Science and Mathematics Education Centre

Literacy Challenges Faced by Students Using Scientific Texts

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

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Date: 14 June 2011

ABSTRACT

Student perceptions of science text impact on their ability to read and understand; highly developed literacy skills are needed to understand the complex language, and scientific descriptions.

Textbooks play a big role in science education: these include complex text features, such as diagrams, charts, tables etc and offer many distractions for students in understanding the information presented here. The skills are also different from those required to read and understand fiction text.

The study investigated students' perceptions and attitudes of changing text types (fiction to non-fiction) in their transition to secondary school. It also identified challenges they faced in making meaning of science text. There was also a focus on the impact on student achievement as a result of targeted action with identified student groups around the use of non-fiction text in the classroom.

The findings included higher achievement gains for the targeted groups of students, and improved achievement for students in the study. Students were reported to be engaged more fully in the classroom and enjoying learning science as their skills developed. Students, however, appeared to show more enjoyment in reading fiction compared to non-fiction text.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND TO STUDY

Students are supposed to be able to read and write when they enter their first year at secondary level of education, but teachers would argue that this is not always apparent in science classrooms.

Students' perceptions of science texts impact on their ability to read and understand; highly developed literacy skills are needed to understand the complex language and scientific descriptions.

Textbooks play a big role in science education: these include complex text features, such as diagrams, charts, tables etc and offer many distractions for students in understanding the information presented here. The skills are also different from those required to read and understand fiction text.

The study is intended to investigate students' perceptions of and attitudes to changing text forms (fiction to non-fiction) as they transition to secondary school, as well as identify the challenges they face in making meaning of science text. It is also proposed to focus on the impact on student achievement as a result of targeted action with identified student groups around the use of non-fiction text in the classroom.

The study was carried out in five secondary schools in the Otago/ Southland region of New Zealand: these schools had indicated they were interested in identifying the literacy challenges that students faced and wanted to participate in the study. The schools all elected to make literacy a focus in their own professional development programme.

The five schools are all co-educational schools: two schools are in the urban area of Invercargill in the Southland region and three schools are in the urban area of Dunedin in the Otago region. These schools range in size: from about 400 to 1200 pupils, and ranging from 2 to 7 in decile ratings. The Ministry of Education (2009) defines a school's Decile as "indicating the extent to which it draws its students from low socio-economic communities". Decile 1 schools are the 10% of schools with the highest proportion of students from low socio-economic communities. Decile 10 schools are the 10% of schools with the lowest proportion of these students. Therefore, we have a range of schools which could impact on the achievement levels of its students.

In each school, all year 9 students were tested and the researcher worked with one year 9 group, named the focus class, to address the gaps identified through the testing and to provide some data around targeted interventions in literacy in science. It also allowed a comparison to be made between the focus class and the whole cohort to see if there was any improvement in achievement for students in the focus class. This was part of the professional development carried out with the science departments of all schools throughout a year.

Data were gathered from pre-tests, analysed and used with the science departments to identify gaps in understanding and to develop some activities to address these gaps. The outcomes of these activities were to build students' literacy skills and assist in improving achievement for them in this area. Data were also gathered from post-tests later in the year and made it possible to compare results and determine the impact on student achievement for all students. Additional information gathered during the test times allowed comparisons to be made by gender, ethnicity and between schools.

1.2 AIM AND OBJECTIVES

Therefore the overall aim of this research was to identify and address the literacy challenges that students face in reading science texts and determine whether it was possible to make an impact on their achievement with increased understanding of those texts.

To achieve this aim the following objectives were derived:

- to identify the literacy challenges students face in using any scientific text at year 9 level;
- to investigate the perceptions and attitudes students have in changing text types, fiction (narrative text) to non-fiction (science text);
- to track student achievement with targeted groups of students using standardized testing methods; and
- to discuss the implications and meanings for student learning in the use of scientific text.

To guide the research the following research questions were framed:

1. What literacy challenges does science text present to students and what impact does this have on their attitudes to reading?
2. What are the differences in reading science text from other types of text that students may have read previously during their primary education?
3. What impact does the understanding of science text have on students' achievement, as assessed by use of a New Zealand standardized assessment tool (asTTle), the diagnostic literacy assessment (DLA), and attitudes to reading?

4. Can targeted interventions in literacy impact on student achievement, as assessed by asTTle and the DLA, and attitudes to reading science text?

With these questions in mind, research was carried out in the areas of science texts, literacy challenges presented to students, the difference between science text and narrative text and the impact on student achievement. The results of the research may have implications for the texts that are used in teaching across the curriculum, especially in science.

1.3 OVERVIEW OF METHODOLOGY

The research investigated students' perceptions and attitudes of changing text forms, as they attempted to make meaning of the science text. The problem was investigated by surveying over 300 students from five different schools. The schools and students were from the southern region of New Zealand where the researcher was working as a literacy facilitator in secondary schools. The student samples were from the year 9 cohorts of different types of schools: urban and rural, small and large and of different decile ratings.

A combined quantitative and qualitative approach to the research design allowed this study to incorporate a range of methods to gain the data with which to attempt to make some meaning or understand the problem. Quantitative data were collected from over 300 students in order to identify what the students' perceptions and attitudes were toward pieces of non-fiction and fiction text. Analysis of the data indicated the differences students faced between the two texts.

Through the survey of students' perceptions and attitudes toward narrative and science texts it was hoped to identify whether their preferences for types of text supported the findings from the testing. Students' perception and attitude toward texts allowed for the target group to receive instruction in identified aspects of understanding. Data from the pre-attitude survey gave an understanding of the problem which informed the researcher's actions in professional development with the teachers also. It also showed whether attitudes could be linked to student achievement.

Students were tested using two passages of text, one narrative (fiction) and one science (non-fiction), which was linked to the theory that students had difficulty in changing text type, especially on entering year 9 at secondary school. Test construction of a diagnostic literacy assessment, which was originally developed by the national secondary literacy facilitators in New Zealand (McDonald & Thornley, 2002), had been extensively practised by the researcher. The validity of the information was then supported by the attitudes and perceptions survey of students.

Changes or improvements in student achievement over the year were measured through the use of a standardized assessment tool, Assessment Tool for Teaching and Learning (asTTle). The scores for each participating student were recorded in pre- and post-tests in 2009 which used a range of narrative (fiction) and science (non-fiction) texts in the tests.

Data were generated at the beginning and end of the year in 2009. The pre-tests were carried out in February 2009 – both the diagnostic literacy tests and the student surveys – and the post-tests in early November 2009. The target groups (one class in every school which was negotiated with the school itself) received instruction through the year, whereas the rest of the students received no explicit instruction. The researcher gathered all the data and ensured that conditions for administering all the tests were the same in each school.

Data from the diagnostic literacy assessments was summarized: checking of data was essential to ensure validity. Analysis was then carried out to ascertain whether there were quality data to answer the research questions, support the sampling strategies, and identify themes.

Analysis of the student surveys was similar to that of the questionnaires; themes were identified and collated. The survey allowed the researcher to collect directly from participants, informing on certain perspectives that could be presented. Any new themes from the surveys were grouped and separated from what you would expect to learn. Contrasting views were expressed as well as the reinforcing of shared views.

The quantitative data were analyzed first to get a feeling for the participants, and then the qualitative data. All the data was pre-coded to allow for ease of entering data and also for grouping or identifying common themes arising from the data. Qualitative data obtained through surveys also added to issues or themes and this helped to make clear links to the research questions.

1.4 SIGNIFICANCE

In particular, this study should help to improve the approaches the researcher will take in working with targeted groups of students in the future. It is hoped to add knowledge of students' interpretation of text and the use of strategies that can be used to improve this. Science teachers could be helped to address the gaps in understanding science text that students have when entering year 9.

Through this study it is hoped to identify what will make students more successful as readers and writers in science. Overall, it is hoped that the results obtained in this study would have value for others working in the field of secondary literacy through demonstrating a successful way of working with schools and students to raise student achievement.

1.5 LIMITATIONS

In order to produce valid and reliable data, attempts were made to gather the data in a similar manner from the five different schools. However, there were limitations in using the attitude survey as there could be no guarantees that students were thoughtful in their responses. This was thought to depend on when students were asked to complete the survey. The instructions asked teachers to give these attitude surveys in a lesson following the DLA tests but it was possible that due to time constraints they gave them directly following the tests. For some students this could have put more pressure on them and the survey may have been completed in a superficial manner. The validity depends on the honesty of the participants to respond as required. The information gathered from the attitude survey gave insight into what students thought but was interpreted by the researcher so may not necessarily have reflected what the student actually meant at the time.

1.6 OVERVIEW OF THESIS

The thesis is divided into seven chapters. Chapter 1 places the study in the context of New Zealand secondary schools, and in schools in the southern region of New Zealand. The study involved working with science teachers to integrate literacy skills into the teaching of science. The aim of the study was stated and the research questions introduced. The significance of the study was also outlined.

The literature regarding scientific literacy is examined in Chapter 2, as well as exploring the different text types of narrative and expository text that students are required to read and make meaning from. In addition, literature related to the attitudes of students to different types of text as well as the possible impact on achievement is also examined.

Chapter 3 presents the research design and methodology used in this research. The sampling method, data collection and data analysis of the two phases of testing are described and justified. Ethical considerations are also noted.

Chapters 4 reports on the consistency of the tools used to gather the data from the schools and students through the use of standardized data (asTTle), a diagnostic literacy assessment tool and an attitude survey. The findings from both pre- and post-tests are presented in this chapter. Chapter 5 describes the targeted interventions with groups of students from the schools in the study, and presents the results for each group from four of the five schools.

Chapter 6 includes a discussion of the findings in relation to the differences that students face in making meaning from different types of text, and particularly how this can impact on their attitude and achievement in science.

Chapter 7 presents the conclusions for the research study and will discuss the implications for teacher practice. The significance of the study is outlined and some ideas for future research are suggested.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 2 presents a literature review that begins with a discussion on what scientific literacy means and then compares and contrasts the difference between the varied types of text that students will face on entering secondary school. It also highlights the challenges that complex science text presents to students, and what is involved in their being able to understand the text. Lastly, it focuses on how the challenges can impact on student perception and attitudes to science and link to their achievement or academic progress in science.

2.2 SCIENTIFIC LITERACY

Scientific literacy could be defined as the skills required for students to be able to read and write specialised science texts. Knowledge of science becomes more specific and detailed as the student progresses through each level. The grammar of the texts is quite different to everyday spoken English. Scientific literacy, however, is not taught explicitly in most secondary schools, neither is the language of science. Generally, it is accepted that students should be able to pick it up for themselves in the course of learning the subject matter, or that they already have the skills to gain understanding of or from the text when they begin learning science at the beginning of secondary school.

The focus of the curriculum at secondary school is more on the content of each subject area and the relevant practical and thinking skills. Subject-specific language teaching is not undertaken; yet most teachers acknowledge the role of language in constructing fields of knowledge, and in the way students acquire their knowledge and skills. Furthermore, the need for a science-literate workforce has dominated the direction of science teaching in secondary schools. Students will also require today a high level of scientific literacy in seeking related avenues of employment.

Assessments in science are based on specific tasks where the language of science is not explicitly demanded by the curriculum. However, students who wish to direct their energies into tertiary science are forced to engage with a large amount of science content and knowledge in their last two years at secondary school. This has implications, therefore, on what is taught in the junior curriculum and supports the notion that students will need to learn to read and write in the science curriculum area at an earlier stage. Hence, this may also be a factor in the decline in numbers of students applying for courses at university as students struggle to move from 'doing' science to engaging with scientific knowledge through the written texts in their senior school years.

Osborne (2002) refers to the notion of science that it is seen as essentially a practical subject which involves the 'doing' mostly and little 'reflecting'. He talks about the stereotypical image of a scientist surrounded by 'test tubes, potions and equipment' and it being seen as an action role rather than one which involves 'reading, writing and communicating science'. In addition, he points out the link between the subject of science and it having a specialised teaching area which supports this notion of it being practically focused. He maintains that if we want to change this stereotypical view of science then we must allow for opportunities in reading and writing science and being able to talk about how ideas are supported by evidence as well as using the language of science. To be literate in science also fits with the idea of scientists explaining how things happen in the world and this is done by reading and writing and presenting arguments for this.

Norris and Phillips (2001) stated that literacy is "constitutive of science itself"; science does not exist without the ability to read, write and talk about it. 'Doing' science is therefore seen as inclusive of reading, writing and talking activities. Being seen as implicit in the teaching of science already may be the reason why teachers do not see the need to focus on the literacy of science so much.

Dillon, O'Brien, Moje and Stewart (1994) refer to the literacies that students face in all contexts of learning. They may need to work in new ways, teaching students differently the content and use reading, writing, speaking and listening in order to help students construct new knowledge. Moje (1996, p. 172) states that teachers teach students, not subjects; she refers to the literacies used in the classroom and talks about the literacies that are involved in teaching practices which influence the teaching practices. Her study of the literacy practices in a chemistry classroom stressed effective relationships between teachers and students which could lead to learning more effectively and in this case in a science classroom. Lemke (2004) refers to the multiple literacies in science and urges science educators even to study how teachers and students read, write and talk science, as well as learning how and why scientists do so. In addition, he says that, in teaching students, we need to help them make sense of the visual text and connect this to the verbal.

In a position paper published by The Science Teachers' Association of Ontario (2005), explicit literacy instruction was advocated within a science framework.

This call was supported by the idea that students needed to be able to 'communicate clearly about scientific and technological inquiries'. Although students are involved in 'doing' science, their skills can be developed in reading critically and communicating through oral discussion and writing. The paper also refers to the gaps in science teaching where students do not learn the strategies for understanding informational text, and then understand how and when to use these strategies for reading. Being actively involved in science is considered to help students improve their understanding and 'communicate with and about the world around them'. Thus the notion of scientific literacy is important for students to be able to express themselves confidently in science.

De Boer (2000, p. 594) discusses the different meanings for scientific literacy and concludes that "scientific literacy defines what the public should know about science in order to live more effectively with respect to the natural world", but that there are many different routes to achieving it. It is not seen as about what they know in school but rather acknowledging that what they learn in school will influence how their attitudes about science are formed and what they learn from that point in time. Since the current focus is on transmitting content mostly from textbooks in secondary classrooms, scientific literacy is dependent on students not being assessed for mastery of a body of knowledge. However, what they are taught should be meaningful and relevant so that they can understand and appreciate it, and relate it to themselves. Scientific literacy is about the meaning they extract from the content and knowledge in science, so the relevance of what they are learning is vital.

Murcia (2005, p. 4) states that "scientific literacy is a way of understanding or thinking about science that influences our actions and decisions"; it is clearly about knowledge but also about ways of thinking and doing. Her view encompasses the need for students to build the critical thinking and questioning skills that link the role of science to problem solving when faced with their own problems and others that they face in daily life. Science is not seen as just facts, but an opportunity to model an inquiry into learning – the process of discovering, and then linking to the original context, question or problem. Therefore, reading and interpreting non-fiction science texts is vital for students to motivate them to learn more by inquiring into what they read. By using real-life contexts, students will be able to make links to the science in the world around them and to develop a scientific literacy which also will develop their understanding of the science.

Opportunities to read and question throughout their learning is also essential to make sense of what is presented to them, often as a body of knowledge. This has little meaning for students unless they are able to talk, test ideas and absorb new ideas. It is therefore easy to see that there is a need to consider the amount of information students are presented with as a barrier to understanding and suggest that we need to focus on helping them how to learn rather than what to learn. This is in keeping with the intent of the latest New Zealand Curriculum 2009 document, currently being implemented with an emphasis on how students learn, in addition to what they learn. This is not to say that science content knowledge is less important; rather that developing the skills of students in how to learn is equally as important. Traditionally, in secondary schools there has been a focus of preparing students for their future pathways and working in science based areas; however, it is quite clear that the future requires students to achieve scientific literacy for future living. To be scientifically literate then requires students to have an understanding of how science fits with society, and more emphasis needs to be placed on developing these skills in science classrooms. Yet again, it is suggested that students need more than just science knowledge; it is what they will do with that knowledge that is important.

Scientific literacy, which is the focus of the present study as well as the major domain assessed in the PISA (Programme for International Student Assessment) 2009 survey, refers to the students' level of scientific competencies involving both knowledge of science and knowledge about science. This survey is an international comparative assessment which monitors the educational outcomes every three years in terms of student achievement and focuses on students' knowledge and skills, particularly with a focus on 15-year-olds' capabilities in reading literacy, mathematics literacy, and science literacy. It has a common framework for testing which includes the understanding of concepts, mastering of process and an ability to function in real-life situations with the domains of reading mathematics and science (OECD, 2006a). It has a primary aim of assessing 15-year-old students' competence in using important knowledge and skills in reading, mathematics, and science to face real-life problems and situations of future adult life, rather than at mastering a specific school curriculum (OECD, 1999, 2000, 2003b, 2006a).

The 2006 results for New Zealand showed students were performing highly for science but the 2007 NEMP (National Education Monitoring Project) Report 44 on Science voiced concerns that year 4 students were not being exposed to science activities at school with diminished time being spent on science related to the physical and material worlds. In addition, the results for year 8 students raised concerns about the lack of science knowledge that those students had gained since the last testing four years ago. This has been identified as an area of concern in maintaining positive attitudes in students towards science in their learning pathway.

Research by Hatzinikita, Dimopoulos and Christidou (2008) concluded that experiments and other investigations were important for science learning, but teaching practices did not go so far as to include making science lessons more relevant to contexts that students would recognize or accommodate student interests. Their research showed a much more academic view of school science and one that precluded the concept of scientific literacy. Students would therefore need to develop their literacy skills much more in order to make meaning of the text.

Ebbers (2002, p. 40) posits scientific literacy as 'being more than just reading about science'. She states that one should be able to "engage in social conversation about the validity of the conclusions" (p. 40). The type of text encountered in science is grouped loosely along with other 'informational texts', but this should be explored more to be of benefit to students. She refers also to the "building of explanatory structures" as important for students to build their scientific understanding. The text type of explanation is one that students will use in science and other curriculum areas and this is not typically outlined to them early in their secondary years, which can put them at a disadvantage if they are unable to comprehend how different it is from narrative text.

Hanrahan (1999, p. 714) in her study suggested that "science literacy has less to do with producing correct technical terms and a particular kind of rationality, and more to do with teachers and students engaging each other in ways which are personally meaningful and which promote not only better communication in the short term, but also better personal understanding of the interaction between humans and their environment in the long term". Her research findings showed that where students had had experience of science in primary school this advantaged them in gaining better marks and supports the notion of prior knowledge related to science knowledge as being important for new learning. The research also highlighted that students with low literacy skills became more engaged with science learning through the author's focus on journal writing and the students writing down their responses to aspects of science learning. It emphasized the importance of the relationship between teacher and learner and allowed for meaningful communication in science learning. Thus, there are examples in Hanrahan's research of how literacy integrated into the science learning can help students to build their understanding. The feedback allowed the teacher also to better meet the needs of the students in their learning.

In addition, Hanrahan explained her choice of personal writing as a way of changing the learning environment as a way of emphasizing the importance of a "learning community of science inquiry" (p.712) in a junior science classroom. Scientific literacy could be seen, therefore, as promoting a better understanding of the links between people and their environment, and for students it is again more about how they can explain this rather than just the knowledge acquisition.

According to the PISA (2009) results, New Zealand was one of the three best performing countries in terms of reaching the highest proficiency levels in scientific literacy, with 18 percent reaching Level 5 or above. Fourteen percent of New Zealand 15 year-old students did not reach beyond the lowest level of scientific literacy (Level 1), a proportion which was significantly lower than the average across the OECD countries. It would seem, therefore, that the achievement levels in scientific literacy are still not a concern as the results from 2009 show that New Zealand's 15-year-olds' mean performance in scientific literacy did not change between 2006 and 2009.

Pressley and Wharton McDonald (1997) have challenged the myth that children can understand a text simply because they can decode words in it. Reading is seen as a vital part of learning and doing science. Being able to know the words and locate information needs to be linked to what the reader's background knowledge is or the experience they bring to their reading. Thus scientific literacy could be seen as learning to read and write in a science context.

Scientific literacy becomes really important when students are required to read the complex text they are faced with in their science classes. McDonald and Thornley (2002) refer to the need for students to be independent learners: students need to read and use content area texts effectively and if they do not then problems arise. Their research in New Zealand has highlighted successful teaching approaches which were supported by schools and teachers across the content areas. The students in their study identified attitudes, practices, and their understandings of reading and writing processes which helped them to develop the approaches in reading and the effective use of literacy strategies.

Students are expected to be able to use a variety of text types when they enter secondary school, and to interpret vocabulary, text features such as tables and diagrams, and to make meaning of the complex text that they face in science. Being able to navigate their way round this complex text is also a skill that needs to be developed by the content area teachers.

2.3 TYPES OF TEXT

At primary level, the literacy demands for students are different from secondary level: students often read texts they know about, with topics that are of interest to them. They may be asked to summarise stories and recall items stated in the text. However, secondary students are required to learn new words, new facts and ideas in reading text as well as interpret meaning, analyse, comment on and summarise the texts. The literacy demands are less obvious in reading text but impose greater demands on students which can challenge them in their reading particularly in science. An understanding of text type will assist students to learn from text and this can happen in any curriculum area, which will give students ways of organizing and talking about what they read and observe.

Pohl (1983) talks about students learning to read in primary school through graded reading books, but at secondary level students are taught subjects. This, however, presents a number of problems for students who are not used to tackling fairly dense texts independently when previously they may have been used to reading in ability groups and their reading graded at an appropriate level for their ability. Added to that, the texts themselves will present challenges in content and the specialist vocabulary used. She also points out also that the achievement of these students indicates how successful they may be in various reading tasks, but there is no information available on how they read and this can present challenges to teachers in teaching their subject material.

In the 2010 Carnegie Report on Adolescent Literacy, Lee and Spratley talk about students being excellent readers of narrative text but struggling to be motivated by the content of science, maths or social studies texts. The role that texts play in the lives of our teenagers is not often explored but is an issue in engaging students in what they are reading. Narrative texts can reflect some of the issues that are faced by teenagers and they can often see the relevance, but it is not always easy to make links with the complex text that students are required to read in science.

Alvermann and Boothby (1982) make reference to teachers' explanations that the reason for students finding expository text more difficult than narrative text is due to their lack of experience and knowledge about expository text structure, being unfamiliar with the subject specific vocabulary and their inability to deal with the complex concepts embedded in the text. Researchers (such as Fang, 2006; Joseph and Schisler, 2009; Norris, Phillips, Smith, Guilbert, Stange, Baker, and Weber, 2008) have alluded to the generic teaching of strategies and vocabulary development that needs to be more relevant to the teaching of a specific discipline such as science. The Carnegie Report on Adolescent Literacy (2010, p. 10) also states that "the demands of comprehending scientific text are discipline specific and are best learned by supporting students in learning how to read a wide range of scientific genres."

Ebbers (2002) described texts in science as 'explanation books', with a primary focus of showing purpose and causality. Information in science books is arranged in a particular way to encourage students to move from one topic to the next. This information will explain how something occurs, or cause and effect – how and why it occurs. There is a wealth of factual information and also many technical terms are used. Science text also includes features such as headings, figures, tables, diagrams, graphs, drawings, photographs and reference lists. All of these features help skilled readers to make meaning by predicting as they read but it becomes difficult if they do not know to use these clues. In the last two decades, the emphasis on textbooks has decreased and there has been a focus on 'doing' science which is designed to lead students into scientific thinking. Reading and writing in science has been replaced by teacher explanations, along with illustrations and diagrams, in an effort to include all students in the learning. However, this does lead to other issues as they do not get any practice in reading or making meaning from the text they are required to read as in science.

In contrast, textbooks are well used in senior school because students are required to sit examinations to continue in their pathways of learning at a tertiary level. Students, therefore, are faced with large volumes of science knowledge and learning which naturally excludes many students as they are ill-equipped with scientific literacy skills to break down the complex text in the science discipline areas (Lee and Spratley, 2010). From the time they encounter science as a subject, students are required to build on their knowledge which becomes more specialized and more systematically organized as they progress through the senior school.

A science text can present students with a different structure to what they may have encountered previously. The author of a science text will have used an informational structure which has a main idea and then facts, reasons and examples which support this idea. Students need help in navigating their way round this type of text, as his or her ability in reading comprehension and recall of information depend on his or her ability to recognize this different text structure. Boling and Evans (2008) agree that students' knowledge of text organization is directly related to their ability to understand what they read. In particular, at-risk readers who are struggling already with text will face huge challenges in being able to recall what they have read and make meaning from the text. Yet again if there has been no explicit instruction around how to use text features the students will struggle to comprehend what they are reading.

