A7. Jane was wearing as red hat on her head.
Comprehension Strategy Instruction
(Does this answer the question?)
(Is this the whole answer?)

Q8. What was Jane wearing on top of her clothes?
A8. Jane was wearing a thick, black overcoat on top of her clothes.
(Does this answer the question?)
(Is this the whole answer?)

Q9. Where does Jane like to put her hands?
A9. Jane puts her hands in her pockets.
(Does this answer the question?)
(Is this the whole answer?)

Q10. Why does Jane like to put her hands in her pockets?
A10. Jane likes to put her hands in her pockets because it keeps them warm.
(Does this answer the question?)
(Is this the whole answer?)
## LESSON 2

### PART 1 - FINDING WHAT TO LOOK FOR
#### USING CLUE WORDS FROM THE QUESTION

<table>
<thead>
<tr>
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<td>WHAT</td>
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<td>NAME (S)</td>
<td>Tim is holding a book. (the cats, mum, a cake, toy, people, a house, the world, the men)</td>
</tr>
<tr>
<td>WHERE</td>
<td>Where is mum going? Where is the cat sitting?</td>
<td>NAME (S) OF A PLACE (S)</td>
<td>Mum is going home. The cat is sitting in the kitchen. (the river, Dubbo, the moon, Japan, floor, on the chair)</td>
</tr>
<tr>
<td>WHEN</td>
<td>When will we be going? When will dad be home?</td>
<td>TIME</td>
<td>We will be going at ten o'clock. (later, morning, soon, midnight, in a while, evening... till lunch, till one o'clock, till late)</td>
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<tr>
<td>WHY</td>
<td>Why is mum here? Why is Tim crying?</td>
<td>REASON(S) &amp; because</td>
<td>Mum is here because she has to pick me up. Tim is crying because he is sad. (because my eyes hurt, because I did the wrong thing, because I asked my friend)</td>
</tr>
</tbody>
</table>

ALL THESE QUESTIONS are questions where the answer is RIGHT THERE in the story IN ONE SENTENCE. Most of the words in the question can be found in one sentence in the story. This sentence is the whole answer to the question.
OTHER QUESTIONS need more than one sentence in the story for the WHOLE answer. We'll learn about these questions later.

**STEPS FOR FINDING A RIGHT THERE ANSWER**

1. Underline the words you need from the question. These words will be a part of your answer.

2. Circle the clue word that tells you what to look for. (Use the table to help you eg "What", "Where")

3. Find a sentence in the story that has the words from the question. The sentence might be anywhere in the story.

4. Underline these words & the rest of the sentence.

5. Read the question and read the underlined sentence again.

6. Ask yourself: Does the sentence answer the question? AND Is this the whole answer?  
   * If YES, then go on to the next step.  
   * If NO, look for information in another sentence(s).

7. CHECK: Ask yourself: Is this the whole answer?  
   For RIGHT THERE questions, this will be YES.

8. Write the sentence for your answer.

9. CHECK AGAIN: Read your answer and question again: THINK: Is this the whole answer?
Tammy and Jan were good friends. Tammy and Jan lived next door to each other. Tammy and Jan liked to play together in the mornings. Tammy and Jan were best friends because they liked the same things.

QUESTIONS & ANSWERS

Q1. Where did Tammy and Jan live?
   A1. Tammy and Jan were good friends.
       (Does this answer the question?)____
       (Is this the whole answer?)____

Q2. Where did Tammy and Jan live?
   A2. Tammy and Jan lived next door to each other.
       (Does this answer the question?)____
       (Is this the whole answer?)____

Q3. When did Tammy and Jan like to play?
   A3. Tammy and Jan liked to play together in the morning.
       (Does this answer the question?)____
       (Is this the whole answer?)____

Q4. Why were Tammy and Jan best friends?
   A4. Tammy and Jan were best friends because they liked the same things.
       (Does this answer the question?)____
       (Is this the whole answer?)____
Comprehension Strategy Instruction

PART 2
Find the answer to each question. Write the answer and write Yes or No to check your answer.

Tom and Jimmy were playing on the school oval.
Ben and Chris ran across the oval and joined in the game. All the boys were playing soccer. The boys were playing soccer after school.

QUESTIONS & ANSWER STARTERS

Q1. Where were Tom and Jimmy playing?
A1. Tom and Jimmy were.................................................................

.................................................................

(Does this answer the question?)___
(Is this the whole answer?)___

Q2. Where did Ben and Chris run?
A2. Ben and Chris ran.................................................................

.................................................................

(Does this answer the question?)___
(Is this the whole answer?)___

Q3. What game were all the boys playing?
A3. All the boys.................................................................

.................................................................

(Does this answer the question?)___
(Is this the whole answer?)___

Q4. When were the boys playing soccer?
A4. The boys were playing.................................................................

................................................................

(Does this answer the question?)___
(Is this the whole answer?)___
Mike plays the computer almost every day. Mike got a new game because it was his birthday. Mike likes to play this game on the fastest speed. Mike doesn't score many points on this game because he hasn't had it very long. Mike will score higher when he has played the game a lot of times.

QUESTIONS TO ANSWER
1. What does Mike play almost every day?
   Mike plays ...........................................................................................................
   ..........................................................................................................................
   (Does this answer the question?_____ Is this the whole answer?___)

2. Why did Mike get a new computer game?
   Mike got ............................................................................................................
   ..........................................................................................................................
   (Does this answer the question?_____ Is this the whole answer?___)

3. How does Mike like to play his new game?
   Mike likes to .......................................................................................................
   ..........................................................................................................................
   (Does this answer the question?_____ Is this the whole answer?___)

4. Why doesn't Mike score many points?
   ..........................................................................................................................
   (Does this answer the question?_____ Is this the whole answer?___)

5. When will Mike score higher?
   ..........................................................................................................................
   (Does this answer the question?_____ Is this the whole answer?___)
LESSON 3

STEPS FOR FINDING A RIGHT THERE ANSWER

1. Underline words in the question
2. Circle Clue Word
3. Underline sentence in the story
4. Read the question and the sentence
5. Does the sentence answer the question? Whole?
6. Check: Is this the whole answer?
7. Write your sentence answer.
8. Check again: Is this the whole answer?
OLD & NEW CLUE WORDS—Fill in the third column for the four clue words you know already!

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>WHAT</td>
<td>What is Tim holding?</td>
<td></td>
<td>Tim is holding a book. (the cats)</td>
</tr>
<tr>
<td>WHERE</td>
<td>Where is mum going?</td>
<td></td>
<td>Mum is going out. (river, Japan)</td>
</tr>
<tr>
<td>WHEN</td>
<td>When will we be going?</td>
<td></td>
<td>We will be going later. (morning)</td>
</tr>
<tr>
<td>WHY</td>
<td>Why is mum here?</td>
<td>b..................</td>
<td>Mum is here because she is.</td>
</tr>
<tr>
<td>WHO</td>
<td>Who is skipping? Who is at home?</td>
<td>NAME(S)</td>
<td>Tom is skipping. Dad is at home. (the cat, the men, birds, animals)</td>
</tr>
<tr>
<td>HOW</td>
<td>How will we get home? How will Pam make the cake?</td>
<td>WAY(S) or METHOD</td>
<td>We will get home in the car. (walk, by bus) Pam will make the cake with the mixer.</td>
</tr>
<tr>
<td>HOW MANY? HOW MUCH?</td>
<td>How many cakes do you want? How much is the car?</td>
<td>NUMBER OR AMOUNT (unit of measure)</td>
<td>I want five cakes. The car is one hundred dollars. (ten, one, a few, lots, lots of...)</td>
</tr>
</tbody>
</table>
PART 1 - McDoNALDS 1

Most children like to eat at McDonalds. McDonalds can be found on many busy roads in the city. People travel to McDonalds by car most of the time. Most children eat hamburgers and french fries at McDonalds. James likes to eat two hamburgers because he isn't full after one burger. Boys like to drink Coke with their hamburgers because Coke makes them burp. Girls love to eat ice cream sundaes for dessert at McDonalds. When they go to McDonalds, James' family eats seven hamburgers. The meal at McDonalds usually costs a lot of money.

QUESTIONS
Q1. Where do most children like to eat?

A1. Most children..............................................................
(Does this answer the question?___ Is this the whole answer?___)

Q2. How do people travel to McDonalds most of the time?

People travel..............................................................
(Does this answer the question?___ Is this the whole answer?___)

Q3. Where can McDonalds be found?

McDonalds can be ..............................................................
(Does this answer the question?___ Is this the whole answer?___)

Q4. How many hamburgers does James like to eat?

James..............................................................
(Does this answer the question?___ Is this the whole answer?___)

Q5. Why does James like to eat two hamburgers?

James..............................................................
(Does this answer the question?___ Is this the whole answer?___)

Q6. Why do boys like to drink Coke?

..............................................................
(Does this answer the question?___ Is this the whole answer?___)

EXTENSION QUESTIONS
Comprehension Strategy Instruction

Q7. Who likes to eat ice cream sundaes?

(Does this answer the question? ___ Is this the whole answer? ___)

Q8. How many hamburgers does James' family eat?

(Does this answer the question? ___ Is this the whole answer? ___)

Q9. How much does a meal at McDonalds cost for James' family?

(Does this answer the question? ___ Is this the whole answer? ___)

Q10. What do boys like to drink at McDonalds?

(Does this answer the question? ___ Is this the whole answer? ___)

Write a couple of sentences about WHAT you would like to eat at McDonalds and WHY you like to eat those things:

................................................................................................................

................................................................................................................

................................................................................................................

................................................................................................................
PART 3 - INDEPENDENT PRACTICE STORY
The mother kangaroo is covered with soft grey fur. Kangaroos have strong tails because strong tails help them jump fast. Kangaroos jump quickly through the bush when they see a person. Kangaroos jump away quickly and disappear because they are afraid of people. Some kangaroos are quite tame because they have been raised by people. People who raise tiny baby kangaroos to adult size often work in zoos or wildlife parks. Kangaroos do not usually jump away from humans when they have been raised by people. Instead, tame kangaroos jump toward people because they think they might get something nice to eat from the person.

QUESTIONS
1. What is the mother kangaroo covered with?
   1. ____________________________________________

   (Does this answer the question? ___ Is this the whole answer? ___)

2. When do kangaroos usually not jump away from people?
   2. ____________________________________________

   (Does this answer the question? ___ Is this the whole answer? ___)

3. Why do tame kangaroos jump toward people?
   3. ____________________________________________

   (___? whole answer? ___)

4. Where do people who raise baby kangaroos often work?
   4. ____________________________________________

   (___? ___?)

5. Why do kangaroos jump away quickly and disappear?
   5. ____________________________________________
6. Why do kangaroos have strong tails?

   ____________________________________________________________

   ____________________________________________________________

   __________?________

Draw a picture of a kangaroo with a joey in her pouch in the space below.

Write a sentences that tells about your whole picture:

   ____________________________________________________________

   ____________________________________________________________

   ____________________________________________________________

   ____________________________________________________________
LESSON 4  STEPS FOR FINDING A RIGHT THERE ANSWER

1. Underline _______ in the question

2. Circle C_____ W_______

3. Underline sentence in the story

4. Read the _____________ and the _____________

5. Does the sentence answer the question? Whole ?

6. Check: Is this the ______ answer?

7. ______ your sentence answer.

8. Check again: Is this the ______ answer?

CLUE WORDS**Fill in the last two columns:

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<td>WHERE</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>When will we be going?</td>
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<td>WHY</td>
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</tr>
<tr>
<td>WHO</td>
<td>Who is at home?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HOW</strong></td>
<td><strong>HOW WILL WE GET HOME?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>---------------------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td><strong>HOW MANY?</strong></td>
<td><strong>HOW MANY CAKES DO YOU WANT?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HOW MUCH?</strong></td>
<td><strong>HOW MUCH IS THE CAR?</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PART 1 - MORE ABOUT KANGAROOS**

The mother kangaroo has a baby kangaroo in her pouch. The mother's pouch is found right where her stomach is. The pouch is soft and warm inside because the baby kangaroo needs to be kept very warm. The mother kangaroo feeds her joey milk. The mother kangaroo lets the joey ride in her pouch because it will protect the joey from danger. In some areas of Australia, there are too many kangaroos. Farmers might get rid of the kangaroos by shooting several kangaroos each day. Sometimes, the kangaroos that are shot have baby joeys. These joeys whose mothers have died are the ones that might be raised in zoos.

**QUESTIONS**

1. Who has a baby kangaroo in her pouch?
   1. ______________________________________

2. What does the mother kangaroo feed her joey?
   2. ______________________________________

   ______________________________________
3. Why does the mother kangaroo let the joey ride in her pouch?
   3. ____________________________________________

   ____________________________________________

4. How might the farmers get rid of kangaroos?
   4. ____________________________________________

   ____________________________________________

   (___? whole answer?___)

5. How many kangaroos do farmers shoot each day?
   5. ____________________________________________

   ____________________________________________

6. Where is the mother's pouch found?
   6. ____________________________________________

   ____________________________________________

   (Does this answer the question?___ Is this the whole answer?___)

EXTENSION EXERCISE

Write two sentences OF YOUR OWN about WHAT a kangaroo is and WHERE a kangaroo and joey might be found:

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

Draw a picture about your sentences

PART 3 - INDEPENDENT STORY
Comprehension Strategy Instruction

Termites are called pests by most people because they can damage the wood in houses. Termites are vital to the Australian bush because they eat dead trees and rotting wood. Most Australian termites live in the bush. Termites make their nests in living trees and dead tree trunks. Termites eat dead wood, leaves and roots. The numbat feeds mainly on termites. The numbat uses its long sticky tongue to lick up the termites.

There are about 350 species of termite living in Australia. Only about 20 termite species eat the timber found in homes. The termite has been eating wood for millions of years. The termite's closest living relative is the cockroach. Not many people know that cockroaches and termites are alike.

QUESTIONS:
1. Why are termites called pests by most people?

1. ____________________________________________________________

___________________________________________________________

(Does this answer the question? __ Is this the whole answer? ___)

2. What do termites eat?

2. ____________________________________________________________

___________________________________________________________

(Check? __ ? __)
Comprehension Strategy Instruction

3. What animal feeds mainly on termites?
3. ________________________________ ________________________________ (Check? __ ? ___)

4. How many termite species eat the timber found in homes?
4. ________________________________ ________________________________

5. Who is the termite’s closest living relative?
5. ________________________________ ________________________________ (? __ ? ___)

6. Where do termites make their nests?
6. ________________________________ ________________________________

(Does this answer the question? __ Is this the whole answer? ___)

7. How does the numbat eat the termites?
7. ________________________________ ________________________________ (Check? __ ? ___)

EXTENSION QUESTIONS

8. How many people know that termites and cockroaches are alike?
8. ________________________________ ________________________________

9. Why are termites vital to the Australian bush?
9. ________________________________ ________________________________ (? ?)

10. How many species of termite live in Australia?
10. ________________________________ ________________________________

LESSON 5
**STEPS FOR FINDING THE ANSWER:**

1. U_____ _____ words in the _____ _____ .

2. _____ _____ the Clue Word

3. U_____ _____ sentence in _____ .

4. Read the _____ _____ and the _____ _____ .

5. Does the sentence answer the _____ _____ ? Whole answer?

6. Check: Is this the w _____ answer?

7. Write the sentence answer.

**REMEMBER - SO FAR WE'VE ONLY HAD ANSWERS THAT ARE**

**RIGHT THERE IN THE STORY IN THE ONE SENTENCE**
FILL IN THE SECOND COLUMN OF WHAT TO LOOK FOR THAT MATCHES THE CLUE WORD:

<table>
<thead>
<tr>
<th>CLUE WORD</th>
<th>LOOK FOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHAT</td>
<td></td>
</tr>
<tr>
<td>WHERE</td>
<td></td>
</tr>
<tr>
<td>WHY</td>
<td></td>
</tr>
<tr>
<td>HOW MANY</td>
<td></td>
</tr>
<tr>
<td>WHO</td>
<td></td>
</tr>
<tr>
<td>HOW MUCH</td>
<td></td>
</tr>
<tr>
<td>WHEN</td>
<td></td>
</tr>
<tr>
<td>HOW</td>
<td></td>
</tr>
</tbody>
</table>
PART 2 - STORY:
The Great Barrier Reef is the world's largest coral formations and is found off the coast of Queensland. The Great Barrier Reef is a natural wonder of the world because the coral and fish are not found anywhere else in the world. Many fish and other sea creatures live in and around the reef. Many tourists visit the reef. Tourists can travel to the reef by boat, by plane or by air. The Great Barrier Reef is made up of a collection of islands and reefs. The best time of year to visit the reef is around June or July. June and July are the best months because there are no heavy rains or fierce storms in those months. Tourists can stay overnight on these islands for about one hundred dollars per night. Package holidays can make the price go down to about sixty dollars for one night but tourists must stay for at least one week.

QUESTIONS:
1. Where is the Great Barrier Reef found?
   1. ____________________________________________________________
   (Does this answer the question? ___ Is this the whole answer? ___)

2. What is the Great Barrier Reef made up of?
   2. ____________________________________________________________
      ____________________________________________________________
   (Check? ?)

3. How can tourists travel to the reef?
   3. ____________________________________________________________
   ____________________________________________________________
   (Check? ?)

4. Why is the Great Barrier Reef a natural wonder of the world?
   4. ____________________________________________________________
   ____________________________________________________________

5. How much does it cost for tourists to stay overnight on the
Comprehension Strategy Instruction

islands?

6. When is the best time to visit the reef?
6. _____________________________

Does this answer the question? Is this the whole answer?

7. How much does it cost for one night if tourists can stay for at least one week?
7. _____________________________

EXTENSION EXERCISE

8. Draw a picture of one way tourists might travel to the islands

9. Write one of the sentences from the story and draw a picture for that sentence (CHECK: Does the picture tell about the sentence? Does the picture tell about the WHOLE sentence??)
The Christmas holidays had seemed really long to Jon. Jon knew that now the holidays were almost over. It was the week before school started when the new people in the street were first seen. The moving van arrived first at the house with the For Sale sign out the front. The house for sale was the biggest in the street and it would have cost a lot of money to buy. Next, the Smiths, the new people, drove up in their yellow car.

There were four people in the car. Jon knew that this was the new family moving into the street. Jon hoped that he would find a friend in this new family because he had been so lonely over the holidays. When the car pulled into the driveway, the family jumped out of the car and raced quickly inside because they wanted to see their new house. Jon watched the family run in. Jon was really pleased because one of the kids seemed to be a boy about his age.

The parents were your normal, average people. The Smiths were the kind of parents who keep you inside on a cold, chilly morning and always make you wear a hat on a sunny day. Mrs Smith was a tall lady with blond hair. Mr Smith was a short man with a bushy beard and a big smile.

Archie was a normal, ordinary boy as well. Archie wasn’t sure if he would find good times or bad times in this week before school. Before school started, Archie wanted to make some new friends. Archie saw a boy sitting on the grass at the house across the road. Archie had a good feeling about moving in to this new house because he saw that there was a boy about his age living nearby.

QUESTIONS
1. Where did the moving van arrive?
1. ________________________________________________________________

(Does this answer the question? __ Is this the whole answer? ___)

2. Who hoped he would find a friend in this new family?

2. ________________________________________________________________
Comprehension Strategy Instruction

2. ________________________________

(Remember to check? ?)

3. How did the Smiths get to the new house?
3. ________________________________

4. Why was Jon really pleased?
4. ________________________________

5. How many people were in the car?
5. ________________________________

6. When were the new people in the street first seen?
6. ________________________________

7. What kind of parents were the Smiths?
7. ________________________________

(Check? ?)

8. Why did Archie have a good feeling about the new house?
8. ________________________________
9. Why did Jon hope he would find a friend in this new family?

9.______________________________________________________________

_____________________________________________________________________

10. How much would the house that was for sale cost to buy?

10.______________________________________________________________

_____________________________________________________________________

11. Where was the boy Archie saw?

11.______________________________________________________________

_____________________________________________________________________

12. What did Mr Smith look like?

12.______________________________________________________________

_____________________________________________________________________
REVIEW

Complete this list of the steps for finding answers:

1. Underline ________________________________.

2. Circle ________________________________.

3. Underline ________________________________.

4. Read ________________________________ and ________________________________

5. Ask: ________________________________? AND ________________________________?

6. Check: ________________________________?

7. ________________________________

SOMETIMES THE CLUE WORD MIGHT NOT BE AT THE START OF THE QUESTION. For each clue word on the next page you need to fill in what to look for AND read carefully the example with the Clue Word NOT at the beginning of the question

Where do you find the answer to a RIGHT THERE QUESTION?

______________________________
Circle the clue word in each of the sample questions below AND Underline the words you would use in your answer:

<table>
<thead>
<tr>
<th>CLUE WORD</th>
<th>What to FIND</th>
<th>EXAMPLE - WITHOUT CLUE WORD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FIRST</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instead of a dog, what was Bill holding?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If dad is too young, why can he still play the game?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Since the car is broken, how will we get home?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In the morning, who will be sleeping in the big bed?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last night where did Tommy and Jane go?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>As the car broke down twice, when will the girls get home?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Before dad came home how many cakes had the boys eaten?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the special price was finished, how much will it cost?</td>
</tr>
</tbody>
</table>
PART 2 - NEW SOUTH WALES

***CIRCLE ALL the CLUE WORDS BEFORE you do anything***

New South Wales is a very large state. In New South Wales, most people live on the east coast. In New South Wales, the land can be very dry. Much of the west of New South Wales is desert and sandhills. There are not many animals in this dry land. In the desert, many animals live in the shade of rocks because it is cooler. A few animals live in caves. The desert and sandhills can be covered with nothing but grass. Gum trees might grow in places with more water. Red kangaroos that live in the desert like to stay in the shade of the gum trees. As the temperature is lower, lots of animals come out in the middle of the night to hunt for food. Another animal that lives in the desert is the lizard. People travel in their car quickly through the desert because it is so hot.

QUESTIONS

1. In New South Wales, where do most people live?

1. ____________________________________________________________

______________________________________________________________

(Does this answer the question? ___ Is this the whole answer? ___)

2. In New South Wales, what can the land be like?

2. ____________________________________________________________

______________________________________________________________

3. What type of land is much of the west of New South Wales?

3. ____________________________________________________________

______________________________________________________________

4. In the desert, where do many animals live?

4. ____________________________________________________________

5. Where do red kangaroos that live in the desert like to stay?
5. __________________________________________________________________________

______________________________________________________________________________

(? ?)

6. As the temperature is lower, when do lots of animals hunt?
6. __________________________________________________________________________

______________________________________________________________________________

7. In places with more water, what might grow.
7. __________________________________________________________________________

______________________________________________________________________________

8. What is another animal that lives in the desert?
8. __________________________________________________________________________

______________________________________________________________________________

9. Because it is hot, how do most people travel through the desert?
9. __________________________________________________________________________

______________________________________________________________________________

10. In the middle of the night, how many animals hunt for food?
10. __________________________________________________________________________

______________________________________________________________________________
Almost everyone in Australia loves going to the beach. If the weather is hot, people go to the beach because they want to cool down in the clear, blue water. If they do the wrong thing, the beach can be a dangerous place.

In the early mornings, the lifesavers arrive at the beach. The lifesavers’ first job very morning is to decide where they will place the yellow and red flags on their beaches. In any type of weather, it is the lifesaver’s job to look carefully at the beach and the waves. With lots of practice, lifesavers can tell which parts of the beach are dangerous for swimmers. Dangers in the water might be rips in the waves or sand banks that can collapse without warning. Sometimes, if the waves are too rough or there are bluebottles in the water, the lifesavers may close the beach.

If swimmers are between the flags, the lifesavers can more easily save them if they get into trouble. When tourists come to Australia from overseas, they might swim in dangerous places because they don’t know they should swim between the yellow and red flags. On planes coming into Australia and in hotels where tourists stay, there is now lots of information about safety on the beach. The information is in many different languages because tourists come from many different countries.
1. What is the lifeguards' first job every morning?

2. If the weather is hot, why do people go to the beach?

3. Why is the information in many different languages?

4. With lots of practice, what can lifeguards tell?

5. If the waves are too rough or there are bluebottles, what may lifeguards do?

6. Why have some tourists drowned?
7. If swimmers are between the flags, what can lifesavers do?

8. What colour are the flags on the beach?

9. In any type of weather, what is the lifesavers’ job?

10. What might be the dangers in the water?
REVIEW
Where do you find the answer to a RIGHT THERE QUESTION?

Complete this list of the steps for finding answers:

1. Underline ____________________________.

2. ______________________________________.

3. Underline ____________________________.

4. R _ _ _ ___________________ and ___________________________

5. Ask: ____________________________? AND
   ____________________________?

6. Check: ____________________________?

7. ______________________________________

THE CLUE WORD MIGHT BE ____________________________
OF THE QUESTION OR THE CLUE WORD MIGHT BE IN THE
M__________ OF THE QUESTION. You need to FIND the
C_____ W_______ BEFORE you can write your answer.
Circle the clue word in each of the sample questions below AND Underline the words you would use in your answer:

<table>
<thead>
<tr>
<th>CLUE WORD</th>
<th>What to FIND</th>
<th>EXAMPLE - WITHOUT CLUE WORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRST</td>
<td></td>
<td>Since the oven is broken, how will we get dinner?</td>
</tr>
<tr>
<td>Last year where did we travel for work?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instead of a bomb, what was Bill throwing?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the morning, who will be making in pancakes?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before mum came home how many lollies had the girls eaten?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the special show was finished, how long will it be till the next show?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If Jack is so young, why is he still allowed to fight like that?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>As the bus has broken down, how will the team get home from school?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PART 2 - SPIDERS

If people see a spider, they can be very scared of it. Usually, spiders don't hurt people unless they are disturbed. Because they have many enemies, spiders lay many eggs. Most normal spiders eat living insects and other spiders. Large spiders might eat worms and snails. In South America and Africa, some very large spiders can eat lizards and small birds. Unless they are upset, these large spiders do not attack humans.

