FOSTERING IN-DEPTH LEARNING WITH GIFTED STUDENTS

A thesis presented in partial fulfillment of
the requirements for the degree of

Master in Education

at Massey University, New Zealand

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2004

ACKNOWLEDGEMENTS

My sincere thanks to:

- The gifted kids who were the inspiration for this thesis and who participated with enthusiasm, honesty, and commitment;
- My supervisors, Tracey Riley for sharing your wealth of knowledge about gifted education and your invaluable assistance, guidance, and academic mentorship, and Jenny Poskitt for sharing your experience and guiding me through the action research process;
- The staff and trustees at the Gifted Kids Programme for your time, commitment, and professional support;
- And finally my family, friends, and colleagues for your ongoing support, encouragement, and guidance, and, in particular, Mum and Dad for your moral support and for believing in me.

ABSTRACT

This action research project investigated ways to improve the depth of gifted students' learning. In particular, it sought to identify strategies that could be used to foster deeper understanding and to improve students' learning outcomes. The motivation for this project was sparked by the teacher/researcher's experience in teaching a class of sixteen gifted students aged between 8 and 11 years. She observed highly capable students working below, what she perceived to be, their full potential. This incongruence between her expectations and her students' learning outcomes led to an exploration of ways to improve her teaching practice so that it would have a positive influence on the depth of the students' learning.

A literature review explored the needs for a differentiated curriculum for gifted students that supports in-depth learning. It also examined theory around approaches to learning and their relationship with learning outcomes. How to influence students' approaches to learning, and subsequently their learning outcomes, was also explored. The literature review showed little evidence of studies that explored in-depth learning in a gifted education context.

This project set out to answer the following research questions:

- What strategies can be used with gifted students to effectively foster in-depth learning?
- What influence does the implementation of these strategies have on the depth of gifted students' learning?

The study involved the teacher/researcher working with her class of gifted students to improve the quality of her teaching and their learning. Baseline data on quality of teaching and the depth of students' thinking was gathered. This involved students completing a questionnaire based on sixteen teaching strategies that had been identified as important for fostering in-depth learning.

The questionnaire included Likert scale questions and open-ended responses. The SOLO Taxonomy was used to design an evaluative test to measure the depth of students' understanding around familiar social studies, maths, and reading concepts. Students' feedback from the questionnaire was used to frame an intervention, which focused on the four weakest strategies (as indicated by the baseline data). After a ten-week period, this data gathering process was repeated, which provided comparative data. This was used to measure change over time, and to determine the success of the intervention. During the intervention a detailed research diary was kept. This helped the teacher/researcher to remain focused on the identified strategies.

The discussion of findings focused on two themes: 'Measuring and influencing the depth of students' learning' and 'Improving the quality of teaching'. The study found that before the intervention most students were operating at the quantitative stages of the SOLO Taxonomy, which indicates that they were not demonstrating in-depth thinking. The post-intervention test results showed little improvement, indicating that the intervention had limited impact on improving the depth of the students' learning. However, the study did find that, even before the intervention, the sample group performed at higher levels on the SOLO Taxonomy than their same-aged peers might be expected to perform. The discussion around improving the quality of teaching showed that the teacher/researcher's implementation of the focus strategies aligned with current research to a certain extent, but that her practice could have been better informed. The design of the action research project was critiqued, which highlighted the need for more collaboration with other educators, a longer duration for the intervention, and a stronger content focus. An additional finding from the study was an overlap between how best to meet the learning needs of gifted students and how best to encourage all students to engage in in-depth learning.

Recommendations for future research include further action research cycles, which address the limitations of the present study. Other recommended research includes exploration of realistic expectations for the depth of gifted students' learning, a study into in-depth learning with gifted students in a fulltime gifted programme or in the regular classroom (as opposed to a one-day-school model like the present study), or research around the overlap between teaching gifted students and teaching for in-depth learning.

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Chapter One: Introduction

Many people assume that students who have been identified as gifted are highly motivated learners who constantly perform at a level higher than their same-aged peers. People who make this assumption may be surprised with the reality. Just like regular learners, gifted students' motivation and dedication to their learning is influenced by many factors such as interest in the topic of study, the level at which the topic is pitched, and the way in which learning is facilitated.