Chiang-Soong and Yager (1993) refer to textbooks as being sources of information for students and that some, such as chemistry textbooks, are "too difficult for the intended readers". Although the concepts are difficult for students to understand, the word difficulty and sentence structure are usually kept fairly simple. This presents a problem for students who need to grasp complex information as they progress into senior school; if they are not helped to break down this information earlier in their secondary schooling then they may struggle higher up in the system. Awareness of the different text structure and context will improve students' ability to gain meaning from the text.

In a number of science texts there are a large number of ideas presented in the text. This raises questions about the amount of prior knowledge that students may be expected to have to comprehend these ideas. Lee and Spratley (2010) refer to the challenges that scientific texts present to adolescents faced with unfamiliar texts and making sense of them by using the 'basic decoding tools acquired in "learning to read". Science texts also are described as using technical vocabulary and syntax, using language that is peculiar to this curriculum area and learning the terms and syntax will challenge students as they read to learn in science. Baram-Tsabari and Yarden (2005) refer to the impact on students' understanding where they do not have prior knowledge of science information in text. The scientific language may be difficult for students to read with such complex terminology and new subject matter.

Scientific writing also uses such aspects of grammar as passive voice, abstract nouns instead of verbs and verbs that are more abstract than concrete which are not always clear to students in their reading of the text. Students are not aware of these differences if the grammar has not been taught to them at some stage before they embark on reading text such as expository science text.

The vocabulary of science is linked heavily to the old languages of Greek and Latin and sometimes the meanings of words will differ from the everyday use in this particular context of science learning. The grammatical forms may also be difficult for struggling readers such as concepts which are not clearly stated but implied within one word or phrase. This makes it very difficult for some students to make meaning from the text easily.

Digisi and Willett (1995) refer also to the aspects of science learning around text type: specialized vocabulary, complex sentence structure, and difficult concepts which are linked to science writing particularly in senior school. Many students, they state, require instruction and practice in understanding this type of writing – how to work out the main idea, how to synthesize what is being read, and how to build new knowledge by integrating what they read with what they already know.

Reading and writing are essential features of any teaching programme in a classroom and the teaching of some strategies in order to read and write more effectively is advantageous for both students and teachers so that they can communicate more easily and fluently in any curriculum area. Expository text can present challenges to readers of all abilities but is obviously very challenging to those who struggle with reading or have reading disabilities. The texts which contain content specific vocabulary and a lot of background information that is not necessarily known to the readers make it difficult for students to make sense of new information and thus increase their inability to understand. Hall (2004) examined studies that focused on how to increase the understanding of struggling readers and the selected studies showed that it was possible to help struggling readers comprehend the text using various methods. Therefore, an understanding of how students see themselves as readers and also the reading process would be beneficial for secondary teachers.

Expository text or informational text as it is referred to in research papers deals with content that is largely unknown to students; in addition, the organizational patterns are not familiar ones with students being more comfortable with the usual narrative structure. The informational texts do appear in prose or document formats, which include textbooks, journals, and manuals and similar types of text. Information can be conveyed through tables, diagrams, charts, graphs, illustrations and other formats.

The different text types presented to students in their various curriculum areas can be connected but students often do not link them without some training. Skills in navigating text can assist in building their skills to ensure they can access the meaning successfully across the curriculum areas. In Brown (2003) there is discussion of how much exposure to informational texts there is for students, yet little training in how to read such texts. His observation was that the type of text changed also from paper-based to "hypertext informational texts" which could then be easily transferred into student work. This allowed students to use information without fully comprehending what they were reading all the time. If students are assisted to find patterns and structures across all text types then they will be able to approach the reading of texts more successfully. Useful headings and definitions, new specialist vocabulary may all be embedded inside the text which are not recognized easily by the students.

The frequency of reading informational text and unfamiliarity of the genre are two reasons stated by Armbruster, Anderson, Armstrong, Wise, and Janisch and Meyer (1991) in their paper which analyses science and social studies lessons that they studied. They also referred to the type of instruction given to students as not encouraging understanding and meaningful learning. Yet again the low frequency of reading opportunities was cited as a factor and even less time being spent out of school on reading.

Lack of practice in reading informational text through this and again once they start secondary school does not support the assumptions often made that students are able to read with understanding when complex text is put in front of them. In classrooms today there is a heavy emphasis on textbooks showing topics with minimal text, often in large font, and a number of pictures/ illustrations as well as diagrams – much more visual than textbooks of 20 to 30 years ago.

Gregg and Sekeres (2006) states that students need exposure to expository or informational text early in their reading career to build the skills need to learn from such texts. The difference between narrative text, telling stories, and expository text which conveys information about subjects, needs to be exposed equally in any reading programme so that students' experience also grows as they progress through their schooling. However, as texts become more complex there appears to be a drop in reading achievement and assumptions are made that students should be able to understand. It is clear, however, that instruction does not continue and students do not have the level of skills required to make meaning of this type of text.

Students encounter expository text in nearly all their curriculum areas: English would be the only area where the text type is mainly narrative although they are exposed to expository text often. However, the informational text found in science, history and mathematics often present differently – for example, reports can be quite different and students may not recognize the structures unless some attempt has been made to identify the common structures that exist in reports. Descriptive writing in the various curriculum areas can be quite different too and language features are important when making the distinctions as is the vocabulary choices that students must make particularly in writing. In addition, the sentence structure seen in different curriculum area text changes from simple to compound sentences and in complexity as more difficult concepts are presented.

McTavish (2008) reiterates the idea that one should be able to read and understand literature which is evidenced in the writing of stories and essays. As students advance through school they widen the range to include analyzing the text structures of classic literacy works. McTavish (2008) agrees that narrative text has been dominant in primary classrooms, but believes that equal time should be devoted to informational text so that they can be familiar with non-narrative forms and be open to the new concepts and ideas found in these types of texts, which are after all used in curriculum areas other than English. Therefore, the idea of teaching students to read expository text with explicit strategies is well supported in the research.

McDonald and Thornley (2009) carried out research with students around the texts they worked with and tasks they completed. They concluded that there needs to be a critical review of how texts are read due to the demands of the content areas on reading and writing. They suggested that explicit instruction in the texts and discussions of content areas is needed for students to succeed. From their study, they reported students' realization that they had to read differently according to the task and that the construction of text across the curriculum areas would differ as a result of the content knowledge appertaining to that subject.

A diet of narrative text and an interspersing of informational or expository text is therefore not enough to build the skills that students require to be successful in making meaning of text as they progress into secondary school. Learning to read is the major focus in primary schools but as students progress to secondary school the focus changes to 'reading to learn' and students will require more explicit instruction in navigating expository text. The challenges in reading expository text that they face are enormous and impact on their achievement.

As they struggle also with making meaning this affects their attitude to reading and also can be a barrier to understanding.

2.4 LITERACY CHALLENGES

Students arriving in year 9 are reported to lack understanding in the content knowledge in science. They also appear to have difficulty in the transition from primary to secondary education, and through the literacy work being carried out in secondary schools this can be clearly linked to the different kinds of texts used in a number of curriculum areas such as science. At year 9 students face a large increase in exposure to non-fiction text and it is assumed, rightly or wrongly, that, since they can read, that they should be able to read the complex text they face in science. Research (Hanrahan, 1999); Armbruster, et al.,2009) cites the difficulties students face when making the transition also from "learning-to-read" in primary schools to the "reading-to-learn" stage in secondary schools; students are given little or no instruction in adapting to different kinds of texts, particularly non-fiction ones, when they enter secondary school.

Fang (2008) alludes to the difficulty that students face in reading expository (non-fiction) text, especially in science: he points out that students are "exposed primarily to storybooks" whereas higher up (in secondary school) what they have to read is dominated by the informational or expository type of text. Because of the challenges that students face, they will require specific instruction in this new type of reading. The impact of meeting this new text can also turn students off their learning and affect their achievement levels.

Challenges have been identified in a number of research papers as the specialized technical vocabulary, the ability to interpret charts, tables, diagrams and illustrations, the cross checking of text, graphics, and visual elements in a range of different formats. Peacock and Weedon (2002) refer to the "linguistic complexity" of science texts and the use of text features which are intended to meet the needs of a range of student reading abilities. They also reinforce the notion that expectations of students are that they can read non-fiction text by the time they reach secondary school. It was also found that previous research identified problems students face include vocabulary, and more particularly the "need for visual literacy to interpret charts, diagrams and illustrations" (p. 186). In the secondary literacy initiative in New Zealand there is currently a focus on teaching students how to use text features to develop their understanding of complex text as in science.

Do-Yong Park (2005) refers also to the use of science textbooks as a key issue in science education. They have dominated science instruction and therefore play a huge role in influencing students in their studies. If they do not understand how to read a science textbook then this will impact on their achievement and can hinder their progress academically.

Through targeted instruction many believe that students can be taught the critical reading and thinking skills that are required to understand complex science text (Glynn & Muth, 1994; Lee and Spratley, 2010; Norris et al., 2001). This is seen as necessary to support real learning in science rather than just memorizing facts and details. In interpreting illustrations, diagrams and other text features students need assistance and teachers neglect to build the literacy skills required in navigating these features to gain an understanding of the science behind them (Peacock & Weedon, 2002). For a number of students, they will struggle at senior level where there is more emphasis on use of textbooks without the literacy skills needed to develop their understanding of the subject content. Students are required to learn a lot of science and scientific literacy that was previously taught in the junior area.

McDonald and Thornley (2009) state that students need to master content across the curriculum and to understand the ideas and concepts and how the content is communicated. Being able to read and understand large amounts of unfamiliar text, often containing specialized technical vocabulary, and in a range of text structures are the expectations of secondary students, and mostly without any explicit instruction on how to make meaning of the texts. In addition, they point out that often the need to be literate in all curriculum areas is an idea that comes from literacy areas and not the content areas.

The National Research Council, USA (1996) advocated that there should be instruction in content area literacy to assist students in understanding language in any subject, and stated that "reading and science skills are interwoven" and that students need to apply these to help improve both their science and reading comprehension. Reference is made to research such as that by Brown (2003) which shows that students have difficulty with textbooks which relates to a "lack of knowledge about expository text structures". This has also been corroborated by research carried out in New Zealand by McDonald and Thornley (2002) and has led to the use of a diagnostic literacy tool to identify needs for students to help improve their understanding in science and other subjects across the curriculum. In their work in the San Diego Striving Readers' Project, McDonald, Thornley, Staley, and Moore (2009) report that this is a significant tool, known as the SLIC ("Strategies for Literacy Independence across the Curriculum"): this uses content area texts around which are framed questions to test students' application of skills from the curriculum. With the help of descriptors and exemplars developed from student responses, they are able to score student responses and measure improvement in skills. It is thus suggested that literacy instruction in different content areas could be considered essential.

Focusing on reading in a curriculum area such as science, however, will assist students to focus on the main ideas, details and content vocabulary that are related to this particular subject. One challenge for students is the reading level of the texts used: sometimes the textbooks can be too difficult for the students who are the intended readers. Chiang-Soong and Yager (1993) state that science textbooks were identified as a crucial factor in students' experience of science in the USA. When textbooks are found too difficult, then students' interest level decreases and the subject becomes less popular. This may help to explain the decline in student numbers in senior science subjects in New Zealand. In the 2010 Carnegie Report Lee and Spratley make reference to research projects that are addressing what students need to know and how to read with understanding textbooks and other science related texts. This is a relatively new practice within circles of science education. One example was given where texts are able to be accessed by students and teachers. Teachers are given professional development in engaging students with text–based inquiry, with a focus on building vocabulary and learning how to predict, and synthesise information from text.

Science teachers also talk about the lack of comprehension skills in their students and this can be broken down into vocabulary knowledge, critical reading skills, finding information, reading rate and word analysis skills – all of which are vitally important for science reading. The level of word difficulty and sentence length may pose problems for many students and even if shortened, students may still struggle to understand the complex concepts found in science. Textbooks used are often chosen when presented in simple words and shorter sentences but students still need to make meaning from the concepts presented. In addition, the reading problems can be misinterpreted by teachers and confused with poor attitude to the subject such as science when these interfere with the desired achievement. Teachers also contribute inadvertently to the difficulties students face in making meaning of the text as they tend to simplify the text and even re-write a complex piece of science text in order to help their students. However, students then are deprived of the experience needed to build their skills in understanding the complex text.

Lloyd and Mitchell (1989) suggested that science teachers relied on textbooks for the curriculum they covered and also for instruction, and were not happy about their students' inability to understand the text. They suggested also that teachers needed some help with practical activities to make the texts more easily understood. They stated that it is then easy to overlook the importance of the ideas contained in the text and the teacher is crucial in this process of helping students find that information. The way the text is written has a bearing on how students find that information too. They also found that the text contained a large number of ideas and concepts and believed this added to the difficulty experienced by students.

Breaking down the ideas and concepts is important both for the curriculum and the students' needs and determining the level of prior knowledge that students have on these. However, breaking down the ideas in the text and linking them to students' background knowledge fits with the teachers deciding what students need to learn. Once students have the skills to understand the big ideas, then they are able to find them as they read the text. This also may be more helpful for them rather than rewriting the text.

The use of scientific vocabulary has also been highlighted as an issue for students. Peacock and Weedon (2002) stated that discussion of science concepts is not often involved in the teaching of science. Students' comprehension is stretched when a large amount of the vocabulary is not recognized; they add to the vocabulary issue stating that a lot of students cannot understand science texts as at least 60% of the vocabulary, grammar, connectives and conventions have not been seen before. Their study concluded that more attention should be paid to the teaching of visual literacy skills and the connection of text and visuals so that students could be successful in learning science concepts.

Halliday and Martin (1993) refer to a 'secret English' in science and this becomes a challenge for some students to access the knowledge through reading, writing, and speaking science. They talk about some students being put off science through the 'language of science' and they point to a need for this language to be made more accessible, and to understand how it is constructed. Nominalization and the kind of grammar found in science text are also seen as challenges for students in learning the language of science.

Fang (2006) adds to the dialogue on the issue of vocabulary, stating that students often hear words that are not commonly used in their everyday conversations and often have more than one meaning which presents comprehension challenges. Students, unaware of the different meaning of words, can be frustrated by their inability to make meaning from text when they are able to decode the words easily. One example would be the word 'school' which commonly presents no difficulty to students who go to school every day; yet, when referring to a number of fish who swim together, this can be confusing if that meaning of the word has not been encountered before. Fang quotes a number of grammatical examples that can be problematic for students in their learning of science. Likewise the use of abstract nouns and the number used in science text are likely to be issues for students also. In Cervetti, Hiebert, Pearson, and Jaynes (2009), reference is made to Hiebert's findings in

2007, who shows in his comparisons of texts, that potentially difficult vocabulary is repeated several times in science informational texts. However, this is not the same in the fictional narrative texts. This repetition of words unfamiliar to a reader is considered to make the text more accessible to struggling readers which allows them to make meaning easily.

The use of passive voice creates an impersonal voice which is contrary to student experience at this stage and is in direct opposition to what they have experienced in making meaning from narrative text. Likewise the complexity of sentences makes it hard to make meaning quickly as it demands more time to read and absorb what is being said. In addition, students may not have the prior knowledge which helps them relate to the new information being presented.

McDonald and Thornley (2009) concluded that critical literacy skills are vital for success in literacy learning. The students in their study demonstrated that it was important to access texts explaining complex ideas, compare information across texts and use their own notes to integrate and re-frame new ideas. The importance of this study in identifying what could help students to be successful cannot be minimised. In a study by Dillon, O'Brien and Moje (1994) into how science teachers used literacy activities such as reading, writing and discussion as a way of teaching science concepts, it was found that students saw text, not as textbooks, but as a synthesis of information and literacy helped to make meaning of the text. In contrast, Digisi and Willett (1995) found in their study that students were provided with means to access content but not taught the process of building new knowledge.

Of course, informational text used in science offers opportunities for students to interact with the real world – after all, its purpose is to convey information about the natural world. By reading this type of text, students are given opportunities to expand their reading expertise and once successful their overall reading skills can be improved greatly. However, it would seem clear that instruction in how to make meaning out of informational text would seem to go hand in hand with knowledge building and thereby increase their interest in science. Research (Duke, 2004; Gambrell, 2005) appears to advise an early start for this instruction in reading information text; this also can make students aware of the differences between nonfiction or expository text and narrative text and the different ways we read both types of text. The use of text features in our reading of nonfiction text is one important difference between the two types of text. Duke (2004) considers also that students should read informational text for 'more compelling purposes' (p. 43) than just to answer questions or complete a worksheet. Above all, helping students to read expository text could increase student motivation and improve their attitude to reading this type of text. Owens (2009) suggests that relating science content to students' real life experiences can be a good way to motivate student learning: by building links between science ideas and concepts to what is familiar for students as a result of their own experiences students can gain a greater understanding of the text they read.

It may be, however, that in recent time there has been a greater awareness for the need to integrate literacy into science teaching particularly. It is imperative therefore, that students learn how to read and use texts across the curriculum in order to be effective learners and have success.

2.5 STUDENT ATTITUDES TO TEXT

Evidence exists to suggest that there is a link between the teaching style and student attitudes. The role of the science teacher would seem, therefore, an important one, and especially with reference to the literacy challenges discussed in this chapter. Ormerod and Duckworth (1975) talk about the critical role of the science teacher: they discovered that the relationship between teacher and student is more defined with female students than with male students.

A wide background knowledge and ability to make meaning quickly from text used does appear to impact on students and their attitude which informs their selection of subjects to study further at upper levels of secondary school. Yore (1991) reports on the trend that teaching reading in the content areas is sadly lacking and deprives students of instructional activities to help them understand complex science text. His study, however, revealed that science teachers had positive attitudes towards science reading and science reading instruction but they relied heavily on textbooks in delivering their science curricula which may prove troublesome for students in making meaning of the text more easily.

Guzzetti, Hynd, Skeels, and Williams (1995) found that students preferred expository text which denied any incorrect ideas. However, their observations of students confirmed their findings that students do not like the use of textbooks generally. They reported that students liked 'refutational' text as they believed they got more information from knowing what people think is wrong. They did, however, find expository text less interesting than narrative text, but still did not believe that they learnt less from expository text. Student feedback on textbooks showed that they considered the text failed to provide enough prior knowledge, and required too much inference. Language also was an issue and inaccessible to many, reporting that it needed to be more 'down to earth'. Again, references to narrative text were made as being better for giving you a picture of something, which implies the need to read more closely rather than skim for information.

In Norris et al. (2008) it is stated that there is a risk that comparative reading difficulty and lack of reading success might become associated in children's minds with science, which is so commonly paired with expository text that as shown by at least some evidence they find more difficult to read. It is postured that if we do not expose students soon enough to expository text and assist with instructional strategies, then we encourage the myth that narrative text is much easier to understand.

In part, however, the quality of instruction in reading expository text contributes to student attitudes towards the type of text they prefer to read. In particular, girls' attitudes to science are not encouraged to be more positive by exposing to the different types of text soon enough (Digisi and Willett, 1995; Hanrahan, 1999). Teachers have a huge impact on student attitudes also and if teachers do not model ways of making meaning from the text then students will continue to find the way more difficult and confusing.

In the PISA 2006 and 2009 studies, student attitudes and an awareness of the life opportunities that are opened by science competencies are seen as key elements of an individual's *scientific literacy.* Attitudes to science then are determined by their ability to see the relevance of the science to the student and real life problems. Since the students were required to find information in the tasks set, and make interpretations based on their own judgements of what they have read, this may not reflect the impact of the texts used but the study does measure how students use information related to situations they will face in their own lives.

While attitude to reading has been much researched, there has not been much attention given to the impact of attitude on students' reading of expository text. Cervetti, Bravo, Hiebert, Pearson, and Jaynes (2009) have focused a study on the preference for science content to be presented in informational or fictional narrative text. They state that recent studies do not point to students enjoying the content more when presented in fictional narrative form.

Motivating students to read more non-fiction text is urged, however, by several researchers and writers when they acknowledge the difficulties that students face in making meaning of complex text, such as they face in science.

2.6 LITERACY SKILLS AND LINK TO ACHIEVEMENT

A study by Dwyer (2008) on adolescent readers showed that although attitudes are not always negative towards reading, they did indicate a non-enjoyment factor in reading the non-fiction science and social studies texts they had to read and that this does impact on their attitude to learning. Gewertz (2009) reported on a five year study and urged policymakers in the USA to be more focused on promoting reading and writing: particularly the study highlighted the need to have explicit teaching in high school in all subject areas to address the issues that students face with complex vocabulary, composition, and concepts. The long sentences constructed in non-fiction or expository texts often can put off students with average to below reading skills.

Jacobs (2008) argues that in the USA there is a great need to address the challenges of reading in high school. The demands on adolescent readers and the skills also required to meet those demands are acknowledged as different from those reading at earlier ages. She notes that the skill of reading along with student reasoning ability is needed to comprehend the text. This highlights the need for teachers to integrate literacy into their content teaching, how to read and write in specific content areas, so that adolescent learners can be successful. However, teachers also need some professional development support to allow them to reflect on how this might happen in their content areas: assisting and guiding students through deeper levels of understanding text is particularly needed. The way they teach the content helps to sharpen students' comprehension skills, and build complex vocabulary which will allow them to become independent learners.

Snow and Moje (2010) also refer to the increased demand for adolescent literacy instruction since there has been no significant improvement in achievement in national standardized testing over the decade. They make a call for teachers being enabled to work with literacy professionals to reflect on effective practices on how adolescents learn to read and write, and use literacy to learn. They state that "deep learning in subject areas requires complex literacy skills" (p. 66). Yet again, adolescent learners often struggle to achieve the level required without explicit instruction in areas such as science and integrating literacy skills into the teaching so that they can achieve successfully is again being emphasized.

Knowing how to read at the level where the content can be understood is a key element of the framework that Meltzer and Okashige (2001) refer to in their paper on literacy and learning. They state that adolescent literacy is not a "fad" (p. 16) but a key to student success, yet few teachers, they observe, teach the skills and strategies needed by students to gain meaning from texts. All but the most advanced readers can succeed without explicit instruction. The framework they offer in literacy support has key components in addressing student motivation, making connections, making connections, interacting with text, and creating responsive classrooms. It is interesting to note that all of these feature in the latest New Zealand Curriculum document which is now being implemented in all schools. In science classrooms particularly, they acknowledge the priority for literacy instruction to help students in their reading and writing. Teachers are required to support reading comprehension through a range of experiences, use of a range of texts, and teaching the writing process so that students can build and increase their understanding. So first the literacy, then the learning is being emphasized here.

Joseph and Schisler (2009) refer to the expectation that students are able to read expository text which grows when students enter high school. Their own study showed that by explicitly teaching students some word reading skills brought great benefits for them in their learning. However, they pointed out that there has been little study carried out on the effects of basic reading instruction in understanding expository text or other genres. Reading narrative text as opposed to expository text has not featured either and suggested that this may have a link to academic achievement in content areas such as science.

Helping to close the academic achievement gap by combining content area instruction and literacy instruction is a common theme in the research and topical discourse among literacy professionals. Palumbo and Sanacore (2009) in their research suggest that 'minority children' can also be helped to achieve better when literacy instruction and content area material is combined. Scaffolding students' learning using literacy and language will make the learning seamless. This has implications for all struggling students if this was applied to the teaching in content areas such as science.

Increasing students' vocabulary knowledge is stressed as an important tool for improving reading comprehension and for them to read subject material more fluently. The use of a range of reading approaches is also advised to promote fluency amongst struggling readers. Similarly using relevant texts and providing time for students to read and engage in sharing their understandings on the text contributes to their reading skills.

The current research shows that reading skill and effective reading strategies help readers to use their knowledge to make inferences and successfully understand text. A study by O'Reilly and McNamara (2007) further investigates this idea by looking at multiple measures of high school students' science comprehension and achievement and their relation to knowledge, reading skill, and reading strategies. Their aim was to examine the impact of reading skill and science knowledge on students' content based science achievement in the classroom. Their results showed that reading skill was important for achievement, and that it can partly offset a reduced content knowledge in science. Students with increased reading skills performed better even when their knowledge was poor and helps them to read difficult texts. They stress that exposure to texts will help build reading skills and thereby improve their reading achievement in science.