For all types of spiders, their body is made of two parts. As well as having two parts to their body, all spiders have eight legs. Some spiders make webs out of silk. Once they have spun a web, these spiders catch their food in this sticky web. However, not all spiders use webs to catch their dinner. If they don't use a web, spiders might chase their food by chasing or by ambushing it.

QUESTIONS

1. As well as having two parts to their body, what do all spiders have?

2. If they see a spider, how do some people feel?

3. Once they have spun a web, what do these spiders use it for?

4. What do most normal spiders eat?

5. In South America and Africa, What do very large spiders eat?

PART 3 - STORY
Sue, Jill and Kate all had mountain bikes but they did not know which bike was the fastest. Sue, Jill and Kate decided the only way to see which was the fastest bike was to race them. As no one had much homework on that day, Sue, Jill and Kate chose Wednesday for the race. Sue, Jill and Kate met at Albert park. Since the three friends were racing, Sue's friend Samantha came along because the girls needed a starter and judge for the finish.

Samantha lined all the bikes up across the path at the start. For the whole race all three bikes went very fast and very close. At the finish Jill just made it over the finish line first. Kate and Sue came second together.

QUESTIONS: BEFORE YOU ANSWER - CIRCLE THE CLUE WORD FOR EACH THE QUESTION
1. What type of bikes did Sue, Jill and Kate have?
   1. ____________________________

2. How did Sue, Jill and Kate decide to see which was the fastest bike?
   2. ____________________________

3. As no one had homework, when did Sue, Jill and Kate choose to have the race?
   ____________________________

4. Since the three friends were racing why did Samantha come along?
   4. ____________________________

5. Where did Sue, Jill and Kate meet?
   5. ____________________________
EXTENSION QUESTIONS

6. For the whole race, how did the bikes go?

6. __________________________________________________________

7. What did Samantha do at the start?

7. __________________________________________________________

8. At the finish, who just made it over the finish line first?

8. __________________________________________________________

9. Who lined up the bikes at the start of the race?

9. __________________________________________________________

10. Where did Sue and Kate come in the race?

10. _________________________________________________________
LESSON 8
REVIEW OF FINDING THE ANSWER:

1. ___________ words in the ___________.

2. ___________ the Clue Word

3. ___________ sentence in ___________.

4. Read the ___________ and the ___________.

5. Does the sentence answer the ___________? Whole answer?

6. Check: Is this the w_________ answer?

7. Write the sentence answer.

Last lesson covered questions where the clue word was not at the beginning of the question.

Sometimes it can be even trickier than that: There might be two clue words in one question.

You need to figure out which one is the clue word you must use to tell you what to look for.

In some stories, these extra clue words may be in the story and may help you to find the answer - but in other stories these clue words will not be in the story. First, we'll look at examples With the Extra clue words in the story

Sometimes all the words from the question will be in the story - sometimes only some of the words will be in the story
This is a table with some examples - you need to circle the clue word that you will use to get your answer. And fill in the first two columns of the table - then underline the words you would use in your answer:

<table>
<thead>
<tr>
<th>CLUE WORD</th>
<th>What to FIND</th>
<th>EXAMPLE - WITHOUT CLUE WORD FIRST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>While he is going to school, where does Jim live?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When dad is older, why will he still want to play the cricket?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What will Bill have when he grows to be a man?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>While the sun was shining, how many fish did the boys catch?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How did we get home when the rain was falling?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When it gets late who will be in charge of the children?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When the storm was finished how many people had been hurt?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Who will clean up when the party is over?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In the next hour what will Tom be riding?</td>
</tr>
</tbody>
</table>
PART 2 - THE THREE BEARS

Mother Bear had made the porridge too hot. The three bears went for a walk because they wanted to wait for their porridge to cool off. While the bears were out, Goldilocks came to the bear's house. When nobody was home, Goldilocks went in.

When Goldilocks sat on Father Bear's chair, the chair felt too hard. When Goldilocks sat on Mother Bear's chair, the chair felt too soft. When Goldilocks sat on Baby Bear's chair, it broke.

Then, Goldilocks tried the Bear's porridge. When she tried Papa Bear's porridge she burnt her mouth because Papa Bear's porridge was too hot. Mama Bear's porridge was much too cold. When she tried Baby Bear's porridge Goldilocks loved it so much that she ate all of Baby Bear's porridge.

After she had eaten the porridge, Goldilocks felt sleepy. When she had tested all the beds, Goldilocks fell asleep in Baby Bear's bed. While Goldilocks was asleep, the Three Bears came home. The Three Bears found Goldilocks asleep in Baby Bear's bed. When Goldilocks woke up she screamed and jumped out of bed. The Three Bears thought Goldilocks was scared because she ran home as fast as she could.

QUESTIONS

1. Why did the three bears go for a walk?

2. When Goldilocks sat on Father Bear's chair, how did it feel?
3. After she had eaten the porridge how did Goldilocks feel?

4. Where did the Three Bears find Goldilocks asleep?

5. What happened when Goldilocks sat on Baby Bear's chair?

6. Why did the Three Bears think Goldilocks was so scared?

7. While Goldilocks was asleep who came home?

8. When she woke up what did Goldilocks do?

9. Who went into the house when no one was home?

10. Why did Goldilocks burn her mouth?
"THE SPEEDING DRIVER" - PART 1

When Susan was driving her old, loud, brown car, she decided to buy a new pink and purple car. Susan decided to buy the new car because the old car was making so much noise and looked very dirty. When Susan got the money out of the bank for the new car, she had no money left in the bank at all. But Susan loved the new pink and purple car so much that she didn't care about having no money.

While she was driving along in the new pink and purple car, Susan didn't notice she was going at 250 kilometres per hour. She didn't notice how fast she was going because the new pink and purple car was so quiet. The police wanted to give her a ticket for speeding but she didn't see them because she was going so fast.
1. Why did Susan decide to buy the new pink car?

________________________________________________________________________

________________________________________________________________________

2. When she was driving the old, loud, brown car, what did Susan do?

________________________________________________________________________

________________________________________________________________________

3. What did the police want to give Susan?

________________________________________________________________________

________________________________________________________________________

4. When Susan got the money for the pink car how much was left in the bank?

________________________________________________________________________

________________________________________________________________________

5. While she was driving the pink and purple car what didn't Susan notice?

________________________________________________________________________

________________________________________________________________________
LESSON 9

REVIEW OF FINDING THE ANSWER:

1. _____ _____ _____ words in the _____ _____ .

2. Circle the ___________________________

3. __________________ sentence .

4. ______ the _____ _____ and the _____ _____ .

5. Does the sentence answer the______________ ? Whole answer?

6. Check: Is this the _______ answer?

7. Write________________ answer.

LAST LESSON COVERED QUESTIONS WHERE THERE MIGHT BE TWO CLUE WORDS IN ONE QUESTION.

YOU NEEDED TO FIGURE OUT WHICH ONE IS THE CLUE WORD YOU MUST USE TO TELL YOU WHAT TO LOOK FOR.

REMEMBER:
IN SOME STORIES, THESE EXTRA CLUE WORDS MAY BE IN THE STORY AND MAY HELP YOU TO FIND THE ANSWER - BUT IN OTHER STORIES THESE CLUE WORDS WILL NOT BE IN THE STORY. FIRST, WE'LL LOOK AT EXAMPLES WITH THE EXTRA CLUE WORDS IN THE STORY

SOMETIMES _____ THE WORDS FROM THE QUESTION WILL BE IN THE S_______ - SOMETIMES ONLY _________ OF THE WORDS WILL BE IN THE STORY

THIS IS ANOTHER TABLE WITH EXAMPLES - CIRCLE THE CLUE WORD THAT YOU WILL USE TO GET YOUR ANSWER AND FILL IN THE TABLE & Underline the words you would use in your answer:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLUE WORD</td>
<td>What to FIND</td>
<td>EXAMPLE - WITH 2 CLUE WORDS</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>While he is going to holidays, where will Jim live?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When Tom is older, why will he still be a good runner?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What will Jane have when she gets to be a teenager?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>While the rain was falling, how many soccer games were played?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How did we get home when the river floods?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When it gets late who will be in charge of the dinner?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When the dance was finished how many people helped clean up?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Who will wash up when dinner is over?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For the next hour what will Sandy be doing?</td>
</tr>
</tbody>
</table>
A platypus is a small animal that is native to Australia. Even though it is not like a duck, a platypus has webbed feet and a bill. Except for its tail and its bill, a platypus is mostly covered with soft fur. A platypus has a flat tail which helps it to swim faster. When it uses its tail well a platypus can swim very fast.

While some live in rivers, a small platypus can live in a pond. When it is good at hunting, a platypus can catch and eat small fish, yabbies, worms, leeches and dragonflies. A playtpus doesn't have babies, it lays eggs. When a baby platypus is born, it comes from an egg. A platypus makes its home in a burrow under the ground. Sometimes, the entrance to the burrow can be under the water. When the entrance is underwater, the underwater entrance protects the platypus from its enemies.

(If you want you can draw a platypus here!?)
QUESTIONS

1. Even though it's not a duck, what does a platypus have?

2. What is a platypus mostly covered with?

3. When it swims fast, what does a platypus use?

4. When a baby platypus is born where does it come from?

5. Where does a platypus make its burrow?

6. When the entrance is underwater, what is the platypus protected from?
"THE SPEEDING DRIVER" - PART 2

When they finally caught up with Susan, the police fined her one thousand dollars for speeding so fast. When she tried to explain what happened, the policeman just laughed and told her that she should watch the speedometer in her car.

Susan was sent to jail because she didn't have any money to pay the fine. Before her mum came to pay the fine, Susan had spent three days in jail. When she saw her mum, Susan was so happy that she cried. She decided to sell the new pink and purple car because it had made her so unhappy. After she had been in jail, Susan bought a smaller yellow car that was a little more noisy because she thought that this would make her drive slower. When she was driving the new yellow car, Susan drove past the policeman and waved to him.

(You can draw a picture about the story here, if you have time?!)
1. How much did the police fine Susan for speeding?

2. When she saw her mum what did Susan do?

3. After she had been in jail, what did Susan do?

4. Why was Susan sent to jail?

5. Before her mum paid the fine how many days was Susan in jail for?

6. When she tried to explain, what did the policeman do?
LESSON 10

SOMETIMES YOU MIGHT NEED TO REMEMBER THE ORDER THAT THINGS HAPPEN IN DURING THE STORY TO ANSWER THE QUESTION.

SOME QUESTIONS MIGHT HAVE A DIFFERENT TYPE OF CLUE WORD THAT HELPS YOU KNOW THAT THE ORDER OF THINGS IS IMPORTANT TO YOUR ANSWER.

TWO OF THESE WORDS ARE: **BEFORE** & **AFTER**

SOMETIMES THE ANSWER WILL BE IN THE ONE SENTENCE. THE EXAMPLES YOU WILL DO FIRST WILL BE LIKE THIS.

FOR THESE EXAMPLES THE WORDS **BEFORE** & **AFTER** ARE IN THE QUESTION AND IN THE SENTENCE THAT IS YOUR ANSWER.

THE WORDS BEFORE AND AFTER MIGHT BE ANYWHERE IN THE QUESTIONS AND ANYWHERE IN YOUR SENTENCE ANSWER.
Comprehension Strategy Instruction

EXAMPLES OF QUESTIONS - only some have before & after:

CIRCLE BEFORE OR AFTER IN THE QUESTIONS BELOW:

1. Before we go home, what do we need to pack up?
2. Where will the boys go before they see the movie?
3. What did we see after the polar bear?
4. How will we get home when the car breaks down?
5. Before dinner, how much time is there?
6. What are the girls playing after school?
7. After we get up who will make the breakfast?
8. How many girls will be going if they find out the time we are leaving?
9. When it’s hot, how will we keep nice and cool?
10. Before it gets cold, what do the children put on?
11. Where are we going before we go to the pool?
12. When will Billy, Jane and Mary make the breakfast together?
13. Why are we going to the movies after we got so hungry?
14. After the fight, what did the boys decide to do?
15. Will the teacher be very angry after she gets no homework?
16. Before sunset, who will be leaving?
17. Where will the cattle be after they have had their calves?
18. Why has Thomas gone home before he has spent his money?
PART 2 - Little Red Riding Hood

Early one morning, her mother woke Little Red Riding Hood. Little Red Riding Hood had to leave right away because she knew it would take two hours to reach Grandma's house. Before she left, her mother gave Little Red Riding Hood a basket of food for her grandmother. While she was on her way through the woods, Little Red Riding Hood met a wolf. When Little Red Riding Hood was picking flowers, the wolf ran ahead to Grandmother's house. For the next hour Little Red Riding Hood played in the woods. Then Little Red Riding Hood walked the rest of the way to Grandma's house. When Little Red Riding Hood got to Grandma's, the wolf pretended that he was Grandmother.

After she opened the door, Little Red Riding Hood asked, "Why do you have such big teeth?"

After she had asked the wolf about his teeth, Little Red Riding Hood screamed because the wolf tried to eat her. When the wood cutter was chopping wood, he heard the scream. After he heard the scream, the woodcutter stopped chopping wood and ran to help. Running up with his axe, the woodcutter chased the wolf into the woods. When he came back to Grandma's, Little Red Riding Hood give him some tea and cake. The wolf ran far away. After the tea and cakes, the woodcutter went back to the woods to chop wood.
1. Before she left, what did her mother give Little Red Riding Hood?

2. While she was on her way through the woods who did Little Red Riding Hood meet?

3. After he heard the scream, what did the wood cutter do?

4. What did Little Red Riding Hood do after she asked the wolf about his teeth?

5. What did Little Red Riding Hood say after she opened the door?

6. What did the woodcutter hear when he was chopping wood?

PART 3 - BEFORE & AFTER QUESTIONS
No one has seen a Tasmanian Tiger for many years. Before any white settlers came to Tasmania, there was never a large number of Tasmanian Tigers. White settlers came to Tasmania after the First Fleet landed in New South Wales. The first white settlers to live in Tasmania used to kill Tasmanian Tigers because they thought that the Tasmanian Tigers would eat their sheep. Before they were all gone, Tasmanian Tigers looked a bit like dogs but had a longer tail like a kangaroo. Tasmanian Tigers had dark brown stripes that ran across their backs.

After they are born, female Tasmanian Tigers fed their babies milk. Female Tasmanian Tigers also had a pouch like a kangaroo. Female Tasmanian Tigers carried their babies in their pouches like a kangaroo does. After the baby grew larger, it might walk through the bush with its mothers. If an enemy was seen or heard, the baby would hop back in their mother’s pouch.

The pouch was like a kangaroo's but it opened towards the tiger's tail. The reason it opened towards the tiger's tail was because, if it opened toward the front, when the tiger was walking along sticks would get stuck in it. After Tasmanian Tigers were all gone, people realised how precious they were. If a Tasmanian Tiger were found today, everyone would try to protect it because no one has seen one for a long, long time.
QUESTIONS

1. What did female Tasmanian Tigers have that was like a kangaroo?

2. Why did the settlers kill Tasmanian Tigers?

3. After the baby grew larger, how did it move around?

4. How many Tasmanian Tigers were there before white settlers came?

5. When did baby Tasmanian Tigers hop back into their mother’s pouch?

6. What did Tasmanian Tigers look like before they were gone?

7. Who used to kill Tasmanian Tigers?

8. What did people realise after the Tasmanian Tigers were gone?

9. What did Tasmanian Tigers have that ran across their backs?
10. What do female Tasmanian Tigers feed their babies after they are born?

Could you draw a Tasmanian Tiger?
(If you can't, find a book and copy or trace one!?)
Circle the clue word you need from each sentence. (Be careful of tricks!) Fill in the clue word column and what you would look for. (Don't forget to circle before or after if these are in the sentence!)

<table>
<thead>
<tr>
<th>CLUE WORD</th>
<th>LOOK FOR</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>How many dogs do you have?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When you go out what will you see?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In the morning what will you wear?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Why will you ask mum when she gets home?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When dad goes out who will be in charge of the family?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>What will you have to do before mum gets home tomorrow?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How much will the cow cost when it is winter?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>When it is raining what will you wear on the way home?</td>
</tr>
</tbody>
</table>
ANOTHER CLUE WORD YOU MIGHT SEE IN A QUESTION IS **WHICH**

WHICH IS A TRICKY WORD BECAUSE YOU MUST LOOK AT OTHER WORDS AROUND WHICH TO HELP YOU FIND WHAT TO LOOK FOR.

<table>
<thead>
<tr>
<th>CLUE WORD</th>
<th>SAMPLE QUESTION</th>
<th>WHAT TO LOOK FOR</th>
<th>ANSWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHICH</td>
<td>Which colour was his hat?</td>
<td>Name - Colour</td>
<td>His hat was pink.</td>
</tr>
<tr>
<td>WHICH</td>
<td>Which boy was first in line?</td>
<td>Name - Boy</td>
<td>John was first in line</td>
</tr>
<tr>
<td>WHICH</td>
<td>Which way did the car go?</td>
<td>Name - way - road.....</td>
<td>The car went on Black Road.</td>
</tr>
<tr>
<td>WHICH</td>
<td>Which side do you cheer for?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WHICH</td>
<td>Which friend do you like best of all?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TRY THE NEXT STORY - BE CAREFUL - THERE ARE LOTS OF DIFFERENT TYPES INCLUDING **WHICH**!!!
PART 2 - TIME TRAVEL (EPISODE 1)
The time travel machine was invented in the year 2018. The time travel machine was invented by Dr Tom Banks. Dr Banks lived in Sydney, Australia. Dr Banks wanted to invent the time travel machine because he wanted to see what the future was like. Before the machine was invented many scientists had been trying for a long time the invent such a machine. No one really believed that Dr Banks had invented a machine that would travel through time. Reports in the newspapers made fun of Dr Banks after his invention was announced. When they heard about the invention, many people asked Dr Banks to prove that his machine could travel through time. Dr Banks decided to invite people to try out his machine. When he asked for volunteers, most people said that they were too scared to get into the machine. These people were afraid to see what would happen. Sam Sanders, a reporter, stepped forward and said that he would try out the machine. (To be continued)

QUESTIONS
1. Who invented the time travel machine?

2. Which reporter stepped forward to try out the machine?

3. Before the machine was invented, what had many scientists been trying to do?

4. How many people believed that Dr Banks had invented a
Comprehension Strategy Instruction

machine to travel through time?

5. When he asked for volunteers, what did most people say?

6. Why did Dr Banks want to invent the time travel machine?

EXTENSION QUESTIONS

7. When they heard about the machine, what did people ask Dr Banks to prove?

8. What did reports in the newspapers say?

9. Where did Dr Banks live

10. Which year was the time machine invented in?
The game of tennis was first played in France hundreds of years ago. When tennis was first played, two people would hit a ball to each other with the palm of their hand. After a while, players used pieces of wood and gloves with webbed fingers. Much later, people began to use racquets with strings that were like those used today.

In Australia, we have had many great tennis players over the years. With champions in both men’s and women’s tennis, Australia’s history in the game is one we should be proud of. Women like Margaret Court and Evonne Cawley have won many, many international tournaments. Pat Cash, John Newcombe and Tony Roche were great men players.

Today, we have a new young crop of champion tennis players. After training hard for many years, players like Alicia Molik, Leyton Hewitt, Mark Philippoussis’ and Pat Rafter can win tournaments and money. When they have played for a long time, some players become tennis coaches. Pat Cash is one of Mark Philippoussis’ coaches. Tennis coaches help players to play their shots better and to think carefully about the tactics of the game. If a player wins a game of tennis, their tactics might be very important. These tactics can include knowing the best and worst shots of your opponent and making your opponent run all over the court. When any player runs a lot, they get very tired and don’t play very well. John Fitzgerald coaches the players who represent Australia in the Davis Cup. The Davis Cup has mens teams from many countries that play each other.

QUESTIONS
1. If a player wins a game of tennis, what might be important?
2. When tennis was first played what did people do?

3. What do tactics include?

4. Which women players have won many, many tournaments?

5. When they have played for a long time, what do some players become?

6. What does the David Cup have?

7. Which player does Pat Cash coach?
8. After training for many years, what can players win?

9. Which man coaches the players who represent Australia in the Davis Cup?

10. Where was the game of tennis first played?

Can you draw a tennis racquet or a ball or a tennis court in the space below??
LESSON 12

CONNECTING DIFFERENT WORDS THAT STAND FOR THE SAME THING OR THINGS

Some questions will need to be answered by looking at MORE THAN ONE SENTENCE in the story. You might need to use parts of TWO OR MORE sentence to get the whole answer.

In stories that we read and write, we sometimes use different words to stand for the same thing/person or group of things/people. To understand what a story is about, we need to make sure we know ALL the words that stand for the same person/people/thing(s).

Some words will only stand for one of something (SINGULAR). e.g. he, she, it, her him. Some words only stand for more than one person/thing (PLURAL). e.g. they, them, we, these, those. Some words can stand for EITHER one or more things e.g. you.

<table>
<thead>
<tr>
<th>SINGULAR</th>
<th>PLURAL</th>
<th>EITHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>he, she, it, her, him</td>
<td>they, them, we, these, those</td>
<td>you</td>
</tr>
</tbody>
</table>
Some words can only stand for things that are alive e.g. he, she, her, him, we, you. Some words can stand for things that are alive and not alive e.g. it, they, them.

<table>
<thead>
<tr>
<th>ALIVE ONLY</th>
<th>EITHER ALIVE OR NOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>he, she, her, him, we, you</td>
<td>it, they, them</td>
</tr>
</tbody>
</table>

Some words can only stand for girls, women or FEMALES eg she, her, hers. Some words can only stand for boys, me or MALES eg he, him, his. Some words can stand for either males or females eg they, their, it, its, theirs, them.

<table>
<thead>
<tr>
<th>FEMALES</th>
<th>MALES</th>
<th>EITHER/BOTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>she, her, hers</td>
<td>he, his, him</td>
<td>it, they, their, its, theirs, them</td>
</tr>
</tbody>
</table>

It is possible that the same word can be used for different people or things in a story. It is also possible for lots of different words to be used for the one person or thing.

On the next page are lots of examples of these worked out for you.

READ through ALL these examples carefully and UNDERLINE the words that stand for the same thing WITH THE ONE COLOUR

On the following page are some EXAMPLES for you to work out.
EXAMPLES OF DIFFERENT WORDS THAT MIGHT STAND FOR
THE SAME PERSON(S)/THING(S) IN A STORY:

<table>
<thead>
<tr>
<th>SAMPLE SENTENCES</th>
<th>NAME</th>
<th>Other Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bill got a new bike. He liked to ride his bike.</td>
<td>Bill</td>
<td>He</td>
</tr>
<tr>
<td>Bill's mother had given the bike to Bill. It was shiny and new.</td>
<td>the bike</td>
<td>it</td>
</tr>
<tr>
<td>John has an ice cream and I want one as well.</td>
<td>an ice cream</td>
<td>one</td>
</tr>
<tr>
<td>Jane went for a walk. She found a dollar on the ground. She put it in her pocket.</td>
<td>Jane</td>
<td>She, her</td>
</tr>
<tr>
<td>Mary was in the garden. She was watering it(1) with the hose. Then, it(2) sprang a leak and water went everywhere.</td>
<td>Mary</td>
<td>She</td>
</tr>
<tr>
<td>Has the boat arrived? Yes. it has.</td>
<td>the boat</td>
<td>it</td>
</tr>
<tr>
<td>Bob and Jan got in trouble with their parents. They(1) had done the wrong thing. They (2) decided to punish them.</td>
<td>Bob and Jane</td>
<td>They (1), them.</td>
</tr>
<tr>
<td></td>
<td>Their parents</td>
<td>They(2)</td>
</tr>
</tbody>
</table>

PART 2 - You need to complete the table:
**SAMPLE SENTENCES**

<table>
<thead>
<tr>
<th>The boy was eating a hamburger. He was licking his lips and fingers. His sister wanted one too. She was hungry.</th>
<th>The boy hamburger His sister</th>
</tr>
</thead>
<tbody>
<tr>
<td>The mother dog had four puppies. She fed them milk. They were very noisy. She looked after them.</td>
<td>mother dog puppies</td>
</tr>
<tr>
<td>Bill, Jane and Tony all had thick jumpers. Jane was wearing her jumper. She had a yellow one. The boys had their jumpers on the table. They were too hot to wear them.</td>
<td></td>
</tr>
<tr>
<td>The teacher told the class to finish their work. She told them that they would have some free time when it was finished.</td>
<td>teacher class work</td>
</tr>
<tr>
<td>The boys have brought a soccer ball and a football to the park. They decided to play soccer because the ball was easier to kick and it wouldn't get lost.</td>
<td></td>
</tr>
</tbody>
</table>

**PART 3 - GOING TO THE BEACH!**

One day two families went on a picnic together. The Jones family lived near the beach. The Smith family lived further from the beach
but it was only a short drive away. They both decided that the beach would be a great place to go. The Jones family had a lot of gear that was just right for the beach because they lived so close. They owned a huge umbrella. It was big enough for everyone.

The Smith family packed enough food for everyone because the Jones' had filled their car with other gear. It was so full that they could hardly all fit in. The Smith's offered to take one of them in their car because they still had some room. The Jones' just managed to fit in their own car but it was really squasy.

THE FIRST THING YOU NEED TO DO IS TO DECIDE WHO OR WHAT EACH OF THE UNDERLINED WORDS STANDS FOR? THE STORY HAS BEEN SPREAD OUT SO THAT YOU CAN WRITE THIS ABOVE THE WORD TO HELP YOU REMEMBER.

(TO HELP: You can either underline in the same colour or highlight in the same colour the words that all stand for the same thing)
QUESTIONS:

1. Who owned a huge umbrella?

2. Why did the Smith family pack enough food for everyone?

3. Where did the Jones family live?

4. What did the Smith's offer to do?

5. Who decided the beach was a great place to go?

Draw a picture about something in the story?
Comprehension Strategy Instruction

PART 4- Extra Practice Story

(Remember to watch for words that stand for people or things!)