As a teacher new to teaching in a gifted and talented programme, the researcher of the present study was surprised to find that many students in her class did not display dedication and motivation towards their learning. She expected that her students would be excited about learning enough to engage in it fully, to go off on self-selected tangents, and to develop in-depth understanding in areas in which they were interested. Their learning outcomes fell well short of her expectations.

> "When expectations are high, teachers are more likely to assume that they can and will provide whatever programmes and resources students need to succeed"(Reyes, Scribner, and Scribner, 1999, cited in Timperley, 2003, p. 75).

In this case, despite the teacher's expectations, the students were not performing to their full potential. This discrepancy between student performance and teacher expectations formed the motivation for this action research project.

The study took place in a gifted education programme called the Gifted Kids Programme (GKP). Students who attended the programme had been identified as gifted through a multi-method identification process which included data from each student's caregivers, school, and community (when applicable), as well as an interview and observations administered by the Gifted Kids Programme. Students attended their regular school four days per week,

and attended GKP on the fifth day. This day gave them opportunities to work with like-minded peers and a teacher who specialized in gifted education in an environment that was designed to meet their cognitive, social, and emotional needs. The students in this study were from one GKP class.

Having recognised the need for her students to engage in their learning at a more in-depth level, the teacher became teacher/researcher. The initial focus of her study was to better understand the concept of "in-depth learning" and to find out whether this was something that she, as a teacher, could influence. This foundation was a vital step in the path to improving the learning outcomes of her students. However, the teacher/researcher was not satisfied with just identifying an issue and finding out how to resolve it. The primary goal of this research was to actually put this theory into action so as to improve the quality of the learning outcomes of her students. This meant a dedicated focus on the quality of her teaching.

> "Improved teaching is the best path to increased learning, but students' learning will be transformed only if teachers' classroom practices reflect high standards" (Birman, Desimone, Porter, and Garet, 2000, p. 28).

It was the teacher/researcher's high expectations and desire to improve her teaching, and subsequently the depth of her students' learning, that influenced her decision to choose action research as the methodology for this study. Unlike other methodologies, action research allowed her to bring about change in response to the issue that she had identified (Stake, 1995).

> "Action researchers set out with the avowed intention of improving their practice ... Understanding a problem, through interpretive work, can be a useful step, but solving the problem requires action" (Kember, 2000, p. 25).

The structure of this research was guided by the Deakin Model of Action Research (Kemmis & McTaggart, 1988), which constitutes the following four steps: to develop a plan of action to improve what is already happening; to act to

implement the plan; to observe the effects of action in the context in which it occurs; and to reflect on these effects as a basis for further planning and subsequent action.

Initially, the study involved the gathering of baseline data. This included information about the depth of the students' thinking and the teacher's use of strategies that foster in-depth understanding. This was followed by a ten-week intervention period in which the teacher/researcher focused on deep-learning strategies. Post-intervention data was then gathered so that change brought about by the intervention could be measured.

The two research questions for this study were influenced directly by the teacher/researcher's aim to improve the depth of her students' learning. The questions were:

- What strategies can be used with gifted students to effectively foster in-depth learning?
- What influence does the implementation of these strategies have on the depth of gifted students' learning?

The teacher/researcher hypothesized that, if able to identify and implement strategies that foster deeper learning, she would be able to positively influence her students' learning outcomes.

1.2 Organization of the Thesis

Chapter One: Introduction

This chapter introduces the thesis by explaining the motivation that underpins this study. It briefly explains why action research was the chosen methodology and how the action research cycle was framed. This chapter includes an overview of the content of the thesis and outlines the research questions.

Chapter Two: Literature Review

This chapter presents findings from a review of the literature related to gifted education, approaches to learning and teaching, and measuring the depth

of students' thinking. It sought to identify trends and to reveal gaps in the literature related to these areas.

Chapter Three: Methodology

The methodology chapter examines the action research model. It includes an explanation as to why action research was chosen, descriptions of the methods used to gather data, a description of the research sample, and an outline of the procedure that the research followed. Validity and reliability issues are also discussed.