Munoz (2007) refers to reading competence as a vital skill in order to achieve greatly in academic subjects such as science. The problem, however, which has been alluded to earlier, is that reading in the content areas is not a focus for secondary schools. Teaching reading for understanding and scaffolding student learning is highlighted as approaches that would improve student reading ability. The focus, of course, in secondary schools is on 'reading to learn' and not on 'learning to read', since students are deemed to have developed all the skills that they need by the time they reach high school. Therein lays the challenge for secondary teachers.

2.7 SUMMARY

This chapter builds on the previous chapter by reviewing research studies described in the literature that has been conducted in schools and with selected groups of students. The first section in the chapter reviewed the definitions of scientific literacy that are held by practitioners working in the field of adolescent literacy. The research indicates that there is much agreement on what is meant by scientific literacy and the impact that lack of skills in reading and writing can have on student achievement and attitude.

Much has been written about adolescent literacy that says our students cannot learn without knowing how to read at the level where the content can be understood. Most content areas do not teach the skills and strategies that students need to make meaning from the texts and without these the students face huge challenges to achieve at the level they need to.

The next section explored the types of text that students are exposed to on entering secondary school. The changes in literacy demands are not clearly expressed but can pose challenges for students in learning complex ideas and concepts in science. The key points that emerged from the literature were the change from predominantly narrative text to fairly dense expository text; the complex ideas and concepts and subject specific vocabulary, the lack of knowledge around text organization, lack of prior knowledge around a subject such as science, training in reading such text, and lack of explicit teaching in this 'reading to learn' stage.

The next section outlined some of the difficulties that students face in reading expository text especially in science. The literature supports the targeting of instruction to enable students to develop critical reading and thinking skills with which to learn in science. The research shows agreement in what students need to know and how to read texts with understanding and that professional development must be given to teachers to help students to learn.

In the next section, the research was explored around student attitudes to text and a common theme emerges around exposing students to expository text at an earlier stage. Being able to relate to the subject material and see the relevance of something in science to real life is considered vital for students to remain positive. Another theme explored is the preference for narrative text by students which is more familiar to them than expository or non-fiction text.

The last section explored the links between literacy skills and achievement: the research shows that enjoying what they read does impact on their attitude to learning which can then lead to higher achievement. The research seemed to indicate that there has been no significant change in achievement in standardized testing in the last few years. Explicit teaching of literacy skills and strategies is advocated to help students improve their reading and writing in content areas such as science.

This research study, focusing on the improvement of reading of science text, links to previous research which has identified the challenges facing adolescents in learning, and in particular in science. Various studies have referred to the need for teaching reading strategies which assist students in accessing the meaning from the text. In addition, being able to read complex text, such as in science, can impact on students' motivation and attitudes to science. This study has developed an approach where students were explicitly taught in an effort to develop their skills and improve achievement levels and was indeed the case. The study builds onto the body of research available in adolescent literacy but is unique in showing how students' attitude and enjoyment in reading non-fiction can be changed.

Despite the difficulties that students face in reading science text, the study indicated how they can overcome these and become more engaged in science learning. Using a targeted group of students to build their reading skills in science was also an original feature of this research. The improvement that these students showed indicated the relevance of the study in the field of content literacy today. The next chapter will outline the research design and methodology used in this study.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

In the previous chapter a review of the literature was presented and provided a reliable research basis and theoretical framework for this study. The literature highlighted the need for students to have exposure to different types of text and to have explicit teaching in the skills and strategies needed to make meaning from complex non-fiction text that they face in all content areas across the curriculum, particularly though in science. The methodologies used in most studies reported in the literature were qualitative and there has been little research around the use of non-fiction text and students' attitudes to text as such. Given this limitation, an approach combining some qualitative with quantitative methods was used in this study and is described in this chapter.

This chapter also describes the reasons underpinning the choice of such methods. This chapter also outlines the use of two measuring instruments, the Assessment Tool for Teaching and Learning (asTTle) and the Diagnostic Literacy Assessment Tool (DLA), as well as the attitude survey. The results included a comparison of the testing of the two passages of text in the DLA and students' responses to these, as well as a comparison of the asTTle data.

3.2 RESEARCH TITLE AND SIGNIFICANCE OF STUDY

The title of the research was "Literacy challenges faced by students using scientific texts" and the research sought to investigate students' perceptions of and attitudes to changing text forms, as they tried to make meaning of the text. The researcher wanted to provide new information about students' perceptions and attitudes toward reading science text as well as identify the literacy challenges students faced, and consider what would make successful readers and writers in science.

The strategies for collecting, recording and analyzing data are described in this chapter. Issues of reliability, validity and ethics are also addressed.

3.3 RESEARCH QUESTIONS

The research questions emerged from both the work I have been carrying out with science teachers and also from research carried out by others. The main aim of the study was to investigate students' perceptions and attitudes of changing text forms (fiction to non-fiction) as they transition to secondary school, as well as identify the challenges they face in making meaning of science text: the impact on student achievement was linked to targeted action with identified student groups around the use of non-fiction text in the classroom.

The objectives of this research are:

- to identify the literacy challenges students face in using any scientific text at year 9 level;
- to investigate the perceptions and attitudes students have in changing text types of fiction (narrative text) to non-fiction (science text);
- to track student achievement with targeted groups of students using standardized testing methods; and
- to discuss the implications and meanings for student learning in the use of scientific text;

From this emerged the research questions which are detailed below:

3.3.1 Question One

The first research question was:

What literacy challenges does science text present to students and what impact does this have on their attitudes to reading?

The study was focused on determining the skills that students have in making meaning of science text as opposed to narrative text so this was partly answered through the use of the DLA and the attitude survey. The DLA uses two passages of text, one science and one narrative and allows for comparisons to be made and identifies difficulties students have in changing text type. The DLA was used to determine students' skills in responding to different types of text and provide information on the challenges they faced. The tool as described in detail later in this chapter is one that is personalized to a curriculum area but gives an indication of how effective the student is in finding information, reading for deeper understanding and in their acquisition of vocabulary knowledge in the particular curriculum area. This tool had been developed by the national coordinators of secondary literacy in New Zealand (McDonald & Thornley, 2006-8) through their own research.

3.3.2 Question Two

The second question related to those challenges that students faced in making meaning from text, both expository and narrative:

What are the differences in reading science text from other types of text that students may have read previously during their primary education?

The comparison of results gained in both the fiction (narrative) and non-fiction (expository) texts helped to identify some of those challenges that students face in reading the different types of text; for example, whether students find it easier to locate the main points in science text compared with narrative text. Through this identification it was hoped to identify students' prior knowledge and help students to transfer skills from one text type to another when reading.

Initially, the diagnostic literacy test helped to identify the challenges that students faced in understanding the text especially in science, as well as identify what strengths they already had. The researcher was also interested in how students might respond to changing text types and whether this would show their preferences for the different types of text they read.

3.3.3 Question Three

The third question would provide some answers as to whether students can determine their own outcomes by their feelings about different types of text.

What impact does the understanding of science text have on students' achievement, as assessed by use of a New Zealand standardized assessment tool (asTTle) and the Diagnostic Literacy Assessment (DLA), and attitudes to reading?

The data gathered on student achievement through asTTle, and the DLA helped to determine whether different types of text (fiction or non-fiction) could impact on students' achievement.

3.3.4 Question Four

The final question was designed to provide an answer to how effective was the professional development given to the teachers in schools to determine whether the specifically designed targeted interventions made a difference.

Can targeted interventions in literacy impact on student achievement, as assessed by the asTTle, the DLA, and attitudes to reading science text?

Given that the researcher wanted to provide new information about students' perceptions and attitudes towards science text and identify the challenges they faced, it was considered important to evaluate the deliberate acts of teaching that were carried out with the teachers in each school to be able to measure any impact on student achievement and attitudes in science. Using the data gathered has underpinned the approach taken by the researcher in all schools and has helped to identify what strengths and gaps exist in groups of students in order to make a difference in students' overall achievement and attitudes.

3.4 SELECTION OF INSTRUMENTS

The study required the collection of quantitative data through using national standardized testing results. These data gave the study some baseline data and also allowed for data to be collected again at the end of the study, thus offering an opportunity to measure if there had been any impact of the intervention. In addition, an attitude survey was devised as this seemed the best way to test 500 students in order to identify what student perceptions and attitudes existed towards pieces of non-fiction and fiction text.

Secondly, students were asked to respond to a piece of science (non-fiction) text as well as a piece of narrative (fiction) text and answer eleven questions on each piece of text. The texts were gathered through working with classroom teachers and using what was considered to be the level of text appropriate for students working at this year 9 level. The texts were also considered to be 'normal' texts for the curriculum areas of both science and English, and were selected carefully. The texts had to have a range of text features, such as headings, pictures, diagrams, bullet points, etc. In addition, texts that were in colour were selected to maximize the opportunity for students to relate to these texts as current and relevant texts.

Analysis was carried out to determine the differences students face between the two different types of text. The results then assisted in identifying what strategies could be valuable for students to learn to help them access the text more easily. From the research, it was hoped to gain an understanding of the problem that would inform the researcher's actions for professional development with the teachers of the target groups also.

3.4.1 AsTTle Testing

The asTTle assessment instrument was chosen as it is commonly used in secondary schools in New Zealand. It is an educational resource for assessing reading ability developed for the Ministry of Education in New Zealand. The asTTle provides teachers, students, and parents with information about a student's level of achievement, relative to the curriculum achievement outcomes, for levels 2 to 6 and national norms of performance for students in years 4 to 12. Originally released in 2002, the tool was then updated and improved with v4, the version used in this study, being released late in 2004.

Since that time, this tool has been replaced with an online version, known now as e-asTTle, in 2009.

Brown and Hattie (2003) describe the tool as one that allows teachers to test their interpretations of student learning needs by comparison to criteria, standards, and norms and in so doing identify strengths, gaps, and learning priorities. Underpinning the assessment model is the SOLO Taxonomy, which describes the processes involved in asking and answering a question on a scale of increasing difficulty or complexity. This also forces the learner to think beyond a surface response, activating prior knowledge, ideas or information in order to respond, predict or form a hypothesis that is broader and can be applied to a wide range of situations. Each created test has at least 25% surface and 25% deep items in each 40-minute paper-and-pencil test. The asTTle then reports student performance by surface and deep items compared to appropriate year and sub-group norms.

The asTTle test is usually a 40-minute paper and pencil test designed for a particular group of students' learning needs. Once the tests are scored, the asTTle tool generates the reports that allow teachers to analyse student achievement against curriculum levels, curriculum objectives, and population norms. Research and development over 2003–2004 has extended asTTle into years 8–12 and curriculum levels 5–6. Generally it is expected that students by the end of year 9 will be achieving at Level 4P or better; yet again this has been revised in 2009 and students are now expected to be working towards Level 5 of the NZ curriculum for reading.

Generally testing is carried out by the schools twice for comparison purposes: a pre-test at the beginning of year and post-test at the end of year. Since it is an indication of reading ability, it was appropriate to use such a tool especially as it was designed as a cross-curricular tool for schools.

In this study, the choice of this tool was therefore to give a means for tracking any changes or improvements in student achievement over the year. The scores for each student were recorded and allowed comparisons to be made to ascertain if there had been any improvement in student achievement in the period of the research study.

3.4.2 Diagnostic Literacy Assessment Tool

The Diagnostic Literacy Assessment (DLA) instrument was developed by McDonald and Thornley (2002) in order to identify the needs of students to help improve their understanding in science and other subjects across the curriculum. They have continued to develop this instrument in the USA in their work with the San Diego Striving Readers' Project. McDonald and Thornley were also the National Secondary Literacy Coordinators from 2006 to 2008 and this allowed for the researcher, who was working as a literacy facilitator at that time, to gain in-depth knowledge about the instrument and have professional guidance in the use of it.

The tool uses content area texts from which questions are constructed to test how students apply their skills to that text in the particular curriculum area. Descriptors and exemplars have been developed which enable these researchers to score student responses and measure improvement. An early version of this tool has been used for this research study, so the full ranges of descriptors have not been used. However, the researcher has used this tool extensively since 2007 and designed a large number of cross-curricular tests for use in secondary schools in the region.

The DLA was used to determine students' skills in responding to different types of text. It can indicate how good a student is in finding information, reading for deeper understanding and building vocabulary knowledge in a curriculum area such as science or English. There are eleven questions in the diagnostic literacy test which are divided into three sections: using text features to make predictions about reading; reading for deeper meaning; and building vocabulary knowledge. The questions were marked as correct, incorrect and no response where applicable. Furthermore, each item was also recorded individually and compared from the first test to the second test.

The three sections are also valuable in establishing what strengths and gaps existed in the student groups and this can lead to targeted interventions to address the literacy needs of a particular group of students. The aim of comparing two sets of results is to analyse the changes that have taken place in the students' learning over one year in reading science text, and also comparing this with the reading of narrative text. It was expected that there would be some difference but there was also a logical assumption that students would read narrative text more ably than science text. In view of the fact that students are exposed to more narrative text in their primary schooling, this was a natural assumption to make.

The design of the tests for use in this research were peer reviewed by McDonald in October 2008 to ensure that the use of the tool was consistent with the intent for which it had been developed. The pre-tests were developed, one fiction and one non-fiction, and were used to identify student needs and allow for professional development to be designed for teachers in order that the students could benefit. This allowed for targeted instruction for at least one group of students in each school. The post-tests were also sent to McDonald to ensure they were consistent with the pre-tests.

The questions are personalized to the curriculum area such as in science for the science text and English for the narrative text: the questions were designed according to the descriptor; for example, for making predictions using text features a particular question was asked: What is this passage about?

The pre-test using two passages of text, one science and one narrative, allowed for a comparison to be made, whereas the post-tests provided an opportunity to compare overall progress in addressing the gaps identified by the pre-tests, further comparison to be made between the different text types and how students responded to these.

3.4.3 Attitude Survey

Students were surveyed as to their perceptions and attitudes regarding the science and narrative texts and their responses were added to the findings from the DLA and asTTle results. Research was carried out on attitude surveys in known studies such as the National Literacy Trust's 2008 survey into the perceptions that young people have about themselves as readers. The survey given to the students, which is included in Appendix 5 of this thesis, was designed to find out what the students thought about themselves as readers and also to find out what they felt about different types of text. The design of the survey was, however, linked to the research questions so that it produced relevant information and could provide data which could be linked to student achievement. A major consideration was to keep it to no more than two pages so that students would complete it successfully and also to have most questions as closed and only six questions open. Kind, Jones, and Barmby (2007, p. 873) point out that the most common method of measuring attitudes uses scales where students choose statements on a continuum to reflect their attitudes. In this survey students were given three points to choose from – Agree, Disagree and Not Sure to reflect their attitude to a number of statements. The paper discusses the lack of clarity that can be present over the terms of 'attitude' and 'science' and that the instrument needs to be internally consistent. They suggest the use of Cronbach's α as a measure of internal consistency which was used in this study.

The requirement was for an efficient survey which would not take a long time for students to complete but give an insight into how they felt about reading, especially around science (non-fiction) text as opposed to narrative (fiction) text. The ten closed questions had three possible responses which were 'Disagree/ Not Sure/ Agree'. For example, questions were set out as in the table below and students selected a response by circling it.

Table 3.1

Example Item from Attitude Survey

	DISAGREE	NOT SURE	AGREE
1. I enjoy reading fiction text (such as a novel or short story)	1	2	3

There were eighteen items in the attitude survey. Ten questions were set out similarly, with two further questions asking about reading at home, one for homework and one for other than homework. The last six items related to enjoyment of reading fiction or non-fiction and understandings of the different text type and required students to write freely their own answers.

The survey was reviewed by a literacy colleague with whom the researcher worked and the national coordinators for adolescent literacy, McDonald and Thornley. All agreed that the survey should be contained on a two-sided page and that a balance of multi-choice and free responses for ease of getting information from students. The wording of the survey was reviewed after comments from the critique.

To improve the reliability of the attitude survey, an information sheet was constructed outlining how teachers were to administer the tests and the test conditions. In addition to this, a request was made of the schools that they provide printed sheets with names of students in each class group and also give their ethnicity. This allowed me to identify students who had not written full details on their papers, such as only their Christian name. The research material was delivered by hand to the science department in each school and was subsequently collected once the tests were completed. This ensured that the test papers reached the right person and also established and strengthened the link with a key person in each school.

3.5 TARGETED INTERVENTION

A focus of the research was to look at changes in achievement that may take place as a result of targeted interventions with students. Targeting groups of students within the schools in the study was also a way of comparing the achievement within the whole year group to establish whether there was an impact by addressing gaps/strengths in students' reading. The schools in the study were asked to identify a group or class of students with a science teacher who would work closely with the researcher.

Following the data analysis achievement gaps/strengths were identified and some possible ways of working with the class were established. The researcher and teacher met to discuss the data and then agreed on a range of activities to help build students' skills. For example, where a group of students clearly had difficulty in finding information in the text, activities around the use of text features were designed.

Observations of these particular groups of students were carried out and feedback given to teachers, which led to agreed approaches between the researcher's visits. Professional development was given to these teachers to help build their own literacy knowledge and skills which they could integrate into the planning of their science lessons. In addition, they could share the knowledge and skills with other teachers in their department. Furthermore, contact was maintained with the Heads of Science through the year to ensure that there was adequate support for the teachers involved with the targeted groups.

3.6 SCHOOLS IN THE STUDY

3.6.1 Selection of Schools

The schools in the study were all selected because they were in the southern region of New Zealand where the researcher works. All schools were known to the researcher, either through a working relationship or were approached to be part of the study. Although five schools accepted to be part of the research study, and an expectation was made clear about working with a target class, only four of the schools provided a group for the researcher to work with. The five schools ranged in size and in Decile rating which is described by the Ministry of Education as an indicator which shows the extent to which a school draws its students from low socio-economic communities. Decile 1 schools are the 10% of schools with the highest proportion of students from low socio-economic communities, whereas decile 10 schools are the 10% of schools with the lowest proportion of these students. However, a school's decile does not indicate the overall socio-economic mix of the school.

The student sample was made up of the year 9 cohorts from different types of schools, such as urban and rural, small and large. The choice of year 9 students relates to this being the first year in a secondary school in New Zealand.

The Otago-Southland area is in the southern part of the South Island of New Zealand. In that southern region there are 43 secondary schools with approximately 21,000 students from years 7 – 13. The five schools selected for the study were all co-educational state schools of varying sizes and decile rating and are described further.

3.6.2 School Descriptions

School A is a small urban state secondary school in the smaller of two towns represented in the study, and of low decile rating at 2. This school has a roll of less than 400 students and its student population is comprised of at least 30% Māori students with a further 5-10% of Pasifika students. An Education Review Office (ERO) report from 2007 states that: "Students benefit from small class sizes receiving individual attention from teachers in many subjects. Home base rooms for Years 7 to 9 provide continuity of learning and a stable environment for students." The school offers a positive environment to students and it maintains a positive attitude towards professional development. When approached to join this study there was agreement from the Principal, Science Department and English departments.

There is a range of achievement within the school and the year 9 cohort was identified as presenting some concerns with low achievement results in 2008 so teachers were keen to participate in the study with a view to helping their students improve in achievement over 2009.

School B is a large urban state secondary school in the larger of the two towns represented in the study and has a decile rating of 6. The school is predominantly New Zealand European (92%) with about 6% Maori students.

The 2006 ERO report stated that years 9 and 10 students were generally performing at or above the expected levels of achievement of the New Zealand curriculum norms; Maori students also showed comparable levels of achievement. The school joined the national Secondary Literacy Project in 2009 and there has been significant improvement over that time. This school, however, did not provide a target group of students for the research study.

School C is an urban state secondary school in the larger of the two towns and has a decile rating of 7. The school has a roll of around 570 pupils and its ethnic composition is predominantly NZ European students (77%) with 9% of Māori students, and a similar number of international students. The ERO reported in 2009 that although students were achieving very well academically, Māori students' achievement was much lower than that of other students at the school. In addition, they remarked on the lack of aggregated information on students at years 9 and 10.

School D is a large state secondary school which is on the outskirts of the larger of the two towns with an increasing roll over the past five years. Generally, students perform well with progress in literacy and numeracy reported to be above national expectations. The school has just over 1000 students on its roll with a high population of NZ European students (86%) and around 8% of

Māori students. In the past five years the school has participated in the national secondary literacy initiative and achieved good results.

School E is a medium-sized state secondary school in the smaller of the two towns in the study. The roll of this school is just over 600 students with about 77% of NZ European students, and 16% Māori students. The school draws its students from the surrounding countryside and has recently expanded from a year 9-13 school to a year 7-13 school. Being of Roman Catholic faith, the school has religious education as an integral part of the school culture. Achievement for Māori students is reported to be above the national average.

3.6.3 Initial Contact with Schools

Initially, the five schools in the study were contacted late in 2008 with a letter to the Principal and a copy emailed to the Heads of Departments. The letter invited the school to participate in the study and outlined the process for gathering the data and the tools to be used. The schools were informed at this stage of their right to withdraw without any consequences at any time during the study. They were also given information about the data storage, use of the data and confidentiality material. The researcher asked them to confirm their acceptance for participation in the study. Contact details were provided both for the researcher and for the supervisor and study institution.

About two weeks after the letter had gone to the Principal, the researcher contacted those schools who had not responded. All five schools confirmed their acceptance and responded with written letters. Assurance was given at this point that the researcher would provide all the testing material and any other resources that were required for the study to be carried out successfully. The schools were asked to confirm numbers of students in their year 9 cohorts at the beginning of the 2009 year so that the researcher could provide the necessary number of tests and attitude surveys and resource sheets for one class as these were to be in colour and laminated.

Further contact then took place early in 2009 to obtain the final numbers and also to confirm delivery details for all the testing material. Appointments with each Head of Department were made so that they were clear about the process for the testing, and a manual for each school was constructed with all the instructions.

3.6.4 Data Collection Pre-Test

For each school, a box containing the DLA and attitude survey was provided containing test forms for each year 9 student, along with a set of resource sheets (one for narrative text and one for science text) which would allow for testing one class at a time. In addition, a booklet was provided which included instructions for administering the tests and attitude surveys, with copies of the test design with possible answers to the questions, so that the teachers could understand what lay behind the asking of the questions. For example, the first question of the DLA was designed to find out if students could make predictions using text features.

Each student was asked to complete an answer booklet for the two DLA texts and also an attitude survey. This instruction process was made very simple and clear, and included a message for the students that the gathering of the data was in order to identify their needs and assist them in improving their literacy skills. Copies of all tests and attitude survey, as well as teacher instruction booklets, are in Appendix 4 of this thesis.

Teachers were asked to observe students while they were completing the tests and report back if there were any particular difficulties or issues in the testing process. Teachers were also allowed to write comments on test papers if they felt this to be necessary.

Once all classes had completed the testing and surveys the Heads of Department were asked to contact me and arrange for the data to be collected from the school office.

The completed forms were kept in school sets, and each class kept in their groups to allow for ease in marking and coding as well as linking to their asTTle achievement data. The asTTle data, which showed the scores and levels of the reading achievement for each student, were also requested from the schools at this time so that this could be indicated on each test paper for each individual student and allow for data entry to be a smoother process.

3.6.5 Data Collection Post Test

Later in the year through regular contact with the Heads of Department and having observed teachers working with one group, it was reasonably simple to go through the data collection process again. Once again numbers were requested and then the new tests and surveys were produced. As at the first data collection point, each school was given a set of texts (one science and one narrative), with answer booklets and attitude surveys, along with an instruction manual for each teacher. At this point the researcher met with each Head of Department to check if there were any issues or questions regarding the testing. A time frame was agreed upon as the end of the year does present some issues when junior students usually have some sort of examination or testing to be completed in school.

The schools were again requested to contact the researcher once the testing had been completed and an arrangement would be made to collect the data in one go. In addition, the schools were asked to provide either hard copy or electronically the asTTle data for each of the year 9 students involved in the study.

Once again the data were kept in school sets, and in class lots for ease of marking and coding. At this stage the schools were asked to provide up-to-date records on the ethnicity for their year 9 students so that this information could be checked with the initial data and also provide for new students who may have joined the school after the first collection of data.

Data collection was carried out in exactly the same manner for both sets of data; instructions to the teachers were also the same. The tests for Time 2 were, however, based on different texts but all texts were peer reviewed by the original authors of the DLA. All the questions for these diagnostic literacy assessments were similar in all texts. The attitude surveys were the same for both sets of data also. The tests were carried out with the same groups of students at both data collection times.