Tom Brown lived with his family in Blacktown. There were four people in the Brown family. It included Mrs Brown, Mr Brown, Tom and his sister, Jane. This family also included the dog called Denny. He liked to bury bones in the garden. Tom liked to do some things that his mum didn't approve of. She thought he should spend all his time studying for school.

His father was a little kinder. He thought that some of his son's time should be spent studying and some time spent playing. Tom liked playing with his best friend, Denny. His baby sister liked to play all the time. She didn't have to study and his mother didn't much care what she did. The only time mum got made was when she made a big mess with whatever she was doing.

Tom wished he was young like her because she didn't have to finish his schoolwork every night. The only time he seemed to be better off was when she had to go to bed early because she was so young. Tom's parents were very strict about when he went to bed as well. His bedtime was 8.30 pm on a school night.
QUESTIONS

1. Who didn't have to study every day?

2. What was Tom's bedtime on a school night?

3. Who thought he should spend all his time studying for school?

4. Why did Tom wish he was like his young sister?

5. What was the only time mum got mad?

6. What did Tom's father think he should spend his time doing?

7. Who did Tom like playing with?

8. When was the only time Tom seemed better off?

9. What was the family dog's name?
LESSON 13 - THINK AND SEARCH QUESTIONS

When answering questions, sometimes we might need to look in more than one sentence in the story to find the whole answer to the question. You might need to THINK and SEARCH to find the whole answer.

**STEPS FOR FINDING A THINK & SEARCH ANSWER**

1. UNDERLINE the words you need from the question. These words will be the start of your answer.

2. CIRCLE the clue word that tells you what to look for. (Use the table to help you eg "What", "Where")

3. FIND a sentence OR SENTENCES in the story that have these words. The sentence(S) might be anywhere in the story.

4. UNDERLINE these words & the rest of the sentence(S).

5. READ the question & the underlined SENTENCES/WORDS.

6. Ask yourself: CAN I WRITE A SENTENCE from these sentences OR from WORDS in these sentences that will answer the question? AND Is this the whole answer? * If YES, then go on to the next step.

   * If NO, then look for more information in another sentence.

7. CHECK: Ask yourself: Is this the whole answer? For RIGHT THERE questions, this will be YES. For THINK & SEARCH questions you will need to THINK:

   * IS THIS THE WHOLE ANSWER??
   * IS THERE ANYTHING ELSE IN THE STORY THAT MIGHT BE IMPORTANT??

8. Write the sentence for your answer.

9. CHECK AGAIN: Read the question & answer again: THINK: Is this the whole answer? If no, go back AND LOOK FOR SOME MORE CLUES IN THE STORY. If you are happy with this answer, go on to the next question. THINK & SEARCH questions can use different words to stand for the SAME person(s) or thing(s) - just like the last lesson.

SAMPLE STORY:
Comprehension Strategy Instruction

Jane went to the zoo last week. In the morning, she looked at the monkeys. At lunchtime, Jane watched the brightly-coloured parrots while she ate. Later, she saw the lions and the tigers.

FOR THE QUESTION:
What animals did Jane see at the zoo?

You need to know that the words "Jane" and "she" both stand for Jane.
You also need to know that the words "looked", "watched" and "saw" all stand for "seeing".

THE CORRECT WHOLE ANSWER IS:
Jane saw monkeys, parrots, lions and tigers at the zoo.
Ned Kelly was a famous bushranger. He was born just outside of Melbourne in June in 1855. His father was John Kelly. He was sent to Australia because he had committed crimes in England and he was an ex-convict. Many of Ned Kelly's family were found guilty of the sorts of crimes that Ned committed later. One of his uncles spent nine years in jail because of ten crimes he had committed.

Before he turned to crime, Ned Kelly was a good horseman, and a good shooter. He was also a good fighter. He was first charged with the crime of violently robbing people at the age of fourteen. Later on, he was charged the crime of stealing horses. Ned Kelly even spent some time in prison when he was still a teenager.

After he got older, Ned Kelly wore a metal helmet. He also wore a metal suit because he wanted to protect himself from the bullets which came from the policemen's guns. Before he had killed anybody Ned's friends thought that Ned Kelly was a hero. They thought that the police were unfairly picking on the Kelly family and blaming them for things that they didn't do. Other people thought that Ned Kelly was a robber because he stole money and goods from other people.

Some of these questions have hints (numbers) in them that tell you how many things/people make up the whole correct answer. These hints have been underlined.
1. In which year was Ned Kelly born?

2. Before he turned to crime, what three things was Ned Kelly good at?

3. Why was Ned Kelly's father sent to Australia?

4. After he got older, what two things did Ned Kelly wear?

5. Who thought the police were unfairly picking on the Kelly family?

6. Why did Ned Kelly wear the metal helmet and suit?
7. What two crimes was Ned charged with?

8. Why did one of Ned's uncles spend nine years in jail?

9. At the age of fourteen, what was Ned first charged with?

10. Why did people think Ned Kelly was a robber?

Draw a picture of Ned Kelly below?
PART 3 - Extra Practice Story NED KELLY - Episode 2

After he had stolen from many people, the police said that anyone who helped them to capture Ned Kelly would get a reward. The reward of $8,000 was set for any information about him or his gang that would lead to their capture. After many crimes, the police finally caught up with Ned Kelly and his gang. When they captured Ned Kelly, they tried to shoot Ned and the gang to get them to give up. In the end, they had to burn down the hut that the Kelly gang was hiding in. They had to burn it down because he would not come out and just kept on shooting them dead. Most of the men in Ned Kelly's gang were killed after the hut burnt down. Some were only injured and escaped. Others had run off long before the police arrived.

Before he was tried for his crimes, Ned Kelly had to travel by stagecoach to Melbourne. He also needed to travel by stagecoach because there was no other way to get to Melbourne. Ned Kelly was tried for the crimes he had committed. He had robbed many people. He had stolen horses and money. He had killed several people and some were policemen Ned Kelly had also murdered others. After the jury had heard the evidence they found that Ned Kelly was guilty of all the crimes. The judge sentenced him to hang because he was so upset about all the people who had been killed. He was hanged in Melbourne on November 11, 1880 because he had been found guilty of murdering many people.

REMEMBER: CHECK THAT YOU HAVE THE WHOLE ANSWER!
1. Who would get a reward for helping the police?

2. What things did the police do when they were trying to capture Ned?

3. How much was the reward for information about Ned Kelly and his gang?

4. Before he was tried, how did Ned travel to Melbourne?

5. What crimes was Ned tried for?

6. Why did the judge sentence Ned Kelly to hang?

7. When did the jury find that Ned was guilty?

8. What happened to the men in Ned Kelly's gang?
LESSON 14

RIGHT THERE QUESTIONS AND ON MY OWN QUESTIONS

RIGHT THERE QUESTIONS are questions where the answer is RIGHT THERE in the story. ALL the words used to make the question and the words used to make the answer are RIGHT THERE IN THE ONE SENTENCE. There is only ONE CORRECT ANSWER and it is in ONE SENTENCE THE STORY.

ON MY OWN QUESTIONS ARE QUESTIONS WHERE THE ANSWER IS IN YOUR HEAD. You need to add something you ALREADY KNOW about the story or the topic to make up your answer. THINK: I HAVE TO ANSWER THIS ON MY OWN

YOU WILL KNOW IF THE QUESTION IS ON MY OWN IF YOU SEARCH RIGHT THROUGH THE STORY AND DON'T FIND ENOUGH TO MAKE THE WHOLE ANSWER.

The question might have the words DO YOU THINK in it - these words mean you have to THINK of an answer that FITS IN with the story using what you ALREADY KNOW and SOME BITS from the story. ALL the words used to make the answer MIGHT NOT BE IN THE STORY.
Comprehension Strategy Instruction

There is MORE THAN ONE ANSWER - Each person might have a DIFFERENT ANSWER IN THEIR HEAD. The answer in your head MUST FIT IN with the story. You need to add something you ALREADY KNOW about the story or topic to make your answer.

SOME of the examples we do NOW will have the words DO YOU THINK to tell you the question is an ON MY OWN one.
OTHER examples will have NO CLUE in the question AND nothing in the story that matches BOTH the WORDS FROM THE QUESTION & THE CLUE WORD.

You might need to work ALL THE WAY THROUGH the steps for FINDING AN ANSWER before you figure out that the question must be answered ON MY OWN using just a couple of hints from the story.
Comprehension Strategy Instruction

STEPS FOR FINDING THE ANSWER TO A QUESTION

1. UNDERLINE the words you need from the question.

2. CIRCLE the clue word that tells you what to look for.
   (Use the table to help you eg "What", "Where")

3. FIND a sentence OR SENTENCES anywhere in the story.

4. UNDERLINE these words & the rest of the sentence(S).

5. READ the question & the underlined SENTENCES/WORDS.

6. Ask yourself: CAN I WRITE A SENTENCE from these sentences
   OR from WORDS in these sentences that will answer the question?
   AND Is this the whole answer?
   * If YES, then go on to the next step.
   * If NO, then look for more information in another sentence.

7. CHECK: Ask yourself: Is this the whole answer?
   For RIGHT THERE questions, this will be YES.
   For THINK & SEARCH questions you will need to THINK:
   *IS THIS THE WHOLE ANSWER??
   *Is there ANYTHING ELSE in the story that I might need to make the
   WHOLE ANSWER?

8. CHECK AGAIN: Read the question & answer again: THINK: Is this
   the whole answer? If no, go back AND LOOK FOR SOME MORE
   CLUES IN THE STORY. If you get the WHOLE answer, then this
   was a THINK & SEARCH question. If you are not happy, go to the
   next step.

9. IF YOU HAVE SEARCHED ALL THROUGH THE STORY and
   NOT FOUND ENOUGH to write THE WHOLE ANSWER. Then this
   is an ON MY OWN question - you must think about WHAT YOU
   ALREADY KNOW ABOUT THE TOPIC AND THE STORY and then
   MAKE UP an answer that FITS IN WITH BOTH OF THESE AND
   GIVES THE WHOLE ANSWER TO THE QUESTION.
PART 1 - RIGHT THERE AND ON MY OWN QUESTIONS
THE MOTHER CAT
The mother cat is covered with soft, black and white fur.
The mother cat is purring softly.
The mother cat has four kittens.

QUESTIONS AND ANSWERS
Circle if the question is RIGHT THERE OR ON MY OWN?
Q1. What is the mother cat covered with?
A1. The mother cat is covered with soft, black and white fur.
(Is the answer in the story?)
RIGHT THERE ON MY OWN
(If ON MY OWN - where did the answer come from?)

Q2. Why is the mother cat's fur so soft?
A2. The mother cat's fur is so soft because she licks it clean.
(Is the answer in the story?)
RIGHT THERE ON MY OWN
(If ON MY OWN - where did the answer come from?)

Q3. What is the mother cat doing?
A3. The mother cat is purring softly. (Is the answer in the story?)
RIGHT THERE ON MY OWN
(If ON MY OWN - where did the answer come from?)

Q4. Why is the mother cat purring softly?
A4. The mother cat is purring softly because she has just had a
drink of milk. (Is the answer in the story?)
RIGHT THERE ON MY OWN
(If ON MY OWN - where did the answer come from?)
PART 2 - RIGHT THERE & ON MY OWN

LITTLE RED RIDING HOOD

Her mother gave Little Red Riding Hood a basket of food for her Grandmother. Little Red Riding Hood met a wolf on her way through the woods.

The wolf ran ahead to Grandmother's house. The wolf pretended that he was Grandmother.

"What big teeth you have," said Little Red Riding Hood. Little Red Riding Hood screamed because the wolf tried to eat her, The woodcutter chased the wolf into the woods.

QUESTIONS AND ANSWERS

Q1. Who did Little Red Riding Hood meet on her way through the woods?
A1. Little Red Riding Hood met a wolf on her way through the woods. (IN THE STORY?)

RIGHT THERE ON MY OWN

Q2. Why did her mother give Little Red Riding Hood a basket of food for her Grandmother?
A2. Mother gave Little Red Riding Hood a basket of food for her Grandmother because Grandmother had a broken leg. (IN THE STORY??)

RIGHT THERE ON MY OWN

Q3. Why did Little Red Riding Hood ask about the wolf's teeth?
A3. Little Red Riding Hood asked about the wolf's teeth because the teeth looked shiny and white.

RIGHT THERE ON MY OWN
Q4. Why did Little Red Riding Hood scream?
A4. Little Red Riding Hood screamed because the wolf tried to eat her.

RIGHT THERE ON MY OWN

Q5. What do you think the woodcutter was doing?
A5. I think the woodcutter was picking flowers to give to his wife.

RIGHT THERE ON MY OWN

Q6. Where did the woodcutter chase the wolf?
A6. The woodcutter chased the wolf into the woods.

RIGHT THERE ON MY OWN

Q7. What happened to the wolf?
A7. The wolf came back the next day and ate Grandmother and the food. (STORY??)

RIGHT THERE ON MY OWN

If you have time, write one of the sentences from the story and draw a picture about that sentence.
RIGHT THERE & ON MY OWN - LIZARDS

Lizards are very common all over the world. Most lizards live on land. Lizards are covered with a strange type of skin. A lizard's skin looks very horny and is folded into scales. This scaley skin stops the lizard from losing water from its body.

Most lizards have four legs and can run quickly across the ground. The lizard's foot has five toes. Most lizards have a tail. Some lizards have tails that fall off when the lizard is attacked by an enemy. These lizards can grow a new tail to replace the tail that has fallen off.

QUESTIONS: Circle RIGHT THERE or ON MY OWN

Q1. Where are lizards very common?
A1. Lizards are very common all over the world.
RIGHT THERE ON MY OWN

Q2. What do lizards eat?
A2. Lizards eat insects, leaves and other lizards.
RIGHT THERE ON MY OWN

Q3. What colour is a lizard's skin?
A3. A lizard's skin can be green, brown, grey or other colours.
RIGHT THERE ON MY OWN

Q4. Describe what a lizard's skin looks like.
A4. A lizard's skin looks very horny and is folded into scales.
RIGHT THERE ON MY OWN

Q5. Why does a lizard have this scaley skin?
A5. This scaley skin stops the lizards from losing water from its
Comprehension Strategy Instruction

Q6. Where do lizards live?
A6. Lizards live under rocks, trees and in burrowed holes.

Q7. How many toes does a lizard's foot have?
A7. The lizard's foot has five toes

Q8. When does a lizards' tail fall off?
A8. Some lizards have tails that fall off when the lizard is attacked by an enemy.

Q9. What do lizards use their tails for?
A9. A lizard's tail is used to store fat that the lizards can live off when there is not much food.

Q10. What do these lizards do when their tail has fallen off?
A10. These lizards can grow a new tail to replace the tail that has fallen off.

Draw a picture of a lizard - make sure that the lizard has the right number of legs and toes!!!!
THREE QUESTION TYPES COVERED SO FAR ARE:

RIGHT THERE QUESTIONS - where the answer is RIGHT THERE in the story and in the ONE SENTENCE.

THINK & SEARCH QUESTIONS - where the answer is in the story in MORE THAN ONE SENTENCE

ON MY OWN QUESTIONS - where there is very little information in the story to make the answer. You need to think about what you already know from the story and the topic, and make up an answer that fits in with the story.

Over the next few lessons, we will cover different types of THINK & SEARCH questions. There might still be RIGHT THERE or ON MY OWN questions mixed in with the THINK & SEARCH questions.

You have already covered one type of THINK & SEARCH question where different words stand for the same thing. You have to THINK about which words in different sentences might stand for the same thing or person. These words or sentences might all form a part of your THINK & SEARCH answer.

This lesson will look at some more examples where different words stand for the same person or thing in the story. These words might be some of the words we have already covered but they might be other words as well.

Sometimes these words are called SYNONYMS. A synonym is a word with a similar meaning to another word eg mum & mother, sad & gloomy, happy & glad, fast & quickly, grass & lawn. You might use these words in your story writing to make your story more interesting.

SYNONYMS are words that mean ALMOST THE SAME THING.
REMEMBER: SYNONYMS are words that mean

TABLE 1 - Circle the word(s) in the second column that mean(s)

ALMOST THE SAME THING as the word in the first column.
(The first one has been underlined - be careful there might be more than one!)
(Maybe for the last space - you can think of a word and some synonyms for that word??!!)

<table>
<thead>
<tr>
<th>1. quiet</th>
<th>black</th>
<th>silent</th>
<th>boy</th>
<th>plane</th>
<th>elephant</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. big</td>
<td>large</td>
<td>girl</td>
<td>huge</td>
<td>sand</td>
<td>yellow</td>
</tr>
<tr>
<td>3. start</td>
<td>box</td>
<td>man</td>
<td>tree</td>
<td>time</td>
<td>begin</td>
</tr>
<tr>
<td>4. happy</td>
<td>car</td>
<td>glad</td>
<td>cheerful</td>
<td>paper</td>
<td>loud</td>
</tr>
<tr>
<td>5. stones</td>
<td>river</td>
<td>blue</td>
<td>rocks</td>
<td>pot</td>
<td>pebbles</td>
</tr>
<tr>
<td>6. small</td>
<td>book</td>
<td>tiny</td>
<td>chair</td>
<td>little</td>
<td>mini</td>
</tr>
<tr>
<td>7. sea</td>
<td>saltwater</td>
<td>rain</td>
<td>boat</td>
<td>ocean</td>
<td>man</td>
</tr>
<tr>
<td>8. lovely</td>
<td>yellow</td>
<td>book</td>
<td>pretty</td>
<td>nice</td>
<td>little</td>
</tr>
<tr>
<td>9. afraid</td>
<td>read</td>
<td>frightened</td>
<td>ship</td>
<td>scared</td>
<td>timid</td>
</tr>
<tr>
<td>10. cried</td>
<td>sobbed</td>
<td>smiled</td>
<td>sound</td>
<td>whined</td>
<td>whimpered</td>
</tr>
</tbody>
</table>
Using Synonyms in Sentences:
Write a synonym for the words in brackets in each sentence:
1. Susan put on a (lovely) ___________ dress to go out.
2. Tom picked up a (rock) ___________ and threw it.
3. Jane was already (afraid) ___________ of the (large) _______ dog.
4. The boy (cried) ___________ because he was lost.
5. The teacher was (angry) ___________ because the children were (talking) ___________.
6. The teacher (liked) ___________ to give awards for (good) _______ work.
7. Dad was mowing the (lawn) ___________ before it got too (hot) ___________.

Writing Some Synonyms of Your Own:
The first column has one word. You need to try to write some words that mean something similar in the second column. These words don’t have to mean exactly the same thing but they must be similar enough to stand for that word in a story. Try to write at least two words for each word in the first column.

<table>
<thead>
<tr>
<th>GIVEN WORDS</th>
<th>YOUR SYNONYMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. good</td>
<td></td>
</tr>
<tr>
<td>2. mother</td>
<td></td>
</tr>
<tr>
<td>3. walked</td>
<td></td>
</tr>
<tr>
<td>4. dog</td>
<td></td>
</tr>
<tr>
<td>5. looking</td>
<td></td>
</tr>
<tr>
<td>6. slowly</td>
<td></td>
</tr>
<tr>
<td>7. dirty</td>
<td></td>
</tr>
<tr>
<td>8. running</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
</tr>
</tbody>
</table>

(You have to write in the last two for yourself!)
Sometimes there might be one of these words in the story and the matching partner for that word in the question. You need to THINK what other words in the story mean something similar to the word that is used in the question. Below are some examples of these that are done for you and some you have to complete.

Sometimes, there might be more than one word in the story that might have a similar meaning to the word in the question. You need to think and use the other clues in the question to search for the correct answer. Some of these words might include examples like these:

(The underlined words stand for the same person or thing)

<table>
<thead>
<tr>
<th>SENTENCE IN THE STORY</th>
<th>QUESTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>John went to get a cake from the shop.</td>
<td>Where did the boy go?</td>
</tr>
<tr>
<td>Pam needed to get her maths textbook from her bag.</td>
<td>Which book did Pam get from her bag?</td>
</tr>
<tr>
<td>The wind was blowing gently through the trees.</td>
<td>How was the breeze blowing?</td>
</tr>
<tr>
<td>Dad was making the dinner.</td>
<td>What was father doing?</td>
</tr>
<tr>
<td>The family were silently watching the movie.</td>
<td>How quietly was the family watching the movie?</td>
</tr>
<tr>
<td>The girls were walking very quickly down the road. The boys walked slowly.</td>
<td>Who was walking swiftly down the road?</td>
</tr>
<tr>
<td>The puppies were all sleeping with their mother. The kittens were playing with balls of wool.</td>
<td>Which baby animals were with their mother?</td>
</tr>
<tr>
<td>The teacups were filled with hot water. The mugs were filled with coffee. The jugs were filled with milk.</td>
<td>Which cups were filled with coffee?</td>
</tr>
</tbody>
</table>
For the questions below, write a sentence that might be the answer in a story that uses a word of a similar meaning to the underlined word:
(The first one is completed for you)

<table>
<thead>
<tr>
<th>Question</th>
<th>Suggested Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which <strong>magazine</strong> did the girl buy?</td>
<td>The comic the girl bought was about dogs.</td>
</tr>
<tr>
<td>Whose <strong>mum</strong> would bring the cakes?</td>
<td></td>
</tr>
<tr>
<td>Which <strong>mutt</strong> had dug up the lawn?</td>
<td></td>
</tr>
<tr>
<td>When the sun <strong>went down</strong>, how many fish did the <strong>lad</strong> catch?</td>
<td></td>
</tr>
<tr>
<td>With the <strong>showers</strong> falling, which woman put up her umbrella?</td>
<td></td>
</tr>
<tr>
<td>Who had smashed <strong>mum's</strong> lovely vase while she was out?</td>
<td></td>
</tr>
</tbody>
</table>

The first column has a sentence written for you. In the second column write a sentence that has a similar meaning but put synonyms for the underlined words.
(If you don't know a word - read the rest of the sentence to figure out what it means OR look it up in the dictionary) (You can use more than one word for some of these if you want)

| The man who played a **trick** on the boy got all wet. |                                         |
| The children felt **ucky** and threw up **everywhere**. |                                         |
| The **tempest** was so **severe** that water was **falling heavily** from the sky. |                                         |
Comprehension Strategy Instruction

REVIEWING THE STEPS FOR FINDING THE ANSWER TO A QUESTION

1. UNDERLINE the words in the question.

2. CIRCLE the clue word.

3. FIND one (or more) sentences with these words OR OTHER CLUES LIKE SYNONYMS OR OTHER WORDS THAT STAND FOR THE SAME THING.

4. UNDERLINE these words.

5. READ the question and underlined parts

6. Ask: Can I WRITE A SENTENCE answer?

7. Ask: IS THIS THE WHOLE ANSWER?

8. WRITE the sentence answer.

9. Read the question & answer & CHECK: WHOLE ANSWER??

10. SEARCHED ALL THROUGH - STILL NEED MORE INFORMATION? Then use: what you know about the TOPIC & what’s in the story to MAKE UP an answer that FITS IN AND GIVES THE WHOLE ANSWER.

REMEMBER: SOMETIMES the WORDS in the QUESTION and the WORDS in the STORY might NOT MATCH EXACTLY - BUT they MIGHT MEAN THE SAME THING!!

REMEMBER: SOMETIMES ON MY OWN questions have the WORDS "DO YOU THINK" that tell you to answer the question "ON YOUR OWN". SOMETIMES "ON MY OWN" QUESTIONS will have NO CLUE in the STORY EXCEPT when you find NOTHING!!
PART 3 - THE RABBIT’S BURROW

(A burrow is a name for a rabbit’s home)

One day, there was a soft, grey mother rabbit who woke up because she was feeling very hungry. The mother decided to leave her warm burrow. The soft animal squeezed slowly out of the entrance to her cosy home. The baby rabbits were still asleep in the warm nest under the ground because it was very early in the morning. Mother rabbit left the safety of her home and hopped away. Rabbits usually build homes under the ground because it protects them from foxed and other animals that might eat them.

The mother rabbit hopped toward the road but couldn’t find anything. Then she went across the creek. Finally, she jumped through the fence into the farm.

She had hopped a short way when she found a field that was part of the farm. The farmer had planted lots of carrots in the field. The carrots were just right for eating. She dug up just a few of the tasty vegetables. She carried them carefully in her mouth back to the arm burrow.

In her cosy home, the baby rabbits were just waking up. When the babies woke up, they could smell the tasty carrots. The mother rabbit had squeezed carefully back into the hole and the carrots were waiting to be eaten. All the rabbits who lived in that cosy hole ate well that morning!

(You might like to draw a rabbit in her cosy burrow below?)
QUESTIONS

1. Why do rabbits usually build burrows underground?

2. When they woke up, what did the babies smell?

3. Why did the mother rabbit wake up early?

4. In what places did the rabbit look for food?

5. Why do you think the mother rabbit was so hungry?

6. How did the baby rabbits know there were carrots?
LESSON 16

A SYNONYM IS A WORD THAT

REVIEWING THE STEPS FOR FINDING THE ANSWER

1. U___________ the words in the question.

2. Circle___________________________.

3. _______ one (or more) sentences with these words or other clues like synonyms or other words that stand for the same thing.

4. ______________ these words.

5. Read the q___________ and underlined parts

6. Ask: Can I write a sentence answer?

7. Ask: is this the ________answer?

8. Write the sentence answer.

9. Read the q___________ & a_________ &CHECK: WHOLE ANSWER??

10. Searched all through - still need more information? Then use: what you know about the TOPIC & what's in the story to make up an answer that______________ and gives the ________ answer.

******************************************************************************

Remember: It's ok if you skip these and you are sure you have the right answer & the whole answer - if you're not sure - check using these steps!!!
PART 2 - HONEY POSSUMS & ECHIDNAS

A Honey Possum is a small animal with a long, thin nose. These small animals are not really possums. They are called possums because that's what they look like.