Chapter Four: Results

The findings of the research from the three data gathering tools – a questionnaire, formal tests, and a research diary – are presented. Pre-intervention results are presented first, followed by post-intervention results. Finally data from the research diary are presented and correlations between data from the different sources are drawn.

Chapter Five: Discussion

The results from the research are analyzed and discussed in relation to the findings from the literature review. They are organized under two themes: 'Measuring and influencing the depth of students' learning' and 'Improving the quality of teaching'.

Chapter Six: Limitations, Implications, and Recommendations

This final chapter acknowledges the limitations of this research study. It discusses the contribution that it makes to the body of existing literature and provides recommendations for future research around fostering more in-depth learning with gifted students.

Chapter Two: Literature Review

2.1 Introduction

This chapter examines literature related to fostering in-depth learning with gifted students. It reviews literature in three key areas. The first section, 'Gifted Education', explores who gifted students are, how they can be identified, and how to meet their learning needs. It touches on the importance of including the teaching of thinking skills in gifted eduction programmes to help facilitate in-depth learning. The second section, 'Teaching for In-depth Learning', examines conceptions of learning, approaches to learning, how approaches are decided for different learning tasks, and the relationship between approaches to learning and learning outcomes. Particular emphasis is placed on a deep approach to learning and its association with positive learning outcomes. This section also outlines how teachers can influence the approach that their students choose. The third and final section, 'Measuring Depth of Learning', examines Piaget's stages of cognitive development and introduces the SOLO (Structure of the Observed Learning Outcome) Taxonomy. The design and function of the taxonomy is explored in detail. Parallels are drawn between the SOLO Taxonomy and Bloom's Taxonomy. This is included because Bloom's is a more widely known taxonomy that has some similarities with SOLO. Outlining the relationship between the two can be used to highlight the strengths of SOLO and provide evidence as to why it was chosen as a key tool to measure the depth of students' learning in the present study.

2.2 Gifted Education

The purpose of this section is to explore who gifted students are, how they can be identified, and how their learning needs differ from their same-aged peers. It explains how the curriculum can be differentiated to better meet the learning needs of gifted students. This section also outlines the relationship between thinking skills instruction and in-depth learning and explains why this is an important component in gifted education programmes.

2.2.1 Defining Giftedness

> "The gifted and talented represent a wide range of students with many different abilities." (Ministry of Education, 2000, p. 12)

Historically, giftedness has been interpreted as high intelligence, however, present-day theories associate giftedness with a wide range of abilities including intelligence, creativity, leadership, the arts, sport, and other curriculum areas (McAlpine, 1996; Ministry of Education, 2000). Cultural abilities and qualities are also recognised in the Maori concept of giftedness (Bevan-Brown, 1996). Some definitions only include demonstrated performance, whilst others recognise that a person may have the potential to be gifted, but that potential has not yet been realised or demonstrated (Ministry of Education, 2000). This study assumes a multicategorical definition of giftedness, which includes potential.

Students' giftedness may be recognised through observation of their behaviours that differ from their same-aged peers. Hattie and Bachor (in review) carried out a synthesis of meta-analyses involving hundreds of studies on gifted students, and over five hundred meta-analysis in education to explore the impact that the following four factors have on students' learning outcomes: the child, the home, the culture, and the school. When exploring the 'child' factor, they identified the following behaviour characteristics that the gifted student may bring to the classroom:

- A vast repertoire of integrated knowledge, skills, and dispositions;
- A facility for integration and synthesis;
- An ability to tolerate complexity and uncertainty;
- Automaticity over learning – memory of knowledge and skills;
- An ability to be versatile and apply many strategies of learning;
- Likelihood to show mastery (including performance mastery);
- A desire for undertaking challenging tasks;
- A high sense of self-efficacy or confidence in learning;
- The use of learning strategies that lead to further mastery; and
- A conception of learning that leads to surface and deep understanding.

Like many other researchers in the field of gifted education, McAlpine and Reid (1996) have published a list of characteristics that may be recognised in gifted students. They are grouped under the following headings: Learning Characteristics, Creative Thinking Characteristics, Motivational Characteristics, Social Leadership Characteristics, and Self-determination Characteristics. Not all students will demonstrate strengths in all of these areas, but such lists of characteristics demonstrate the broadness of the abilities of gifted students and can be used to identify gifted students.