3.7 DATA SORTING AND ANALYSIS

3.7.1 Procedures and Instruments

When the tests were collected, each school's data set was kept separately, as well as each class or group of year 9 students. The researcher then started systematically working through schools, mostly in order of receiving the data, and marked the texts: the science texts were marked first, followed by the narrative texts for all students. For each school, all the diagnostic literacy texts were marked first and then the attitude surveys were coded and then all data for each class or group were put together. At this point the asTTle achievement scores and levels were then entered on the top of the test papers.

All texts were marked over a four week time frame so that the researcher marked consistently. Once all tests were marked the scripts were given to an assistant to enter the data on a computer database.

3.7.2 Administration

A database was designed on which to enter all the students' data easily. A simple number system was developed to correspond to the marking; for example, in the diagnostic literacy assessments a number was allocated to the responses of Correct, Incorrect and No Response of one to three and for the attitude survey a similar scale was developed to correspond to the choice of three alternatives students could select. For the last six questions in the attitude survey which were word answers freely written by students, responses were grouped accordingly; e.g. if students stated that they found reading fiction interesting, although with different wording, then the responses were grouped together. The researcher developed a table which showed these allocated to the numbers one to ten. All the data were then entered onto the database and all information was available to the researcher. Later in the year a separate database was constructed for the post-test data; once this was completed another database combining pre-test and post-test data was created.

3.7.3 Data Analysis

First, the database was 'cleaned' by removing students for whom there were gaps in the two sets of data. From the original set of approximately 550 students it was expected that there would be some reduction in numbers participating but the number was only slightly reduced from pre-tests to post-tests. However, the numbers of students for whom data sets were incomplete led to more than a third of students being removed from the final database. This left a total of 313 students. Numbers for schools were as follows: School A had 19 students; School B had 59 students; School C had 67 students; School D had 96 students; and School E had 72 students.

3.7.4 Matching of Data

Firstly, a combined database of the pre-tests and post-tests was created. All students were removed from the original database with incomplete sets of data. For example, if a student did not complete either the pre-tests or post-tests, or if they did not complete either the diagnostic literacy assessments or the attitude survey, then that record was removed.

Since the major construct of this thesis was to investigate the impact of the targeted interventions through the testing and attitude surveys on their achievement, it was considered vital to ensure that full records for any students remained.

This produced a database of 313 students over the five schools in year 9. The data were then presented on one single spreadsheet using SPSS and analysed for associations between the various data points using accepted statistical methods.

3.8 ETHICAL CONSIDERATIONS

Gaining ethics approval is always essential and this was sought from the supervising university which had clearly set out its requirements. The considerations given to these requirements are summarised in sections 3.7.1 to 3.7.4.

3.8.1 Informed Consent

Contact initially was through the Heads of the Science Departments in each of the five schools; the researcher had outlined the research study and responded to questions and issues raised such as who would see the results. Following this expression of interest, a letter was sent to the Principals of the five schools who indicated interest in participating in the study. A brief outline and copies of relevant documents such as a possible survey and test material, along with a sample consent form and information sheet were given to each school. All schools involved were made aware of full details and also attention drawn to the right to withdraw at any stage.

Copies of ethical documents are included in Appendix 3 of this thesis.

3.8.2 Confidentiality

It was guaranteed to all schools involved that any identifying information, such as names, would be removed from the data collected. Schools were informed that no individual or institution would be identified in the study and the raw data with any names would only be available to the researcher and her supervisor.

3.8.3 Pressures

Completion of all the testing and attitude surveys was negotiated with each school in order to avoid stress on staff and students. The tests on the two types of text would take one hour to complete and schools were asked to complete the attitude surveys in the following period so that students had ample time to complete the tests carefully and would provide more reliable data for the study. The schools were asked to complete the tests and surveys by the end of March 2009 and end of November 2009, and at a time that suited other school requirements.

Schools were provided with an analysis of the data following the two data collection points on their own school data. They were able to access any data during the study and help was given in understanding the data.

3.8.4 Data Storage

The completed testing forms and attitude surveys were stored with the researcher until converted into electronic form and then they were destroyed through the disposal of sensitive documents system in the researcher's institution. The electronic data will be stored in the supervisor's office at Curtin University for a period of five years.

3.9 OVERVIEW

The schools in the study were selected to fit with the researcher's employment and allowed her to work with them when it fitted with the demands of her work. Schools in both towns were selected initially for their readiness to participate in the study but it became apparent that all five schools were coeducational and that this could be a good point of comparison.

There was a range of decile ratings within the five schools but this was not considered as a factor in the study necessarily: all but one school are above average in decile rating. The science teachers and literacy leaders in each of the five schools expressed keen interest in the study and perceived benefits of participating.

The data collection process was outlined to each school and the researcher allowed them the flexibility to administer as was appropriate for each school. The disadvantage of this is that it is impossible to comment on the conditions for testing and that the data could be incomplete as the teachers did not feel it was their responsibility to follow up with students who were absent.

Early in the year observations were carried out on target groups of students and following data analysis resources and guidance were given to the teachers of those groups. Each school was encouraged to make contact if they required more than one visit per term, and all but one school took advantage of this.

The final database contained students from all schools but the number was lower than the originally intended sample. It was appropriate also to obtain the data over one year and this was a positive benefit to the schools as they were able to use the data also to report on to the Board of Trustees as well as the whole staff.

The use of the assessment tools have been outlined in this chapter and were considered the most appropriate for this research study.

3.10 SUMMARY

The chapter outlined the intent of the study and then stated the research questions. It shows how the questions relate to the methodology that followed and how this reflects the aim of the study to investigate students' perceptions and attitudes towards the different text forms as they transition to secondary school and to see if there is any impact on student achievement through the testing and attitude responses.

Research Question One asked about the literacy challenges that science text presented to students and the impact of this on their attitude to science. Research question Two covers how this complex science text differs from other types of text which students may not have encountered previously. Research question Three is about the understanding of science and its impact on student's achievement or progress and attitudes in science. Research question Four refers to the use of the targeted interventions in the study and the impact of these on student achievement and attitudes to reading in science.

This chapter also presented the methodology and explained the reasons behind the data collection. The details of the data set were described and the decrease in numbers from the beginning of the study was justified. The schools in the study were described, giving details about the type of school and other background information.

The ethics requirements are detailed and the gaining of ethics approval was commented on.

Any limitations of the data are explained and the use of the selected tools explained.

The final section gives an overview of the chapter and explains much of the rationale behind it. The information about the schools involved will have a bearing on the outcomes of the study and reference to them will be shown in the next chapters focusing on the qualitative data.

CHAPTER 4

RESULTS

4.1 INTRODUCTION

This chapter presents the results of the research after the data collected had been analysed using the SPSS programme. The results are explained in the relevant sections in this chapter. The purpose of the results presented is to address the relevant research questions. The implications of the results are covered in a later chapter.

The second section of this chapter looks at the validity and reliability of the data from the diagnostic literacy assessment tool (DLA) used for the sample in the study. It details the results from the usual standard statistical techniques which were used to measure the internal consistency of the eleven items in the DLA. It also assesses the reliability of the attitude survey.

The third section reports on the changes in the test results over the year. The data presented in this section show how student achievement changes over the year in reading both science and narrative text and compares students' scores at the beginning and end of the year. The tables also show the differences for students by gender and by ethnicity.

The fourth section links the DLA results to the nationalized test scores (asTTle). The table compares the students' test scores over one year, showing changes in achievement.

The fifth section describes students' attitudes towards reading and how this changes over the year. The data show gross means for two parts of the attitude survey. The first table shows students' understandings about narrative (fiction) and science (non-fiction) text and compares these over the year. The second table gives a comparison between the time spent reading for homework and personal reading over the year.

The next section presents the last set of results with a comparison between the five schools. This shows some variation in results between the schools and the diversity of the schools in the study.

The final section summarises the information presented. In addition, reference to the research questions are made in this section.

4.2 RELIABILITY OF THE DLA

The reliability was calculated using the Cronbach alpha which give a measure in the New Zealand setting and are based on the consistency of responses to different items in the same scales of the DLA. As noted earlier, the DLA was developed by New Zealand researchers, Trevor Mcdonald and Christina Thornley (2003).

The Cronbach alpha scores for all scales (with item seven in the first scale, and item four in the second scale removed, as their inclusion reduced the reliability of the whole scale measured) are above the accepted range (De Vellis, 1991; Nunnally, 1978). It is commonly accepted that an alpha of 0.6-0.7 indicates an acceptable reliability, although 0.8 or higher would indicate good reliability.

As shown in Table 4.1, the scores for the scales of the DLA were between 0.55 and 0.81 indicating good internal consistency of the DLA for use in this study.

The scale of Use of Text Features is 0.73 and 0.75 (science and narrative), Reading for Deeper Meaning is 0.55 and 0.81 (science and narrative) and Building Vocabulary Knowledge is 0.68 and 0.80. This indicates it being a reliable tool for use in the study.

Table 4.1

Internal Consistency (Cronbach's Alpha Coefficients), Means and Standard Deviations of Scales of the Diagnostic Literacy Assessment Test

Scale	Cronbach Alpha	
	Science	Narrative
Use of Text Features	0.73	0.75**
Reading for Deeper Meaning	0.55*	0.81
Building Vocabulary Knowledge	0.68	0.80

*Item 7 removed (from DLA results for science text)
**Item 4 removed (from DLA results for narrative text)

The attitude to text survey was constructed by the researcher in order to find out if this was something related to student achievement. The first ten questions asked for students' responses to statements about reading and a judgment on where they saw themselves with regard to reading the different types of text and expectations of these. This survey was also analysed for internal consistency.

Questions one to ten have a Cronbach alpha score of 0.62 showing that there is internal consistency among these items in the survey. It indicates also that the 10 item attitude to text survey is a reasonable tool for the purpose of establishing a link with student achievement and is suitable for use with similar groups of students.

4.3 DIAGNOSTIC LITERACY ASSESSMENT RESULTS

This section presents two analyses of data. The first shows the changes in students' reading achievement over one year as measured by the DLA. Later each item is examined so that a clear picture of the strengths and gaps of students can be observed.

The effect sizes have been calculated on all data tables, but it should be noted that they are dependent on a normal distribution. In most cases, the effect size is small to medium, according to Cohen (1977).

Table 4.3

Means and Standard Deviations of the Diagnostic Literacy Assessment scales at Beginning (Pre-test) and End of Year (Post-test)

Scale	Mean		Standard Deviation		Difference	t-value	Effect Size
	Pre	Post	Pre	Post	Post-Pre		
Use of Text Features	1.71	1.95	0.37	0.62	0.24	6.65***	0.48
Reading for Deeper Meaning	1.87	2.03	0.54	0.55	0.16	4.72***	0.30
Building Vocabulary Knowledge	2.06	1.93	0.54	0.70	-0.13	3.45***	0.21

n=313, ***$p \leq 0.001$

The table shows that the means of the first two scales of Use of Text Features and Reading for Deeper Understanding are greater at the end of year and show significant improvement in student achievement. However, for the scale of Building Vocabulary Knowledge, students would appear to have deteriorated over the year and this variation is discussed later. The effect for the first scale of

Use of Text Features could be described as medium only, but could be seen as showing improvement in achievement.

The standard deviations for these three scales at both the beginning (pre-tests) and end of the year (post-tests) suggest that there was more variability in the student responses in the post testing.

4.3.1 Student achievement changes in reading science and narrative text

The means and standard deviations were calculated for reading both science and narrative tests at the beginning and the end of the year in the three scales of using text features, reading for deeper understanding and building vocabulary knowledge.

Table 4.4

Student Achievement for All Students for the DLA Tests in Reading Science Texts

Scale	Mean		Standard Deviation		Difference	t-value	Effect Size
	Pre	Post	Pre	Post	Post-Pre		
Use of Text Features	1.71	1.95	0.54	1.17	0.24	3.31***	0.28
Reading for Deeper Meaning	1.88	2.03	0.88	0.70	0.15	2.49*	0.19
Building Vocabulary Knowledge	2.07	1.94	0.63	0.74	-0.13	2.21*	0.19

n=313, *$p \leq 0.05$ **$p \leq 0.01$ ***$p \leq 0.001$

Table 4.4 shows that the means in reading science text for the scales of Use of Text Features and Reading for Deeper Understanding have increased over the year and show significant improvement in student achievement. The scale of

Building Vocabulary Knowledge shows deterioration over the year, however. This is also discussed later.

Table 4.5

Student Achievement for All Students for the DLA Tests in Reading Narrative Texts

Scale	Mean		Standard Deviation		Difference	t-value	Effect Size
	Pre	Post	Pre	Post	Post-Pre		
Use of Text Features	1.62	1.84	0.65	0.66	0.22	4.20***	0.34
Reading for Deeper Understanding	1.76	1.94	0.77	0.67	0.18	3.12**	0.25
Building Vocabulary Knowledge	2.14	1.82	0.68	0.84	-0.32	5.24***	0.43

n=313, *$p \leq 0.05$ **$p \leq 0.01$ ***$p \leq 0.001$

This table shows that the means have increased in reading narrative text for the two scales of Use of Text Features and Reading for Deeper Understanding and show also significant improvement in student achievement. The deterioration in Building Vocabulary Knowledge is shown in reading narrative text, and also is discussed later.

There was variation in the pre-tests in reading both science and narrative text and this led to further investigation to identify specific areas which could be improved. It also helped to pinpoint areas for the professional development of the teachers which would assist students to build their skills where needed. It was also hoped to establish if there were any differences in those skill areas by comparing both science and narrative text. Furthermore, there was an expectation that students would improve through natural growth of skills and that students would be able to transfer these skills from one text type to another when reading.

Table 4.6

Students' Achievement in Reading Science Text

Question	Mean		Standard Deviation		Difference	t Value	Effect Size
	Pre	Post	Pre	Post	Post-Pre		
1	1.85	1.61	0.37	0.66	-0.24	6.73***	0.46
2	1.54	2.04	0.60	0.54	0.50	12.39***	0.88
3	1.49	1.79	0.61	0.67	0.30	6.86***	0.47
4	1.79	2.20	0.61	2.32	0.42	3.08*	0.15
5	1.89	2.11	0.41	0.63	0.22	5.49***	0.42
6	1.81	2.07	0.63	0.53	0.26	6.41***	0.45
7	1.96	1.98	1.29	0.76	0.02	0.27	0.02
8	2.16	1.79	0.67	0.82	-0.37	6.81***	0.50
9	1.57	2.31	0.77	0.64	0.75	15.57***	1.06
10	2.16	1.87	0.56	0.79	-0.29	6.48***	0.43
11	1.97	2.00	0.69	0.76	0.03	0.56	0.04

n=313, *$p \le 0.05$ **$p \le 0.01$ ***$p \le 0.001$

As shown in Table 4.6, there were significant changes in students' reading of science text over the year. In three questions, (1, 8 and 10), it would appear that the students' achievement deteriorated. These three questions derived from the three scales of Use of Text Features, Reading for Deeper Meaning and also Building Vocabulary Knowledge, as there was one question from each scale showing a decrease in achievement. In two questions (7 and 11) there was no significant change in the students' skills in developing an understanding the main idea and in making meaning of vocabulary using morphology. In the other six questions the means increased showing where students made gains in the scales of Use of Text Features and Reading for Deeper Understanding. The effect size for question two shows a clear difference between the two sets of data. Through the investigation there was an assumption that students would improve naturally over a year of teaching, but the comparison of pre-test and post-test data showed that there was no significant change in student achievement for some questions. In the scale of Building Vocabulary Knowledge the data showed that students deteriorated over the year.

Table 4.7

Students' Achievement in Reading Narrative Text

Question	Mean		Standard Deviation		Difference	t Value	Effect Size
	Pre	Post	Pre	Post	Post-Pre		
1	1.73	1.57	0.67	0.63	-0.17	3.26***	0.26
2	1.63	1.70	0.65	0.62	0.07	1.73	0.11
3	1.56	2.02	0.67	0.65	0.46	9.83***	0.70
4	1.62	2.03	0.65	0.70	0.42	10.20***	0.62
5	1.54	1.86	0.60	0.72	0.32	7.17***	0.48
6	1.94	1.82	0.62	0.68	-0.12	2.66**	0.18
7	1.76	1.93	0.90	0.64	0.18	3.15**	0.23
8	1.60	1.69	0.69	0.74	0.09	1.90	0.12
9	1.75	2.33	0.83	0.61	0.58	12.77***	0.81
10	2.13	1.91	0.61	0.80	-0.21	4.31***	0.30
11	2.15	1.72	0.75	0.88	-0.43	7.90***	0.53

n=313, *$p \leq 0.05$ **$p \leq 0.01$ ***$p \leq 0.001$

In Table 4.7, the results show that students deteriorated in four questions (1, 6, 10, and 11) and there was no significant improvement in one question (2). In the other six questions students achieved improved results in the post-tests.

Student improvement was reflected in the results for making predictions in Use of Text Features, and Reading for Deeper Understanding. Table 4.7 indicates that students have improved in the same scales seen in their reading of science text but the table also shows some differences. The effect size for question three shows an improvement in achievement in this aspect of students' using their knowledge of paragraph and sentence structure. Students appear to be weaker in developing an understanding of the main idea and locating main points in reading narrative text. In Building Vocabulary Knowledge, students have deteriorated significantly in reading the two different text types.

In reading science text it is expected that students will need to learn new vocabulary in order to make sense of the informational text type and therefore that the variable would increase over the year. It is interesting to note that Building Vocabulary Knowledge is similarly low in reading both science and narrative text. However, one would expect that students were more comfortable in reading narrative text, as the vocabulary is more familiar to students, unlike the vocabulary in science text.

Generally, it is expected that students would add to their vocabulary over a year, and one possible explanation could be that students are continually learning new vocabulary, since reading unfamiliar text is a characteristic of teaching and learning programmes at the level they are studying. It is also possible that the teaching of vocabulary knowledge is not being well executed in secondary schools.

Table 4.8

Comparison between Students' Reading of Science and Narrative Text (Pre-test

Question	Mean		Standard Deviation		Difference	t Value	Effect Size
	Pre	Post	Pre	Post	Post-Pre		
1	1.85	1.73	0.37	0.67	0.12	2.90**	0.23
2	1.54	1.63	0.60	0.65	-0.08	1.72	0.13
3	1.49	1.56	0.61	0.67	-0.06	1.40	0.09
4	1.79	1.62	0.61	0.65	0.17	3.99***	0.27
5	1.89	1.54	0.41	0.60	0.36	9.52***	0.71
6	1.81	1.94	0.63	0.62	-0.13	3.05**	0.21
7	1.96	1.76	1.29	0.90	0.20	2.39*	0.18
8	2.16	1.60	0.67	0.69	0.57	11.48***	0.84
9	1.57	1.75	0.77	0.83	-0.19	3.30***	0.24
10	2.16	2.13	0.56	0.61	0.03	0.76	0.05
11	1.97	2.15	0.69	0.75	-0.17	3.55***	0.27

n=313, *$p \leq 0.05$ **$p \leq 0.01$ ***$p \leq 0.001$

Table 4.8 shows the results for the testing carried out at the beginning of the year (pre-tests), where students have clearly achieved better results in reading science text. In five questions (1, 4, 5, 7 and 8) students have achieved better results in reading science text than narrative text; questions five and eight show improvement as evidenced by the effect size. In three questions (6, 9, and 11) students have not done as well in reading science text compared to narrative text. The other three questions (2, 3, and 10) do not show statistically significant variations.

Student improvement in reading narrative text compared to reading science text is noted in the results for three questions (6, 9 and 11). However, the results are not as great in reading science text as was expected, in view of students' limited experience in reading science text at the beginning of the school year, and being relatively new to science learning. Some questions, however, could be posed about the building of skills generally in reading narrative text.

The variation, however, between science and narrative text is still surprising considering students' exposure to narrative text throughout the previous eight years' of schooling.

Table 4.9

Comparison between Students' Reading of Science and Narrative Text (Post-test)

Question	Mean		Standard Deviation		Difference (Sci-Nar)	t Value	Effect Size
	Sci	Nar	Sci	Nar			
1	1.61	1.57	0.66	0.63	0.05	0.95	0.08
2	2.04	1.70	0.54	0.62	0.35	8.40***	0.61
3	1.80	2.02	0.67	0.65	-0.22	5.03***	0.33
4	2.20	2.03	2.31	0.70	0.17	1.28	0.11
5	2.11	1.86	0.63	0.72	0.25	5.65***	0.37
6	2.07	1.82	0.53	0.68	0.25	6.15***	0.41
7	1.98	1.93	0.76	0.64	0.05	1.00	0.07
8	1.79	1.69	0.82	0.74	0.11	2.01*	0.14
9	2.31	2.33	0.64	0.61	-0.02	0.38	0.03
10	1.87	1.91	0.79	0.80	-0.05	0.90	0.06
11	2.00	1.72	0.76	0.88	0.28	5.30***	0.34

n=313, *$p \leq 0.05$ **$p \leq 0.01$ ***$p \leq 0.001$

Although Table 4.9 shows improvement for students in reading science text, there are only two questions (5 and 8) where the changes were consistent with the results from the initial testing. There were five questions again (2, 5, 6, 8, and 11) where reading in science was better than in narrative text. There were four questions (1, 4, 7, and 9) which showed no statistically significant variations. However, one question (3) showed that students achieved better results in reading narrative text.

What is interesting is that the results are overall better for reading science text than narrative text which students have been exposed to considerably more in their reading experience up to year 9. Tables 4.8 and 4.9 show, however, that students are making progress in making predictions in the Use text features and in Reading for deeper understanding but much weaker in Building vocabulary knowledge.

4.3.2 Student achievement changes for subgroups in reading science and narrative text

Changes in student achievement for Māori students were investigated in the study, as it is a focus of professional development in secondary literacy work in New Zealand currently.

Table 4.10

Student Achievement of Māori Students for the DLA

Question	Mean		Standard Deviation		Difference	t Value	Effect Size
	Pre	Post	Pre	Post	Post-Pre		
Science Text	1.93	2.19	0.43	0.48	0.26	2.24*	0.57
Narrative Text	1.99	2.16	0.47	0.51	0.17	1.34	0.35

n=30, *$p \leq 0.05$ **$p \leq 0.01$ ***$p \leq 0.001$

Table 4.10 shows that there have been significant improvements in the achievement for Māori students on the diagnostic literacy assessment in reading science text, but not in reading narrative text. These changes are consistent with patterns of achievement within New Zealand schools, but standardized data suggest that this group of students is still performing at a lower level than their New Zealand European counterparts. The data are, however, consistent with the results for all students in the reading of science and narrative text.

In addition to the cultural sub-group investigation, the study investigated whether the male or female sub-groups showed differences in achievement through the testing. Similar numbers of students existed in both groups which would allow for a comparison to be made easily.

Table 4.11

Student Achievement of Male Students for the DLA

	Mean		Standard Deviation		Difference	t Value	Effect Size
	Pre	Post	Pre	Post	Post - Pre		
Science text	1.87	1.75	0.35	0.41	0.12	2.73**	0.32
Narrative text	2.01	1.94	0.53	0.50	0.07	1.18	0.14

n=151, **p≤0.01

Table 4.11 shows that there are significant differences for male students in reading science text, but not in reading narrative text. However, there is a decrease in achievement for reading both types of text. However, the ANOVA analysis showed that the only result of significance was that male students performed better in reading narrative text in the post-tests. This is based on an F-*value* 3.55 (p<0.05). The preference for a particular text type is discussed in a later chapter.

Table 4.12

Student Achievement of Female Students for the DLA

	Mean		Standard Deviation		Difference	t Value	Effect Size
	Pre	Post	Pre	Post	Post - Pre		
Science text	1.80	1.77	0.40	0.50	-0.03	0.57	0.07
Narrative text	1.92	1.80	0.54	0.46	-0.08	2.07*	0.16

n= 150, *$p \leq 0.05$

Table 4.12 shows that for female students there are significant differences in the reading of narrative text but not in reading science text. However, there is a decrease also in achievement for both types of text.

Within the group of targeted students there were some changes in reading narrative text, compared to reading science text, but there was no significant difference in the quantitative data for this group of students. This could be because the number in the group was too small to determine the difference clearly but the changes will be examined in the next chapter using qualitative data.

4.4 STANDARDIZED TESTING RESULTS

The asTTle testing gave beginning and end scores so that improvement in student achievement could be investigated. The results of this nationalized test which assesses reading ability give teachers a curriculum level which was expected to be around Level four to five for year 9 students. Both the asTTle and the DLA data were used to determine if literacy interventions would be successful in improving student achievement.