Echidnas are small native animals that live in the bush in Australia. They are covered with spikes all over. Echidnas eat ants and have long, sticky tongues that they put into the ants' nest to eat lots of ants. The possum has a long tongue with fine hairs on the end. They poke their long noses down into flowers with nectar in them. The fine hairs help it to eat the nectar from the flowers. These possums are found only in south western Australia because this place is where the large flowers with nectar can be found all year round. These flowers grow on Australian plants like banksias and gum trees. These small animals live in empty bird nests. Sometimes, they might live in hollow stems of trees.

QUESTIONS:

1. Where are honey possums found?

2. What does a honey possum have?

3. Are the honey possums really possums?
4. Why are honey possums only found in south western Australia?

5. What are echidnas covered all over with?

6. Why are these small animals called possums?

7. Where are two places that honey possums might live?

8. What do both these small animals have that is the same?

9. Why does an echidna have a long, sticky tongue?

10. What plant do the flowers that honey possums eat grow on?
LESSON 17 - GOING TO THE BEACH

It was the first day of the holidays. The five children all decided to go to the beach because it was such a nice sunny day. Tom and Glen wanted to go because they loved to surf. They spent all day every weekend surfing. Every afternoon the two boys would clean and wax their surfboards. James wanted to go because he enjoyed scuba diving. He had started to dive before he had started school. Whenever he went diving, he saw many different kinds of colourful and dangerous fish. His mother was always worried because she thought that one day he would get hurt by one of the sharks that he had seen. She also feared that he might get a cramp and not come up.

The two girls loved to watch the waves and swim in the saltwater pool at the beach. They would put up Kathy's umbrella to give some shade. Then they would put on lots of sunscreen because they didn't want to get sunburnt. Sometimes Cara and Kathy would go body surfing but not where the boys were surfing. They always swam between the yellow and red flags which the surf-lifesavers had stuck in the sand. The girls swam between the flags because they thought that the lifeguards knew more about the safest place to swim than they did because that's why they were lifesavers.

QUESTIONS
1. What were the names of the five children who decided to go to the beach?

2. What did Tom and Glen spend all day every weekend doing?

3. Which flags did Cara and Kathy always swim between?
4. When had James started to dive?

5. Every afternoon, what did Tom and Glen do?

6. How did the girls stop themselves from getting sunburnt?

7. Whenever he went diving, what did James see?

8. Why did the kids decide to go to the beach?

9. Why did Cara and Kathy swim between the flags?

10. What things did the girls do at the beach?

11. Who put up Kathy's umbrella?

12. What were two things James' mum worried about?
LESSON 18

REVIEW OF STEPS FOR FINDING THE ANSWER:
(some of the first few steps have been put together)

1. UNDERLINE words in the question & CIRCLE the clue word.

2. FIND sentences with these words(or words that have a similar meaning) in.

3. READ the question again

4. THINK: Can I write a sentence answer for this question?

5. CHECK: Is this the WHOLE answer? IF NOT, Think & Search some more.

6. CHECK AGAIN: Is this the WHOLE answer?

7. If the whole story has been checked, MAKE UP AN "ON MY OWN" ANSWER that FITS IN with the story and what you know about the topic.

******************************************************************************

Now that you have had lots of practice with this way, you might start to do some of these steps WITHOUT HAVING TO THINK ABOUT THEM. That's just GREAT, if you get the CORRECT ANSWER. If you start to make mistakes OR you are NOT SURE that your answer is correct, THEN USE THESE STEPS to MAKE SURE of your answer.

******************************************************************************

REMEMBER: Sometimes there might be DIFFERENT words with SIMILAR MEANINGS in the story and the question. When you are looking for your answer, you need to think about what the words in the QUESTION and the words in the STORY mean.

******************************************************************************
PART 2 - MORE PRACTICE WITH SYNONYMS- SIBERIAN TIGERS

The Siberian tiger is the largest member of the tiger family. These tigers live for about 15 years. Scientists have estimated that there are about 200 of these magnificent beasts left in the world. People have killed these tigers because they are afraid of them. Hunters have killed this wild animal for its beautiful coat. There are very few Siberian tigers left in the world.

The Siberian tiger lives in the ice land of Siberia. Because the Siberian tiger lives in places where the temperature falls well below freezing point, it has a much longer and thicker coat than any other tiger in the world. This tiger’s coat might also be a faded orange compared to other tigers. The fading of its coat helps to protect the tiger from its enemies because it blends in with the snow and ice where it lives. The tiger also grows a layer of fat on its stomach because this fat will keep it warm in the snow.

QUESTIONS:
1. How many Siberian tigers are left in the world?

2. Why does the Siberian tiger’s coat help to protect it?

3. What two reasons has this tiger been killed for?

4. What does the Siberian Tiger have that no other tiger in the world has?
5. Where do these wild animals live?

6. What do you think these tigers might eat?

7. Why does this animal have a longer, thicker coat that other tigers?

8. How long do these tigers survive for?

9. Why does the Siberian Tiger grow a layer of fat?

10. How do you think we can stop these animals from being killed?

Perhaps you can draw a Siberian Tiger in the space below?
LESSON 19 - MORE THINK & SEARCH QUESTIONS

REVIEWING THE STEPS FOR FINDING AN ANSWER
1. UNDERLINE words in the question & CIRCLE the clue word.

2. FIND sentences with these words or SYNONYMS (words with a similar meaning) or CLUE WORDS like AND, ALSO, AS WELL AS...

3. 

4. THINK: Can I write a sentence answer for this question?
5. CHECK: ____________________________?
   IF NOT, ______________________________

6. CHECK AGAIN: Is this the WHOLE answer?
7. If the whole story has been checked, ____________________________
   ____________________________ with the story and what you know about ____________________________.

******************************************************************************

REMEMBER: Look for CLUES like SYNONYMS & words like AND, ALSO, AS WELL AS, IN ADDITION TO
******************************************************************************
Another type of THINK & SEARCH questions might use some other CLUE WORDS that tell you that different parts in the story go together to make the WHOLE ANSWER. These CLUE WORDS might include:

and  also  in addition  along with  as well as

ALL THESE CLUE WORDS might tell you that whatever follows goes with something else that was in the story that was in the story before.

Below are some examples where these words have been used. In each example, these NEW CLUE WORDS have been underlined:

<table>
<thead>
<tr>
<th>Example</th>
<th>Meaning &amp; Whole Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tom went to the park.</td>
<td></td>
</tr>
<tr>
<td>Mary went <strong>along with</strong> Tom.</td>
<td>The words &quot;along with&quot; tell us that Mary went to the park with Tom. If the question were:</td>
</tr>
<tr>
<td></td>
<td>Who went to the park?</td>
</tr>
<tr>
<td></td>
<td>The WHOLE answer would be:</td>
</tr>
<tr>
<td></td>
<td>Tom and Mary went to the park.</td>
</tr>
<tr>
<td>Sharon was making some cakes. She also made some pies.</td>
<td>The word &quot;also&quot; tells us that Sharon made both cakes and pies. For the question: What did Sharon make? The WHOLE answer would be: Sharon made cakes and pies.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>(Who is &quot;She&quot;?)</td>
<td></td>
</tr>
<tr>
<td>The lion was sleeping in the shade. The cubs were sleeping in the shade as well.</td>
<td>The words &quot;as well&quot; tell us that the WHOLE answer to the question: Who was sleeping in the shade? The lion and the cubs were sleeping in the shade.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>The red parrots were flying through the trees. The sparrows were flying along with the parrots.</td>
<td>The words &quot;along with&quot; tell us that the WHOLE answer to the question: Who was flying through the trees? will be????</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Dad was washing the car. He used hot soapy water. Also, he used a sponge. On the really dirty parts he used an old rag as well. Dad also used a special cloth to wipe the streaks off the window.</td>
<td>Can you tell the WHOLE answer to the question: What did Dad use to wash the car? (Remember who &quot;he&quot; stands for???)</td>
</tr>
</tbody>
</table>

These NEW Clue Words with similar meanings are _______________
PART 1 - Story about KIWIS

Kiwis are small strange birds that come from New Zealand. These birds live on the North Island of New Zealand. They also live on the South Island. Kiwis don't look much like birds because they don't seem to have wings or a tail. In addition, their feathers look a lot like hair rather than the feathers of other birds. Along with this, kiwis don't fly.

Kiwis have a very good sense of smell because they have very acute nostrils at the end of their beak. As well, kiwis have a very good sense of hearing and a very fine sense of touch. These senses help the kiwi to find food to eat.

Draw or copy a picture of a kiwi in the space below.
QUESTIONS

1. What do kiwi feathers look like?

2. Why don't kiwis look much like birds? (use 3 sentences)

3. Where do kiwis come from?

4. What senses help kiwis find their food? (use 2 sentences)

5. Why do kiwis have an excellent sense of smell?

6. Where do kiwis live? (use 2 sentences)

7. Do you think a kiwi could live in the Australian bush? Why or Why not?
LESSON 20 - PRACTICE WITH THINK&SEARCH QUESTIONS
JASON'S BIG PARTY

When Jason was turning 13 years old, he decided to have a huge party because he was finally becoming a teenager. He wanted to invite all his relatives. Also, he wanted to ask lots and lots of his friends. As well, he was really keen to ask all his friends in the football team. His mum had said that it was okay to invite lots of people. She hoped that it would be a fine night because not many of the guests would fit into their house and everyone would get wet if it rained.

Jason wanted to have a party with heaps of great food. He also longed to have loud music because all his friends loved to dance. Jason asked his mother to buy lots of food. He told her to buy hot dogs, roast chicken and potato chips. He told her to buy some really delicious cakes as well. Along with the food, he asked his mum to buy plenty of soft drinks because his friends would get really thirsty when they were dancing. When she came home with everything, he helped her unpack the car and carry all the things inside.

Finally, the big night came. The guests all started to arrive around eight o'clock. Jan and Peter turned up first. Jenny, Sue and Tom arrived along with them. As well as those five, six of Jason's football team appeared at the door. During the party everyone had a great time. The music was louder than anyone had ever heard before. All the neighbours had been invited because Jason's mum didn't want anyone to be upset by all the noise.
At the end of the night, even though he was very tired, Jason helped his mum to clean up the party mess. He returned the chairs that had been borrowed. He also threw all the used cups and paper plates in garbage bags. In addition, Jason helped to put as much of the leftover food as he could in the refrigerator. Along with all this, he had to return the tapes and CD's to people who had loaned them to him for the party. He thought he would leave this till the next morning because it was so late. Even though he was so tired, Jason decided he had had such a great time that he would ask his mum if he could have another party next year.

**QUESTIONS ABOUT JASON'S PARTY**

1. Why were all the neighbours invited to the party?

2. Why did Jason's mum hope that it would be a fine night?

3. When his mum came home, what did Jason help her with?

4. Who were all the people to arrive first to the party?

5. Why do you think Jason's mum might not want to have another party?
6. What were all the things Jason had to help with at the end of the party?

7. Why did Jason decide to have a party?

8. What did Jason ask his mum to buy for the party?

9. Why did Jason leave returning the tapes and CD’s till the next morning?

10. Who did Jason want to invite to his party?
LESSON 21
REMEMBERING ALL THE CLUES TO LOOK FOR IN THE
QUESTION AND IN THE STORY
The CLUES to look for in a question and in a story will MEAN THE
SAME THING in both the story and the question.
BUT the CLUES might not be EXACTLY THE SAME WORDS.
You need to REMEMBER all the different types of clues to look for.

TYPES OF CLUES TO REMEMBER are:
1. EXACTLY MATCHING WORDS
2. DIFFERENT WORDS THAT STAND FOR THE SAME WORD
   Examples: they, she, it, he, you..........................
3. WORDS THAT HAVE SIMILAR MEANINGS (SYNONYMS)
4. WORDS THAT TELL YOU THINGS ARE TOGETHER
   Examples; and, along with, .........................
MAKE SURE YOU CHECK FOR ALL THESE CLUES
MAKE SURE YOU HAVE THE WHOLE ANSWER

REMEMBER: When you are looking for your answer, you need to
think about what the words in the QUESTION and the words in the
STORY really MEAN. Putting some steps together is fine but
make sure you check for all the types of clues!!!
DIFFICULT WORDS IN STORIES

Sometimes there might be words in a story that you can't read, that you haven't read before or that you don't know the meaning of. These words make it hard for you to understand the story or to answer questions about the story. If you don't know what a word in the story means, then you can't tell whether it might be a CLUE WORD for finding an answer to a question or not.

You should make sure you know what **all the words** in a story MEAN. If you don't know what a word means, you can try some different ways BY YOURSELF or WITH OTHER PEOPLE that can help you FIND OUT what the word means:

1. **Keep reading through the story** - try to figure out what the word means by looking at the other words around the word you don't know. Try to figure out if **another word** you know (maybe a word in the story) has a **similar meaning** to the word you don't know.

2. **Check if the book has a list of special words** - Some books have a list of special or difficult words at the start of a chapter or section. Other books might have a section at the beginning or end with these words. This section might be called the **GLOSSARY** or **KEY WORDS** or something else.

3. **Ask someone near you** - maybe someone can tell you the meaning of the word that you don't know - maybe if they say the word you might know it?

4. **Look up the word in a dictionary** - Find the word in the dictionary and read the meaning for that word. If there is more than one meaning, you must THINK which fits in with the story you are reading.

5. **Look up the word in another book on that topic** - you might find another book on that topic that has the meaning of that word.
PART 2 - CORAL REEFS

SPECIAL WORDS FOR THIS STORY

colyp - a very tiny animal which lives in a coral reef.
skeleton - bones of an animal whether alive or dead.
reproduce - have babies.
algae - seaweed

A coral reef is not made of rock. It is made of millions and millions of polyps. Also, it is made of millions and millions of skeletons of polyps that lived in the reef over the years but have died. The reef is sometimes said to be alive because it is always growing and changing as polyps reproduce and die. As well, the reef is made of special seaweeds called algae, that also form part of the reef when they die.

The huge reef is really like a group of underwater hills that are covered with a thin layer of living polyps instead of grass. It is this thin layer that shows all the brilliant colours that divers on the reef see. The rest of the hill is made up of skeletons and remains of dead polyps and seaweed.

Different types of polyps live in different parts of the reef. Some polyps can only live where there is some sunlight shining through the water. These polyps form the hard parts of the reef. Where the coral is white, these polyps were once alive but have now died. This white coral has no live polyps. Where there is no sunlight, far beneath the sea, other types of coral grow. This coral is much softer and looks more like the branches of a tree.(NOTICE that in the second paragraph, the writer used something most people know about, "hills" and "grass", to help explain what the reef is like.)
QUESTIONS

1. When the polyps are alive, what is the coral like?

2. Why is the reef sometimes said to be alive?

3. What is the coral reef made of?

4. What is the coral like that grows where there is no sunlight?

5. Where the coral is white, what are the polyps like?
LESSON 22

TYPES OF CLUES TO REMEMBER are:

1. EXACTLY M_____________ WORDS
2. DIFFERENT WORDS THAT _______________ THE SAME WORD

Examples: they, ..............................................

3. WORDS THAT HAVE ___________________ (SYNONYMS)
4. WORDS THAT TELL YOU THINGS ARE ______________

Examples: ..............................................

REVIEW OF STEPS FOR FINDING THE ANSWER:

1. UNDERLINE words in the question and CIRCLE the clue word.
2. FIND sentences with
   * MATCHING WORDS
   * WORDS THAT STAND FOR THE SAME THING
   * WORDS WITH A SIMILAR MEANING
   * WORDS THAT PUT THINGS TOGETHER

3. READ the question again

4. THINK: Can I write a sentence for this question?

5. CHECK: Is this the WHOLE answer? If not Think&Search more.

6. CHECK AGAIN: Is this the WHOLE answer?

7. If the whole story has been checked, and you don’t have the WHOLE answer, MAKE UP AN "ON MY OWN" ANSWER that FITS IN with the story and what you know about the topic.
WAYS TO HANDLE DIFFICULT WORDS IN STORIES:

1. KEEP

2. CHECK IF THE BOOK HAS A

This section might be called the G_______ or K____
WORDS or something else.

3. ASK

4. L________ the WORD in a _______________. If there is more than one meaning, you must __________ which fits in with the story you are reading.

5. LOOK UP THE WORD IN ANOTHER ________________.
MAKE SURE YOU KNOW WHAT MOST OF THE WORDS MEAN OR YOU WON'T BE ABLE TO ANSWER A QUESTIONS ABOUT THAT STORY!!!

PART 2 - AUSTRALIAN CORAL REEFS

SPECIAL WORDS (Can you remember some?)

polyp - a very tiny _________ which lives in the coral _________.
skeleton - _________ of an animal whether alive or dead.
vivid - very brightly coloured.
algae - _________
reproduce - have _________.
flourescent - glowing
incandescent - brilliant, bright, glowing

REMEMBER what you can do if you don't know OTHER WORDS!

Write below which of the three of the difficult words have s similar meaning to each other?
Most people in the world know of the Great Barrier Reef. It is found off the north east coast of Queensland in Australia. Fewer people know of the smaller coral reefs that can be found off the western coast of Western Australia. While these reefs are smaller than the Great Barrier Reef, they are just as colourful and full of life. One of these reefs is called Rowley Shoals.

Many brightly coloured sea creatures live in the coral reefs off the Australian coasts. The grouper is a large fish that lives in the Great Barrier Reef. At Rowley Shoals, the potato cod and the parrot fish are found. Potato cod can sometimes seem to attack people because it can grab the diver’s flipper, hand or another part of their body in its mouth. These fish are feeling this part of the diver because they want to try to find out what the diver is. If the diver stays calm, the potato cod will feel these parts of the diver. And, then, it will usually let the diver go without harming him or her.

In addition, there are many other smaller fish that have quite vivid skins. Along with the bright colours of the living polyps, these small fish make the reef seem even more colourful. Some of these fish can be fluorescent pink, incandescent purple or vivid blue. As well, others might have dark black markings or spots that make these colours seem even brighter. In addition to fish, there are many sea snakes, starfish, dugong and sharks that live in and around the reefs. Also, above the water, there are large numbers of birds that live on the fish in the reef.
QUESTIONS

1. Where, in Australia, in the Great Barrier Reef found?

2. What is the name of one of the smaller reefs in Australia?

3. What animals live in and near a coral reef?

4. Which types of fish might be found at Rowley Shoals?

5. Why do potato cod grab parts of divers in their mouth?
LESSON 23

REVIEW OF CLUES TO REMEMBER:

1. EXACTLY _________________________________

2. Different words that ________________________________
   Examples: _________________________________

3. Words that have a __________ MEANING
   (__________)
   Examples: _________________________________

4. Words that tell things are __________________________
   Examples: _________________________________

******************************************************************************

REMEMBER CHECK FOR _____ OF THESE CLUES!!
******************************************************************************

REVIEW: WAYS TO HANDLE DIFFICULT WORDS IN STORIES

1. Keep ______ through the ______ -(Use other words in the story).

2. Check for a ________________ - (Glossary or Key Words or Index).

3. A__________________________ - (or Try to say is yourself).

4. Use a D______________ - (choose meaning that FITS IN with story).

5. Use another _____ on that _____ - (an easier book on the subject).
A CLOSER LOOK AT WORDS IN QUESTIONS

Sometimes, questions might have different words in them that mean almost the same thing as a question you know. Questions might seem to be different but are asking the SAME THING using DIFFERENT WORDS WITH A SIMILAR MEANING (SYNONYMS).

You need to THINK which of the questions you know mean something SIMILAR to the question you have to answer.

You need to THINK CAREFULLY because you have to figure out EXACTLY WHAT THE QUESTION IS ASKING SO THAT YOU KNOW WHAT YOU NEED TO LOOK FOR IN THE STORY to help you write a SENTENCE to answer the question.

You need to think about SYNONYMS (words with similar meanings) in BOTH THE QUESTIONS and the STORY to make sure that you find the WHOLE ANSWER for the question that was asked.

This lesson will look at some questions you already know and other questions that have a SIMILAR meaning.

Read all these examples CAREFULLY - you might think of other questions you know that have a similar meaning.

THINK: What do I need to look for to answer all these questions?
1. Circle the **clue word** in Column 1

2. **Underline** the words in the Column 2 that have a similar meaning to what the Column 1 Question is asking.

(The first few on what something looks like is done for you)

<table>
<thead>
<tr>
<th>KNOWN QUESTION</th>
<th>QUESTIONS with SIMILAR MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>What does something look like?</td>
<td>Describe something.</td>
</tr>
<tr>
<td></td>
<td>How does something <strong>appear</strong>?</td>
</tr>
<tr>
<td></td>
<td>What are the <strong>characteristics</strong> of...?</td>
</tr>
<tr>
<td></td>
<td><strong>Specify the image</strong> of something.</td>
</tr>
<tr>
<td></td>
<td>Identify the appearance of...........?</td>
</tr>
<tr>
<td></td>
<td>What are the details of how it looks?</td>
</tr>
<tr>
<td></td>
<td>Illustrate the appearance of ...........?</td>
</tr>
<tr>
<td></td>
<td><strong>Outline the figure(form) of...........</strong>?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WHEN DID SOMETHING HAPPEN?</th>
<th>AT WHAT TIME.......?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>What hour did something occur?</strong></td>
</tr>
<tr>
<td></td>
<td>During which period did..............?</td>
</tr>
<tr>
<td></td>
<td><strong>What was the time when..............?</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WHERE DID SOMETHING HAPPEN?</th>
<th>IN WHAT PLACE did..............?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At which location (site) was..............?</td>
</tr>
<tr>
<td></td>
<td>In which area(locality) did this occur?</td>
</tr>
<tr>
<td></td>
<td><strong>What spot(position) was..............?</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WHO DID SOMETHING?</th>
<th>WHICH PERSON (boy, girl)..............?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>What character did...........................?</strong></td>
</tr>
<tr>
<td></td>
<td>Who played the role of .............?</td>
</tr>
<tr>
<td></td>
<td><strong>Which individual (guy, woman)......?</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HOW WAS SOMETHING DONE?</th>
<th>WHICH METHOD did you use to..............?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In what manner did you perform....?</td>
</tr>
<tr>
<td></td>
<td><strong>What action(s) did you use to...........?</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Which plan(procedure) did you try..?</strong></td>
</tr>
<tr>
<td></td>
<td><strong>What routine(techniques) was used?</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Which process operated to...........?</strong></td>
</tr>
</tbody>
</table>
### PART 2 - FIGURING OUT WHAT TO LOOK FOR

Circle the CLUE WORD(s) in each question & write what to look for:

<table>
<thead>
<tr>
<th>QUESTION ASKED</th>
<th>LOOK FOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>At which place did the fire take place?</td>
<td></td>
</tr>
<tr>
<td>In the end what plan of attack did the army use?</td>
<td></td>
</tr>
<tr>
<td>How did the bushwalker appear after being lost?</td>
<td></td>
</tr>
<tr>
<td>What time of year do we usually have a picnic?</td>
<td></td>
</tr>
<tr>
<td>By which process was the rock changed?</td>
<td></td>
</tr>
<tr>
<td>Which character was the girl?</td>
<td></td>
</tr>
<tr>
<td>On Sunday, which position in the team did Sue play?</td>
<td></td>
</tr>
<tr>
<td>Illustrate the characteristics of the leader.</td>
<td></td>
</tr>
<tr>
<td>During which time of day did the robbery occur?</td>
<td></td>
</tr>
<tr>
<td>Describe the old tiger after the fight.</td>
<td></td>
</tr>
<tr>
<td>What area of the coast are penguins found?</td>
<td></td>
</tr>
<tr>
<td>Specify the plan for building a yacht.</td>
<td></td>
</tr>
<tr>
<td>When it was dark which person was outside the hut?</td>
<td></td>
</tr>
<tr>
<td>Who played the role of the child in Home Alone?</td>
<td></td>
</tr>
<tr>
<td>Over a period of time, which process is at work?</td>
<td></td>
</tr>
<tr>
<td>Identify the expression on the baker's face.</td>
<td></td>
</tr>
<tr>
<td>What is the habitat of the wombat like?</td>
<td></td>
</tr>
<tr>
<td>Although he was working at home, what time did Tom leave?</td>
<td></td>
</tr>
<tr>
<td>In which locality will the doctor be found?</td>
<td></td>
</tr>
</tbody>
</table>
LESSON 24 - USING THESE DIFFERENT QUESTIONS IN A STORY

REVIEW

TYPES OF CLUES TO REMEMBER are:

1. EXACTLY M____________________ WORDS

2. DIFFERENT WORDS THAT ___________________ THE SAME WORD

Examples: they, ..............................................

3. WORDS THAT HAVE ______________________ (SYNONYMS)

4. WORDS THAT TELL YOU THINGS ARE _____________

Examples; .....................................................

REVIEW OF STEPS FOR FINDING THE ANSWER:

1. UNDERLINE words in the question and CIRCLE the clue word AND THINK ABOUT THE MEANING OF THE QUESTION

2. FIND sentences with

   * MATCHING WORDS
   * WORDS THAT STAND FOR THE SAME THING
   * WORDS WITH A SIMILAR MEANING
   * WORDS THAT PUT THINGS TOGETHER

3. READ the question again AND THINK: Can I write a sentence for this question?

4. CHECK: Is this the WHOLE answer? If not Think&Search more.

5. CHECK AGAIN: Is this the WHOLE answer?

6. If the whole story has been checked, and you don't have the WHOLE answer, MAKE UP AN "ON MY OWN" ANSWER that FITS IN with the story and what you know about the topic.

7. REMEMBER TO THINK & CHECK: WHAT IS THE QUESTION ASKING ME TO LOOK FOR?
PART 2 - DIFFERENT TYPES OF QUESTIONS WITH A STORY

THE TREEHOUSE
Jason and Tom wanted to build a treehouse. There was a great gum tree in Jason's backyard. The boys thought it would be perfect for a treehouse because its branches were thick and strong. The tree, also, had good footholds that made it easy to climb up. These footholds were made from knots in the wood where old branches of the tree had been cut off. The gum was really old and big. It was so big that it shaded Jason's house in summer and winter.