2.2.2 Identification of Gifted Students

McAlpine (1996) and the Ministry of Education (2000) recommend basing an identification process on the following principles:

1. Have a school policy on gifted education.
2. Begin identification in the early years of schooling.
3. Ensure open communication between parents, caregivers, students, teachers, the principal, the Board of Trustees, and the wider community.
4. Make identification continuous throughout the school year.
5. Identification should be unobtrusive and embedded into everyday learning and teaching.
6. Identification should be seen as a means to an end, and not an end in itself.
7. A team approach should be used – including the student.
8. A multi-method approach should be used.
9. The identification system should be constantly evaluated.
10. The system should cater for the identification of underrepresented groups such as ethnic, lower socio economic, and students with disabilities.

There are two different philosophies in gifted identification. A **formal data gathering approach** gathers information from several sources, analyses it, and uses it to identify gifted students. Methods of data gathering may include teacher observation and nomination, standardised tests, rating scales, parent, peer, or self nominations, and product evaluation (McAlpine, 1996).

A **responsive environment identification approach** offers challenging opportunities within the class for students to demonstrate behavioural characteristics associated with giftedness such as, higher level thinking, creativity, and original research. Maker and Neilson (1996) describe an ideal environment for gifted students as one that has resources, space, and opportunities that allow students to construct, create, and inquire actively. Such an environment enables students to demonstrate gifted behaviours and to further develop their abilities. Within a responsive environment, the teacher can identify gifted students by observing, talking to students about their learning, taking anecdotal notes, and collecting samples of students' work (McAlpine, 1996). Identification tools that are used in a formal data gathering approach can also be used in a responsive environment identification approach. A combination of the formal data gathering approach and a responsive environment identification process can be used to identify gifted students.

In New Zealand schools, the identification of Maori students needs special attention. Bevan-Brown (1996) stresses that identification procedures must be culturally appropriate and must not be influenced by socio-economic status, lineage, or gender. Bevan-Brown (1993) conducted a study that explored Maori people's conceptions of giftedness. She found that Maoridom has a wide concept of giftedness which includes spiritual, cognitive, affective, aesthetic, musical, psychomotor, social, intuitive, creative, leadership, and cultural abilities and qualities. Bevan-Brown supports a responsive environment identification process for the identification of Maori students.

The Gifted Kids Programme (GKP), where the present study was conducted, uses a combination of approaches to identify gifted students. This is discussed in more detail in chapter three, on pages 47–48.

2.2.3 Meeting the Learning Needs of Gifted Students

A working party on gifted education was established in 2001 to clarify a vision for gifted education and to make recommendations to the Ministry of Education. It consisted of eight members – two academics, five educators, and one parent of gifted children. The group invited submissions from the general public, and gifted and talented children, and asked some particular groups and

individuals for submissions. They collated their findings and, in 2002, published a report for the Minister.

Their report stated that "all children have a right to an education that acknowledges and respects their individuality and that offers them maximum opportunities to develop their strengths and abilities" (Ministry of Education, 2002, p. 1). One of the core principles outlined in the report reads: "Gifted and talented children should be offered a curriculum expanded in breadth, depth, and pace to match their learning needs" (Ministry of Education, 2002, part II, section 3). The report goes on to say that education for gifted students should be centred on the learner, should be flexible, should encourage creative and complex thinking, and should provide opportunities for students to search for greater understanding. This requires a differentiated curriculum.

2.2.4 Curriculum Differentiation

June Maker, from the University of Arizona, Tuscon, describes curriculum differentiation as a combination of modifications to content, process, environment, and product (Maker, 1982). She recommends the following:

1. The learning **environment** should encourage students to work to their full potential. It should be open, accepting, student-centred, and encourage independence. It should be highly mobile, both within and beyond the classroom. The environment should include a rich variety of resources, media, ideas, methods, and tasks.
2. **Content** modification should remove the ceiling on what is learned. Students should study a wide variety of abstract and complex content including the study of people and the study of methods of inquiry.
3. The teaching and learning **process** should promote creativity and higher level cognitive skills, and encourage the *use* of information. Processes should be open ended, variably paced, and provide for freedom of choice. Processes should facilitate group interaction and encourage reasoning and conclusiveness.
4. **Products** should reflect students' potential. They should be based on new knowledge, real problems, and real audiences. Real deadlines and appropriate evaluation are also recommended.