Table 4.13

Student Achievement in National Standardized Test (asTTle) for Year 9 (2009)

	Mean		Standard Deviation		Difference	t Value	Effect Size
	Pre	Post	Pre	Post	Post-Pre		
asTTle score	597/4B	659/4A	102	114	63/ 1 sub-level	98.34***	0.58

n= 313, $^{***}p \leq 0.001$

Table 4.13 shows that there is significant improvement in achievement over one year. The effect size also supports this improvement. It would be considered normal for there to be some improvement due to natural growth; however, the gains are considered greater than the normal increase in achievement of one sub-level which is expected of students over any one year. The mean score moves from level 4B to level 4A (an increase of two sub-levels), placing the students within the expected range of achievement for year 9 students, which is 4P, by the end of year 9.

4.5 COMPARISON BETWEEN SCHOOLS IN STUDY

Table 4.14

Student Achievement in National Standardized Test (asTTle) for Year 9 (2009)

School	No of students	Mean Score/Level		Difference	t value
		Pre	Post	Post - Pre	
School A	17	438 / 2P	523 / 3P	3 sub levels 85 points	24.16***
School B	54	672 / 4A	743 / 5P	2 sub levels 71 points	62.18***
School C	40	639 / 4P	714 / 5B	2 sub levels 75 points	56.35***
School D	89	592 / 4B	637 / 4P	1 sublevel 45 points	75.68***
School E	64	575 / 3A	596 / 4B	1 sublevel 21 points	45.24***

$^{***}p \leq 0.001$

Table 4.14 shows the increases in scores and levels for the students within each school in the study over the year. In all schools the increases were between one and three sub-levels (e.g., 2P to 3P = three sublevels), and between 21-85 points in their scores. School A, with the smallest number of students made the largest gains with three sublevels and a gain of 85 points over the year. Schools B and C both had an average of two sub-level gains or 70+ in scores. Schools D and E moved one sub-level, D with a 45 point increase and E with a 21 point increase. It could be argued that for School E the intervention was not reflected in these results which could have been as a result of normal growth being such a small increase in points and only one sub-level gain.

Table 4.15

Student Achievement for Schools in Reading Science Text using the DLA

	Mean		Standard Deviation		Difference	t Value	Effect Size
	Pre	Post	Pre	Post	Post - Pre		
School A (19)	2.01	1.77	0.41	0.33	-0.24	2.01	0.65
School B (59)	1.80	1.78	0.32	0.38	- 0.02	0.35	0.06
School C (67)	1.85	1.78	0.42	0.48	-0.07	1.32	0.16
School D (96)	1.79	1.82	0.38	0.44	0.03	-0.62	0.07
School E (72)	1.88	1.65	0.37	0.33	-0.23	4.42***	0.66

**$p \leq 0.001$

From Table 4.15 it would seem that only one school (School E) shows significant changes in reading science text overall, and it is showing deterioration overall. The means for the other four schools are not significant but have decreased mostly by small margins.

Table 4.16

Student Achievement for Schools in Reading Narrative Text using the DLA

	Mean		Standard Deviation		Difference	t Value	Effect Size
	Pre	Post	Pre	Post	Post - Pre		
School A (19)	2.21	2.11	0.46	0.49	-0.10	0.70	0.21
School B (59)	1.86	1.81	0.41	0.42	-0.05	0.96	0.12
School C (67)	2.17	1.83	0.58	0.55	-0.34	5.53***	0.60
School D (96)	1.92	1.84	0.57	0.46	-0.08	1.39	0.15
School E (72)	1.91	1.92	0.41	0.50	0.01	-0.17	0.02

***$p \leq 0.001$

As shown in Table 4.16, only school C shows significant change in reading narrative text, although the results show deterioration in reading narrative text. However, there would appear to be very little change over the year in reading narrative text.

4.6 STUDENT SURVEY ON ATTITUDE TO TEXT

The students' attitude to reading text may change over the year. The attitude survey was designed to capture whether students' achievement could be influenced by their attitude to the different types of text. Students were asked to respond to statements about their enjoyment and perceived competence in reading by circling the responses of 'Agree', 'Not Sure' or 'Disagree'.

Table 4.17

Student Perceptions about Different Text Type at Beginning of Year

Student opinion about text type	Agree	Not Sure	Disagree
Enjoyment of fiction	60%	29%	11%
Enjoyment of non-fiction	23%	42%	35%
Good at reading fiction	50%	40%	10%
Good at reading non-fiction	32%	56%	12%

n=313

Table 4.17 shows students' opinions about their enjoyment of the different types of text and their perceived competence. It was expected that students would generally prefer reading narrative (fiction) text, and the table shows that students enjoy reading fiction more than science (non-fiction) text. In addition, they also perceive that they are better at reading narrative text and find it easier to read than science text.

It is interesting to note that 60% of students indicated that they enjoyed reading narrative text, compared with only 11% who do not enjoy reading fiction and 29% who are not sure what they thought about this. However, a much smaller percentage indicated that they enjoyed reading non-fiction text, as opposed to a large number of students who do not enjoy reading it or are not sure.

Students perceived that they were better at reading fiction than non-fiction: 50% in reading fiction as opposed to 32% in reading non-fiction. However, it was interesting to note that a similar percentage (10% in reading fiction, and 12% in reading non-fiction) considered that they were not good at reading that particular type of text.

Table 4.18

Student Perceptions about Different Text Type at End of Year

Student opinion about text type	Agree	Not Sure	Disagree
Enjoyment of fiction	63%	27%	10%
Enjoyment of nonfiction	22%	35%	43%
Good at reading fiction	52%	42%	6%
Good at reading nonfiction	32%	49%	19%

n=313

Table 4.18 shows that students responded similarly in the second time of testing. Students again enjoyed reading fiction text more than non-fiction text and similarly there was minimal change in their perceptions about how good they felt they were at reading the different types of text as well as how easy the text was. What was also interesting was that after one year of reading a lot of non-fiction text there was minimal change in their responses in the 'not sure' category.

The last six questions in the survey on attitude to text were designed to help determine what students thought about different types of text in their own words. These open questions allowed students to express freely what they thought about reading fiction or non-fiction text and whether they thought this had any impact on student achievement or progress over the year.

Students were able to state their preference for either type of text, indicating overall preference for one type of text and if they considered knowledge of text type helpful in reading. The results show preference, and what students like about the different types of text.

Table 4.19

Student Preference in Reading Fiction Text

Question 13 What do you like about reading fiction text?	Pre-test	Post-test
Exciting/Interesting to read	30%	39%
Imaginative	20%	16%
Like reading	9%	4%
Diff types good	3%	1%
Easy to read	0%	1%
Negative response	28%	27%
No response	10%	12%

n=313

Table 4.19 indicates the responses that students gave to the question on their likes about reading fiction text. The students were asked to respond to the question freely and no support was given to elicit the responses. The student responses were categorised into seven groups which show clearly that more students indicated that they do like reading fiction text. Students' responses were grouped into positive and negative categories: the negative category included 28% of students in the first testing and 27% in the second round. 10% of students in the initial survey and 12% in the end of year survey made no response to this question which could also be considered as negative.

Therefore, 38% of all students (in the initial survey) were grouped as not liking reading fiction, along with those who wrote 'don't like' along with those who wrote 'not sure', and 'no response' as well as those who did not understand the question.

Thus 62% of all students did like reading fiction text and indicated that they liked reading fiction text: their responses included the 'exciting/ interesting to read' which was by far the most common response, as well as it being 'imaginative', that they liked reading different types of text and found it easy to read. In addition, as opposed to 6% stating they did not like reading fiction text, 9% stated they did. It was noted that the biggest increase in responses between the first and second surveys was in the response that they found fiction text exciting or interesting to read. A similar overall response was indicated in the comparison of data between the initial survey and end survey where 39% responded negatively to the question around reading fiction text.

Table 4.20

Student Preference in Reading Non-fiction Text

Question 14 What do you like about reading non-fiction text?	Pre-test	Post-test
Like reading	5%	28%
Find out info	39%	11%
Sometimes interesting	7%	6%
Tells something true	9%	10%
Negative response	30%	34%
No response	10%	11%

n=313

Table 4.20 indicates how students responded to the question on reading non-fiction text in a similar manner to the question about reading fiction text. In the initial testing, 30% of students reported that they did not read, or liked nothing about reading non-fiction text. Also they were not sure, did not understand, or did not respond at all. In the end survey, the same range of negative responses to this question was noted. 40% of all students responded negatively in the first survey, as compared to 45% in the second survey. For example, students stated that they did not like reading non-fiction as they did not know a lot of the words or it was too hard and these responses occurred in the pre-test as well as the post-test.

The table also indicates that 60% of all students in the first survey responded positively and 55% in the second survey, which was only slightly higher than those who responded positively to reading fiction text. Students felt that non-fiction text told something true; or you could find out information from it; that it was sometimes interesting or that they like reading that type of text. It was interesting to note a very similar pattern regarding fiction and non-fiction text where students did not give a response. However, the largest increase was in the liking of reading non-fiction text from 5% in the first survey to 28% in the second survey. This may relate to the amount of non-fiction text that students are required to read over the year on entering secondary school, but will be discussed further in a later chapter. Again a very similar pattern is presented in both these questions in the responses but it was noted that less students responded that they found out information from non-fiction text.

Table 4.21

Awareness of Different Types of Text

Question 15 What different types of text are you aware of?	Pre-test	Post-test
Fiction/non-fiction	44%	47%
Heaps/lots	3%	3%
Negative response	30%	31%
No response	23%	19%

n=313

Table 4.21 indicates a smaller range of responses given for this question. Awareness of different types of text was poor: 44% of all students in the first survey as opposed to 47% in the second survey were able to respond with fiction and non-fiction. However, together with those who responded 'heaps or lots' there were 47% and 50% respectively who responded positively. On the other hand, 30% in the first testing responded negatively, stating that they were not sure, or they did not understand, or were not aware of any different types of text. 31% responded similarly in the second round of testing. The percentage of students who did not respond is higher than for the questions on preference of reading fiction or non-fiction text which may be related to the awareness of different text types.

One of the research questions focused on student perceptions of different types of text and to find out what they thought about them. The patterns for response were similar in first and second surveys with gains in identifying fiction and non-fiction and less students with a 'no response' in the second survey. But Table 4.21 shows that a significant number of students were not aware of the different types, and yet they are expected to read both types of text on entering secondary school. The intent of all these questions was to provide some insight into student attitude to text and also to link this to achievement. It is considered interesting that awareness of different types of text is low and yet may be related to the responses to reading fiction or non-fiction text.

Table 4.22

Knowledge about Different Types of Text

Question 16 What do you know about these different types of text?	Pre-test	Post-test
Fiction - made up; non-fiction - fact	28%	25%
Written differently	9%	12%
Negative response	35%	38%
No response	28%	25%

n=313

Table 4.22 shows that student knowledge about the text types is minimal: only 28% of all students responded that they knew fiction was 'made up' in the first survey, which dropped to 25% in the second survey. A further nine percent knew that they were written differently in the first survey and 12% in the second survey. In both surveys the responses showed that only 37% of students have some knowledge about the different types of text which is of concern. It is interesting also that the percentage of students who gave no response has also increased to approximately a quarter of all students, and again may relate to lack of awareness of different text types.

In question fifteen students indicated that they were more aware of the different types of text, but in this question student knowledge of these different types of text is lacking. This data will be valuable in the discussion related to challenges students face in using the different text types.

Table 4.23

Use of Knowledge about Text Types in Reading at School

Question 17 Do you use knowledge of different types of text to help you in your reading at school?	Pre-test	Post-test
Negative response	34%	37%
No response	37%	31%
Yes	12%	15%
If yes, how do you use the text type to help understand the text?		
Key words	3%	4%
Read text	14%	13%

n=313

Table 4.23 indicates student responses to this question: most students do not use knowledge of text type to help them in their reading. A large number of students gave no response to the question although this had decreased slightly from the first to second surveys – 31% as opposed to 37% in the first survey. Only 30% of all students in the first survey and 31% in the second survey use their knowledge of text type to help them, usually by identifying key words or reading the text closely. When asked what they might use instead of knowledge of text types, there was a nil response recorded.

A smaller group of students responded that they either did not know or did not understand the question (17% and 15%) which is also concerning, considering how important it is that a reader can use this knowledge to help with the reading in determining purpose and audience.

Table 4.24

Preference of Text Type

Question 18 Which types of text do you prefer – e.g. range of fiction text or non-fiction text?	Pre-test	Post-test
Fiction	47%	52%
Non-fiction	14%	12%
Negative response	21%	17%
No response	18%	18%

n=313

Table 4.24 shows that students prefer fiction text to non-fiction text and that over the year that preference has increased from 47% in the first survey to 52% in the second survey. Non-fiction text is favoured by only 14% of students in the first survey and the preference decreases to 12% in the second survey results. Enjoyment of reading non-fiction does not appear to gain popularity over the year, and this may be something to consider when considering the second research question which focuses on the different text types that students may have been exposed to in their primary education years.

Overall, however, at least 61% of students did express a preference for types of text, albeit that the majority preferred fiction text in the first survey and 64% in the second survey. This would suggest that at least students are thinking about different text types and expressing their opinion here. It is also interesting to note that only small numbers of students express no preference for either type of text and also do not read unless they are required to do so. However, a number of students did not respond to this question and a larger number were either not sure or did not know what they preferred.

4.7 SUMMARY

The results presented in this chapter show changes in student achievement over the year of testing; in the asTTle test the results reflected that all schools showed improved achievement for their year 9 students. Schools raised student achievement by between one to three sublevels according to this test data.

Students were successful in improving their literacy skills and were able to transfer their skills from one text type to another and this was seen clearly in the results from the use of the DLA in reading science text. However, it would appear that students performed better in reading science text than in reading narrative text.

In a number of areas within the three scales of Use of Text Features, Reading for Deeper Understanding and Building Vocabulary Knowledge there was minimal improvement or no change in results and this is discussed in a later chapter. In Building Vocabulary Knowledge there was deterioration even in the scores.

There were differences in the data gathered on students' reading of science and narrative text and this has challenged the researcher's assumptions around the reading of types of text. The variation was noted and was supported in part by the responses that students made in the attitude survey. Again this is discussed further in Chapter Six.

The data reflected significant improvement in the achievement for Māori students on the DLA for reading science text but not in reading narrative text. The results for this sub-group were consistent with the pattern of achievement for all New Zealand European students, but the asTTle results support current research that states that these students are still performing at a lower level than their counterparts. Little or no change was observed in the data, however, between male and female students males performed better in reading science text than the female students, who performed better in reading narrative text.

Between schools there was change observed in the standardized testing but not in the diagnostic literacy testing. However, when broken down the results for the DLA are consistent with earlier findings that students perform better in the first two scales of Use of Text Features and Reading for Deeper Understanding but not in Building Vocabulary Knowledge.

The first five questions from the attitude survey showed student preference for reading fiction text compared to non-fiction text. In addition, the data showed that students believed they were better at reading fiction text, and found it easier than reading non-fiction text. The results from the last six questions in the attitude to text survey provided clear preferences and understandings about the students surveyed. The results presented in this chapter show that students have expressed clear preferences towards the different types of text, such as fiction and non-fiction. Their responses were categorized into positive and negative groupings and give the researcher insight into their attitudes towards text especially science text when they begin secondary school in year 9. The data allows for some links to be made between their attitude towards text and their achievement in science particularly.

Awareness of different types of text was considered poor and this can be linked to students' preference for particular text such as fiction and also link to achievement in reading text such as science text. Using knowledge of text type also gave insight into whether students' used this to help them read and the results showed that this is not the practice of a large group of students. The importance for a reader in using this knowledge in determining purpose and audience in reading has been stressed in a number of studies.

The preference for reading fiction text compared to non-fiction was expressed in the attitude surveys. Clearly students did not change their minds over one year as this did not change in the second round of testing.

The data will be discussed in detail in Chapter Six and interpretations made in relation to the research questions. Students' preference for fiction text is evident, but students show improvement in reading science text overall, which is interesting when compared to their results in reading narrative text.

It will be linked to the data related to the targeted groups of students and results from the five schools.

CHAPTER 5

TARGETED INTERVENTION

5.1 INTRODUCTION

This chapter reports on the targeted interventions in the five schools in the study, including the professional development given to help teachers meet the needs identified through the initial data collection of the pre-tests. It also presents tables showing how the needs were identified and compares the pre-test results with the post-test results. The chapter also focuses on the targeted groups in science classes and compares their achievement with the control group. Lastly, there is a summary of the information presented in the chapter.

5.2 USE OF TARGETED INTERVENTIONS

A focus of the research was to evaluate the professional development given to teachers in each of the schools and determine whether a targeted intervention could make a difference and improve students' skills in reading science text. The school data gathered were used to identify strengths and weaknesses to address and help improve one class within the whole student group in each of the five schools and also to help target the particular needs of that group within each school.

Four out of the five schools participated in the selection of a target group to work with the researcher. Professional development was then negotiated with the Head of Science in each school and in four out of the five schools the researcher was then able to work with a designated teacher and student group. Within each school the needs were not necessarily the same but there were areas of common need.

School A had a large number of students in the year 9 group who were not reading at the level required and wanted to improve their achievement results over the year. The asTTle testing also showed that the students were well below the level expected at year 9. The diagnostic literacy assessment results provided more specific information to address the needs of students in this school and then the target group.

Table 5.1

School A: Pre-test Results of Target Class and Other Year 9 Students for DLA

	Target class (16)		Other Year 9 students (33)	
	SCI	NAR	SCI	NAR
Use of Text Features	Items (% correct)			
1 Use of text features	0	18	18	43
2 Crosscheck	56	6	16	0
3 Sentence/paragraph structure	63	19	30	28
4 Text form - explanation	25	6	24	15
5 Authorial intent	6	0	12	19
Reading for Deeper Understanding				
6 Integrate information	25	6	9	0
7 Locate main points	39	6	9	12
8 Gather literal/inferred information	6	32	7	21
9 Categorise, summarise	50	0	34	12
Building Vocabulary Knowledge				
10 Vocab using context	0	32	3	31
11 Vocab using morphology	12	32	9	12

Table 5.1 shows the pre-test results for School A: there were a number of gaps identified in all three scales of Use of Text Features, Reading for Deeper Understanding and Building Vocabulary Knowledge. These included using text features, gathering literal and inferred information, and the building of vocabulary knowledge, both in using context and morphology. After an initial observation of the target class, it was agreed that the teacher would focus initially on using text features to help students build the skills they needed to make meaning of the text in science. The teacher introduced the students to the text features and referred to these every time they began a new topic. The students quickly adapted to this way of working and were able to develop their skills in finding the main ideas by using all parts of the text instead of just using the words as they did previously. For example, the students could use visual as well as verbal clues to help them understand the text.

The teacher identified what information could be gained from a heading; for example, she told the class that they could look at the heading or sub-heading to know what the text was about. In each lesson, she would then ask what the text was about or what a particular section was about and students were able to locate that information easily and then understood how to find it quickly.

Later in the term, the teacher focused on locating main points; the teacher introduced students to the structure of paragraphs with a main sentence which contained a main idea and then the supporting detail and examples. Students were able to find main ideas more easily once they knew that this structure existed. This helped students then to distinguish between literal and inferred information also. In one lesson, students were given a list of statements which contained information in a paragraph and were asked to identify a main idea. They were then asked to delete any statements which did not support this main idea. Ordering the statements that remained was their next step and at that point they were able to share their thoughts with other students. In this way, the students could build their own understanding by working with other students.

As the DLA had shown, the students' vocabulary skills were poor, so the teacher also focused on vocabulary building in lessons. In one lesson, the teacher used a PowerPoint presentation on Forensics, asking students to watch a segment of this. As the students watched, words moved across the screen hidden amongst random letters and students had to write down the words as they saw them. This vocabulary related to the topic that had been taught previously. Following this task the students were then asked to collect a card from the teacher to match their word, and if they were not sure of the meaning of the word, they would look for it. As they completed their matching exercise, they could then place the word and meaning on a board at the back of the classroom. The teacher maintained the same approach to working with text throughout the year to help students build their skills in using text features, locating main ideas, gathering literal and inferred information and building vocabulary knowledge.

Each term the class was observed and following discussion with the teacher more resources were developed in order to address the needs of the students. The teacher reported that the students were more engaged in their learning as they became more confident as 'text users' and their understanding appeared to grow. The regular focus on the three areas in the DLA also helped students to build their skills. The results for this target group appeared to be very positive.

Table 5.2

School A: Pre and Post-test Results of Target Class and Other Year 9 Students for DLA

	Target class (16)				Other year 9 students (33)			
	SCI		NAR		SCI		NAR	
Using text features	Items (% correct)							
1 Use of text features	0	19	18	59	18	20	43	59
2 Crosscheck	56	47	6	47	16	61	0	31
3 Sentence/paragraph structure	63	76	19	12	30	54	28	12
4 Text form - explanation	25	47	6	24	24	22	15	10
5 Authorial intent	6	47	0	12	12	16	19	7
Reading for deeper understanding								
6 Integrate information	25	29	6	29	9	7	0	12
7 Locate main points	39	53	6	52	9	47	12	10
8 Gather literal/ inferred information	6	59	32	57	7	56	21	41
9 Categorise, summarise	50	9	0	0	34	46	12	7
Vocabulary knowledge								
10 Vocab using context	0	18	32	12	3	31	31	25
11 Vocab using morphology	12	18	32	47	9	15	12	44

Table 5.2 shows the changes in the target students from the DLA pre- to post-test. In the focus areas of the DLA, the students made gains: in using text features students increased from 0% to 19% for reading science text and from 18% to 59% in reading narrative text. In gathering literal and inferred information students showed an increase from 6% to 59% in reading science text, and a gain from 32% to 47% in reading narrative text.

In identifying authorial intent students in the target class increased from 6% to 47% and for locating main points there was an increase from 39% to 53%. In the aspects focused on, the gains were smaller for the other two classes of students. The target students improved their scores in the asTTle test also: the class improved their average score by three sub-levels from level 2P to level 3P. In their post-test asTTle, the year 9 students as a whole had improved one whole curriculum level over the year, from level 2P to level 3P, which is considered significant for this test in New Zealand.

In addition, it would appear that the students made gains in reading narrative text and their skills developed well in most areas. The teacher reported that more time was spent on preparation for building students' literacy skills but the students exhibited more enjoyment in reading than previously and actively participated in lessons.

Table 5.3

School B: Pre- and Post-Test Results of Year 9 Students for the DLA

	All Year 9 students (54)				
	SCI		NAR		
	Pre	Post	Pre	Post	
Use of Text Features	Item (% correct)				No Target class
1 Use of text features	33	41	30	41	
2 Crosscheck	47	32	14	38	
3 Sentence/paragraph structure	54	45	26	15	
4 Text form - explanation	34	50	19	20	
5 Authorial intent	13	56	15	36	
Reading for Deeper Understanding					
6 Integrate information	20	18	9	44	
7 Locate main points	17	31	31	21	
8 Gather literal/ inferred information	13	52	40	55	
9. Categorise, summarise	60	42	12	3	
Building Vocabulary Knowledge					
10.Vocab using context	7	10	33	32	
11. Vocab using morphology	22	26	34	65	

The results for School B are shown in Table 5.3 where no target class was included. The researcher worked with the Head of Department and looked at the initial results to identify student needs: Use of Text Features and some aspects of Reading for Deeper Understanding, such as locating main points, and distinguishing between literal and inferred information, were identified initially and resources were shared with the teacher who intended to take these to his department and find a teacher to participate in the study. Unfortunately, this did not happen and the researcher met with the Head of Department each term and once with two other teachers in the school. It was pleasing to note that gains were made by the whole cohort in a number of areas and across both types of text by the end of the year. Resources similar to those provided to the other schools were given to the science department and at least one teacher did try some of the activities.

The teacher used the activities to help students identify text features and use them to locate information to increase their understanding. This also involved asking questions such as: "What do we already know about this subject?", "What do we learn from the title and subheadings?", "On scanning the text, what do you observe about the features that the author has used?" In addition, the teacher introduced vocabulary activities to help students learn and use the specialised vocabulary; for example, students used an activity where they matched up terms and definitions and then had to put the words into a sentence within the relevant context. The teacher was consistent in the use of these activities through the year and was enthusiastic about the response from the students who appeared to enjoy learning science more.