Lots of different birds visited the gum tree to eat the nectar in the gumnut flowers. The birds also ate insects on the tree. Native animals had been seen by Jason and his dad at night time. Possums, even snakes, had been spotted climbing through the top of the tree.

Jason said that he would like to build the house in the middle section of the tree because it would be protected from bad weather. Another good reason why it should be in the middle of the tree was that the animals and birds usually stayed near the end of the tree. Also, the branches were stronger near the trunk.

The boys built the treehouse in small sections which they had to get up into the tree somehow. They used a long, strong rope which they tied one end to the section they had built. Then, they threw the other end up over one of the strong branches near the trunk. Next, Jason would push the part of the house into the right spot so that he could hammer nails through it into the trunk. When he was sure that section of the treehouse would not fall, he carefully untied the rope and dropped it down to Tom.

The boys worked hard and, after three weeks, the treehouse was finished. They wanted to spend the night in the treehouse. Both their mums were a little bit worried about this because they didn't know whether the treehouse might fall down. Also, they didn't know how cold it would get at night. Finally, their mums agreed......
QUESTIONS ABOUT THE TREEHOUSE

1. Provide details about the tree the boys used for their treehouse.

2. What method did the boys used to build the treehouse?

3. In which area of the tree did the boys build their house?

4. Why did they build the treehouse in that part of the tree?

5. When the boys finished the house, what did they want to do?

6. What animals might be found in the gum tree?
7. Describe the feelings of the mums about what they wanted to do.

8. Outline some reasons for these feelings.

9. What might happen when they stay in the house at night?

10. For what period of time did the boys work to build the treehouse?
LESSON 25 - A NEW TYPE OF THINK & SEARCH

REVIEW OF CLUES TO LOOK FOR:

1. EXACTLY MATCHING WORDS TO THE QUESTION

2. DIFFERENT WORDS THAT STAND FOR THE SAME THING
   Examples: 

3. Words that have a SIMILAR MEANING (______________)
   Examples: 

4. Words that tell things are TOGETHER
   Examples: 

5. WORDS IN QUESTIONS THAT HAVE A SIMILAR MEANING
   Example for Where: place, area, position, locality, ______________
   Example for What something looks like: ________________________

REVIEW: WAYS TO HANDLE DIFFICULT WORDS

(THIS MIGHT INCLUDE WORDS IN QUESTIONS OR STORIES)

1. __________________________

2. __________________________

3. __________________________

4. __________________________

5. __________________________

Another type of THINK & SEARCH questions might include the use of a word that stands for a GROUP OF THINGS OR PEOPLE.

You might find that this word is included in the words in the story OR you might need to make up the word from the things or words
that are in the story.

FIRST, we'll look at stories where the GROUP CLUE WORD is stated in the story. LATER, we'll look at stories where you must MAKE UP THE GROUP NAME from the things or people or words in the story.

Below, there are some examples of GROUP NAMES and the things that belong in each group. The first table has been completed for you - maybe you can think of some to add to the group members section? In the table on the next page, you might need to fill in EITHER the Group Name or Names of things that belong in that Group.

<table>
<thead>
<tr>
<th>GROUP NAME</th>
<th>GROUP MEMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>family</td>
<td>mum, dad, sister......</td>
</tr>
<tr>
<td>fruit</td>
<td>apple, banana,......</td>
</tr>
<tr>
<td>boys (by name)</td>
<td>Tom, John,...........</td>
</tr>
<tr>
<td>plants</td>
<td>trees, flowers, bushes...........</td>
</tr>
<tr>
<td>toys</td>
<td>trucks, dolls, lego.....</td>
</tr>
<tr>
<td>homework</td>
<td>maths, spelling........</td>
</tr>
</tbody>
</table>
Can you think of two Group Names and the things in that group??

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Group Members</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REMEMBER: A GROUP NAME MIGHT BE USED INSTEAD OF A LIST OF NAMES OF THINGS OR PEOPLE

**********************************************************

A GROUP NAME IS LIKE A SYNONYM FOR ALL THE MEMBERS OF THE GROUP IS STANDS FOR

**********************************************************

USING GROUP NAMES IN SHORT PARAGRAPHS
Sometimes in a paragraph or a story, you will find the Group Name directly stated in the story. You might be asked a question directly about the Group Name (the Group Name might be one of the Clue Words in the question) OR you might be asked a question that needs the Group Name in the answer but doesn't have the Group Name in the question.
FIRST, we'll look at examples where the Group Name is in the story. (In some examples, the sentence with the Group Name is underlined)
EXAMPLE 1
Boys like to play with toys. Boys like to play with cars. They love to play with blocks. Boys, also, like to play with lego. Boys like to play with planes. Boys, sometimes, like to play with dolls. Boys like to play with bikes.
QUESTION: What do boys like to play with?

IF YOU WERE TO WRITE THE ANSWER:

"Boys like to play with planes."

THAT ANSWER WOULD BE ONLY PARTLY CORRECT

{ALL the sentences in the story (EXCEPT FOR ONE) would be partly correct}
THE BEST ANSWER WOULD BE:

"Boys like to play with toys."

BECAUSE "toys" IS THE GROUP NAME FOR ALL THE THINGS IN THE STORY THAT WE ARE TOLD BOYS LIKE TO PLAY WITH.

YOU MIGHT WRITE:

"Boys like to play with cars, blocks, lego, planes, dolls and bikes."

BUT INSTEAD OF LISTING ALL THE SEPARATE THINGS, YOU CAN USE THE GROUP NAME FOR ALL THOSE THINGS.

EXAMPLE 2

Seagulls like to eat fish. Kookaburras like to eat snakes and lizards. Magpies like to eat worms and fruit. Birds like to eat a variety of things.

QUESTION: What do birds like to eat?

YOU MIGHT WRITE: "Birds like to eat worms." BUT THAT WOULD ONLY BE PARTLY RIGHT - IT'S NOT THE WHOLE ANSWER

IN THIS EXAMPLE, THERE ARE TWO GROUP NAMES:

Fill in the Group Names, used in the story, in the table below:

<table>
<thead>
<tr>
<th>Things in the Story</th>
<th>Group Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seagulls, Kookaburras, Magpies</td>
<td></td>
</tr>
<tr>
<td>fish, snakes, lizards, worms, fruit</td>
<td></td>
</tr>
</tbody>
</table>
PART 2 - ANSWERING QUESTIONS USING GROUP NAMES

THE EXCURSION
On Tuesday, year 5 were going on an excursion. All the students in year 5 had to arrange a special way to get to school on Tuesday because they had to leave very early. Jane arranged to go to Susan's house. Jane and Susan were then going to walk together as quickly as they could. Allan asked his dad to give him a lift to school on his way to work. Josh told his mum she would need to drive him to school early that day because he lived too far away to walk. Tom and Danny decided to catch an early bus that would drop them to school before the time to leave for the excursion. All year 5 were really excited about the excursion!

QUESTIONS

(BE CAREFUL: Only some of these need you to use Group Names!)
1. How were Jane and Susan going to get to school for the excursion?
2. Why did Josh's mum have to drive him to school that day?

________________________________________________________________________

3. What did all the students have to organise on Tuesday?

________________________________________________________________________

4. How did the pupils feel about their excursion?

________________________________________________________________________

5. Who arranged to catch an early bus on Tuesday?

________________________________________________________________________
LESSON 26 - MORE PRACTICE WITH GROUP NAMES

REVIEW OF CLUES TO LOOK FOR:

1. EXACTLY MATCHING WORDS TO THE QUESTION

2. DIFFERENT WORDS THAT STAND FOR THE SAME THING
   Examples: ____________________________________________

3. Words that have a SIMILAR MEANING (_______________)
   Examples: ____________________________________________

4. Words that tell things are TOGETHER
   Examples: ____________________________________________

5. WORDS IN QUESTIONS THAT HAVE A SIMILAR MEANING
   Example for Where: place, area, position, locality, __________
   Example for What something looks like: _______________

6. WORDS IN QUESTIONS OR IN SENTENCES THAT HAVE GROUP NAMES

REMEMBER: Sentences with Group Names might be ____________ in the story. Some stories might NOT have any sentences with Group Names - you might need to THINK and write a Group Name ON YOUR OWN by using the things listed in the story or a word in the question.

*********************************************************************************

Sometimes, the question might ask for the MAIN IDEA, the MAIN THING, the MOST IMPORTANT THING or IDEA - ALL THESE TYPES OF QUESTIONS are asking for a GROUP NAME to be in the WHOLE answer to the question.
REVIEWING THE STEPS FOR FINDING AN ANSWER

1. UNDERLINE the words in the question

2. CIRCLE the clue word (THINK about the Question's meaning)

3. FIND one (or more) sentences with these words OR other CLUES like SYNONYMS, OTHER WORDS that stand for the same thing or that tell you things go together, OR GROUP NAMES(including Main Idea or thing or Most Important thing)****.

4. UNDERLINE these words.

5. READ the question and underlined parts.

6. Ask: Can I WRITE A SENTENCE answer?

7. Ask: IS THIS THE WHOLE ANSWER?

8. WRITE the sentence answer.

9. Read the question (Check: what do I need to look for?) & Read the answer & CHECK: WHOLE ANSWER??

10. SEARCHED ALL THROUGH - NEED MORE INFORMATION? Then use: what you know about the TOPIC & what's in the story to MAKE UP an answer that FITS IN AND GIVES THE WHOLE ANSWER.

******************************************************************************

REMEMBER: A GROUP NAME MIGHT BE USED INSTEAD OF A LIST OF NAMES OF THINGS OR PEOPLE
******************************************************************************
A GROUP NAME IS LIKE A SYNONYM FOR ALL THE MEMBERS OF THE GROUP IS STANDS FOR

EXAMPLE 1 (Can you underline the sentence with the Group Names?)

Sandy likes to play tennis. Jane loves to play cricket. Girls like to play many different sports. Jessie likes to play softball. Mary enjoys playing indoor soccer.

QUESTION: What do girls like to do?

YOU MIGHT WRITE: Girls like to play tennis and soccer.

BUT THAT WOULD ONLY BE PART OF THE ANSWER - NOT THE WHOLE ANSWER.

Fill in the Group Names and Group Members from this story:

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Group Members in this story</th>
</tr>
</thead>
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</table>

Write the BEST (WHOLE) answer to: What do girls like to do?

______________________________

REMEMBER: If the story has a sentence with a Group Name, this sentence might be ________________ in the story.

SOMETIMES, the story might NOT have a sentence with a Group Name - you might need to THINK of a Group Name for the things that are listed in the story.
REMEMBER: Questions that ask for the Most I ____________ thing are asking for a Group Name in the WHOLE answer.

PART 2 - ANSWERING QUESTIONS: AFTER SCHOOL

When school finished each day, children would get home somehow or they would stay at school at the special classroom. Some students went to the special classroom because their mum worked. Others like to go there because they enjoyed the things that they could do. Jim liked to play cards. Steven liked to kick the soccer ball around. Debra liked to talk to her girlfriends while they drank milk and ate biscuits. Rob loved to draw pictures of lots of different things in his sketchbook. He drew trees and buildings. He, also, sketched people he saw at the classroom. Rob enjoyed copying things he saw in photos and pictures in books as well. After school, there were lots and lots of interesting activities that the children could do at the special classroom. Mandy liked to help the teachers to get the materials out for the others to use. Tim would sometimes practise playing his flute out the back of the classroom. Some of the other children liked to listen to the radio and talk.
Questions

1. What did Mandy like to do at the special classroom?

2. What did Rob draw?

3. Where would Tim practise his flute?

4. What could children do at the special classroom after school?

5. Write two reasons why children liked to go to the special classroom?
LESSON 27 - QUESTIONS & STORIES WITHOUT GROUP NAMES

REVIEW OF CLUES TO LOOK FOR:

1. EXACTLY M_____________ WORDS TO THE QUESTION

2. DIFFERENT WORDS THAT _________ FOR THE SAME THING

3. Words that have a _____________ MEANING (SYNONYMS)

4. Words that tell things are T___________

5. WORDS IN QUESTIONS THAT HAVE A S________ MEANING

6. WORDS IN QUESTIONS OR SENTENCES WITH G____ N_____

REMEMBER: Some stories might NOT have any sentences with Group Names - you might need to THINK and write a Group Name ON YOUR OWN by using the things listed in the story or a word in the question.

Sometimes, the question might ask for the MAIN IDEA, the MAIN THING, the MOST IMPORTANT THING or IDEA - ALL THESE TYPES OF QUESTIONS are asking for a GROUP NAME to be in the WHOLE answer to the question.
REVIEWING THE STEPS FOR FINDING AN ANSWER

1. UNDERLINE the words in the question
2. CIRCLE the clue word (THINK about the Question's meaning)
3. FIND one (or more) sentences with these words OR other CLUES like Synonyms, Other Words that stand for the same thing or tell you things go together, or Group Names.
4. UNDERLINE these words.
5. READ the question and underlined parts.
6. Ask: Can I WRITE A SENTENCE answer?
7. Ask: IS THIS THE WHOLE ANSWER?
8. WRITE the sentence answer.
9. Read the question (Check: what do I need to look for?) & Read the answer & CHECK: WHOLE ANSWER??
10. SEARCHED ALL THROUGH - NEED MORE INFORMATION? Then use: what you know about the TOPIC & what's in the story to MAKE UP an answer that FITS IN & GIVES THE WHOLE ANSWER.
HOW TO MAKE UP A GROUP NAME

Sometimes, a story might NOT have a sentence with a Group Name.

When you have a question that asks for a Group Name (like What is the main idea? What is the theme? What is the most important thing in this story?), you need to think about the things in the story and try to put them together into a Group that you know these things might belong to. If you can think of this Group Name, then this becomes the best answer to the question.

An answer that includes a Group Name is much better than an answer that lists all the separate things from the story. You might miss one of the things in the story, and then your answer is NOT the WHOLE answer to the question. When you use a Group Name, if you miss one of these things, this might not be as important.

You must think carefully about what the question is asking. If the question asks you to list the things in a Group from the story, then putting the Group Name in your answer will NOT be correct.

Below are some examples of stories WITH and WITHOUT Group Names and questions that ask you to think of the Group Name for your answer. There are also some questions that ask you to list the members of a particular Group Name in a question.

You must read each question carefully and think about what the question means and then choose or write the best (whole) answer in a sentence.
Example 1 (WITHOUT Group Name):
The wind was rushing through the trees. The lightening could be seen in the distance. It was getting much, much darker. The clouds were moving closer and closer. Drops started to fall from the sky.

QUESTION: What is this story mainly about?
(a) The children were cold.
(b) It was getting much, much colder.
(c) There was a storm coming.
The BEST answer is "(c) There was a storm coming." because all the sentences in the story tell something about the storm that's coming.

Example 2 (WITHOUT a Group Name):
Dad lit the fire to cook on. Mum made the green salad to eat. Tom got the drinks out of the car. Sandy got the meat from the fridge. Mike put the plates and cutlery on the table.

QUESTION: What is the main idea of this story?

POSSIBLE ANSWERS MIGHT BE:
(a) Dad likes to light the fire. (Only about ONE sentence!)
(b) Mike and Sandy felt hungry. (Only about some of the people!)
(c) The family all helped get the barbecue dinner ready.
(d) Mum's most favourite food in the world for dinner is green salad. (Only about mum and what she did!)
The BEST answer from the choices is "(c) The family all helped get the barbecue dinner ready" because:
- you can PROBABLY say that Mum, Dad, Tom Sandy & Mike make up a family (This might not be true - but on what is in the story it's a good guess!)
- you can PROBABLY say that lighting the fire, making salad, getting drinks, meat and plates & cutlery MIGHT all be included under "getting barbecue dinner ready."
Because stories don't always tell you **ALL** the information you need to know, you **MIGHT** need to fill in bits and make a guess about some things - The **MOST IMPORTANT THING** is to make sure that the guess **FITS IN** with what has been said in the story.

For Example 2 above:

e) The army made a barbeque dinner. (Fits in with what everyone did BUT the idea that the people in the story are an "army" does not really fit in)

f) The family ate dinner. (Fits in with the idea that the people might make up a family BUT eating dinner is not what they did in the story - they got dinner ready - so THIS PART of the answer doesn't really fit in)

The WHOLE answer must **FIT IN** with what you know from the story.

**PART 2 - SHORT STORIES WITH QUESTIONS**

**STORY 1**

Tom went to bed. Tom always went to sleep very quickly. Jeff jumped into bed. Jeff was so tired because he had been bushwalking he fell asleep right away. Jane climbed into bed very late. She had slept in that morning so she wanted to stay up.

(REMEMBER TO USE GROUP NAMES IF YOU CAN)
QUESTIONS

1. Who went to bed?

2. Why did Jeff fall asleep quickly?

3. Who went to sleep straight away?

4. Who had slept in that morning?

STORY 2

Roses need water to live. Wattle trees must have enough water or they will die. Plants need to have water to stay alive. Weeds will not be able to live without water.

What is the main idea of this story?
(Try using one of the sentences in the story)
STORY 3

Susan got out her bowl and cereal. She put the toaster on the bench and cooked two pieces of toast. Susan cooked some scrambled eggs. Susan ate quickly. Then she washed up the dishes she had used.

QUESTIONS

1. What was the last thing Susan did?
   ____________________________________________________________
   ____________________________________________________________

2. What is the whole story about?
   ____________________________________________________________
   ____________________________________________________________

3. How many pieces of toast did Susan cook?
   ____________________________________________________________
LESSON 28

REVIEW OF CLUES TO LOOK FOR:
1. EXACTLY M__________ WORDS TO THE QUESTION
2. DIFFERENT WORDS THAT ________ FOR THE SAME THING
3. Words that have a ____________ MEANING (SYNONYMS)
4. Words that tell things are T__________
5. WORDS IN QUESTIONS THAT HAVE A S________ MEANING
6. WORDS IN QUESTIONS OR SENTENCES WITH G____ N____

REMEMBER: Sometimes, the question might ask for the MAIN IDEA, the MAIN THING, the MOST IMPORTANT THING or IDEA - ALL THESE TYPES OF QUESTIONS are asking for a GROUP NAME.

******************************************************************************************************************************************

REVIEWING THE STEPS FOR FINDING AN ANSWER
1. READ the question CAREFULLY
2. CIRCLE or THINK ABOUT ANY CLUES AND ABOUT WHAT YOU KNOW ABOUT THE STORY OR THE TOPIC
3. FIND one (or more) sentences with these words OR other CLUES.
4. READ the question & Ask: Can I WRITE A SENTENCE answer?
5. CHECK: IS THIS THE WHOLE ANSWER?
6. WRITE the sentence answer.
7. Read question & Read answer & CHECK: Is this the WHOLE ANSWER??
8. CHECK AGAIN: DOES THE ANSWER FIT IN WITH THE STORY AND WITH WHAT YOU KNOW ABOUT THE TOPIC

HOW TO MAKE UP A GROUP NAME
Sometimes, a story might **NOT** have a sentence with a Group Name.

When you have a question that asks for a Group Name, you need to think about the things in the story and try to put them together into a Group that you know these things might belong to.

An answer that includes a Group Name is MUCH BETTER than an answer that lists all the separate things from the story.

You must THINK CAREFULLY about what the question is asking.
If the question asks you to list the things in a Group from the story, then putting the Group Name in your answer will NOT be correct.

**REMEMBER:** Questions can use different words to ask for the SAME ANSWER. **Questions that ask for GROUP NAMES** might include these sorts of examples:

What is this story mostly about?
What is the main idea of the third paragraph?
Describe the most important idea from this story.
Write the theme of this legend.
Name the main idea of this tale.
What topic does this essay tell us about?
What image does this account bring to mind?
**THESE ALL USE DIFFERENT WORDS TO ASK FOR A GROUP NAME.**
The platypus is a strange-looking animal that looks like parts of other animals. It has a bill that looks like a duck. Also, the platypus has webbed feet like ducks do. It is covered with thick fur that keeps the water out. In addition, it lays eggs. Its tail is like the tail of a beaver which is an animal that lives in North America.

The wide, flat tail of a platypus is used when it swims to guide where the platypus swims. This tail is usually covered with fur on the top but is bald underneath. The tail can also be used for digging. Tails are where the platypus stores its fat. A fat tail means the platypus is healthy and can survive a long winter or a drought.

When it dives for food, the platypus closes its eyes and its nose. The platypus uses its duck-like bill to help find food under the water. It moves the bill quickly from side to side as it swims. The bill is very sensitive to moving things in the water. The platypus uses its bill a lot like boats and submarines use a radar detector. (Some questions need group names - others don't!!)

QUESTIONS
1. What is the first paragraph mainly telling the reader?
   a) The first paragraph tells about the platypus?
   b) The first paragraph tell us about the animals that the platypus looks like?
   c) The first paragraph tells us about ducks?
   d) The first paragraph tell us lots of things about the platypus?
   Answer _______ is the best answer because

2. What does the platypus use its bill for?

3. What is the most important idea in the final paragraph?

4. How does the platypus use its bill?

5. Name some ways that the platypus is like a duck.

6. What does the second paragraph tell us about?

7. What does the platypus use its tail for?
8. What does the whole story tell us about?

9. Can you write a better title for this story on the line below?

LESSON 29

FILLING IN STORY DETAILS

Filling the parts of a story is like reading a Group Name in a story and you making up the things that might make up that Group.

When you read a story, you SHOULD think about what you already know about the story (itself) AND what you already know about the things that the story is about.

For example: You might read a story about someone called Tom eating breakfast. As you read the story, you might think about the things you have been told about "Tom" AND you might also think about what you know about "breakfast" AND what YOU eat for "breakfast".

You could say that the word "breakfast" is like a Group Name for all the things you know about "breakfast" and all the things you think people might eat for "breakfast" and maybe what you eat for breakfast. In the space below, write down all the things that you can think of about "breakfast":

<table>
<thead>
<tr>
<th>&quot;breakfast&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

In your class, everyone will probably have written something a little different. There might be some things on lots of lists - but there might be some things that only you or one other person have written.

STORY VERSION 1: What if the story about "Tom eating breakfast" told you some other things about "Tom"?

Nowhere in the story does it say exactly what Tom eats for breakfast. The other things in the story about Tom might help you to say what EXACTLY Tom might have had for
breakfast.

**What if somewhere in the story you are told "Tom" is a baby?**

The question is: **What might Tom have eaten for breakfast?**

You need to use this other clue FROM THE STORY (that Tom is a baby) AND think about what you ALREADY know (ABOUT BABIES AND BREAKFAST) to make sure your answer MAKES SENSE.

You could write these answers that would **MAKE SENSE and "FIT IN"** with the story:

a. Tom ate a bottle of milk for breakfast.
b. Tom ate creamed apple for breakfast.
c. Tom ate mashed baby food for breakfast.

These answers could ALL be correct BECAUSE they are the sorts of things that we would expect a baby to eat, SO it is LIKELY that "Tom" could have eaten them.

These answers do **NOT MAKE SENSE - don't FIT IN** with the story:

d. Tom ate bacon and eggs for breakfast.
e. Tom ate a cup of coffee for breakfast.

The reason these answers DON'T make sense is that we know that MOST babies DON'T eat these things for breakfast SO it is UNLIKELY that Tom, who is a baby, would have eaten them for breakfast.

**STORY VERSION 2:** What if you are told that "Tom" is a man and that "Tom" has been stranded on a deserted tropical island?

The story is STILL about Tom eating breakfast and NOWHERE are you told EXACTLY what Tom is eating.

The question STILL is: **What might Tom have eaten for breakfast?**

Some POSSIBLE answers are written below - some MAKE SENSE and some DON'T MAKE SENSE.

**REMEMBER:** You need to use these clues from the story and things you already know to decide if the answer MAKES SENSE.

(Think about "breakfast", "a man" and "a deserted island" - the answer must "FIT IN" with all three of these)

**TICK** the three answers that MAKE SENSE and **CROSS OUT** the answers that DON'T make sense.

**POSSIBLE ANSWERS:**

a. Tom ate a bottle of milk for breakfast. (Is this food for breakfast?) (Can a man eat this?)

b. Tom ate a cup of coffee for breakfast. (Is this food for breakfast?) (Would a man eat this?)
c. Tom ate some bananas for breakfast. (Is this food for breakfast?)
   (Would a man eat this?) (Can you get this on a tropical island?)

d. Tom ate curried chicken for breakfast. (Is this food for breakfast?)
   (Would a man eat this?) (Can you get this on a tropical island?)

e. Tom ate pineapples for breakfast. (Is this food for breakfast?)
   (Would a man eat this?) (Can you get this on a tropical island?)

f. Tom ate bacon and eggs for breakfast. (Is this food for breakfast?)
   (Would a man eat this?) (Can you get this on a tropical island?) island?

TOM ate __________________ OR __________________ OR __________________

are three answers that might all be correct because they are things a man
would probably eat for breakfast, AND Tom is stranded on a
tropical island, AND they are likely to be found on a tropical island. The first two reasons
(man & stranded) are FROM THE STORY & the third reason (found on tropical island)
most people ALREADY KNOW about.

Here is a short story with questions (with no exact answer in the story) and some
possible answers. You need to think about the CLUES GIVEN in the story AND things
you might ALREADY know to give a REASON WHY one of the answers is MORE
LIKELY and the other answers are UNLIKELY. (Some of the MOST LIKELY answers
are UNDERLINED. The first one is done.)

STORY 1.
Jane woke up early. She felt happy to finally be on her summer school holiday. She
quickly got dressed. Through the window she could see the blue waves crashing on the
sand. She raced off to have fun.

QUESTIONS & POSSIBLE ANSWERS:
1. Where had Jane gone for her holiday?
   a) Jane had gone to the desert for her holiday. (This doesn't make sense because she
      saw "blue waves crashing on the sand".)
   b) Jane had gone to the beach for her holiday. (This makes sense because
      ____________________________________________________________.)

2. Where did Jane race off to?
   a) Jane raced off to school.
      ____________________________________________________________

   b) Jane raced off to the beach.
      ____________________________________________________________
c) Jane raced off to the shops.