Enrichment and acceleration are recognised as important approaches in meeting the needs of gifted students (Townsend, 1996) and are components of curriculum differentiation. Acceleration is providing instruction at a pace that matches the readiness of the gifted student (Townsend, 1996), whilst curriculum enrichment is the provision of richer, more varied and in-depth learning experiences and is ideally based on the needs and interests of the students (Schiever & Maker, 1997). Enrichment is achieved by differentiating content, process, and product. Acceleration and enrichment are complementary components of gifted education – the needs of gifted students will best be met by providing *enriched* learning experiences at an *accelerated* pace (Townsend, 1996; Schiever & Maker, 1997).

2.2.5 Thinking and Learning

It is recommended throughout the literature on gifted education that thinking skills be taught as part of curriculum differentiation (Maker & Neilson, 1996; Maker, 1982; Van Tassel-Baska, 1994; Renzulli, 1977). Maker and Neilson (1996) advocate for the teaching of higher level thinking skills to all students, and in particular gifted. Teaching thinking skills will stress the use, rather than the acquisition, of information. They explain that since gifted students can acquire information quickly and with little effort, they should be evaluating information, applying information to new situations, and using it to develop new ideas and products. Marzano, (1992, cited in Van Tassel-Baska, 1997) emphasises the importance of gifted students being taught metacognition so that they better understand the process of learning and apply higher order thinking skills more readily. Students who understand their thinking and learning processes become better problem finders and problem solvers (Gallhager and Gallhager, 1994; Gallagher, 2001).

2.2.6 Thinking Skills

In broad terms, thinking skills can be defined as "the ability to learn and make sense of new information" (Gough, 1991, cited in Cotton, 2001, p.1). As gifted students can acquire information more quickly and easily than their same-age peers, gifted programmes should aim to develop thinking skills to the

highest levels possible, so that students can use information in new situations, and develop new ideas and products (Maker & Neilson, 1996; Maker, 1982).

Thinking skills are often divided into three areas: critical thinking, creative thinking, and problem solving (Bellanca & Fogharty, 1990).

Critical thinking in an education context is described by Norris and Ennis (1990) as "reasonable and reflective thinking that is focused upon deciding what to believe or do" (p. 3). The teaching of critical thinking skills may cover clarifying information, questioning the accuracy of information, digging deeper for more detail, assessing relevance, relating statements to other statements and questions, considering other points of view, and assessing the logic or reasoning behind an argument (Paul, 1998).

Creative thinking is "the ability to think of original, diverse, and elaborate ideas" (Infinite Innovations, 2001, no page given). Creative thinking skills include arranging patterns, designing solutions to problems, discovering solutions, forcing relationships, generalising, generating ideas, imaging, inferring, inventing, making analogies, predicting, and transforming information (Bellanca & Fogharty, 1990).

Problem solving is thinking about how to achieve a goal when there is no obvious solution (Mayer & Wittrock, 1996). Problem solving skills include identifying a problem, goal planning, examining options, goal setting, and creativity (Bellanca & Fogharty, 1990). Effective problem solving requires both critical and creative thinking.

2.2.7 Thinking Skills and In-depth Learning

As defined by Biggs and Collis (1982), in-depth learning involves the ability to consider several aspects of a topic or problem at the same time, to draw logical conclusions or relationships between the different aspects, and to present a reasoned argument or form a comprehensive judgment about the topic or problem. This involves a combination of creative thinking, critical thinking, and problem solving. Thinking skills programmes and some gifted education programmes place a lot of emphasis on critical and creative thinking and problem solving, but this literature review did not find any evidence of

programmes that focused on helping students make connections from thinking skills to in-depth learning.