However, the researcher was not able to observe the classrooms and it was not possible to ascertain whether the resources were used to target the identified gaps in students' skills. The results at the end of the year, including the asTTle scores, where there was a gain of two sublevels from level 4A to level 5P, indicated that there had been an improvement in students' reading of both science and narrative text through the whole cohort.

All the teachers were positive about the professional development material and shared some of their experiences which indicated that they had been trying to increase students' understanding of the text, and particularly in using text features, through the use of the DLA.

Table 5.4

School C: Pre-Test Results of Target Class and Other Year 9 Students for DLA

	Target class (18)		Other year 9 students (67)	
	SCI	NAR	SCI	NAR
Use of Text Features	Item (% correct)			
1 Use of text features	6	44	23	52
2 Crosscheck	25	0	53	17
3 Sentence/paragraph structure	31	12	62	22
4 Text form - explanation	6	0	33	25
5 Authorial intent	0	6	9	17
Reading for Deeper Understanding				
6 Integrate information	12	0	39	11
7 Locate main points	19	12	29	26
8 Gather literal/inferred information	0	25	15	35
9 Categorise, summarise	19	6	64	12
Building Vocabulary Knowledge				
10 Vocab using context	0	31	14	27
11 Vocab using morphology	6	6	39	22

Table 5.4 helped identify in School C the gaps and strengths for the whole group and then the target class. The target class was a low band group; only 40% of this group were reading at or above the level expected for year 9 students and it was a challenging group in terms of behaviour. There were a number of identified needs: using text features to make predictions and inferences, using these to locate main ideas, and using both visual and verbal

clues, as well as building their vocabulary knowledge through context clues and morphology were agreed upon by teacher and researcher, after gathering the initial data. Getting the students to listen was also difficult so it was agreed that they needed to be engaged by activity often to help them build their understanding of science text. This led the teacher and researcher to work on some activities that would build their skills and keep them involved in their learning.

It was observed that the teacher always made the learning intention clear to the students: linking their learning also to relevant examples so that they could understand more easily. For example, in an experiment on determining liquids and solids the students were invited to predict what they thought might happen as they melted a solid. In addition, the teacher linked vocabulary to students' current vocabulary such as 'lolly stick' for 'spatula' so that they could remember it. Students were encouraged to draw what they had observed in the experiment prior to writing it up in a formal way. The teacher also had some examples to show them such as balls in a jar and the students were also invited to guess how many balls were in the jar, which engaged them well, as this is an activity with which they are familiar. The teacher summarised the learning by telling the students that "particles come together and sometimes stick together better – with wooden balls/marbles there are spaces between particles". This then helped the students to write up the experiment with help from the teacher and the writing frame on the whiteboard.

In another lesson, the teacher indicated on the board what they were going to do: they were to dissect a flower and then build a flower. Key words, such as petal, sepal, anther, filament, pollen (stamen), stigma, stylo, ovary (carpel), were written in different colours on the board which students had to copy into their books. The words were grouped under "boy bits" and "girl bits" to help the students understand what they were learning. The teacher asked individual students to explain what a petal is. Students suggested that it was the "colourful things on the outside of the flower", "something to attract insects", and "so pollen can be obtained", and the teacher pulled together the student contributions to help them write something. When a student used the word "pollinate", the teacher asked him to clarify what he meant, and the teacher then used his response plus the vocabulary given to help the student state in the end "fertilize". Students were learning to use the vocabulary prior to completing the tasks of dissecting a flower and then labelling it in their books. Following this, students built a flower using a handout sheet with the component parts. At a later point, the teacher asked students to state what each part was and used many questions to help them respond, such as: "What can you tell me about pollen?" and "What else can we say about it?"

Other lessons reflected a similar structure as this one with key words outlined on the whiteboard and students offering possible meanings with the teacher helping them to get the full meaning, sometimes after explicit instruction. Students were encouraged to ask lots of questions and unfamiliar words were tackled collaboratively, so that they extended their vocabulary knowledge.

Similar lessons were observed through the year and the students became more positive about their learning. An increase in their questioning was observed and they were more engaged in learning and positive about science over the year. The researcher continued to send resources which could be adapted to topics to help target the needs of the students in order to help make a difference.

Table 5.5

School C: Pre and Post-Test Results of Target Class and Other Year 9 Students for DLA

	Target class (18)				Other Year 9 students (67)			
	SCI		NAR		SCI		NAR	
Use of Text Features			Item (% correct)					
1 Use of text features	6	31	44	8	23	47	52	58
2 Crosscheck	25	15	0	31	53	58	17	49
3 Sentence/paragraph structure	31	8	12	8	62	65	22	28
4 Text form - explanation	6	8	0	15	33	54	25	37
5 Authorial intent	0	23	6	15	9	52	17	39
Reading for Deeper Understanding								
6 Integrate information	12	0	0	8	39	27	11	37
7 Locate main points	19	15	12	23	29	53	26	26
8 Gather literal/inferred information	0	15	25	23	15	54	35	40
9 Categorise, summarise	19	15	6	0	64	55	12	12
Building Vocabulary Knowledge								
10 Vocab using context	0	8	31	31	14	17	27	43
11 Vocab using morphology	6	0	6	24	39	28	22	60

The target group improved in a few areas in the DLA; in using text features they increased from 6% to 31%, in identifying authorial intent from 0% to 23%, and in gathering literal and inferred information from 0% to 15%. The teacher believed that students had developed better skills in reading science text through focusing on their gaps in the DLA. Although this group had not appeared to improve in many aspects, the teacher believed that their skills in reading science text had developed and that this was reflected in their asking questions, and their ability to better understand the texts they were reading. The results in the DLA were not as distinctive, however, as in their asTTle post-test where they moved two sub-levels, from 3A to 4P. The asTTle data showed also that the number of students reading well below the level had decreased from 50% to 6% which was pleasing.

The class appeared more engaged in their science learning and to enjoy lessons more. Students also stated that they enjoyed learning science where they had not at the start of the year. The teacher also reported that he found the class easier to manage and that they were "more interested in learning about science".

Table 5.6

School D: Pre-Test Results of Target Class and Other Year 9 Students for DLA

	Target class (23)		Other year 9 students (102)	
	SCI	NAR	SCI	NAR
Use of Text Features		Item (% correct)		
1 Use of text features	46	63	38	55
2 Crosscheck	54	8	52	7
3 Sentence/ paragraph structure	54	50	57	41
4 Text form - explanation	33	21	37	29
5 Authorial intent	12	17	14	17
Reading for Deeper Understanding				
6 Integrate information	54	21	28	10
7 Locate main points	17	37	23	33
8 Gather literal/ inferred information	12	54	15	45
9. Categorise, summarise	71	4	72	9
Building Vocabulary Knowledge				
10.Vocab using context	4	54	7	50
11. Vocab using morphology	29	42	13	33

The target class was a middle band class; 63% of students were reading at or above the level expected for year 9 students. The class was a challenging one, and it was a noisy group. Table 5.6 helped to identify the gaps in the areas of Reading for Deeper Understanding, such as locating main points, and gathering literal and inferred information, as well as Building Vocabulary Knowledge.

An observation early in the year showed that students were not fully engaged in their learning in science and also displayed negative attitudes. In working with the teacher of the target class, some possible learning activities were suggested and a number of resources shared that could be adapted, especially to the topic they were currently studying. For example, it was suggested that less activities requiring only cutting out and pasting information into books, and more activities that required students to think about the learning, such as putting together terms and definitions, would be more valuable and encourage active participation by students. Discussion with the teacher and Head of Department was positive and the teacher was keen to try some new things with this group of students.

On successive visits, the teacher appeared to be attempting to use more of the activities: for example, using a 'Preparing for Reading Discussion' resource which helped students to make meaning of the text. The activity involved using the 'STAR' system - which stood for Summarize, Terms, Ask questions, and Reactions. These did not have to be always in that order but it was designed to make students think about what they could do to help them understand the text. For example, students watched a video on chemical reactions and this was linked to previous learning. One example was watching a rocket take off where they were told there was a gas mixture of hydrogen and oxygen. The teacher prompted students by explaining what was happening and students collaborated in writing a sentence in their book: *The mixing of two liquids (hydrogen and oxygen), followed by combustion is combined to form water.* Questions were continually posed such as: "Why is it solid fuel now?" A link was made to the Columbia disaster where the rocket exploded so that students could see the relevance of the learning. In addition, they were told that the reaction provided water for the astronauts during the flight in response to a question on how the astronauts would survive. There were many examples of chemical reactions for students to build on their own learning and then identify the main points of this visual text when asked later in the lesson. In addition, students built their vocabulary knowledge as they used the words in this topic.

Table 5.7

School D: Pre and Post-Test Results of Target Class and Other Year 9 Students for DLA

	Target class (23)				Other Year 9 students (102)			
	SCI		NAR		SCI		NAR	
Use of Text Features	Item (% correct)							
1 Use of text features	46	26	63	65	38	35	55	49
2 Crosscheck	54	61	8	52	52	35	7	33
3 Sentence/ paragraph structure	54	70	50	30	57	48	41	13
4 Text form - explanation	33	70	21	22	36	48	28	19
5 Authorial intent	12	74	17	39	14	49	17	32
Reading for Deeper Understanding								
6 Integrate information	54	22	21	34	28	21	10	34
7 Locate main points	17	61	37	30	23	43	33	28
8 Gather literal/ inferred information	12	61	54	65	15	44	45	52
9 Categorise, summarise	71	48	4	9	72	38	9	4
Building Vocabulary Knowledge								
10 Vocab using context	4	22	54	52	7	13	50	42
11 Vocab using morphology	29	9	42	65	13	13	33	49

Table 5.7 shows the changes that students made in reading science text in the target class and for other year 9 students. Improvement was noted in the area of Use of Text Features, particularly in the skill of cross-checking where students increased from 54% to 61%. In addition, students increased from 54% to 70% in using their knowledge about sentence and paragraph structure. Another focus area was that of locating main points which showed an increase from 17% to 61%, as well as gathering literal and inferred information where students increased from 12% to 61%. There were increases in many aspects for

reading narrative text for this class: for example, in crosschecking there was an increase from 8% to 52%, and in gathering literal and inferred information from 54% to 65%. There were gains also in building vocabulary knowledge: in reading science text from 4% to 22% and in reading narrative text from 42% to 65%.

The students also improved in their asTTle scores over the year. By the end of the year, 89% of students were reading at or above the level expected for year 9, and had moved up two sublevels from Level 4B to Level 4A. Students were observed participating more actively in learning and were more positive about science by the end of the year. Teacher questioning also increased as teachers built their own literacy knowledge and could model ways for students to learn more effectively.

Table 5.8

School E: Pre-Test Results of Target Class and Other Year 9 Students for DLA

	Target class (25)		Other Year 9 students (72)	
	SCI	NAR	SCI	NAR
Use of Text Features		Items (% correct)		
1 Use of text features	44	48	22	50
2 Crosscheck	56	8	53	27
3 Sentence/ paragraph structure	64	52	42	37
4 Text form - explanation	24	16	3	15
5 Authorial intent	28	12	24	18
Reading for Deeper Understanding				
6 Integrate information	32	8	29	16
7 Locate main points	24	28	26	18
8 Gather literal/ inferred information	12	72	20	51
9. Categorise, summarise	64	8	56	8
Building Vocabulary Knowledge				
10.Vocab using context	8	44	3	27
11. Vocab using morphology	24	28	7	10

The data presented in Table 5.8 helped to identify the needs of the target group where there was a wide range of achievement in a class which presented challenges for the teacher. The needs were identified in using text features, particularly for students to use their knowledge of paragraph and sentence structure to predict from the text. In addition, this initial data showed that students could be helped to improve in integrating information from text features with the running text to make meaning. Similarly, as in the other target groups in the scale of reading for deeper understanding, skills in locating main points and gathering literal and inferred information were identified as part of the student needs. Building Vocabulary Knowledge was also a focus for this target class.

Using text features became a regular part of the lesson structure: the teacher always reminded students that there could be a variety of text features in any piece of text they read. Early in the year, the teacher had given students a list of text features, definitions and examples to help them get started. In one lesson, the teacher asked the students to identify any text feature they could see and to state where it was. A range of other activities to build students' reading for deeper understanding skills also were used. For example, the teacher would often start the lesson with a True/False quiz where students were given five questions and asked to put T or F against them and then explain why they had given it that response. The discussion between students and teacher on marking were rich with explanations for their responses and students learnt to use the text carefully to support their answers. One question, "Light rays can be bent", was related to an activity from a previous lesson and a student asked:"Did we shine the light?" which reminded them of the experiment they had done at that time.

An initial observation showed that the students were not good at listening and that they enjoyed working with other students to help them understand what to do in science class. In discussion with the teacher, it was agreed that these needs would be a priority. The teacher began to structure lessons differently: students were not given lots of instructions prior to beginning an activity; rather they were given steps to take at appropriate moments. Various activities were developed to assist in targeting the needs such as a list of text features and definitions and asking students to annotate a text with them once they had paired up the two.

In one lesson, the teacher gave the students a review activity: students were given five questions and had to decide whether the question was true or false. Following this, students were asked to write a sentence with their evidence to support their decision, saying why they thought it was true or false. Students also had to produce a group decision. The teacher explained that if there was no agreement, the group needed to negotiate to have a final decision. Students were observed to be fully engaged in this process and enjoyed the challenge.

The teacher also made links to prior learning and students quickly responded when asked what they knew already. Reference to text features became a usual way of working and students could find main ideas much more quickly. In another lesson, students were given eight activities to complete and these were designed to help them revise their learning for an assessment. Students said they found this helpful to prepare them for their assessment and found it valuable putting together the visual and verbal elements to help them remember.

Table 5.9

School E: Pre and Post-Test Results of Target Class and Other Year 9 Students for DLA

	Target class (25)				Other year 9 students (72)			
	SCI		NAR		SCI		NAR	
Use of Text Features	Items (% correct)							
1 Use of text features	44	50	48	63	27	47	50	61
2 Crosscheck	56	38	8	67	54	55	22	38
3 Sentence/ paragraph structure	64	58	52	17	42	66	37	28
4 Text form - explanation	24	42	16	17	3	43	15	26
5 Authorial intent	28	58	12	29	24	47	18	31
Reading for Deeper Understanding								
6 Integrate information	32	21	8	29	29	33	16	30
7 Locate main points	24	54	28	25	26	45	18	22
8 Gather literal/ inferred information	12	71	72	17	20	57	51	35
9 Categorise, summarise	64	58	8	4	56	63	8	10
Building Vocabulary Knowledge								
10 Vocab using context	8	12	44	21	3	16	27	19
11 Vocab using morphology	24	21	28	42	7	17	10	50

In Table 5.9, changes in student learning can be seen in their reading of science text. Improvements were noted in some areas such as locating main points where there was an increase from 24% to 54%, and in gathering literal and inferred information from 12% to 71%. However, in the Use of Text Features, there was a small improvement from 44% to 50% but in some of the areas targeted students did not make expected increases, such as knowledge of sentence and paragraph structure, or integrating information from text features with running text. Students did improve in reading narrative text in the aspects of use of text features (48% to 63%), cross-checking (8% to 67%), and integrating information (8% to 29%) and in building vocabulary (28% to 42%).

The improvement was also seen in the asTTle results, which indicated that students in the target class had improved one whole curriculum level, from Level 4B to level 5B, and that the number of students reading at or above the level expected for year 9 had increased from 12% to 50%. In addition, students in the target class stated that they had learnt a lot, through the approach the teacher had taken, to help them make meaning of the science text and they found it more enjoyable in the classroom.

5.3 ACHIEVEMENT OF TARGET GROUPS

This section compares the achievement of the targeted students with the other year 9 student groups for the four schools who participated in the study. The numbers of students compared is lower than those used in the pre- and post-test data for the DLA as these were the actual numbers of students for whom data were collected at both data points.

Table 5.10

Comparison of Student Achievement between Target Groups and Other Year 9 Students

School	Number of Students	Target Group Gains	Number of Students	Other year 9 students Gains
A	9	62pts 1 sublevel	19	48 pts 1 sublevel
C	12	54 pts 2 sublevels	67	68pts 1 sublevel
D	14	55 pts 2 sublevels	96	32pts 1 sublevel
E	21	100 pts 3 sublevels	72	22 pts 1 sublevel

Table 5.10 shows that over the year students made gains in the asTTle test from 54 to 100 points, and one sublevel to three sublevels. This compares to the gains of the whole cohort from 22 to 68 points, and for all schools only one sublevel. In School A although both target group and whole cohort made the same sublevel gain, there was a difference in the points. School C showed a gain of two sublevels for the target group compared to one for the whole cohort which is interesting and both groups made good gains in the scores over the year. School D made better gains for the target group compared to the whole cohort; and School E made very good gains for the target group compared to the whole cohort.

As stated earlier there is an expectation that students gain a minimum of one sublevel in a year or the average growth in a year is about 25-50 points. It is also expected that in an intervention this growth would be more than that and in two of the schools there is reasonable growth seen.

5.4 SUMMARY

Targeted interventions with one group of students in each of four schools in the study showed improved results for those groups of students when compared to the remainder of year 9. The needs of these groups of students were identified and then targeted through the year of the study and support material for the teachers involved was linked to the identified needs. The results of this process were shown in the tables, in which results for the targeted groups were compared to the other year 9 students for the three scales contained within the diagnostic literacy assessment tool.

The five schools in the study are all co-educational schools of different decile ratings but similar results are seen in each school. No different patterns were observed in the data gained; only one of the schools did not provide a target group of students but overall the students made good gains in achievement. This variation may be attributed to the school's participation in the professional development through the study which was directed at the whole department rather than just one teacher and group of students. There was improvement for the targeted groups of students in the study and this is shown in the data showing an increase in sublevels and points of the asTTle.

The data are presented in the context of the research question which asked whether it is possible to use targeted interventions to make an impact on student achievement. These data are linked to student attitudes in the following chapter.

CHAPTER 6

DISCUSSION AND INTERPRETATION

6.1 INTRODUCTION

This chapter further examines the results presented in the previous chapter. The results are discussed in the sections in this chapter as they relate to the research questions. Efforts are made to link what has been found in this study with previous research and to present possible explanations for the findings. The second section gives an overview of the study prior to discussing the research questions. The third section looks at the literacy challenges that the students faced in reading science and narrative text and offers possible explanations for the results. The fourth section focuses on the student attitudes to and perceptions of text and different text types and then discusses the results pertaining to these. The fifth section discusses the outcomes of the targeted intervention with groups of students. The next section looks at the overall achievement of the students in the study and interprets the results, and the last section summarises the interpretation of the results, while making reference to the research questions.

6.2 OVERVIEW OF RESEARCH STUDY

The research described in this thesis investigated the literacy challenges faced by students when reading science texts as opposed to narrative texts and sought to establish the differences that may exist. It also looked at students' perceptions and attitudes towards the different text types and to link these to their actual reading of science and narrative text. It was thought that students would be more confident and competent in reading narrative text as it is expected that this type of text is used more at the primary level of their education and therefore they would achieve better results, especially in reading science text. Lastly, there was a focus on student achievement where targeted groups of students received explicit instruction around the use of non-fiction or science text to determine if there was any impact in so doing.

Underpinning the study was an assumption that students would demonstrate more competence as readers if they were motivated to read that particular text type. Data were gathered on their attitudes to text and on the perceptions about themselves as readers to establish if this was possible. Thus, if students like reading that particular type of text, it may influence their attitude to the text and they will achieve better in this case. In addition, it was assumed that students would prefer to read narrative text and that a number would struggle to comprehend science text which is often dense and uses complex vocabulary: this, in itself, could deter students from enjoying reading science text.

By targeting an intervention to focus on a group of students in each of the schools in the study, it was hoped to show an improvement in achievement when comparing them to the remainder of year 9 students. In addition, this meant that the identified needs of a particular group of students could be targeted and relevant professional development given to the teachers involved.

Effective literacy instruction is integrated across the curriculum areas and as science presents a number of challenges to students on entry to secondary school it was thought that this would be a valuable place to start and also build understandings with science teachers. All teachers need to develop successful readers and writers in their curriculum area and science traditionally has focused on teaching content which is fairly complex for new students to secondary school. Challenging text books are used, which highlight the need for instruction around organizational features so that students can access and comprehend the information being presented.

The transfer of literacy skills from one text type to another is vital for students to achieve to the level required across the curriculum and the study involved the use of a diagnostic literacy assessment tool (DLA) to identify the needs in the science area so that teachers could integrate literacy into their teaching and help students achieve better. Breaking down the skills into three areas also made it easier for science teachers to address the challenges of the text. The areas were Use of Text Features, Reading for Deeper Understanding and Building Vocabulary Knowledge. It also assisted teachers in pinpointing areas of need so that the students' literacy skills could be developed further.

The data are discussed with the research questions in mind and interpretations made accordingly.

6.3 LITERACY CHALLENGES

Lee and Spratley (2010) in the Carnegie Report on Adolescent Literacy state that adolescents may struggle with text for a variety of reasons, such as vocabulary knowledge, content knowledge, text structure, and lack of comprehension skills. The DLA was used to determine students' skills in responding to different types of text such as science (non-fiction) and narrative (fiction) text. In some skill areas students were more successful than others, but this could also be attributed to explicit teaching in some aspects rather than others.

It was assumed that students would transfer skills from one type of text to another and across content areas but the results showed quite clearly that this was not the case. Students did make gains in the areas of Use of Text Features and Reading for Deeper Understanding, but this was not consistent across science and narrative text. Making predictions using text features was consistent across both types of text but students appeared weaker in developing an understanding of the main idea and even locating the main points in narrative text. This could be attributed to the clearer structure of science text where, once students know the pattern of topic sentence, supporting detail and examples, they can locate the main points more easily.

The Use of Text Features section covered skills such as making predictions about reading using headings, sub-headings, diagrams, pictures etc, as well as making inferences and cross checking using text features. Despite the use of the initial data to target building skills such as these, the results suggest that this was not maintained throughout the year as students did not make the gains expected. This would appear to be consistent with teachers' expectations that students either have these skills or that they develop them more easily than expected. In addition, the pre-test indicated that students had difficulty in locating main points and developing an understanding of the main idea in science text. Faced with a body of complex text in science, students must be challenged to make meaning from the highly technical vocabulary and lack of background knowledge most of the time. Therefore, as pointed out by Peacock and Weedon (2002), there is a great need for students to be able to interpret charts, diagrams and illustrations in this non-fiction text in order to understand the content. A teacher in the study stated that she had noticed students "were not good at using the diagrams" and that "they often did not read the text with or under the diagrams".

The challenges that the different types of text present also was evident in the student responses from the attitude surveys. Students reported preference for reading fiction text over non-fiction or expository text and also stated that they felt they were better at reading fiction than non-fiction text. Students found fiction text more exciting and interesting to read, as well as liking the imaginative component of the text. Students made comments about reading fiction text like “it was good for letting your imagination go wild”. Although students clearly expressed preference for reading fiction text, there was an increase in the number of students who liked reading non-fiction text over the year. However, it was interesting that students initially saw that they learnt information from non-fiction text, but this perception decreased over the year.

Teachers often assume that students should be able to read science text on entry to secondary school and that their lack of skills is a result of failure in their primary education. One teacher commented that early into the study she believed that “students lacked experience in reading science text”. Another teacher stated that she assumed they “just knew how to read the text, especially if they were deemed to be good readers”. However, students’ preference for narrative text was clearly supported by expressions of enjoyment, such as “exciting” or “interesting to read” and comments that science text was often “too hard”. This could be that they are faced with more familiar vocabulary when reading narrative text, as well as known structures and when reading science text they are faced with a wealth of information while lacking the skills to determine which information is the most important. Background knowledge or experience is important in reading, but students will not necessarily be able to make the same connections when reading a science topic for the first time. In addition, the level of reading skills will play a part in whether students can cope with the reading of complex science text: if students are struggling as readers, then both narrative and science text will be challenging for them.

Self-perception as readers also will play a part in student competence in reading science text. Armbruster (1991) stated that even if a student can read a full length novel they may find science text difficult to read. Good readers can use the text structures to locate the main ideas and help them process what they are reading. It is also suggested that reading instruction is needed at secondary level to become aware of the text structures they face. The results from the study suggest that this may be the case for students who prefer reading fiction to non-fiction as they are not familiar with the text structures in science text.