3. What did Jane get dressed in?
   a) Jane got dressed in her tracksuit.
   b) Jane got dressed in her school uniform.
   c) Jane got dressed in her swimming costume.

4. What sort of fun did Jane have?
   a) Jane had fun doing her maths.
   b) Jane had fun swimming in the surf.
   c) Jane had fun making a cake.
   d) Jane had fun building sand castles.

REMEMBER: to tell which of the likely answers is MORE LIKELY you might need to read on in the story and look for more things you are told about Jane that might help you write an answer that MAKES SENSE.

LESSON 30 - FILLING in MORE DETAILS IN STORIES

REVIEW OF CLUES TO LOOK FOR in QUESTIONS & STORIES:

1. E________ M__________ WORDS TO THE QUESTION
2. WORDS THAT ________ FOR THE SAME THING or have a ________ MEANING (SYNONYMS)
3. Words that tell things are T__________
4. Words that mean things go together or to use a G_____ N_____

REMEMBER: Sometimes, the question might ask for the M___ I___, the or the M___ I__________ T_______ - which means a G____ N____.

********************************************************************

REVIEWING THE STEPS FOR FINDING AN ANSWER
1. READ the question **CAREFULLY**
2. CIRCLE or THINK ABOUT ANY CLUES AND ABOUT WHAT YOU KNOW
   ABOUT THE STORY OR THE TOPIC
3. FIND one (or more) sentences with these words OR other CLUES.
4. READ the question and Ask: Can I WRITE A SENTENCE answer?
5. CHECK: IS THIS THE WHOLE ANSWER?
6. WRITE the sentence answer.
7. Read question & Read answer & CHECK: Is this the WHOLE ANSWER??

**8. CHECK AGAIN: DOES THE ANSWER FIT IN WITH THE STORY AND WITH WHAT YOU KNOW ABOUT THE TOPIC**

**REMEMBER:** When you read a story, you can often think of *extra bits* about the story while you are reading.

MOST people imagine these extra parts about a story when they read it. These extra parts can sometimes be different for different people. These differences happen because different people might know different things about what's in the story or what the story is about. Each person will try to "FIT IN" the new story with whatever they already know.

**SOMETIMES,** you might read a story and you know NOTHING about the things in the story. Sometimes, the things you read in a story MIGHT NOT BE WHAT YOU EXPECTED. The story might include things that you have NEVER seen of or heard of before. If you are writing answers ABOUT THAT STORY you need to make sure your answer "FITS IN" with WHAT THAT STORY SAYS NOT what you think.

You need to use **ALL** the things you are told in the story AND anything you **ALREADY KNOW** about the things in the story. These things might include **ANYTHING** you read ANYWHERE in the story.

For Example: You might read this story:
John was wearing a white coat and trousers. He was wearing a mask over his mouth and nose and a funny hat over his hair. John had on some rubber gloves.

**If you used this clue about what John looked like then, you MIGHT think that John was a doctor - based on this clue, you MIGHT be right.**

**BUT,** if you read the rest of the story (or remembered something else you had already read) that told you that John asked his patient to sit in a soft chair, to rinse his mouth
out with water and open his mouth widely - THEN What job would you think John had? 

**USING ALL THIS INFORMATION FROM THE STORY AND WHAT YOU KNOW ALREADY** (about doctors & dentists) John is MORE LIKELY to be a dentist and NOT a doctor. SO, to write the answer that "FITS IN" with the story, you must use ALL the clues in the story - not just one.

**THE FARM AT DUBBO**
The Jones family lived on a farm in Dubbo. They had lots of animals on the farm. Mrs Jones sold eggs to many people who lived in the town. Mr Jones had a machine that milked the animals.

**QUESTIONS**
1. What types of animals did the Jones family have on their farm?
   a) The Jones family had lions and tigers on their farm.
   b) The Jones family had cows on their farm.
   c) The Jones family had chickens on their farm.
   
   WRITE A BETTER ANSWER THAN THESE

2. Which of the animals might have been used with the milking machine?

3. Which animal would Mrs Jones MOST LIKELY get her eggs from?

---

**STORY 2**
Max Green was walking slowly to school. He was not looking forward to his year 6 class that day. He always found them to be a noisy class, especially when they worked on maths.

Sadie, Ian and Trevor were on their way to school. They were all worried about what work the teacher would ask them to do. Every time they had a maths lesson, the three of them felt that they just didn't know what to do.

**QUESTIONS**
1. What job did Max Green have?
2. What information did you use to help find the answer to question 1?

3. Why were the three children worried on their way to school?

4. What subject did they have particular problems with?

5. Why, do you think, the class were noisy in the maths lessons?
Appendix B: Quantitative Features of Intervention

Quantitative Features of Student Materials, 5 spreadsheets (Tables A through E) are presented using spreadsheets from Excel on the following pages.
Table A: Scope and Sequence of Clue Words by Lesson

<table>
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<th>Clue Word</th>
<th>What</th>
<th>When</th>
<th>Where</th>
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Average per lesson: 241.1

11.4
Table C: Lesson Scope and Sequence of Features of Instruction (for minimising student errors) by Lessons

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Table D: Scope and Sequence of Strategy Instruction (for minimising student errors) by Lessons

The following three tables present the scope and sequence of strategy instruction for the thirty lessons.
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<tr>
<th>Lesson</th>
<th>QAR</th>
<th>Strategy or Concept</th>
<th>Support in Student Materials</th>
<th>Examples</th>
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<td>Example Question</td>
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<td>Circle, Underline</td>
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<td>Explicit Steps- all written</td>
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<td>Oral Model, discuss</td>
<td>Apply to examples</td>
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<td>Partly Written(one word + letter prompt)</td>
<td>9(words)</td>
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<td>Partly Written(miss more whole words)</td>
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**Scope and Sequence of Strategy Instruction (for minimizing student errors) by Lessons**
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Average per lesson

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Appendix C: Detailed Class Data

Table 1

*Numbers of Boys and Girls in each Class*

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Table 2

*Numbers of Boys and Girls in Treatment Groups*

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Table 1

**Experimental Teacher Diary Records**

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D is for Lesson Diary included in Appendix.

# Teacher 4 used class timetable (included), each lesson of 45 mins (except 2 lessons)

Obs indicates that the researcher observed during that lesson and verified time taken.
Table 2

Control Teacher Lesson Times

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Total       1140  1830  675  870  4515
Lessons     24   30   14   18   86
Average      47.5  61.0  48.2  48.3  52.5
per Less

* Teacher 1, Teacher 2 and Teacher 4 used class timetabled times for
Table 1

_Control Treatment Instructional Program Details from Work Samples_

The following page shows a table with details of reading skills completed in Control Classrooms during thirty lessons.
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Treatment Integrity for Question-Answering Program

Treatment integrity data were recorded for all students in all experimental classes and are summarised below (see Table 2). Samples of the data kept on each class, for three classes and three books are presented (see Table 3, Table 4 and Table 5). These data show both questions attempted and questions correct for each student for each lesson on passages and questions completed independently.

Table 2

Summary of Treatment Integrity Data for Experimental Classes

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<th>EXPERIMENTAL GROUP TREATMENT INTEGRITY</th>
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**Maximum** 10 5 6 7 8 6 42

Note: “Att” stands for the number of questions attempted and “Corr” stands for the number of attempted questions that were marked correct by the class teacher.
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Note: “Att” stands for the number of questions attempted and “Corr” stands for the number of attempted questions that were marked correct by the class teacher.
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*Appendix F: P.A.T. Comprehension Passage Features*
Appendix G: Question-Answering Passages and Questions

A. Narrative (Tropical) passage and questions

Tropical Paradise

Keith sprinted out of the hardware store, paint cans thumping together in his school bag.

The clock on the war memorial across the street said eight minutes past eleven. Keith stared. Then he remembered it had been wrong ever since a coconut had hit it in a cyclone.

He looked at his watch. Nineteen minutes to four. Two hours and twenty-four minutes left.

He should just make it.

As long as Mum and Dad didn’t see him.

Keith decided he’d better not risk going too close to the shop so he ran across the road, through the fringe of palm trees and onto the beach. He ran along the soft sand, trying to look like a tourist out for a jog with a couple of tins of paint in a school bag.

He glanced through the palm trees at the shop. Mum and dad were both behind the counter but neither of them was looking in his direction. They were looking at each other. Dad was saying something to Mum, pointing at her with a piece of fish, and Mum was saying something back, waving the chip scoop at him.

Even at that distance, Keith could see that Dad’s mouth was droopier than a palm frond and that Mum’s forehead had more furrows in it than we sand when the sea is choppy.

Keith’s stomach knotted even tighter. Another argument. Poor things. Stuck in a fish-and-chip shop all day in this heat. Anyone’d get a bit irritable standing over a fryer all day with this poxy sun pounding down nonstop.

The trouble with tropical paradieses, thought Keith, as he ran along the beach, is that there’s too much good weather.
Tropical Questions

You have a story and these questions. Write full sentence answers to each of the questions on a separate sheet of paper.

1. What was Dad pointing at Mum?

2. Why did Keith stare at the clock?

3. Why might Keith have needed the paint?

4. Who didn’t Keith want to see him?

5. What did Keith have in his school bag?

6. Why do you think Keith’s stomach was “knotted”?

7. What evidence tells you that Keith’s parents were not happy?

8. Name three places Keith ran from or to?

9. What did Keith think was wrong with living in a tropical paradise?

10. What did Keith’s parents do?

11. How much time did Keith have to use the paint?

12. Where was Keith running from?
B. Factual (Whales) passage and questions

WHALES

There are about ninety kinds of whales in the world. Scientists have divided them into two main groups: toothed whales and baleen whales.

Toothed whales have teeth and feed mostly on fish and squid. They have only one blowhole and are closely related to dolphins and porpoises.

The sperm whale is the only giant among the toothed whales. It is the animal that comes to mind when most people think of a whale. A sperm whale has a huge, squarish head, small eyes, and a thick lower jaw. The male grow to about sixty feet long and weighs as much as fifty tons. The female is smaller, reaching only forty feet and weighing less than twenty tons.

A sperm whale's main food is squid, which it catches and swallows whole. A sperm whale is not a very fast swimmer, but it is a champion diver. It dives to depths of a mile in search of giant squid and can stay underwater for more than an hour.

There are smaller and less familiar kinds of toothed whales. The narwhal is a leopard-spotted whale about fifteen feet long. It is sometimes called the unicorn whale, because the male narwhal has a single tusk. The tusk is actually a ten foot long front tooth that grows through the upper lip and sticks straight out. No one knows for sure how the narwhal uses its tusk. Narwhals live along the edge of the sea in the Arctic.

Perhaps the best known of the toothed whales is the killer whale. That's because there are killer whales that perform in marine parks around the country. A killer whale is actually the largest member of the dolphin family. A male can grow to over thirty feet and weigh nine tons.

Orcas are found in all the world's oceans, from the poles to the tropics. They hunt for food in herds called pods. Orcas eat fish, squid, and penguins, as well as seals, sea lions, and other sea mammals, including even the largest whales. Yet they usually appear gentle in captivity, and there is no record that an orca has ever caused a human death.
Whales Questions

You have a story and these questions. Write full sentence answers to each of the questions on a separate sheet of paper.

1. What is a sperm whale’s main food?

2. Name four different things that toothed whales might eat for food.

3. Why do you think a sperm whale needs to be a champion diver?

4. Why is a nawhale called a unicorn whale?

5. What types of toothed whales are discussed in the passage?

6. Where do nawhales live?

7. By what name are killer whales known?

8. What things might the narwhal use its tusk for?

9. How much larger and heavier are male sperm whales than female sperm whales?

10. Why do you think orcas are gentle in captivity?
Appendix H: Question-Answering Passage Readability

Flesch Reading Ease Score (Microsoft Word, 2002, Microsoft Corporation)


Readability Scores

When Microsoft Word finished checking spelling and grammar, it can display information about the reading level of the document, including the following readability scores. Each readability score bases its rating on the average number of syllables per word and words per sentence.

Flesch Reading Ease Score

Rates text on a 100-point scale; the higher the score, the easier it is to understand the document. For most standard documents, aim for a score of approximately 60 to 70.

The formula for the Flesch Reading Ease Score is:

\[ 206.835 - (1.015 \times \text{ASL}) - (84.6 \times \text{ASW}) \]

where:

- \( \text{ASL} \) = average sentence length (the number of words divided by the number of sentences)
- \( \text{ASW} \) = average number of syllables per word (the number of syllables divided by the number of words).

Flesch-Kincaid Grade Level Score

Rates text on a U.S. grade-school level. For example, a score of 8.0 means that an eighth grader can understand the document. For most standard documents, aim for a score of approximately 7.0 to 8.0.

The formula for the Flesch-Kincaid Grade Level score is:
\[(0.39 \times \text{ASL}) + (11.8 \times \text{ASW}) - 15.59\]

where:

\(\text{ASL} = \) average sentence length (the number of words divided by the number of sentences)
\(\text{ASW} = \) average number of syllables per word (the number of syllables divided by the number of words)

Table 1

*Results for Passages used in the current study*

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Tropical</th>
<th>Whale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Words</td>
<td>291</td>
<td>361</td>
</tr>
<tr>
<td>Characters</td>
<td>1238</td>
<td>1589</td>
</tr>
<tr>
<td>Paragraphs</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Sentences</td>
<td>22</td>
<td>26</td>
</tr>
<tr>
<td>Averages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sentence / Paragraph</td>
<td>2.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Words / Sentence</td>
<td>13.0</td>
<td>13.8</td>
</tr>
<tr>
<td>Characters / Word</td>
<td>4.1</td>
<td>4.2</td>
</tr>
<tr>
<td>Readability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive Sentences</td>
<td>0%</td>
<td>11%</td>
</tr>
<tr>
<td>Flesch Reading Ease Score</td>
<td>81.8</td>
<td>76.9</td>
</tr>
<tr>
<td>Flesch-Kincaid Grade Level Score</td>
<td>5.0</td>
<td>5.9</td>
</tr>
</tbody>
</table>
Appendix I: Standard marking guide for Question-Answering

Marking Guides For Written Question Answering
Students were given one mark for each written answer:

Acceptable Answer - 1 Mark
Written answers were awarded one mark, a half mark or zero marks for the acceptability of the answer when matched against the Marking Guide. Marking Guides include three types of written answers: a set of accepted answers scoring one mark, a set of acceptable but incomplete answers scoring half a mark, and a set of answers that were not acceptable that score zero marks.

For each passage, Tropical Paradise and Whale, a set of answers was devised against which all student written answers would be judged. These sets of answers formed a Draft Marking Guide for each passage. These Draft Marking Guides were not considered complete until the completion of the study when all student written responses had been answered. As marking progressed for both pretesting and posttesting, several problems arose and solutions to these problems were created.

The resulting Final Marking Guides were then used to remark all student written answers for all questions.

Subsequently, 20 percent of all student written answer sheets were selected randomly. These were selected from Class Roll Lists using every 6th name on the list. These answer sheets had the dates and all identifying marks and score marks covered. This was achieved by using strips of cardboard which were stapled to the original answer sheet to cover the original marking and any identifying marks about the student's name, school, class or date on the sheet. They were scored by a second scorer, trained in using the Final Marking Frames. Inter-rater reliability was then calculated to ensure reliability in scoring.

Training in the Marking Procedure
The second marker was trained using the following steps. This marker was familiar with parts of the stories as she had assisted with oral reading fluency pretests and posttest at some schools.
1. Reading of full story for Tropical Paradise.
2. Reading of these instructions pages one and two.
3. Reading of Questions and Marking Frame.
4. Sample marking of 4 covered student response sheets - not included in the selected sample.
5. Discussion of each question for sample set, with guidance from researcher.
6. Immediate comparison with original marking of first sample set.
7. Marking of remaining 3 samples in presence of researcher, with checking after all three completed.
8. First Package of selected sample of covered student response sheets given to marker.
9. Independent marking of selected sheets, handed back to researcher when completed.
10. Calculation of Inter-Rater Reliability and subsequent packages completed this way.
11. Other stories completed in the same way, until desired number completed.
12. Total sample for each story summed for Inter-rater Reliability.
Traditionally, inconsistency in marking comprehension has occurred - what one person thinks is "correct", another person may not. Some teachers use marking frames for ensuring consistency between teachers. A second source of error is inconsistency for any person marking many student responses over a period of time. Marking Frames also reduce this source of error.

Table 1
Problems and Solutions for Question Marking

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spelling errors</td>
<td>Spelling errors are ignored if words could be matched to a known word either in passage or an English word, incl. common slang, excluding words not matching the context eg calling Keith &quot;she&quot;..</td>
</tr>
<tr>
<td></td>
<td>Grammatical errors are ignored.</td>
</tr>
<tr>
<td>A similar answer</td>
<td>Written student answers that included synonyms for nouns or verbs in known answers (already in the Marking Guide) were matched to the answer closest in meaning in the Marking Guide.</td>
</tr>
<tr>
<td>A new, different answer</td>
<td>Where student written answers are not included in the Marking Guide, a judgement was made by marker as to whether the answer matched more closely a full mark, a half mark or a zero mark. The written answer was then added to Marking Guide so that all written answers given by students were included in the Marking Guide.</td>
</tr>
<tr>
<td>Illegible answers</td>
<td>These were given zero marks.</td>
</tr>
<tr>
<td>Half correct answers</td>
<td>Any written answer that includes irrelevant information or unacceptable information (in relation to the accepted answer) is only given half a mark.</td>
</tr>
<tr>
<td></td>
<td>Any answer that includes more than one sentence, with or without irrelevant information only marked as half a mark.</td>
</tr>
<tr>
<td>Other Zero answers</td>
<td>Any no response - question number does not count. Incomplete sentence using words from question. Narrator doesn't say.</td>
</tr>
</tbody>
</table>

Each of the following Marking Frames has three columns: one for correct answers; one for incorrect answers and one for half correct answers. A range of samples is included in each column for each question.

Each question is separated in a section of the table.

Each sample answer is separated by a full stop and begins a new line in the table.

Some sample answers only show the ending of the answer, without the beginning from the question. For these samples, three dots may begin the sample answer.
TROPICAL QUESTIONS – Analysis of Questions as per Raphael’s (1982) definitions of Question-Answer Relationships (QAR Type)

Table 2

*Narrative Question-Answer Relationships*

<table>
<thead>
<tr>
<th>QAR Type</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT</td>
<td>1. What was Dad pointing at Mum?</td>
</tr>
<tr>
<td>OMO</td>
<td>2. Why did Keith stare at the clock?</td>
</tr>
<tr>
<td>OMO</td>
<td>3. Why might Keith have needed the paint?</td>
</tr>
<tr>
<td>TS</td>
<td>4. Who didn't Keith want to see him?</td>
</tr>
<tr>
<td>RT</td>
<td>5. What did Keith have in his school bag?</td>
</tr>
<tr>
<td>OMO</td>
<td>6. Why do you think Keith's stomach was knotted?</td>
</tr>
<tr>
<td>OMO</td>
<td>7. What evidence tells you that Keith's parents were not happy?</td>
</tr>
<tr>
<td>TS</td>
<td>8. Name three places Keith ran from or through.</td>
</tr>
<tr>
<td>RT</td>
<td>9. What did Keith think was wrong with living in a tropical paradise?</td>
</tr>
<tr>
<td>TS</td>
<td>10. What did Keith's parents do?</td>
</tr>
<tr>
<td>TS</td>
<td>11. How much time did Keith have to use the paint?</td>
</tr>
<tr>
<td>RT</td>
<td>12. Where was Keith running from?</td>
</tr>
</tbody>
</table>

**Note:**

QAR stands for question-answer relationship or question type
RT stands for Right There questions
TS stands for Think and Search questions
OMO stands for On My Own questions
**Table 3**

*Narrative Question-Answering Marking Guide*

<table>
<thead>
<tr>
<th>Q</th>
<th>One Mark Answers</th>
<th>Half Mark Answers</th>
<th>Zero Mark Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dad was pointing a piece of fish at mum.</td>
<td>Dad was pointing a fish at mum. Dad was pointing at Mum. He had a piece of fish in his hand.</td>
<td>Dad wanted to buy mum a fish. D pointing at Mum's piece of fish. ..because they were arguing.</td>
</tr>
<tr>
<td>2</td>
<td>Keith stared at the clock because the time wasn't what he expected. ..because it had a funny/strange time ..surprised at the time. ..thought he was late. ..because the time didn't seem right (or was wrong).</td>
<td>..because it was hit by a cyclone. ..because he didn't know what the time was. ..wanted to get home before mum &amp; dad. ..because it was wrong. Student copied sentences. becauseclock said 8past11. ..to see how much time he had left.</td>
<td>..because he wanted to know the time. ..because he thought the time was 8 past 11 ..because it was on the war memorial. ..because he was late for school.</td>
</tr>
<tr>
<td>3</td>
<td>Keith might have needed the paint to paint something at home, his room, mum or dad's car... (allow a range)</td>
<td>..to paint clubhouse. ..to paint graffiti. ..for school work. ..to paint. ..to go to art lessons. ..to help Mum &amp; Dad.</td>
<td>..to paint the shop. ..to look like a tourist. ..for the clock/cans thumping. ..to spray the beach. ..needed paint in bag. ..for Mum &amp; Dad.</td>
</tr>
<tr>
<td>4</td>
<td>Keith didn't want Mum and Dad to see him. ..his parents to see him.</td>
<td>..want Dad to see him. ..want Mum to see him.</td>
<td>..wanted to see him because he better not risk. Kwanted doctor to see him. ..didn't want to see him because he was a stomach.</td>
</tr>
<tr>
<td>5</td>
<td>Keith had a couple/2 of tins of paint in his bag. ..school things and tins of paint. ..paint tins in his bag.</td>
<td>Keith had cans in his bag. Keith had a can of paint in his school bag. Keith had paint(s) in his bag.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>His stomach was knotted because he'd</td>
<td>..because parents fighting (and might divorce).</td>
<td>..because he was hungry. ..paint tins in his bag.</td>
</tr>
<tr>
<td>7</td>
<td>*Dad's mouth was droopier than a palm frond &amp; mum's forehead had more furrows.....etc. *Dad pointing fish at her &amp; Mum saying something back waving chip scoop. *Dad said something to mum &amp; M pointed chip scoop back.</td>
<td>Mum Or Dad from (1). It's rude to point. ...stuck in fish&amp;chip shop &amp; arguing. ...pointing fish(at eachoth) they were hesitating. ...having another argument. ...behind counter&amp;silent. ... stuck in fish&amp; chip shop. ...angry facial expressions. ...arguing or shouting. ...because of what they were doing.</td>
<td>K stomach knotted even tighter. ...because sea was choppy. ...because he felt sick. ...because he was caught. ... because he felt sorry for the fish being cooked. ... so he could get there faster.</td>
</tr>
</tbody>
</table>

| 8 | Need to name 3 of these: hardware store, beach, street, palm fringe, road, memorial, clock, tropical paradise, sand, trees | Any one or two of these places | Something else not in the story or fish and chip store. or mum and dad. |

| 9 | Keith thought there was too much good weather. | ...too much weather. ... sun pounding down. ... too hot/heat. ...wrong thing was weather. ... weather always good. ...poxy weather. | Keith thought that tropical cyclones were what was wrong with tropical paradises. He thought it was good. The weather was wrong or bad weather ...it was boring. ..too many good days. |

| 10 | Keith's parents ran a | Keith's parents ran a shop. | Keith's parents sat on the |
|   | fish & chip shop/store  
(or takeaway store).  
...were arguing/had another argument.  
...looking at each other & pointing things at each. | (or fish & chip factory)  
...were fish & bait sellers.  
...looking in one direction.  
...looking at each other.  
...pointing/talking at each other.  
...were angry.  
...worried about Keith.  
Keith's parents hesitated.  
...speaking to each other.  
Sentence about Dads doopy mouth & mums forehead. | beach.  
...went to hardware store.  
Mum was waving the chip scoop. |
|---|---|---|
| 11 | Keith had 2 hrs and 24 minutes left.  
K had about two and a half hours left. | ... had 2 hrs left.  
...had 24 mins left.  
...had not much time left.  
Any mistake in numbers. | Keith used the paint (one time).  
...nineteen minutes to four.  
Keith used it twice.  
Keith used it once. |
| 12 | Keith was running from the hardware store. | ... from school.  
..... from fish & chip store.  
.... (war memorial) clock to beach. | ... from Mum and Dad.  
...from a tropical paradise.  
...along the beach.  
...from road & soft sand on beach.  
Keith didn't see mum. |
WHALES QUESTIONS – Analysis of Questions as per Raphael’s (1982) definitions of Question-Answer Relationships (QAR Type)

Table 4
*Factual Question-Answer Relationships*

<table>
<thead>
<tr>
<th>QAR Type</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT</td>
<td>1. What is a sperm whale's main food?</td>
</tr>
<tr>
<td>TS</td>
<td>2. Name four different things that toothed whales might eat.</td>
</tr>
<tr>
<td>OMO</td>
<td>3. Why do you think a sperm whale needs to be a champion diver?</td>
</tr>
<tr>
<td>RT</td>
<td>4. Why is a narwhal called a unicorn whale?</td>
</tr>
<tr>
<td>TS</td>
<td>5. What types of toothed whales are discussed in the passage?</td>
</tr>
<tr>
<td>RT</td>
<td>6. Where do narwhals live?</td>
</tr>
<tr>
<td>TS</td>
<td>7. By what name are killer whales known?</td>
</tr>
<tr>
<td>OMO</td>
<td>8. What things might the narwhal use its tusk for?</td>
</tr>
<tr>
<td>TS</td>
<td>9. How much larger and heavier are male sperm whales than female sperm whales?</td>
</tr>
<tr>
<td>OMO</td>
<td>10. Why do you think orcas are gentle in captivity?</td>
</tr>
</tbody>
</table>

**Note:**

QAR stands for question-answer relationship or question type
RT stands for Right There questions
TS stands for Think and Search questions
OMO stands for On My Own questions
### Table 5

**Factual Question-Answering Marking Guide**

<table>
<thead>
<tr>
<th>Q</th>
<th>One Mark Answers</th>
<th>Half Mark Answers</th>
<th>Zero Mark Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A sperm whale's man food is squid.</td>
<td>...fish and squid.</td>
<td>meat</td>
</tr>
<tr>
<td>2</td>
<td>Four thingtoothed whales might eat are squid, fish, seals, penguins, sea creatures, sea mammals, prawns. (Must have 4)</td>
<td>Less than 4 things but at least one of these</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>A sperm whale needs to be a champion diver to catch giant squid which livemore than amile down ... to search for its food more than a mile down. ... because its food is at the bottom of the ocean.</td>
<td>...to get food easily. ... to catch squid/food. ...to get food down deep. ... dives to a mile. ...dives for an hour.</td>
<td>... because it is not a very fast swimmer. ...because it is heavy and that makes it go down fast. ...when a ship comes the whale can champion.</td>
</tr>
<tr>
<td>4</td>
<td>The narwhal is called a unicorn whale because the male has a single tusk like a unicorn.</td>
<td>because it has a single tusk. ...because of its tooth. Copied out sentences.</td>
<td>...becausefemalehas tusk. ...because it has a stick on its head. ...because of its size. ... because it has 2 tusks.</td>
</tr>
<tr>
<td>5</td>
<td>Types of toothed whales discussed are narwhal, sperm, killer</td>
<td>... if baleen included lose half. ...baleen and toothed</td>
<td>smaller and less familiar kinds.</td>
</tr>
<tr>
<td>6</td>
<td>Narwhals live along the edge of the sea in the Arctic.</td>
<td>... in the Artic.</td>
<td>...in the ocean. ...edge of sea. Antarctic. near the shore.</td>
</tr>
<tr>
<td>7</td>
<td>Killer whales are known as orcas.</td>
<td></td>
<td>toothed whales. killer whales. largest dolphin. perhaps. ...because perform in marine parks.</td>
</tr>
<tr>
<td>8</td>
<td>The narwhal might use its tusk</td>
<td>includes only one of</td>
<td>anything about &quot;no one&quot;</td>
</tr>
<tr>
<td>9</td>
<td>Male sperm whales are twenty feet longer and thirty tons heavier than females. Female 20 feet smaller and 30 tons lighter.</td>
<td>...the numbers 20 &amp; 30. either one of length or weight difference One numeral wrong.</td>
<td>No marks for rewriting the actual sentences from the story with the information or 2 wrongno.</td>
</tr>
<tr>
<td>10</td>
<td>...because they are fed so well and don't have to hunt for food. ...because they are treated well. ...because they have gotten used to humans. ...because they are trained from babies not to be fierce.</td>
<td>...because they are unhappy and rather be in the wild. ...because they are endangered. ...because they are or aren't or are scared. ...because it has babies. ...just like that. they like people. ...they have no enemies</td>
<td>Because: ... they have never killed a person before. ... not in normal habitat. ...they don't want to be hurt. ... it's a gentle animal. ... it never comes to shore ... its the largest whale. ... they only eat fish. ... going to catch prey.</td>
</tr>
</tbody>
</table>
Appendix J: Inter-Rater Agreement

The following spreadsheets provide data for inter-rater reliability of marking for all measures. Inter-rater agreement was calculated for 20% or 53 of the students in the current study. Agreement was particularly high for PAT Reading Comprehension and PAT Reading Vocabulary as these were marked with overhead transparencies from multiple choice answer sheets and involved no judgement scoring. Calculations are based on the formula:

Inter-rater Reliability = Agreements divided by (Agreements plus Disagreements).