Another pattern to emerge was the lack of awareness of different types of text which is consistent with research (Dymock, 2005) that points to positive effects on reading comprehension when students have an understanding of text structure. The results showed that there were large numbers of students who lacked awareness of the different text types and the impact of this on their reading. There was improvement in aspects shown through the DLA tests which were targeted by teachers for improvement. The responses in the attitude survey showed that students had a superficial understanding when they stated they knew fiction was 'made up', and that non-fiction text was about 'getting information'. However, there were similar numbers of students who were not sure about reading both fiction and non-fiction text.

It would appear that students generally can tell the difference between the text types in the definitions of 'made up' and 'getting information from text', but the DLA showed that they could not articulate clearly what some of the differences in structure were. For example, they stated that there was a beginning and end in narrative text, whereas non-fiction text was considered to be in sections. Non-fiction text clearly "had information that helps you to learn", but they were not able to give any more detail. However, if they are not aware of different text structures, this can then interfere with their interpretation of the text in front of them.

Building Vocabulary Knowledge was an area that did not improve over the year and this raises concerns in relation to the levels of students' comprehension skills. Students may struggle with word difficulty and the complex sentences that are often found in science text and this can prevent them making meaning of the concepts within the text. This was apparent through the comments that students made in the attitude survey where they referred to the text as being "too hard" to understand and that they did not recognize a lot of the words in the text. One teacher commented also that through the work in the study "it became apparent that teachers need to talk about new words and help students to learn the vocabulary". Weedon and Peacock (2002) referred to the challenge of Building Vocabulary Knowledge when students may not have encountered about 60% of the vocabulary before. This also may affect students' attitude to science where they perceive the subject as being too hard for them and they do not try to overcome these difficulties.

Greater vocabulary awareness was expected from students; vocabulary knowledge in reading both narrative and science text was similarly low and this was considered unusual, since one would expect that new vocabulary would be integral to learning science at year 9 whereas students would have a reasonable level of vocabulary knowledge in reading narrative text by then. Teacher comments at the end of the study indicated that with their greater awareness they believed that vocabulary knowledge was improving. One teacher stated that she had now "implemented glossary notebooks to help the students keep keywords in one place". Another stated that building vocabulary knowledge has "become a key focus with all of my classes". Yet another teacher believed that "the students had more confidence in breaking down the content, taking large chunks of science texts and used their skills in the use of text features.

No discrepancy was noted in comparing the reading of science with narrative text in Building Vocabulary Knowledge, but the results indicated that students fared better in making meaning of unfamiliar vocabulary when they understood the meaning from a context rather than from morphological awareness. Generally, students appeared weaker in morphological awareness rather than using context to help them work out meanings of words. However, through an intervention which used a morphological approach, students were helped to understand that various words are related such as those that end in –logy meaning 'study of', or meta- which indicates an abstract term such as metamorphism meaning 'transformation of a rock type'. This approach appeared to produce better results for students. Science vocabulary often has a Greek origin and can be linked to help students work out meanings, for example, chromosome, hydrogen, atmosphere etc. If students understand the morphological structure of words they can recognize words and then learn them more easily.

6.4 STUDENT ATTITUDE AND PERCEPTIONS TO TEXT

Students' opinions about different types of text were gathered through open-ended questions in the attitude survey. A large number of students liked reading fiction text, considering it 'exciting' or 'interesting' to read. Often, as expected, students stated it was 'imaginative'. Thornley and McDonald (2002) referred to good readers describing reading as fun, and enjoying reading, particularly fiction text, where they could 'build movies in their heads' (p. 19). The results from the study support this view, but a number of students indicated that they did not enjoy reading, finding it boring. Especially they do not like having to read longer texts which often are found in science. It was not surprising, therefore, that a small number of students stated that they did not like reading at all.

Similarly, students responded positively to reading non-fiction text, but it was surprising to note that there was a reasonable increase in the number of students who liked reading non-fiction text over the year. A few students, as expected, stated that they only read when they had to. Also it was noted that there was a wider range of responses to reading non-fiction text than for fiction text. Responses included that "they didn't read it", or "didn't like anything about it", although a number recognized that it usually was true or had some interest depending on what they were reading or what they had to do with the information.

Students also believed that they were better at reading fiction text than non-fiction text which could be a factor in how well they achieve in science. If students believe that they are not good at reading science then this may impact on their motivation in reading as well. Cervetti et al. (2009) referred to the engaging nature of fiction text over informational (non-fiction) text. Their enjoyment also of reading fiction text surpasses that of reading non-fiction text and similarly links to their perceived ability in reading either text type. Students, however, recognized that they obtained a lot of information from non-fiction text, but did not expect to learn much from fiction text.

Preference for text was clearly stated: students liked reading fiction text more than non-fiction text and the number increased over the year. There was an increase in preference for non-fiction text which is not surprising and although the study did not focus on gender preference it would not be surprising if the increase was higher among boys. However, one could argue that the increase in amount of non-fiction text that students are exposed to could account for this and that it also presents problems for struggling readers as the non-fiction text can be complex and dense and therefore harder to understand. Teachers in the study referred to the "overload of information with lots of new ideas and concepts being presented to students in science" and they saw this as a big problem.

Equally, it is not surprising that students find it difficult to change text types when the awareness of text type was relatively poor. This links to the weakness in Building Vocabulary Knowledge where students often encounter specialist vocabulary and do not have the strategies to help them understand it. The Carnegie Report (2010) alluded to the inability of content areas in motivating students to read the complex texts which do not seem relevant to students. Being able to make links to what they are reading in science could be explored further to engage students in what they are learning.

However, the concern that students were not more aware of differences in reading fiction or narrative text is high: students have been exposed to a wealth of this text type in primary education settings and it raises questions as to why this might be so. However, once students are familiar with the text type, such as explanation in science, it is clear that this is helpful in improving their achievement in reading this type of text.

6.5 OVERALL STUDENT ACHIEVEMENT

Changes in student reading achievement were noted over the year through the use of the DLA (diagnostic literacy assessment) and asTTle (national standardized reading test). Although overall the achievement was not huge for the science and narrative texts in the DLA, it was possible to break these results down and note change in individual aspects.

In some skill areas, students were more successful in achieving better results in reading science text than in narrative text. The three scales of the DLA (Use of Text Features, Reading for Deeper Understanding and Building Vocabulary Knowledge) showed clear differences. In both the scales of Use of Text Features and Reading for Deeper Understanding, students' results reflected improved skill levels. Overall, all students improved using text features to cross-check their understanding, make predictions using sentence and paragraph structure and text forms, as well as identify purpose and audience. These skills help good readers to find the information that they need to make meaning of the text.

In addition, students developed in Reading for Deeper Understanding by being better able to combine the information from text features with the running text, as well as categorize or summarize the information. However, although they developed these skills the students did not perform well in locating main ideas. Lastly, in the scale of Building Vocabulary Knowledge all students performed badly and there was clear deterioration in the results over the year. Students wrote that they found science "hard to learn because of all the big words".

In reading narrative text, students did not achieve as expected. Although there were some similarities to the results from reading science text, students showed that they were not as proficient at developing an understanding of the main idea and locating main ideas in the text. It could be argued that it is easier to find main ideas in a science text which has a clear structure in paragraphs of topic sentence, with supporting detail and examples in the following sentences.

There would appear to be little transfer of reading skills from one text type to another by students and this may be because students do not link to science in the world around them, whilst coping with just interpreting the language encountered in the science text. The results may reflect that students have begun to develop their literacy skills and can find the information but still need explicit instruction in how to make meaning of this information. Reference has been made to teachers teaching the content and thus limiting the opportunities for students to inquire into what they are learning in science. The current New Zealand Curriculum reflects an emphasis on how students learn as being as important as science content knowledge.

In both of the reading tests for science and narrative, the results in the vocabulary questions showed gaps in student skill levels. Explicit teaching of new vocabulary is considered essential to assist students in making meaning of the text, especially since science is generally expected to be all new knowledge for students. This being the case, one would expect that there would be some growth in vocabulary over a year. However, when reading narrative text, one expects students to have already strong vocabulary knowledge as they would have been reading narrative text for a longer period of time. What may be missing are the skills to break down words to get the meaning or understand the contextual clues.

Pressley and McDonald (1997) wrote about reading as being an essential part of learning science and that decoding the text does not mean that students can understand it automatically. Linking science content with their own experiences or prior knowledge comes through learning the language or words of science. Therefore, it is important to teach the vocabulary of science explicitly to ensure students will gain a complete understanding of the text.

When the results were compared for both science and narrative texts, it is apparent that students achieved better in reading science text in the pre-tests. Students developed their skills in using text features to predict and cross check, as well as using knowledge of text form and type and being able to identify purpose and audience. In the post-tests there were two items consistent with the pre-test scores, where students scored higher in reading science text compared with reading narrative text: in using knowledge of text form to identify purpose and audience and in gathering literal and inferred information from multiple sources, students performed better in reading science text to narrative text. This could be linked to the informational text type which is often arranged in a particular way, such as in science text with the use of boxes, subheadings, and often use of colours which are similar throughout a textbook.

However, it was not totally expected that students would achieve better results in reading science text, as this would have been new for them compared with reading narrative text. This text type should have been quite familiar to them as students read a large amount of narrative text in their primary years, while learning to read. In contrast to the results for the whole group, Māori students performed well in reading science text and made a significant improvement. As was stated earlier, this pattern of achievement is consistent with other data collected nationally through literacy initiatives that have been operating in New Zealand over the past five years at least (MOE, 2010).

For male students, although the gains were not large, the results showed that they achieved better in reading science text. For female students, the results were better in reading narrative text. This was not a focus of the study but may suggest that preference for text conformed to an expected pattern.

The achievement results for the students in the targeted intervention for each school showed that students had mostly improved in the DLA and asTTle scores. Students made good gains in the three scales of the DLA: Use of Text Features, Reading for Deeper Understanding and Building Vocabulary Knowledge. In the aspects of using text features, cross checking, sentence and paragraph structure, and authorial intent (purpose and audience of text) students improved greatly. Students' skills in locating main points, and gathering literal or inferred information also were strengthened. It was interesting to note that in reading science text students built their skills in vocabulary knowledge through using context, whereas in reading narrative text, students' skills in vocabulary knowledge using morphology were greater. This could be because there is more explicit language instruction occurring in English than in science, or that the vocabulary in science often differs from the everyday use of the language. When this vocabulary is encountered in a different context, students often do not see the links or the differences in meaning.

The results of the standardized test, asTTle, showed significant improvement in achievement among all students. It is usual practice to expect gains of two or more sublevels where any intervention has taken place. With this group of year 9 students the gains were greater than the normal increase in achievement. The scores were between one and three sublevels in four out of the five schools although there may be some reason for the minimal gains in the fifth school such as type of test given or conditions of testing. Generally, there were good gains in the DLA which showed that students had developed their strategies and appeared to be much better than the results from asTTle would suggest. The improved asTTle scores also support the gains seen in the DLA tests and have encouraged the schools to continue to use both tools to help identify the needs of groups of students and help address the gaps. There is enough consistency between the results from the DLA and asTTle to suggest that student achievement did improve over the year.

6.6 TARGETED INTERVENTION

The improvements achieved in the targeted classes could support a need for explicit strategy teaching. Generally, the overall achievement increased for these targeted groups compared to the other year 9 student group: four out of the five schools who had identified a target group of students could report an increase of at least one to three sub-levels in the standardized testing, and that the DLA indicated great improvement for these students. Most students improved in their reading of science text and further developed their literacy skills. Students in the targeted groups were reported to be 'enjoying science greatly' and teachers stated that they had learnt 'heaps to help them in their teaching'.

The improvement made by the lower range of students in the target groups is noteworthy. However, the attitude of these students did not necessarily change in reading enjoyment. What was noted was that there was a change in learning behaviours in the classroom where the students were more engaged with the topic they studied and they indicated that they could understand it more easily than before. Students stated that "the teacher helped us to understand what we are learning, and it is more fun that way". Teachers made great efforts to teach the new vocabulary so that students could make meaning of the text and this was felt to be more successful in these groups than in the other year 9 student groups. One teacher stated that "building vocabulary knowledge continues to be a key focus with my classes", and students are encouraged to keep keywords in a glossary notebook. Another teacher commented that she continues to use activities that develop the students' vocabulary skills as this helps them to understand the text and links science to their own world. It is possible that with continued explicit instruction these students would improve further and attitudes and perceptions about science may change and become more positive.

Students became familiar with using text features to help them find information: every time they began a new topic they used the same format and applied their skills to determining what the text was about and what the main points might be by using titles and subheadings. During a lesson using text features to find information, one student stated that "the title was important as it helps give direction to the text". They were able to isolate the new vocabulary, especially by looking for words that may be in bold or italics; establish what they already knew; and think how the new information might add to this. For example, in one class when they found words in bold or italics, they would then write the word on paper and alongside it write words they thought were similar or a possible meaning, and then talk to someone else to see what they had written. "We could share our ideas and then agree on a possible meaning for the words in bold or italics before we checked a glossary or dictionary". In this way, they were able to build their active vocabulary especially on a new topic.

Building collaborative practice was observed in these targeted classes as teachers sought to engage students in inquiry into what they were learning. Improvement in student attitude became apparent as the year progressed where students exhibited more enjoyment in science classes and stated that they got to 'do more' than they used to. Students reported lessons were better as they understood more and wanted to continue learning science. One student told me that the text told him something about "real things in real life", and this made more sense to him. Another student said: "My teacher used examples like 'lolly stick' to help me remember the word 'spatula' as they look the same". A practical experiment using marbles and wooden balls when the students were learning about solids and liquids helped a student to "get the idea of what it was about". Emphasis was placed on more activity which required thinking skills rather than low level activity of cutting out and more group work so that students could learn from each other.

It was interesting that the groups observed at the beginning of the year did not listen very well but this changed during the year as students became more engrossed in what they were learning. Lessons observed were more structured with clear learning intentions outlined; activities were provided for students to investigate a topic and then link it to the text itself; and there was more involvement in writing notes so that they could express what they were learning. One student stated that they had learnt to "focus on writing out proper or full sentences that make sense", and another student said "it became clearer for me when I could highlight the important things and identify the main ideas for myself.....I liked learning by myself". Another student said: "I liked having the text broken down into smaller bits, as it helped me to get the science stuff". One teacher noted that students became "more independent and confident".

The targeted action such as instruction around Use of Text Features with science teachers fits with studies already carried out, such as that of Peacock and Weedon (2002) where they found that there needed to be more planning for teaching visual literacy skills and linking the text and visual features, so that non-fiction text could be used more effectively.

6.7 SUMMARY

There are some clear conclusions that can be drawn from the results presented in Chapters 4 and 5. Improved reading achievement was noted in the results for all groups but particularly in the targeted groups of students. Where students' needs are identified and then targeted, it is possible to make a difference and also students can feel more confident about their learning when they know how to find the information and respond to questions about the text, thus developing their literacy strategies or skills.

Students' attitudes to different types of text often can be linked to the difficulty or complexity of the text and when ways of breaking down the text are presented to them, they feel more confident in responding. In addition, students' perceptions about their skills and ability are intertwined with their attitude and can affect the way they approach different types of text. Students need explicit teaching around different types of text to increase their awareness so that they can make meaning of the text more easily.

Student learning related to the use of science text needs to be considered by teachers to engage them and help them understand what they are learning. Recognition of the different text structure, the specialized vocabulary related to any new topic, and acknowledgement that students may have no prior experience or learning will assist in planning a teaching and learning programme which will again engage students more easily in learning science.

Clearly, literacy challenges are presented across the curriculum but specifically in science these can be addressed by orienting students to the use of non-fiction or expository text, particularly around the Use of Text Features which help students to locate information, main points, and then fully understand what they are learning. Students can then relate the learning to their world and make more sense of it.

Targeting groups of students and comparing them to the remainder of a whole group is also valuable for assessing whether it is possible to make an impact or difference to student achievement. By identifying and then addressing gaps in their learning it is possible to improve student learning.

In conclusion, there are a variety of challenges for students in reading non-fiction text, particularly science text, and this can affect the attitude and perceptions that students have. It may be possible to change attitudes and perceptions over a longer period than a year and increase their confidence in learning science. Explicit teaching of literacy strategies are needed to ensure that students continue to build onto the skills they have gained at primary level and help them to tackle the complex text that they face in secondary school, especially in science in the confines of this study.

CHAPTER 7

CONCLUSIONS OF STUDY

7.1 INTRODUCTION

This chapter presents the conclusions of the study. These are expressed in the relevant sections of the chapter. The second section describes the limitations of the study which may impact on the outcomes. The third section gives a summary of the research and some of the findings as well as comparing with the results of previous research studies. The fourth section responds to the research questions posed in Chapter One and links the findings of the study to these. The next section discusses future research that could be carried out linked to this particular study. The final section offers some concluding comments.

7.2 LIMITATIONS OF STUDY

In order to produce valid, reliable data, attempts were made to gather the data in a similar manner from the five different schools. This was done by constructing an information sheet (see Appendix Two) which outlined how teachers were to administer the tests and the test conditions. In addition to this, a request was made of the schools that they supply printed sheets with names of students in each class group and also give their ethnicity. This allowed the researcher to identify students who had not written full details on their papers such as only the Christian name. The research material was delivered by hand to the science department in each school and was subsequently collected once the tests were completed. This ensured that the test papers reached the right person and also strengthened the link with a key person in each school.

There were also limitations in using the attitude survey as there were no guarantees that students would have been thoughtful in their responses: this may have depended on when students were asked to complete the survey. The instructions asked teachers to administer these in a lesson following the tests but it was possible that due to time constraints, in some cases, they would have given the survey directly following the tests. For some students this would put more pressure on and they could have completed the survey in a superficial manner. The validity might be dependent on the honesty of the participants to respond as required. The information gathered from the attitude survey gave insight into what students thought, but this could have been interpreted by the researcher and may not necessarily have reflected fully what the student was meaning at the time.

Another limitation was the time frame for the study. The data collection involved two collection points and some students were part of either pre- or post-testing which meant a vigorous checking of the students at each point to ensure that comparisons could be drawn in a reliable manner. The data were then cleaned up so that only students who participated in all testing were included in the final database.

Lastly, only one of the five schools did not provide a target group for the researcher to work with, but the Head of Department met with the researcher each term to pass on resources and discuss the data. However, similar approaches were suggested to ensure that comparisons could be made across all five schools.

7.3 SUMMARY OF RESEARCH

The study investigated students' perceptions and attitudes of different text forms at their transition point into secondary school, that is, year 9 in New Zealand. It also looked at the literacy challenges students faced in reading science text and also the impact on student achievement when targeted action was carried out by comparing an identified group with a whole cohort of students.

Students were given opportunities to build skills in the areas of using text features to locate information, read for deeper meaning by building literal and inferential skills, and expand their vocabulary knowledge. This was achieved in part: skills were developed in using text features and also reading for deeper meaning, but the area of vocabulary knowledge was not as successful. The overall achievement data using a New Zealand standardized test, asTTle, showed that students did make gains and this was supported by the DLA results.

Students' attitudes to text were not unexpected: students preferred reading fiction text to non-fiction text, but acknowledged that they got information from non-fiction and that it could be 'interesting' sometimes, as opposed to fiction text which was generally seen as 'exciting and interesting'. This could be attributed to their familiarity with narrative (fiction) text which is used heavily in teaching students to read and write and also in 'reading to learn' at the upper levels of primary school. Students also perceived that they were better at reading fiction text than non-fiction, believing that non-fiction text (as in the science text primarily focused on) was more difficult. This can be related to the amount of new and specialized vocabulary which is encountered in any topic in science for year 9 students.

It is acknowledged by a number of researchers (e.g. Peacock and Weedon, 2002) that a high percentage of words in science text may be unfamiliar to students which can interfere with their competence in reading. Even students who are good readers can find the science text challenging without the necessary vocabulary to make meaning of the text. It is also apparent that students do not have the vocabulary skills needed to work out the meaning and fully understand the complex text that they are faced with.

From students' comments, the ability to describe the different text types was often not apparent and this lack of awareness is a barrier to achieving as well as expected in reading science text. Students are familiar with the features of narrative (fiction) text but lack knowledge about non-fiction text. However, this could be an indication that they have little experience of science learning until year 9.

Little wonder that students do not want to read non-fiction text and do not have the skills to 'read to learn'. Much literature posits that more explicit teaching of reading skills across the curriculum exists, for example, as stated in a position paper published by The Science Teachers' Association of Ontario (2005), and The National Research Council, USA (1996). It was considered that particularly in science, teachers need to consider creating successful readers and writers, thus integrating literacy into their curriculum area.

An interesting result was that there was a noticeable increase in students' preference for reading science text after one year. Any increases noted were small, but if the study had been maintained for another year it was possible that there could be a change in attitude by students towards types of texts. What was clear was that struggling readers were greatly challenged by the complex text they faced. With explicit teaching, as was evidenced in the target groups' lessons, it was possible to assist students to build skills more easily. The schools in the study were very positive about continuing the course of action begun in the study to maintain the improved levels of achievement that they saw in 2009.

Students generally made greater improvements in reading science text rather than narrative text which was initially surprising. Students did express more confidence in themselves after repeated practice in using text features and other reading skills. Considering the number of years that students have been exposed to narrative text in learning to read and write, it was thought that they would demonstrate a higher skill level in reading different types of text and therefore be able to transfer between text types more easily. Again explicit teaching would appear to be needed for students to develop their reading skills further as they progress through secondary school.

The use of the initial data to plan teaching and learning with the target groups and the ongoing professional development between teachers and researcher led to a successful intervention. Teachers commented that they learnt how to integrate literacy into their teaching and learning programmes and this helped students to learn the science knowledge they needed more easily. By considering what student skills might be needed in learning topics such as the human digestive system, students became more engaged in their learning.

7.4 RESEARCH QUESTIONS

This section provides responses to the questions posed in Chapter One of this thesis. The study is one of few studies which have focused on the literacy challenges that students face on transition to secondary school, as well as their attitudes and perceptions around the change in text types in their secondary programmes. In addition, the study wanted to measure any impact on student achievement as a result of targeting action with groups of students.

7.4.1 Response to Question One

What literacy challenges does science text present to students and what impact does this have on their attitudes to reading different types of text?

Text features were unfamiliar to students which once understood assisted them to read more easily. For example, once students were taught how to find the main points by using titles, subheadings and other visual aids such as diagrams and pictures, they found this helpful to understand what the text was about. In addition, students had to come to terms with complex concepts in science and this is quite different from the narrative text structure which follows a predictable beginning, middle and end framework.

Students do not often have the background knowledge, as evidenced in the results of the DLA. They find the information but do not identify the main ideas in the text. Lack of vocabulary knowledge also, although expected, is a challenge for students who need to develop skills in making meaning using context or using morphological skills to understand what a text is about. In addition, about two thirds of the vocabulary in science is unfamiliar to students, as stated by Peacock and Weedon (2002).

Also, the challenge of reading through dense information was seen in their responses to the attitude survey where they indicated strong preference and enjoyment for reading fiction text rather than non-fiction. This can impact on their achievement as they are less willing to engage with the text unless there is greater understanding.

7.4.2 Response to Question Two

What are the differences in reading science text from other types of text that students may have read previously in primary education?

The structure of science text is quite different from what students will have experienced until that point, in that they will be very familiar with narrative (fiction) text as a text type. Non-fiction text is organized differently with much more emphasis on a range of visual and verbal features. The attitude survey showed that students do not have great awareness of different text types and that the results from the DLA showed that after explicit teaching they were able to respond better to science text than narrative text. It is possible that more explicit teaching in English in reading narrative text could be beneficial for students also.

Vocabulary knowledge was an area which could be investigated further: results indicated that students' skills in understanding unfamiliar text – either fiction or non-fiction – were lacking. Science teachers often assume that students' vocabulary knowledge in reading science text would be much less than that for reading narrative text, but it was surprising to note that there was no discernible difference in reading the different types of text. The results from the DLA showed clear deterioration in the scale of Building Vocabulary Knowledge and would suggest that this is an area of need in science classrooms. Building vocabulary knowledge across the curriculum is an approach used to help particularly struggling readers to comprehend text to a much greater level. By explicitly teaching the organizational patterns in science texts, students were helped to navigate the text more easily.

7.4.3 Response to Question Three

What impact does the understanding of science text have on students' achievement or academic progress, and attitudes to different text types?

The impact on achievement was evident from the overall results obtained through the asTTle and the DLA. Students in the study increased their scores and levels over the year: the increases were between one and three sub-levels, and between 21 and 85 points, and for most students show clear improvement. In the DLA, students' achievement in reading science text was clearly better than that in reading narrative text: in the focused areas of the DLA students made gains in all aspects of the text, such as Use of Text Features, Reading for Deeper Understanding, and Building Vocabulary Knowledge. The gains in the DLA were mirrored in their improved scores and levels in the asTTle test.

Students' attitude appeared to change, particularly in their preferences with an increased number of students enjoying reading non-fiction text in the post-tests. Preference was clearly for reading fiction text, with 62% of all students indicating that they liked reading fiction text. Clearly, they found fiction text more interesting and exciting to read also. The negative responses to reading non-fiction did not change over the year either. In addition, the results showed that students perceive that they are better at reading narrative text and find it easier to read than science which may be linked to their preference for narrative text overall. It was not clear either whether students' preference for fiction text was linked to how good they believed they were at reading that type of text.

The comparison of results between reading fiction and non-fiction text also built onto research begun by McDonald and Thornley(2001), and could be continued into following up on next steps for students who have begun to build skills in reading with understanding.

The attitudes to reading non-fiction text clearly are linked to the reading of non-fiction text and raise concerns about the impact on their achievement in science. Further research could investigate whether it is possible to change these attitudes to different types of text and help students to learn better in science.

7.4.4 Response to Question Four

Can targeted interventions in literacy impact on student achievement, as assessed by asTTle and the DLA, and attitudes especially in science education?

The targeted students in the study did respond well to the intervention; results indicated that these groups of students improved more than the other year 9 students and teachers also reported more engagement with the learning in science than previously observed. Also the overall achievement results support this. Students' skills increased, especially in the areas targeted, students were observed to be more interested in what they were learning, and they appeared to enjoy lessons more, as the learning became more relevant for them.

The results showed that it was possible to improve student achievement through explicit teaching and a targeting intervention. The tracking of students helped teachers to keep a focus on student learning and to make a difference in achievement. The benefits were clear for schools with higher student engagement and more enjoyment in what they were learning.

7.5 IMPLICATIONS OF STUDY

The research adds to the body of knowledge around adolescent literacy in New Zealand and could have implications for science teachers as they grapple with the demands of the New Zealand Curriculum (2009) which demands a focus on the 'how we learn' rather than the 'what we learn'. The document indicates that students who exhibit the competency or skill of being able to use text and interpret the language, can understand and communicate effectively. The importance of literacy in the English language is seen as very important. Integrating literacy into science learning fits well with the intent of this mandate.

The research begun by Thornley and McDonald (2002) identified the difficulties and challenges that students faced in reading across the curriculum. This research study builds on their work and adds to the research by identifying challenges students face in reading both science and narrative text. This study adds to their work in developing teaching approaches which will help students build their knowledge about text and their use of literacy strategies in reading complex text. The study helps to target the gaps identified by Thornley and McDonald (2002), and shows how teachers can make a difference in improving achievement, particularly in reading science text.

Using the DLA to monitor ongoing achievement was shown to be an effective way of building student skills in reading. This has implications for research that is used in pre-service programmes to guide teachers in their practice in the classroom as a way of making a positive difference to student achievement. Teachers also found it a valuable tool to help students learn and to adopt a more positive attitude to their learning in science generally. The use of the DLA was seen by science teachers as an effective way of identifying the needs in their curriculum area, and this was an approach which they had not been introduced to before.

Explicit instruction for students around different text types and building skills in this area will have benefits for them in reading; the importance of this knowledge in determining purpose and audience has been stressed in various studies already. The implications for this could include the impact on students' attitudes to science text and helping them to be more effective readers in science.

7.6 FUTURE RESEARCH

There is a clear need for further research to continue to investigate the links between attitude to different text types and achievement. In addition, it seems clear that student awareness of the different text types needs to be strengthened as they enter into secondary school. As most of their learning derives from using non-fiction text from year 9, it is vital that teachers integrate this into their teaching and learning programmes. This links to the current emphasis on literacy across the curriculum which is demanded by the Ministry of Education, and is evident in the range of new literacy pathways at senior level which can impact on students' entry into tertiary courses.

A longitudinal study would also be valuable for tracking where students lose their enjoyment of reading and to appreciate reading in different types and the purposes for each. By linking students' perceptions about the different types of text and their enjoyment of them it could be possible to determine how important this could be for achievement in subjects such as science.

The implications for further research into following students through the junior school and into their senior assessment environment, tracking achievement and integrating literacy into the teaching and learning programmes, particularly in science, are great. For students to achieve highly, particularly in the science learning area, they need to have targeted instruction to be able to cope with the complex demands of the science curriculum. Explicit instruction in reading skills is needed to ensure that students can cope with the text demands and that they understand how to extract the information they need from the text. This will require more time to be spent on familiarizing students with the structure and features of the text by using a range of different approaches. Further research into how this can be done is needed so that teachers learn from what is working well in science classes and is relevant to the purpose of science learning. This approach fits well with the 'teaching as inquiry' cycle that underpins teaching and learning programmes now at secondary school.

Building vocabulary skills has been identified as an area for concern which is not done particularly well across the curriculum and could benefit from further research to raise awareness of teachers as to how valuable this can be for developing reading competency in their students. Students' preferences for reading particular types of text are closely linked to their perceptions on how difficult or easy the text is. If they are not familiar with the vocabulary in science topics, this can pose major challenges for students, particularly those who already are identified as 'struggling readers' and the effort is too much for some. Research into what works well in building these skills could be of great value to science teachers as they wrestle to make the text more relevant to students. By gathering further data around this aspect it may be possible to identify more effective ways of building these skills for students.

7.7 FINAL COMMENTS

Adolescent literacy skills must include being able to read many different types of text, especially as we enter an age of multiliteracies. The data overall in New Zealand would suggest that there are many students who do not have the necessary skills to achieve at the level required as they enter secondary school. However, it may be a question of how they can acquire these skills if there is not more explicit teaching of reading strategies to enable them to engage with challenging text that they will encounter from year 9 upwards.

The recent PISA 2009 report stated that "the reading performance of New Zealand students, on average, did not change between 2000 and 2009, which is concerning and adds weight to the research gathered in this thesis. There is much to celebrate in this report with one in six students performing at a high level, but there is still much work to be done in catering for the lower achieving students to help them reach their potential.

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APPENDICES

1. Notes for Administering Tests to Students
2. Participant form
3. Pre and Post Tests
4. Attitude Survey

Appendix 1

INSTRUCTIONS FOR ADMINISTERING TESTS

- Before starting the test please tell the students that you are giving them these tests as part of the research project which is investigating how well they respond to the different types of text and if there is any difference in how they approach different types of text.
- Please ask the students to complete all details on the form as I need to correlate the tests, attitude survey and other relevant details.
- The assessments are designed to be given to each class as a group in the classroom.
- Please issue all students with the 2 texts, and 2 sets of questions relating to these texts. The tests should take approximately 40-50 minutes to complete depending on the students' abilities.
- Questions may be read aloud to the students at any time during the test. However, please do not give an answer to the questions, or give meanings of words or hints about how to approach the question as the assessments will determine what needs the students may have.
- Please tell students to try to answer all questions as this will help to assess the impact of what they have learnt this year.
- The attitude survey should be done after the diagnostic literacy assessments (DLA) have been completed. These can be done in a following time slot or at the end of the tests if there is plenty of time.
- Please contact me if there are any queries.

Thanks.

Mal Thompson

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03 4794246/ 021 1901400

Appendix 2

Curtin University of Technology School of Science

Participant Information Sheet

My name is Mal Thompson. I am currently completing a piece of research for my Doctor of Philosophy at Curtin University of Technology, Western Australia.

Purpose of Research
I am investigating the literacy challenges faced by students in using scientific texts.

My Role
I am interested in identifying the literacy challenges students face in using scientific text as well as investigating to make meaning of the text and how we can enable them to navigate the text more easily. I would also like to profile the teachers I will be working with in this study.
The test will be a questionnaire consisting of two passages (1 x narrative text; 1 x expository text), which can be completed within an hour period. This test will be conducted at the beginning of the year and also at the end of the year, using two different sets of text.
The purpose of the tests is to:

- to identify the literacy challenges students face in using any scientific text at year 9 level
- to investigate the perceptions and attitudes students have in changing text types (fiction to non-fiction)
- to track student achievement with targeted groups of students using standardized testing methods
- to discuss the implications and meanings for student learning in the use of scientific text

There will also be an attitude survey for students to fill out when they have sat the above tests.

Consent to Participate
Your involvement in the research is entirely voluntary. You have the right to withdraw at any stage without it affecting your rights or my responsibilities. When you have signed the consent form I will assume that you have agreed to participate and allow me to use your data in this research.

Confidentiality

The information you provide will be kept separate from your personal details, and I will only have access to this. The interview transcript will not have your name or any other identifying information on it and in adherence to university policy, the interview tapes and transcribed information will be kept in a locked cabinet for five years, before it is destroyed.

Further Information

This research has been reviewed and given approval by Curtin University of Technology Human Research Ethics Committee (Approval number: SMEC20080041).

If you would like further information about the study, please feel free to contact me on +6434794246 or by email: mal.thompson@otago.ac.nz.

Alternatively, you can contact my supervisors, Professor Darrell Fisher/ Heather Jenkins on:

Phone: 61 8 9266 3110 / Fax: 61 8 9266 2503

Email: D.Fisher@curtin.edu.au; h.jenkins@curtin.edu.au

I________________________________ (Teacher/ Student) give permission for my information to be used in this study.

Signed:____

Date:___________________

Thank you very much for your involvement in this research, your participation is much appreciated.

Appendix 3 – Pre- tests

Year 9 Diagnostic Literacy Assessment: Science: Seasons and Tides

Ref: New Millennium Science 1, Gary Hunt, pp. 66-67

Using Text Features:		
Make predictions about reading from headings, sub-headings, tables, diagrams, illustrations, captions etc.	This text is about: a. How the Sun and the Moon affects the Earth's seasons and tides b. Opposite hemispheres have opposite seasons c. How the tides are linked to the position of the Sun, Moon and Earth d. Why there are seasons and how tides work on Earth **Best answer 'd' as it shows the reader has used all of the features to combine.**	Correct: Incorrect: No Response:
Making inferences, cross-check and confirm using text features	How does the diagram on p66 help us understand about the seasons? **Shows us the angle of Earth to the Sun and how this links to the seasons** **(Refer to the diagram, italics in bullet points etc)**	Correct: Incorrect: No Response:
Make predictions about reading using knowledge of *sentence* and paragraph structure	Beginning with the sentence: "The Earth turns once every 24 hours….", what does the reader learn about seasons and tides? **That the hours of daylight depends on different seasons – longer in summer than in winter; also that tides are caused by the attraction of the Sun and the Moon for Earth.**	Correct: Incorrect: No Response:
Make predictions about reading using text forms	This text is called an 'explanation' how is it different from a short story? **In this answer look for comparison, in text features, deeper features and information about plot characters as opposed to use of diagrams etc**	0 points 1; 2; 3; 4;
Use knowledge of text form to identify authorial intent	Why do you think that the author might have included the diagrams, and photos on pgs 66 and 67? **To show us why there are seasons and how tides work.**	Correct: Incorrect: No Response:

Reading for deeper meaning:		
Integrate information from text features with running text	How does the tilt of the Earth cause seasons? **The Earth is spinning at an angle to the Sun so the Sun is more overhead and gives more direct heat and light to it.**	Correct: Incorrect: No Response:
Develop understanding of main idea, locate main points	What is happening when there is a high tide that is different from low tide? **Water is pulled towards the Earth by the Sun and/or the Moon.**	Correct: Incorrect: No Response:
Gather *literal* and inferred information from multiple sources	What is the difference in daylight hours for the northern and southern hemispheres? **As one hemisphere is tilted towards the Sun, then the other is tilted away so they have longer and shorter days respectively.**	Correct: Incorrect: No Response:
Categorise, summarise	What can you find out from this passage about seasons and tides? - **Half of the Earth has summer, the other half winter** - **In summer the day length is longer than in winter** - **Tides are caused by the pull of the Sun and Moon for Earth** - **Seasons happen because the Earth is tilted towards or away from the Sun** - **Water can move more easily than land, so tides occur as the Earth is pulled away from the oceans and also the spin of the Earth.**	0: 1: 2: 3: 4: 5:
Vocabulary knowledge:		
Make meaning in unfamiliar vocabulary using context	In the text at the top of p 66 (left side, bullet point), what does ‘horizon’ mean**?** **It's the line where the sky and land meet.**	Correct: Incorrect: No Response: Already knew:
Make meaning in unfamiliar vocabulary using morphology	What does ‘hemisphere’ mean? Is there any part of the word that can help you to work it out? **Either the northern or southern half of the earth as divided by the equator. Hemi = half; sphere = ball, globe**	Correct with morpheme: Correct no morpheme: Incorrect: No Response:

Year 9 Diagnostic Literacy Assessment: Narrative text

- **Ref:** ***My Sixth Literacy Workbook: The Journey***

Using Text Features:		
Make predictions about reading from headings, sub-headings, tables, diagrams, illustrations, captions etc.	Look at the title, caption and illustrations. What might this text called 'The Journey' be about? **About a journey made by a boy in wartime.**	Correct: Incorrect No Response:
Making inferences, cross-check and confirm using text features	What impression do we get of Archie's journey? **That he is travelling some distance and that it is in the countryside and that it could be a bit lonely.**	Correct: Incorrect: No Response:
Make predictions about reading using knowledge of *sentence* and paragraph structure	Read the paragraph starting: "Then his mother had explained about the bombs…" What is the main idea in that paragraph? **That his mother had persuaded him he would enjoy himself at the seaside and it would not be long before he would be able to come home.**	Correct: Incorrect: No Response:
Make predictions about reading using text forms	This text is called a 'narrative'; how is it different from the explanation text like in science? **In this answer look for comparison, in text features, deeper features and information about plot characters as opposed to use of diagrams etc**	0 points 1; 2; 3; 4;
Use knowledge of text form to identify authorial intent.	Why would the author begin the story with Archie in his new bed in the countryside and then flash back to the events leading up to him going to the country? T**o show that he was initially unhappy about where he was but that he got over it.**	Correct: Incorrect: No Response:
Reading for deeper meaning:		
Integrate information from text features with running text	How would you describe Archie's feelings at the end of his journey? **It was all strange for him –it was different from the noise in the streets in London, and they spoke different and he found the people hard to understand, and he wasn't used to playing with just a girl.**	Correct: Incorrect: No Response:

Develop understanding of main idea, locate main points	What things help us to understand what 'The Journey' is about? **The descriptions of Archie's home in London, and then the farm where he goes to stay and also the beach nearby (talk of bombs in London, lack of milk etc in London in the war…).**	Correct: Incorrect: No Response:
Gather *literal* and inferred information from multiple sources	What are the main differences between where Archie has come from and where he is now? **Different places – city and seaside; Archie leaves his family for one he does not know; has the 'girl' May to keep him company; did not know that the farmer's wife was referring to the cow and did not recognize seals (the inferred piece should include something like lack of familiarity in the country)**	Correct: Incorrect: No Response:
Categorise, summarise	What can you find out from this passage about Archie's living situation and his response to the journey? **Answer might list some:** **- He lived in London with his parents and grandparents** **- He didn't want to leave home** **- It was fun until all the children were split up and sent to different homes** **- There were some good things about his new home such as the fresh milk and then the 'amazing' seal.**	0: 1: 2: 3: 4:
Vocabulary knowledge:		
Make meaning in unfamiliar vocabulary using context	In the first paragraph, what does '**familiar**' mean? **Recognizable, well known, usual, typical.**	Correct: Incorrect: No Response: Already knew:
Make meaning in unfamiliar vocabulary using morphology	What does 'evacuated' (in the box at the top) mean? Is there any part of the word that can help you to work it out? **It means 'emptied out', 'taken away from', 'moved out of' or 'sent away'. Links to words like vacant, vacate -**	Correct with morpheme: Correct no morpheme: Incorrect: No Response:

Appendix 4 – Post-tests

A *Year 10 Diagnostic Literacy Assessment: Science (The Rock Cycle)*

Ref: New Millennium Science, Gary Hunt, p 106-7

Using Text Features:		
Make predictions about reading from headings, sub-headings, tables, diagrams, illustrations, captions etc.	What do you think this text is about? (Tick one) a. Different types of rocks and their characteristics b. The process of rocks changing c. How rocks form from sediments and earth **Best answer 'b' as it shows the reader has used all of the features to combine.**	Correct: Incorrect: No Response:
Making inferences, cross-check and confirm using text features	How does the recycling of rocks occur? **Rocks are constantly being formed through heat and pressure and weathered in time to form sediments and soil.**	Correct: Incorrect: No Response:
Make predictions about reading using knowledge of *sentence* and paragraph structure	In the section: "Igneous Rocks", what do you think is the most important detail in this section? Why do you think that? **That these rocks are formed from molten magma/ lava.**	Correct: Incorrect: No Response:
Make predictions about reading using text forms	This text is called an 'explanation' how is it different from a short story? **In this answer look for comparison, in text features, deeper features and information about plot characters as opposed to use of diagrams etc**	0 points 1; 2; 3;
Use knowledge of text form to identify authorial intent	Why do you think that the author might have included the diagrams and illustrations on pages 106 - 107? **To provide examples of the types of rocks and illustrate how the rock cycle works.**	Correct: Incorrect: No Response:
Reading for deeper meaning:		
Integrate information from text features with running text	How would you describe the rock cycle? **Through the magma (molten rock) new rock is formed; then it can be heated, changed and weathered over time. It moves through stages of igneous (melted), sedimentary (becoming solid), metamorphic (changing again to molten rock).**	Correct: Incorrect: No Response:
Develop understanding of main idea, locate main points	What does the text tell us about different types of rock? **That rocks change over time as part of a cycle.**	Correct: Incorrect: No Response:

<table>
<tr><td>Gather literal and inferred information from multiple sources</td><td>What are the differences between each type of rock?
<table><tr><th>Type of rock</th><th>Differences</th></tr><tr><td>Igneous</td><td>Formed from melted magma (rock); size of crystals tells us how quickly it cooled</td></tr><tr><td>Sedimentary</td><td>Hardened under pressure; bonded together by chemicals such as calcium carbonate; forms in layers and may contain fossils</td></tr><tr><td>Metamorphic</td><td>Minerals can recrystallise when rock has been heated under great pressure</td></tr></table>(Need to look at diagrams and also text)</td><td>Correct:
Incorrect:
No Response:</td></tr>
<tr><td>Categorise, summarise</td><td>What can you find out from this passage about the rock cycle?
- Rocks are constantly changing
- There are three different types – igneous, sedimentary, metamorphic
- New rock can be dated by the level of radioactive elements in it
- New rocks are formed out of molten magma (lava)
(Lot of information from the two pages can be used)</td><td>0:
1:
2:
3:
4:
5:</td></tr>
<tr><td>Vocabulary knowledge:</td><td></td><td></td></tr>
<tr><td>Make meaning in unfamiliar vocabulary using context</td><td>In the section headed: Sedimentary rocks, what does ‘sediments’ mean?
Settled matter at bottom of liquid; material from rocks which is deposited somewhere else</td><td>Correct:
Incorrect:
No Response:
Already knew:</td></tr>
<tr><td>Make meaning in unfamiliar vocabulary using morphology</td><td>What does ‘metamorphic’ mean? Is there any part of the word that can help you to work it out?
relating to or involving a change in physical form, appearance, or character e.g. animorphs, transformers and insects such as butterflies.
meta = among, with, after….change; morph = change</td><td>Correct with morpheme:
Correct no morpheme:
Incorrect:
No Response:</td></tr>
</table>

Year 9 Diagnostic Literacy Assessment: Narrative text
Ref: ***English Power, p120-121***

Using Text Features:		
Make predictions about reading from headings, sub-headings, tables, diagrams, illustrations, captions etc.	What might these two pieces of text be about? **About students writing essays on their holidays.**	Correct: Incorrect No Response:
Making inferences, cross-check and confirm using text features	What impression do we get of the characters of Amanda and Kylie? **Amanda was a student who was neat and tidy and presented her description well, unlike Kylie who had lots of inaccuracies in spelling, punctuation and sentence structure. However, Kylie had quite a sense of humour with her tale about the holidays, and came across as not really enjoying writing.**	Correct: Incorrect: No Response:
Make predictions about reading using knowledge of *sentence* and paragraph structure	Read the paragraph starting: "The first essay uses a dash of……." What is the main idea in that paragraph? **That although the two students described very different holidays they were both using humour by exaggerating what the holidays were like.**	Correct: Incorrect: No Response:
Make predictions about reading using text forms	This text is called a 'recount'; how is it different from the explanation text like in science? **In this answer look for sequence of events, use of nouns to identify people/animals etc, action verbs, linking words to do with time**	0 points 1; 2; 3;
Use knowledge of text form to identify authorial intent.	Why do you think that the author might have included the illustrations on this page? **To help us see the different ways of presenting work and using humour.**	Correct: Incorrect: No Response:
Reading for deeper meaning:		
Integrate information from text features with running text	How would you describe the two pieces of writing? **Amanda's piece of writing is well written, with underlying humour, very descriptive and mechanically correct; Kylie's writing is funny, very weak in surface features, but is also very descriptive and engages the reader. Both pieces are hard to believe and unreal, and very clever pieces of writing. The style (with mistakes) that Kylie uses gives you a lot of information about the person she is.**	Correct: Incorrect: No Response:

Develop understanding of main idea, locate main points	Why might the author have included so many errors in Kylie's essay? **The way the pieces of writing are set out; illustrations; also to show the reader what kind of person Kylie is.**	Correct: Incorrect: No Response:
Gather *literal* and inferred information from multiple sources	What are the main differences between the two pieces of writing? • **Moods of the writers;** • **Writing style;** • **Surface features such as spelling, punctuation** • **Choice of vocabulary**	Correct: Incorrect: No Response:
Categorise, summarise	What can you find out from this passage about writing recounts? **Answer might list some:** - **How to structure an essay about holidays** - **Use of exaggeration to create humour** - **Using own experiences for writing**	0: 1: 2: 3:
Vocabulary knowledge:		
Make meaning in unfamiliar vocabulary using context	In the first paragraph, what does '**exaggeration**' mean? **To state that something is better, worse, larger, more common, or more important than is true or usual.**	Correct: Incorrect: No Response:
Make meaning in unfamiliar vocabulary using morphology	What does' unreality'(2nd paragraph) mean? Is there any part of the word that can help you to work it out? **Something that is not real, genuine, or true, or that lacks substance – 'un' = not; reality = something real or true.**	Correct with morpheme: Correct no morpheme: Incorrect: No Response:

Appendix 5

Attitude to Reading Fiction/ Non-fiction text

Student's Name____________________________Date_______Class:________

Items 1-10 below consist of a number of statements about reading different types of text – fiction and non-fiction.
There are no 'right' or 'wrong' answers.
Your opinion is what is wanted.

Please circle the answer which best fits you in responding to these statements.

1 If you Disagree with this statement
2 If you are Not Sure
3 if you Agree with this statement

Example: I look forward to reading science text__________3___________

	Disagree	**Not sure**	**Agree**
	1	2	3

	DISAGREE	NOT SURE	AGREE
1. I enjoy reading fiction text (such as a novel or short story)	1	2	3
2. I enjoy reading non-fiction text (such as science information)	1	2	3
3. I am good at reading fiction text	1	2	3
4. I am good at reading non-fiction text	1	2	3
5. I find fiction text easier than non-fiction text to read.	1	2	3
6. I expect to read more non-fiction text (information) in year 9 than I have done previously	1	2	3
7. I read both fiction and non-fiction text in the same way, using the same strategies.	1	2	3

8. The teacher helps me with non-fiction text (such as science information) by reading it aloud.	1	2	3
9. I know more words in fiction text than in non-fiction text.	1	2	3
10. Long text with words I do not know does not help me learn.	1	2	3

11. How many hours per week do you read at home, for homework?
0-1 hrs *1-3 hrs* *3+hrs*

12. How many hours per week do you read at home, apart from homework?

0-1 hrs *1-3 hrs* *3+hrs*

13. What do you like about reading fiction text?

____

____

14. What do you like about reading non-fiction text?

____

____

15. What different types of text are you aware of?

____

____

16. What do you know about these different types of text?

____

____

17. Do you use knowledge of different types of text to help you in your reading at school? If no, what do you use instead? If yes, how do you use the text type to help understand the text?

18. Which types of text do you prefer – e.g. range of fiction text or non-fiction text? Why?