Inter-Rater Agreement = \{\text{Agreements} / (\text{Agreements} + \text{Disagreements})\} \times 100

This was calculated as a percentage.

For Pretest Narrative Written Question-Answering, this formula resulted in:

\[
\text{Inter-Rater Agreement} = \{(591 + 582.5) / (591 + 45 + 582.5 + 53.5)\} \times 100
= (1173.5 / 1272.0) \times 100
= 92.3\%
\]

For Pretest Factual Written Question-Answering, this formula resulted in

\[
\text{Inter-Rater Agreement} = \{(488 + 484.5) / (488 + 42 + 484.5 + 45.5)\} \times 100
= (972.5 / 1060.0) \times 100
= 91.7\%
\]

Therefore, these data were reported in the Method Chapter (see Chapter 6) Tables of data follow that support these calculations, and included both pretest and posttest performance.

These data have been summarised in the table (see Table 1).
Table 1

Summary of Inter-rater Reliability for Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pretest Inter-Rater Reliability</th>
<th>Posttest Inter-Rater Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAT Reading Comprehension *</td>
<td>99% *</td>
<td>99% *</td>
</tr>
<tr>
<td>PAT Reading Vocabulary *</td>
<td>99% *</td>
<td>99% *</td>
</tr>
<tr>
<td>Narrative Answers (Tropical)</td>
<td>92.3%</td>
<td>91.5%</td>
</tr>
<tr>
<td>Factual Answers (Whale)</td>
<td>91.7%</td>
<td>91.4%</td>
</tr>
<tr>
<td>Narrative Reading Fluency (Tropical)</td>
<td>94.1%</td>
<td>96.1%</td>
</tr>
<tr>
<td>Factual Reading Fluency (Whale)</td>
<td>93.6%</td>
<td>94.8%</td>
</tr>
</tbody>
</table>

* PAT Reading Comprehension and Reading Vocabulary were multiple choice and marked with overhead transparencies.

<table>
<thead>
<tr>
<th>Year</th>
<th>School</th>
<th>Class</th>
<th>Stud</th>
<th>TPREWR</th>
<th>Agree</th>
<th>DISAGRE</th>
<th>TPREERR</th>
<th>Agree</th>
<th>DISAGRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>97</td>
<td>1</td>
<td>5F</td>
<td>162</td>
<td>165</td>
<td>162</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>97</td>
<td>1</td>
<td>5F</td>
<td>139</td>
<td>142</td>
<td>139</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>97</td>
<td>1</td>
<td>5F</td>
<td>198</td>
<td>202</td>
<td>198</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>97</td>
<td>1</td>
<td>5F</td>
<td>116</td>
<td>117</td>
<td>116</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>97</td>
<td>1</td>
<td>5F</td>
<td>116</td>
<td>118</td>
<td>116</td>
<td>2</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>97</td>
<td>1</td>
<td>5F</td>
<td>119</td>
<td>120</td>
<td>119</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>97</td>
<td>1</td>
<td>5K</td>
<td>86</td>
<td>88</td>
<td>86</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>97</td>
<td>1</td>
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| SUM | 5837 | 112 | 180 |
Appendix K: Standardised Administration Procedures for Question-Answering

Preparation: Have available some reading material for students who finish early

1. Write your name and the date on the top of the sheet.

2. You will have 30 minutes to read the story and write full sentence answers to the questions you have. Write a number next to each question.

3. There are easy and hard questions all mixed together. If you come to a hard question, leave space next to that number and go on – if you have time at the end you can have another go at that question.

4. If you can’t read any words in the story, just ask and I’ll tell you what the word says. I cannot tell you if you have written the correct answer.

5. Just do your best with each question and try to work for the full thirty minutes.

6. Are there any questions?

7. You have 30 minutes from now to complete your work. If you finish early, read a book quietly at your desk (or go on with some other work the teacher has selected).

8. At the end of 30 minutes, collect all stories, questions and answer sheets.
Appendix L: Standardised Directions for Reading Fluency

The following directions and scoring were adapted from (Shinn, 1989, p.238)

Testing Materials and Preparation:

Have ready two reading passages (as used for question answering) for students to read from and copies of passages with cumulative word count for scoring.

Taping should begin before reading the oral directions (where necessary)

Oral directions to be read like a script to the student:

"Today you are going to do 2 minutes of reading for me

There are two passages, one story about a Tropical Paradise and one about Whales.

You will read each passage for one minute only.

I will be using a stopwatch to tell when the minute is up and I will be following along on my copy of the passages.

Try to read each word. If you come to a word and you don’t know it, I’ll tell it to you.

Read as quickly and carefully as you can for one minute on each passage.

When you read the first word, I’ll start timing. The first word for each passage is highlighted with yellow.

When you finish the first passage, just turn to the next passage and begin reading.

Are there any questions.

Start when you are ready."

Administration notes:

Begin timing when the student says the first word of each passage.

Follow along and mark any errors.

If a student stops or struggles on a word for more than 3 seconds, tell the student the word and mark it as an error. (Practice counting to three slowly for correct timing)

Place a line after the last word read and thank the student for reading to you.

After testing is completed, place the student’s record sheet in the administration folder, in sequence, and take out a new record sheet for the next student.
Scoring procedure:

1. Words read correctly are those words pronounced correctly given the reading context.
2. Repetitions of words are not counted as errors, but are not added as additional words.
3. Self corrections within 3 seconds are not counted as errors but are not added as additional words read.
4. Errors include:
   - mispronunciations
   - insertions
   - omissions, single words or groups of words
   - words provided by the tester after a 3 second latency.
5. Miss a line – counted as one error – deduct words in that line from the total word count.
6. Repeated errors:
   a) If a student makes the same error for a printed word, count this as one.
   b) If a student makes different errors for the same word, count each different error.
7. Total Words Read includes all words read, including errors (deduct omitted words or lines)
8. Total Errors includes all errors as detailed above.
9. Total Words Read Correctly = Total Words Read less Total Errors
Appendix M: Letters of Informed Consent

The following two letters of informed consent were used with principals of participating schools and with parents of student participants. Both letters were printed on university letterhead during the study.
A. Principal Letter of Informed Consent  

Dear Principal,

As part of a doctoral program of research at the University of Western Sydney Macarthur, the effectiveness of a reading comprehension program for year 5 students is being examined. I am writing to request your assistance in this research through the participation of teachers and students in your school. This study involves three schools and an intervention program in reading comprehension. The use of multiple schools and teachers increases the reliability that improvements in student performance can be attributed to the intervention and that the program will be successful in a variety of school settings. Some teachers will be involved in completing regular year 5 programs with additional documentation than would normally occur. Other teachers would implement the intervention program with their classes.

Students in classes will be required to complete initial pretesting and posttesting using measures of reading comprehension. The intervention program includes materials supplied by the researcher for 30 lessons of about 40 minutes duration. Lessons are taught at a rate of 3 per week for the program to be effective in improving student performance. To date, this program has undergone informal trials at schools in Sydney with favourable improvements in student performance and positive feedback from teachers.

All test results and information collected as part of this research will remain strictly confidential. Data will be coded so that names of schools, teachers and students involves are not able to be identified. Results will be used as part of journal publications, conference presentations and to assist further research in comprehension.

This research has the approval of University of Western Sydney Macarthur Ethics Committee and New South Wales Department of School Education. If you have any further questions about this research please contact Ms Gail Brown (Home Phone: 9484 1764). My supervisor in this work is Dr David Evans, Senior Lecturer in Special Education in the Faculty of Education and he can be contacted on 9772 – 9552.

This copy of the letter is for your records. If you would like to participate in this research, Please sign the duplicate copy, contact me and I will be happy to pick it up. Looking forward To hearing from you and working with you and your staff,

Yours sincerely,

Gail Brown MA (SpEd)
Doctoral Student, University of Western Sydney Macarthur

The ethical aspects of this study have been approved by the University of Western Sydney Macarthur Ethics Review Committee (Human Subjects). If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Ethics Review Committee through its Executive Officer (Telephone (046) 203582). Any complaint you make will be treated in confidence.
B. Parent Letter of Informed Consent

Dear Parent

As part of a doctoral program of research at the University of Western Sydney Macarthur, a research study is being conducted to evaluate a program of instruction in reading comprehension program for year 5 students. This research involves some initial pretesting in reading comprehension, a research-based intervention program and testing at the conclusion of the program. Testing involves written tasks in reading comprehension completed in class and individual measures of oral reading fluency. The program of instruction involves 30 lessons of about 40 minutes duration intended to teach students to write answers to comprehension questions. This program will be implemented by your child's regular year 5 classroom teacher who has agreed to participate in this research. To date, this program has undergone informal trials at schools in Sydney with favourable improvements in student performance and positive feedback from teachers.

Your consent for your child’s participation in this research is sought. Your child’s participation is voluntary and, should he or she wish, your child is able to withdraw from this research at any time. All results from this research will remain strictly confidential and data collected will only be accessed by the researcher Ms Gail Brown, and her supervisor, Dr David Evans, Senior Lecturer, University of Western Sydney Macarthur.

This research has been approved by the principal at your school, University of Western Sydney Macarthur Ethics Committee and New South Wales Department of School Education. If you have any further questions about this research please contact Ms Gail Brown or Dr David Evans, Senior Lecturer in Special Education, University of Western Sydney Macarthur. Results of this project will be made available to classroom teachers and schools, for their students. An executive summary will be provided to the Department of School Education for dissemination.

Would you please return the section of this letter below the dotted line as soon as possible to formally give approval for you son or daughter to participate.

Thank you

Gail Brown MA (SpEd)
Doctonal Student, University of Western Sydney Macarthur

-----------------------------------------------------------------------------------
Research in Reading Comprehension Year 5
I consent to my child, ...................................................... in class.................... to participate in the research in reading comprehension during 1997

............................................. Parent/ Guardian ............................................. Date

The ethical aspects of this study have been approved by the University of Western Sydney Macarthur Ethics Review Committee (Human Subjects). If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Ethics Review Committee through its Executive Officer (Telephone (046) 203582). Any complaint you make will be treated in confidence.
The following table was presented to all classroom teachers, Experimental and control, to ensure that the sequence of pretesting and posttesting was standardised for all classes.

**Testing Schedule for Reading Comprehension Research**

The following table outlines the sequence of used for pretesting and posttesting for all classes, the approximate time for each to be completed, whether the test is group or individual, and the person responsible for administering the test. Please ensure that you adhere to this schedule and that all testing is completed prior to lunch breaks. Times include handout out and collecting materials. Many thanks.

Table 1

**Testing Schedule**

<table>
<thead>
<tr>
<th>Pretest or Posttest</th>
<th>Time for Completion</th>
<th>Person Responsible</th>
<th>Type of Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral Reading Fluency</td>
<td>5-6 minutes</td>
<td>Researcher or Research Assistant</td>
<td>Individual</td>
</tr>
<tr>
<td>PAT Reading Comprehension</td>
<td>50 minutes</td>
<td>Class Teacher</td>
<td>Group, whole class</td>
</tr>
<tr>
<td>PAT Reading Vocabulary</td>
<td>approximately</td>
<td>Class Teacher</td>
<td>Group, whole class</td>
</tr>
<tr>
<td>Narrative Written Question-Answering</td>
<td>40 minutes</td>
<td>Class Teacher</td>
<td>Group, whole class</td>
</tr>
<tr>
<td>Factual Written Question-Answering</td>
<td>approximately</td>
<td>Class Teacher</td>
<td>Group, whole class</td>
</tr>
</tbody>
</table>
Table 2

*Duration of Testing Periods*

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Pretest Average Test Period</th>
<th>Posttest Average Test Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (4 classes)</td>
<td>10.75 days</td>
<td>9.50 days</td>
</tr>
<tr>
<td>Experimental (6 classes)</td>
<td>8.17 days</td>
<td>8.33 days</td>
</tr>
<tr>
<td>Total Sample (10 classes)</td>
<td>9.5 days</td>
<td>8.8 days</td>
</tr>
</tbody>
</table>

Table 3

*Pretesting Dates*

<table>
<thead>
<tr>
<th>Class</th>
<th>Pretest Begins</th>
<th>Pretest Ends</th>
<th>School Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>975K</td>
<td>July 21, 1997</td>
<td>August 7, 1997</td>
<td>10 school days</td>
</tr>
<tr>
<td>975F</td>
<td>July 18, 1997</td>
<td>August 7, 1997</td>
<td>13 school days</td>
</tr>
<tr>
<td>5B</td>
<td>February 16, 1998</td>
<td>March 12, 1998</td>
<td>19 school days</td>
</tr>
<tr>
<td>985K</td>
<td>February 17, 1998</td>
<td>March 3, 1998</td>
<td>11 school days</td>
</tr>
<tr>
<td>985F</td>
<td>February 16, 1998</td>
<td>March 5, 1998</td>
<td>13 school days</td>
</tr>
<tr>
<td>5A</td>
<td>February 9, 1998</td>
<td>February 12, 1998</td>
<td>4 school days</td>
</tr>
<tr>
<td>5N</td>
<td>February 10, 1998</td>
<td>February 12, 1998</td>
<td>3 school days</td>
</tr>
<tr>
<td>5T</td>
<td>February 10, 1998</td>
<td>February 12, 1998</td>
<td>3 school days</td>
</tr>
<tr>
<td>5H</td>
<td>June 16, 1998</td>
<td>June 29, 1998</td>
<td>10 school days</td>
</tr>
<tr>
<td>5S</td>
<td>June 15, 1998</td>
<td>June 25, 1998</td>
<td>9 school days</td>
</tr>
<tr>
<td>Class</td>
<td>Posttest Begins</td>
<td>Posttest Ends</td>
<td>School Days</td>
</tr>
<tr>
<td>-------</td>
<td>------------------</td>
<td>-----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>975K</td>
<td>November 26, 1997</td>
<td>December 9, 1997</td>
<td>10 school days</td>
</tr>
<tr>
<td>975F</td>
<td>November 26, 1997</td>
<td>December 9, 1997</td>
<td>10 school days</td>
</tr>
<tr>
<td>5B</td>
<td>June 12, 1998</td>
<td>June 16, 1998</td>
<td>5 school days</td>
</tr>
<tr>
<td>985K</td>
<td>June 22, 1998</td>
<td>June 30, 1998</td>
<td>7 school days</td>
</tr>
<tr>
<td>985F</td>
<td>June 19, 1998</td>
<td>July 3, 1998</td>
<td>10 school days</td>
</tr>
<tr>
<td>5A</td>
<td>June 18, 1998</td>
<td>June 30, 1998</td>
<td>9 school days</td>
</tr>
<tr>
<td>5N</td>
<td>June 22, 1998</td>
<td>June 29, 1998</td>
<td>6 school days</td>
</tr>
<tr>
<td>5T</td>
<td>June 23, 1998</td>
<td>June 30, 1998</td>
<td>6 school days</td>
</tr>
<tr>
<td>5H</td>
<td>October 21, 1998</td>
<td>November 9, 1998</td>
<td>14 school days</td>
</tr>
<tr>
<td>5S</td>
<td>October 22, 1998</td>
<td>November 5, 1998</td>
<td>11 school days</td>
</tr>
</tbody>
</table>
Table 5

**Summary of Research Phases for Treatment Groups**

<table>
<thead>
<tr>
<th>Intervention Group*</th>
<th>Comparison Group*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>Pretest</td>
</tr>
<tr>
<td>975F</td>
<td>13</td>
</tr>
<tr>
<td>985K</td>
<td>11</td>
</tr>
<tr>
<td>985F</td>
<td>13</td>
</tr>
<tr>
<td>School 2, 1998</td>
<td></td>
</tr>
<tr>
<td>5N</td>
<td>3</td>
</tr>
<tr>
<td>5T</td>
<td>3</td>
</tr>
<tr>
<td>School 3, 1998</td>
<td></td>
</tr>
<tr>
<td>5S</td>
<td>9</td>
</tr>
<tr>
<td>Average</td>
<td>8.7</td>
</tr>
<tr>
<td>Range</td>
<td>3 - 13</td>
</tr>
</tbody>
</table>

* All data are in school days
Appendix O: Interaction Calculations

This appendix documents the calculations used to determine the interaction effects at representative performance levels on the two relevant reading measures, standardized reading comprehension and narrative question-answering. Interaction calculation used the multilevel equation from Model 5 for each measure (see Chapter 7). For each significant interaction effect, the values were inserted for all variables into the relevant Model 5 equation. The predicted posttest values for each measure were calculated for mean performance and for performance at both one standard deviation above and one standard deviation below the mean. Calculated values (at mean, one standard deviation above and one standard deviation below) were plotted on graphs against the pretest performance. For treatment group, 1 was used for experimental and 0 for control groups, respectively.

These calculations involved the following equations for each measure:

For standardized reading comprehension:

\[
\text{Predicted Post Reading Comprehension} = 0.973 + 21.463 \text{ (Group)} + 0.632 \text{ (Pretest Comprehension)} + 0.216 \text{ (Pretest Vocabulary)} + 0.032 \text{ (Narrative Reading Fluency)} + 0.050 \text{ (Factual Reading Fluency)} - 0.158 \text{ (Group X Pretest Reading Comprehension)}.
\]

For narrative question-answering:

\[
\text{Predicted Post Narrative Question-Answering} = 2.806 + 2.818 \text{ (Group)} + 0.601 \text{ (Pretest Narrative Question-Answering)} + 0.002 \text{ (Narrative Reading Fluency)} + 0.009 \text{ (Pretest Reading Comprehension)} + 0.002 \text{ (Reading Vocabulary)} - 0.204 \text{ (Group X Pretest Narrative Question-Answering)}.
\]
For factual question-answering:

\[ \text{Predicted Post Factual Question-Answering} = 1.819 + 1.699 \times \text{(Group)} + 0.448 \times \text{(Pretest Factual Question-Answering)} + 0.008 \times \text{(Factual Reading Fluency)} + 0.002 \times \text{(Pretest Reading Comprehension)} + 0.015 \times \text{(Reading Vocabulary)} - 0.155 \times \text{(Group X Pretest Factual Question-Answering)}. \]

Results for each regression equation were:

Table 1

*Representative Scores for Reading Comprehension*

<table>
<thead>
<tr>
<th>Predicted Posttest Reading</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comprehension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One standard deviation below</td>
<td>51.39</td>
<td>37.92</td>
</tr>
<tr>
<td>Mean</td>
<td>72.91</td>
<td>64.24</td>
</tr>
<tr>
<td>One standard deviation above</td>
<td>94.43</td>
<td>90.56</td>
</tr>
</tbody>
</table>

Table 2

*Representative Scores for Narrative Question-Answering*

<table>
<thead>
<tr>
<th>Predicted Posttest Narrative</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question-Answering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One standard deviation below</td>
<td>8.68</td>
<td>7.25</td>
</tr>
<tr>
<td>Mean</td>
<td>9.89</td>
<td>8.82</td>
</tr>
<tr>
<td>One standard deviation above</td>
<td>11.11</td>
<td>10.40</td>
</tr>
</tbody>
</table>
Table 3

*Representative Scores for Factual Question-Answering*

<table>
<thead>
<tr>
<th>Predicted Posttest Factual</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question-Answering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One standard deviation below</td>
<td>6.61</td>
<td>5.04</td>
</tr>
<tr>
<td>Mean</td>
<td>8.00</td>
<td>6.47</td>
</tr>
<tr>
<td>One standard deviation above</td>
<td>9.39</td>
<td>7.91</td>
</tr>
</tbody>
</table>

Values used for Interaction Calculations were as follows, where means have been taken from results section for pretest performance (see Chapter 7, Preliminary Results)

Table 4

*Pretest Performance for Treatment Groups at Representative Levels for Reading*

*Comprehension and Question-Answering*

<table>
<thead>
<tr>
<th>Measures</th>
<th>Pretest Experiment</th>
<th>Pretest Control</th>
<th>Pretest Experiment</th>
<th>Pretest Control</th>
<th>Pretest Factual</th>
<th>Pretest Factual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>59.3</td>
<td>62.9</td>
<td>8.46</td>
<td>8.43</td>
<td>5.97</td>
<td>5.95</td>
</tr>
<tr>
<td>St Dev</td>
<td>26.9</td>
<td>27.8</td>
<td>2.11</td>
<td>1.98</td>
<td>1.5</td>
<td>1.56</td>
</tr>
<tr>
<td>+1 StDev</td>
<td>86.2</td>
<td>90.7</td>
<td>10.57</td>
<td>10.41</td>
<td>7.47</td>
<td>7.51</td>
</tr>
<tr>
<td>-1 StDev</td>
<td>32.4</td>
<td>35.1</td>
<td>6.35</td>
<td>6.45</td>
<td>4.47</td>
<td>4.39</td>
</tr>
</tbody>
</table>
Table 5

*Pretest Performance for Treatment Groups at Representative Levels for Reading Vocabulary and Reading Fluency*

<table>
<thead>
<tr>
<th>Measures</th>
<th>Pretest</th>
<th>Pretest</th>
<th>Pretest</th>
<th>Pretest</th>
<th>Pretest</th>
<th>Pretest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>Control</td>
<td>Experiment</td>
<td>Control</td>
<td>Experiment</td>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td>Reading</td>
<td>Narrative</td>
<td>Narrative</td>
<td>Factual</td>
<td>Factual</td>
<td></td>
</tr>
<tr>
<td>Vocab</td>
<td>Vocab</td>
<td>Fluency</td>
<td>Fluency</td>
<td>Fluency</td>
<td>Fluency</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>58.3</td>
<td>62.9</td>
<td>129.62</td>
<td>130.59</td>
<td>112.5</td>
<td>115.0</td>
</tr>
<tr>
<td>St Dev</td>
<td>25.7</td>
<td>25.5</td>
<td>41.7</td>
<td>42.5</td>
<td>37.7</td>
<td>37.7</td>
</tr>
<tr>
<td>+1 StDev</td>
<td>84.0</td>
<td>88.4</td>
<td>171.32</td>
<td>173.09</td>
<td>150.2</td>
<td>152.7</td>
</tr>
<tr>
<td>-1 StDev</td>
<td>32.6</td>
<td>37.4</td>
<td>87.92</td>
<td>88.09</td>
<td>74.8</td>
<td>77.3</td>
</tr>
</tbody>
</table>
Appendix P: Pretest Class Data

Pretest class data for ten classes were reported, including means and standard deviations. Pretest class means and standard deviations for all dependent variables were reported in the following six tables (Table 1-6), in the order that measures were presented in the results (see Chapter 7).

Table 1

Pretest Class Means and Standard Deviations for Reading Comprehension

<table>
<thead>
<tr>
<th>School</th>
<th>Class</th>
<th>Treatment</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>5E</td>
<td>Experimental</td>
<td>69.6</td>
<td>24.7</td>
</tr>
<tr>
<td></td>
<td>5J</td>
<td>Control</td>
<td>69.6</td>
<td>27.8</td>
</tr>
<tr>
<td></td>
<td>5F</td>
<td>Experimental</td>
<td>61.3</td>
<td>26.9</td>
</tr>
<tr>
<td></td>
<td>5K</td>
<td>Experimental</td>
<td>56.6</td>
<td>26.8</td>
</tr>
<tr>
<td></td>
<td>5B</td>
<td>Control</td>
<td>63.4</td>
<td>28.9</td>
</tr>
<tr>
<td>School 2</td>
<td>5N</td>
<td>Experimental</td>
<td>60.4</td>
<td>21.4</td>
</tr>
<tr>
<td></td>
<td>5T</td>
<td>Experimental</td>
<td>66.2</td>
<td>26.8</td>
</tr>
<tr>
<td></td>
<td>5A</td>
<td>Control</td>
<td>75.0</td>
<td>21.1</td>
</tr>
<tr>
<td>School 3</td>
<td>5S</td>
<td>Experimental</td>
<td>51.0</td>
<td>29.8</td>
</tr>
<tr>
<td></td>
<td>5H</td>
<td>Control</td>
<td>56.4</td>
<td>31.4</td>
</tr>
</tbody>
</table>
Table 2

*Pretest Class Means and Standard Deviations for Narrative Question-Answering*

<table>
<thead>
<tr>
<th>School</th>
<th>Class</th>
<th>Treatment</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>5E</td>
<td>Experimental</td>
<td>8.78</td>
<td>1.83</td>
</tr>
<tr>
<td></td>
<td>5J</td>
<td>Control</td>
<td>9.02</td>
<td>1.84</td>
</tr>
<tr>
<td></td>
<td>5F</td>
<td>Experimental</td>
<td>8.79</td>
<td>2.05</td>
</tr>
<tr>
<td></td>
<td>5K</td>
<td>Experimental</td>
<td>8.02</td>
<td>1.78</td>
</tr>
<tr>
<td></td>
<td>5B</td>
<td>Control</td>
<td>8.33</td>
<td>2.23</td>
</tr>
<tr>
<td>School 2</td>
<td>5N</td>
<td>Experimental</td>
<td>8.28</td>
<td>2.52</td>
</tr>
<tr>
<td></td>
<td>5T</td>
<td>Experimental</td>
<td>8.52</td>
<td>2.34</td>
</tr>
<tr>
<td></td>
<td>5A</td>
<td>Control</td>
<td>8.11</td>
<td>1.50</td>
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</tr>
<tr>
<td></td>
<td>5H</td>
<td>Control</td>
<td>8.32</td>
<td>2.16</td>
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</tbody>
</table>
Table 3

*Pretest Class Means and Standard Deviations for Factual Question-Answering*

<table>
<thead>
<tr>
<th>School</th>
<th>Class</th>
<th>Treatment</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>5E</td>
<td>Experimental</td>
<td>6.27</td>
<td>1.29</td>
</tr>
<tr>
<td></td>
<td>5J</td>
<td>Control</td>
<td>5.82</td>
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<td></td>
<td>5K</td>
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<td>5.94</td>
<td>1.33</td>
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<tr>
<td></td>
<td>5B</td>
<td>Control</td>
<td>5.90</td>
<td>1.81</td>
</tr>
<tr>
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<td>Experimental</td>
<td>5.76</td>
<td>1.78</td>
</tr>
<tr>
<td></td>
<td>5T</td>
<td>Experimental</td>
<td>5.35</td>
<td>1.62</td>
</tr>
<tr>
<td></td>
<td>5A</td>
<td>Control</td>
<td>5.86</td>
<td>1.33</td>
</tr>
<tr>
<td>School 3</td>
<td>5S</td>
<td>Experimental</td>
<td>6.02</td>
<td>1.72</td>
</tr>
<tr>
<td></td>
<td>5H</td>
<td>Control</td>
<td>6.19</td>
<td>1.56</td>
</tr>
</tbody>
</table>
Table 4

Pretest Class Means and Standard Deviations for Reading Vocabulary

<table>
<thead>
<tr>
<th>School</th>
<th>Class</th>
<th>Treatment</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>5E</td>
<td>Experimental</td>
<td>68.50</td>
<td>23.16</td>
</tr>
<tr>
<td></td>
<td>5J</td>
<td>Control</td>
<td>60.41</td>
<td>23.14</td>
</tr>
<tr>
<td></td>
<td>5F</td>
<td>Experimental</td>
<td>59.61</td>
<td>25.90</td>
</tr>
<tr>
<td></td>
<td>5K</td>
<td>Experimental</td>
<td>56.44</td>
<td>23.21</td>
</tr>
<tr>
<td></td>
<td>5B</td>
<td>Control</td>
<td>63.83</td>
<td>28.21</td>
</tr>
<tr>
<td>School 2</td>
<td>5N</td>
<td>Experimental</td>
<td>53.74</td>
<td>26.77</td>
</tr>
<tr>
<td></td>
<td>5T</td>
<td>Experimental</td>
<td>55.58</td>
<td>25.56</td>
</tr>
<tr>
<td></td>
<td>5A</td>
<td>Control</td>
<td>67.27</td>
<td>22.29</td>
</tr>
<tr>
<td>School 3</td>
<td>5S</td>
<td>Experimental</td>
<td>54.35</td>
<td>28.43</td>
</tr>
<tr>
<td></td>
<td>5H</td>
<td>Control</td>
<td>60.33</td>
<td>27.52</td>
</tr>
</tbody>
</table>
Table 5

*Pretest Class Means and Standard Deviations for Narrative Reading Fluency*

<table>
<thead>
<tr>
<th>School</th>
<th>Class</th>
<th>Treatment</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>5E</td>
<td>Experimental</td>
<td>153.93</td>
<td>34.23</td>
</tr>
<tr>
<td></td>
<td>5J</td>
<td>Control</td>
<td>147.55</td>
<td>33.49</td>
</tr>
<tr>
<td></td>
<td>5F</td>
<td>Experimental</td>
<td>129.65</td>
<td>36.72</td>
</tr>
<tr>
<td></td>
<td>5K</td>
<td>Experimental</td>
<td>123.26</td>
<td>34.51</td>
</tr>
<tr>
<td></td>
<td>5B</td>
<td>Control</td>
<td>119.79</td>
<td>43.85</td>
</tr>
<tr>
<td>School 2</td>
<td>5N</td>
<td>Experimental</td>
<td>114.41</td>
<td>42.08</td>
</tr>
<tr>
<td></td>
<td>5T</td>
<td>Experimental</td>
<td>123.73</td>
<td>51.20</td>
</tr>
<tr>
<td></td>
<td>5A</td>
<td>Control</td>
<td>130.36</td>
<td>44.00</td>
</tr>
<tr>
<td>School 3</td>
<td>5S</td>
<td>Experimental</td>
<td>129.85</td>
<td>42.84</td>
</tr>
<tr>
<td></td>
<td>5H</td>
<td>Control</td>
<td>128.56</td>
<td>44.31</td>
</tr>
</tbody>
</table>
Table 6

*Pretest Class Means and Standard Deviations for Factual Reading Fluency*

<table>
<thead>
<tr>
<th>School</th>
<th>Class</th>
<th>Treatment</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>5E</td>
<td>Experimental</td>
<td>132.13</td>
<td>28.61</td>
</tr>
<tr>
<td></td>
<td>5J</td>
<td>Control</td>
<td>123.09</td>
<td>28.22</td>
</tr>
<tr>
<td></td>
<td>5F</td>
<td>Experimental</td>
<td>107.65</td>
<td>36.24</td>
</tr>
<tr>
<td></td>
<td>5K</td>
<td>Experimental</td>
<td>105.59</td>
<td>34.93</td>
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<tr>
<td></td>
<td>5B</td>
<td>Control</td>
<td>104.69</td>
<td>42.59</td>
</tr>
<tr>
<td>School 2</td>
<td>5N</td>
<td>Experimental</td>
<td>101.15</td>
<td>36.34</td>
</tr>
<tr>
<td></td>
<td>5T</td>
<td>Experimental</td>
<td>114.5</td>
<td>46.76</td>
</tr>
<tr>
<td></td>
<td>5A</td>
<td>Control</td>
<td>115.59</td>
<td>36.46</td>
</tr>
<tr>
<td>School 3</td>
<td>5S</td>
<td>Experimental</td>
<td>112.46</td>
<td>37.50</td>
</tr>
<tr>
<td></td>
<td>5H</td>
<td>Control</td>
<td>118.8</td>
<td>39.47</td>
</tr>
</tbody>
</table>
Appendix Q: Model 1 and Model 2 Multilevel Equations

Establishing similar performance across classes prior to intervention

This first set of results examined the data for all classes and all students for pretest differences on all dependent variables. The six variables included pretest performance on PAT Reading Comprehension, PAT Reading Vocabulary, Written Narrative Question-Answering, Written Factual Question-Answering, Narrative Reading Fluency and Factual Reading Fluency. Each variable was analysed using Model 1, the “basic variance components model” (Rasbash et al., 2002, p.98). This model tested for differences at two levels, the class level and the student level. For all variables, there were significant differences at the student level, but no significant differences at the class level.

The significance of any differences was determined by a standard t score calculated by comparing the residual variance at either level, with the corresponding standard error at that level. Class level differences analysed results from the $u_{ij}$ term. Student level differences analysed results from the $e_{ij}$ term. Each of these variables was analysed in the same way.

Results were presented for each variable, in the order cited above, in the table below (Table 1, Appendix Q). Results from MlwiN, for the basic components model for all variables were reported below.

These results reported in Tables 1 to 3 below and in the multilevel regression equations that follow for each measure. These results were presented in the same order as the results chapter (see Chapter 7), except that reading comprehension and vocabulary were presented together. Firstly, reading comprehension and reading vocabulary were presented, followed by written question-answering measures, and reading fluency. Results from the MlwiN software for Model regression equations for all measures were included with each measure.
Table 1

Basic Component Model MlwiN Results for Pretest PAT Reading Comprehension and PAT Reading Vocabulary

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>PAT Reading Comprehension</th>
<th>PAT Reading Vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept: Mean</td>
<td>60.75</td>
<td>60.20</td>
</tr>
<tr>
<td></td>
<td>(Standard Deviation)</td>
<td>(1.57)</td>
</tr>
<tr>
<td></td>
<td>(2.25)</td>
<td></td>
</tr>
<tr>
<td>Class Level Differences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Class Variance</td>
<td>23.63</td>
<td>0.12</td>
</tr>
<tr>
<td>Standard Error</td>
<td>22.70</td>
<td>11.18</td>
</tr>
<tr>
<td>Standard t score</td>
<td>1.04</td>
<td>0.01</td>
</tr>
<tr>
<td>Student Level Differences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Student Variance</td>
<td>716.71</td>
<td>655.36</td>
</tr>
<tr>
<td>Standard Error</td>
<td>63.22</td>
<td>57.80</td>
</tr>
<tr>
<td>Standard t score</td>
<td>11.34*</td>
<td>11.34*</td>
</tr>
</tbody>
</table>

* significant at p < 0.01.
Pretest performance on PAT Reading Comprehension and PAT Reading Vocabulary are reported in Table 1, above. PAT Reading Comprehension results reported a non-significant standard t value, $t = 1.04, p > 0.05$. This confirmed there were no differences at the class level, at pretest, and that highly significant differences existed between students at pretest on PAT Reading Comprehension. Pretest performance on PAT Reading Vocabulary, also shown in Table 1 above, resulted in a non-significant standard t value, $t = 0.011, p > 0.05$. This confirmed there were no significant differences at the class level. Significant differences between students on the PAT Reading Vocabulary at pretest were shown by the same standard t score value. Pretest performance in Oral Reading Fluency on Tropical (a narrative passage) at the class level resulted in a non-significant standard t value, $t = 1.18, p > 0.05$. 
$\text{COMPREP}_{ij} \sim N(XB, \Omega)$
$\text{COMPREP}_{ij} = \beta_0 + \text{CONS}$
$\beta_0 = 60.753(2.250) + \mu_{0j} + e_{0j}$

$\begin{bmatrix} \mu_{0j} \\ \epsilon_{0j} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 23.629(22.733) \end{bmatrix}$

$\begin{bmatrix} \epsilon_{0j} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 716.713(63.220) \end{bmatrix}$

$-2\text{loglikelihood(IQLS Deviance)} = 2519.453 (267 \text{ of 267 cases in use})$

*Figure 1. Model 1 MlwiN Results for PAT Reading Comprehension*

$\text{VOCPREP}_{ij} \sim N(XB, \Omega)$
$\text{VOCPREP}_{ij} = \beta_0 + \text{CONS}$
$\beta_0 = 60.019(1.570) + \mu_{0j} + e_{0j}$

$\begin{bmatrix} \mu_{0j} \\ \epsilon_{0j} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 0.117(11.176) \end{bmatrix}$

$\begin{bmatrix} \epsilon_{0j} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 655.362(57.801) \end{bmatrix}$

$-2\text{loglikelihood(IQLS Deviance)} = 2489.306 (267 \text{ of 267 cases in use})$

*Figure 2. Model 1 MlwiN Results for PAT Reading Vocabulary*
Table 2

Model I Mwire Results for Pretest Written Narrative and Factual Question-Answering

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Narrative Question-Answering</th>
<th>Factual Question-Answering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept: Mean</td>
<td>8.45</td>
<td>5.96</td>
</tr>
<tr>
<td>(Standard Deviation)</td>
<td>(0.13)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>Class Level Differences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Class Variance</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Standard t score</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Student Level Differences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Student Variance</td>
<td>4.22</td>
<td>2.30</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.37</td>
<td>0.020</td>
</tr>
<tr>
<td>Standard t score</td>
<td>11.55*</td>
<td>11.57*</td>
</tr>
</tbody>
</table>

* significant at p < 0.01.
The student level differences were calculated from comparing the residual variance with the standard error at the student level (4.22 / 0.37). Differences at the student level were significant, $t = 11.55, p < 0.01$. Therefore, at pretest, highly significant differences existed between students and no significant differences existed between classes on Tropical Question-Answering. Similarly, for Pretest Whale Question-Answering, also shown in Table 3 above, similar analyses and results indicated that, at pretest, significant differences existed between students and no statistically significant differences existed between classes.

To summarise, there were identical patterns of results for all variables. Across all six pretest variables, there were no significant differences between any of the ten classes in the two treatment groups. However, across all six pretest variables, there were statistically significant differences at the student level. Therefore, while mean class performance levels were similar, student differences existed within and across classes.
TROPPREQ_{ij} \sim N(\mathbf{X}_B, \Omega) \\
TROPPREQ_{ij} = \beta_{0ij} \text{CON} \\
\beta_{0ij} = 8.451(0.126) + \nu_{0j} + e_{0ij} \\

\begin{bmatrix} \nu_{0j} \\ e_{0ij} \end{bmatrix} \sim N(0, \Omega_{u}) : \Omega_{u} = \begin{bmatrix} 0.000(0.000) \\ 4.217(0.365) \end{bmatrix} \\

-2*\text{loglikelihood(IGLS Deviance)} = 1141.942 (267 of 267 cases in use)

Figure 3. Model 1 MLwiN Results for Narrative Question-Answering

WHPREQ_{ij} \sim N(\mathbf{X}_B, \Omega) \\
WHPREQ_{ij} = \beta_{0ij} \text{CON} \\
\beta_{0ij} = 5.963(0.093) + \nu_{0j} + e_{0ij} \\

\begin{bmatrix} \nu_{0j} \\ e_{0ij} \end{bmatrix} \sim N(0, \Omega_{u}) : \Omega_{u} = \begin{bmatrix} 0.000(0.000) \\ 2.302(0.200) \end{bmatrix} \\

-2*\text{loglikelihood(IGLS Deviance)} = 980.328 (267 of 267 cases in use)

Figure 4. Model 1 MLwiN Results for Factual Question-Answering
Table 3

*Model 1 MlwiN Results for Pretest Narrative Reading Fluency and Factual Reading Fluency*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Narrative Reading Fluency</th>
<th>Factual Reading Fluency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept: Mean</td>
<td>130.03</td>
<td>113.46</td>
</tr>
<tr>
<td>(Standard Deviation)</td>
<td>(3.67)</td>
<td>(2.92)</td>
</tr>
<tr>
<td>Class Level Differences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Class Variance</td>
<td>71.07</td>
<td>33.52</td>
</tr>
<tr>
<td>Standard Error</td>
<td>60.22</td>
<td>38.27</td>
</tr>
<tr>
<td>Standard t score</td>
<td>1.18</td>
<td>0.88</td>
</tr>
<tr>
<td>Student Level Differences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Student Variance</td>
<td>1679.81</td>
<td>1379.29</td>
</tr>
<tr>
<td>Standard Error</td>
<td>148.18</td>
<td>121.68</td>
</tr>
<tr>
<td>Standard t score</td>
<td>11.34*</td>
<td>11.34*</td>
</tr>
</tbody>
</table>

Note: * significant at p < 0.01.
At the student level, Table 2 showed a highly significant standard t value result, $t = 11.34$, $p < 0.01$. Similarly, Table 2 also reported results for Pretest Factual Reading Fluency. At the class level, there is a non-significant standard t value, $t = 0.876$, $p > 0.05$. This confirmed there were no significant differences between the classes at pretest. At the student level, a highly significant standard t value, $t = 11.336$, $p < 0.01$. Therefore, there were highly significant differences between students and no significant differences at the class level on Pretest Narrative and Factual Reading Fluency. Pretest Narrative Question-Answering, basic components variance model as shown in Table 2 above, reported class level differences that varied about a mean of zero, with variance of zero and standard error of zero. This indicated differences at the student level.
TPREWRC$_{ij} \sim N(YB, \Omega)$

TPREWRC$_{ij} = \beta_{0ij} \text{CONS}$

$\beta_{0ij} = 130.029(3.666) + \nu_{0ij} + e_{0ij}$

$\begin{bmatrix} \nu_{0ij} \\ e_{0ij} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 71.059(60.305) \end{bmatrix}$

$\begin{bmatrix} \nu_{0ij} \\ e_{0ij} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 1679.815(148.176) \end{bmatrix}$

$-2*\text{loglikelihood(IGLS Deviance)} = 2748.115(267 \text{ of 267 cases in use})$

*Figure 5. Model 1 MlwiN Results for Narrative Reading Fluency*

WPREWRC$_{ij} \sim N(YB, \Omega)$

WPREWRC$_{ij} = \beta_{0ij} \text{CONS}$

$\beta_{0ij} = 113.457(2.922) + \nu_{0ij} + e_{0ij}$

$\begin{bmatrix} \nu_{0ij} \\ e_{0ij} \end{bmatrix} \sim N(0, \Omega_u) : \Omega_u = \begin{bmatrix} 33.500(38.366) \end{bmatrix}$

$\begin{bmatrix} \nu_{0ij} \\ e_{0ij} \end{bmatrix} \sim N(0, \Omega_e) : \Omega_e = \begin{bmatrix} 1379.296(121.667) \end{bmatrix}$

$-2*\text{loglikelihood(IGLS Deviance)} = 2692.934(267 \text{ of 267 cases in use})$

*Figure 6. Model 1 MlwiN Results for Factual Reading Fluency*
Model 2 examined the data for pretest differences between treatment groups. For all measures, this extended Model 1 equations by adding a term for the group and running the model. The critical test was found in the coefficient of the group term. The comparison was a t-test, and all comparisons were non-significant, confirming the lack of pretest differences. Table 4 (below) summarises the results, and is followed by the MIwiN Results for each measure.

Table 4

MIwiN Model 2 Results Summary

<table>
<thead>
<tr>
<th>Measure</th>
<th>Group Term Coefficient</th>
<th>t-test Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading Comprehension</td>
<td>-3.703 (4.488)</td>
<td>0.825</td>
</tr>
<tr>
<td>Reading Vocabulary</td>
<td>-4.591 (3.225)</td>
<td>1.424</td>
</tr>
<tr>
<td>Narrative Question-Answering</td>
<td>0.034 (0.260)</td>
<td>0.131</td>
</tr>
<tr>
<td>Factual Question-Answering</td>
<td>0.020 (0.192)</td>
<td>0.104</td>
</tr>
<tr>
<td>Narrative Reading Fluency</td>
<td>-1.737 (7.521)</td>
<td>0.231</td>
</tr>
<tr>
<td>Factual Reading Fluency</td>
<td>-2.792 (5.971)</td>
<td>0.468</td>
</tr>
</tbody>
</table>

None of the t-tests was significant, confirmed the lack of pretest differences.
\[ \text{COMPREP}_{ij} \sim N(XB, \Omega) \]
\[ \text{COMPREP}_{ij} = \beta_{0j} \text{CONS} + 3.703(4.488)\text{GROUP}_j \]
\[ \beta_{0j} = 63.025(3.520) + u_{0j} + e_{0j} \]

\[
\begin{bmatrix} u_{0j} \\ e_{0j} \end{bmatrix} \sim N(0, \Omega) : \Omega_u = \begin{bmatrix} 20.708(21.436) \end{bmatrix}
\]
\[
\begin{bmatrix} e_{0j} \end{bmatrix} \sim N(0, \Omega) : \Omega_e = \begin{bmatrix} 716.525(63.202) \end{bmatrix}
\]

\[-2 \times \text{loglikelihood(IGLS Deviance)} = 2518.790(267 \text{ of } 267 \text{ cases in use})\]

\text{Figure 7. MlwiN Model 2 Results for PAT Reading Comprehension}

\[ \text{VOCPREP}_{ij} \sim N(XB, \Omega) \]
\[ \text{VOCPREP}_{ij} = \beta_{0j} \text{CONS} + 4.591(3.225)\text{GROUP}_j \]
\[ \beta_{0j} = 62.890(2.551) + u_{0j} + e_{0j} \]

\[
\begin{bmatrix} u_{0j} \\ e_{0j} \end{bmatrix} \sim N(0, \Omega) : \Omega_u = \begin{bmatrix} 0.000(0.000) \end{bmatrix}
\]
\[
\begin{bmatrix} e_{0j} \end{bmatrix} \sim N(0, \Omega) : \Omega_e = \begin{bmatrix} 650.542(56.307) \end{bmatrix}
\]

\[-2 \times \text{loglikelihood(IGLS Deviance)} = 2487.288(267 \text{ of } 267 \text{ cases in use})\]

\text{Figure 8. MlwiN Model 2 Results for PAT Reading Vocabulary}
TROPPREQ\textsubscript{ij} \sim N(X\beta, \Omega)
TROPPREQ\textsubscript{ij} = \beta_{0ij} \text{CONS} + 0.034(0.260)\text{GROUP}_j
\beta_{0ij} = 8.430(0.205) + u_{0ij} + \epsilon_{0ij}

\begin{bmatrix} u_{0ij} \\ \epsilon_{0ij} \end{bmatrix} \sim N(0, \Omega) : 
\begin{bmatrix} \Omega_u \\ \Omega_\epsilon \end{bmatrix} = 
\begin{bmatrix} 0.000(0.000) \\ 4.216(0.365) \end{bmatrix}

-2*\text{loglikelihood} (IGLS Deviance) = 1141.925 (267 of 267 cases in use)

Figure 9. MlwiN Model 2 Results for Narrative Question-Answering

WHPREQ\textsubscript{ij} \sim N(X\beta, \Omega)
WHPREQ\textsubscript{ij} = \beta_{0ij} \text{CONS} + 0.020(0.192)\text{GROUP}_j
\beta_{0ij} = 5.950(0.152) + u_{0ij} + \epsilon_{0ij}

\begin{bmatrix} u_{0ij} \\ \epsilon_{0ij} \end{bmatrix} \sim N(0, \Omega) : 
\begin{bmatrix} \Omega_u \\ \Omega_\epsilon \end{bmatrix} = 
\begin{bmatrix} 0.000(0.000) \\ 2.302(0.199) \end{bmatrix}

-2*\text{loglikelihood} (IGLS Deviance) = 980.317 (267 of 267 cases in use)

Figure 10. MlwiN Model 2 Results for Factual Question-Answering
TPREWRC_{ij} \sim N(XB, \Omega) \\
TPREWRC_{ij} = \beta_{0ij} \text{CONS} + -1.737(7.521)\text{GROUP}_j \\
\beta_{0ij} = 131.093(5.887) + \mu_{0j} + \epsilon_{0ij}

\begin{bmatrix} \mu_{0j} \\ \epsilon_{0ij} \end{bmatrix} \sim N(0, \begin{bmatrix} \Omega_u \\ \Omega_e \end{bmatrix}) \\
\Omega_u = \begin{bmatrix} 70.929(60.266) \end{bmatrix} \\
\Omega_e = \begin{bmatrix} 1679.535(148.179) \end{bmatrix} \\

-2^*\text{loglikelihood}(IGLS Deviance) = 2748.062(267 \text{ of } 267 \text{ cases in use})

Figure 11. MlwiN Model 2 Results for Narrative Reading Fluency

WPREWRC_{ij} \sim N(XB, \Omega) \\
WPREWRC_{ij} = \beta_{0ij} \text{CONS} + -2.792(5.971)\text{GROUP}_j \\
\beta_{0ij} = 115.177(4.688) + \mu_{0j} + \epsilon_{0ij}

\begin{bmatrix} \mu_{0j} \\ \epsilon_{0ij} \end{bmatrix} \sim N(0, \begin{bmatrix} \Omega_u \\ \Omega_e \end{bmatrix}) \\
\Omega_u = \begin{bmatrix} 32.450(37.857) \end{bmatrix} \\
\Omega_e = \begin{bmatrix} 1378.803(121.628) \end{bmatrix} \\

-2^*\text{loglikelihood}(IGLS Deviance) = 2692.716(267 \text{ of } 267 \text{ cases in use})

Figure 12. MlwiN Model 2 Results for Factual Reading Fluency