There is much debate about whether thinking skills should be taught separately from the rest of the curriculum or whether they should be taught in the context of content area learning (Cotton, 2001). The support that exists for both approaches could lead to the conclusion that both can be effective. Freseman (1990, cited in Cotton, 2001), Van Tassel-Baska (1994), and Bellanca and Fogherty (1990) support the explicit teaching of thinking skills, but also stress that the skills should then be applied in meaningful contexts.

A differentiated curriculum can provide learning processes that promote the development of thinking skills in an environment that is open and supportive of diverse learning styles and individual needs (Tucker & Hafenstein, 1997). An effective thinking skills programme which focuses on thinking more logically and more meaningfully, will promote more in-depth learning for gifted students (Van Tassel-Baska, 1994).

Teaching strategies are an essential key to meeting the needs of gifted students (Braggett, 1997; Hattie & Bachor, in review). Van Tassel-Baska (1994) refers to teaching strategies and processes as "instructional glue". Many educators and researchers in the field of gifted education recommend particular strategies to teach thinking skills. Table 2.1 outlines strategies that are commonly associated with good teaching of thinking skills, which in turn can encourage more in-depth learning.

Strategy	Source
Asking higher-order and open-ended questions during discussions	Maker & Neilson, 1996; Maker, 1982; Purcell, Burns, Tomlinson, Imbeau, & Martin, 2002
Lengthening wait time when questioning	Maker & Neilson, 1996; Bellanca & Fogharty, 1990; Raths, Wasserman, Jonas, & Rothstein, 1986 cited in Van Tassel-Baska, 1994
Having students work in small groups	Van Tassel-Baska, 1994; Purcel et al, 2002
Providing students with reinforcement based on constructive and timely feedback	Van Tassel-Baska, 1994; Bachor & Hattie, in review; Bellanca & Fogharty, 1990
Thematic studies that require students to think critically and creatively and to problem solve in relation to complex, real projects and experiences	Gardner, 1993; Van Tassel-Baska, 1994; Tucker & Hafenstein, 1997; Purcell et al, 2002
The explicit teaching of metacognitive strategies	Cotton, 2001, Bellanca & Fogerty, 1990; Van Tassel-Baska, 1994

Table 2.1: Strategies for Teaching Thinking Skills

A combination of strategies will result in maximum benefits (Van Tassel-Baska, 1994).

2.2.8 Conclusion

This section has demonstrated that gifted students are a unique group of learners with specific learning needs. Teachers need to identify these students and provide programmes that focus on their specific learning needs so that gifted students can work towards their full potential. Teaching critical and creative thinking and problem solving are important components of education for gifted

students and, when combined, can give them essential skills necessary to engage in in-depth learning.

2.3 Teaching for In-depth Learning

> "Research has nominated several features as contributing to deep and achieving approaches to learning and to rich outcomes. These include: a well-structured knowledge base, an appropriate motivational context, interaction with others, and learner activity. Many of these do not comprise teaching methods as such, but are aspects that can be incorporated into one's own teaching, whatever particular methods are used" (Biggs & Moore, 1993, p. 478).

The purpose of this section is to examine how students learn and what influences how they go about learning. This section outlines conceptions of learning and different approaches that students can apply to their learning, detailing the influence of motive and strategy in students' choice of approaches. This section also presents literature around the relationship between approaches and learning outcomes. It explores how teachers can influence students' approaches, and in turn, influence their learning outcomes.

2.3.1 Conceptions of Learning

Marton and Ramsden (1988) describe learning as a qualitative change in a person's view of reality, including how they see, experience, understand, and conceptualise something in the real world. In another publication, Ramsden's (1988) interpretation of learning includes becoming more able to solve unfamiliar problems, and being able to transfer what one has learned from one context to another. This definition sees learning as both content- and context-embedded (Marton & Ramsden, 1988). Prosser and Trigwell (1999) believe that there are successive phases to learning which include both a quantitative and qualitative change in what one knows. They recognise three successive phases to learning – acquiring, knowing, and applying. Biggs and Lam (1989) see learning as gradual and cumulative. First knowledge is acquired, which could be described as a

quantitative change, then once a learner has enough pieces of knowledge, they can structure and apply it – thus making a qualitative change. This aligns with the theory that underpins the SOLO Taxonomy, which is a fundamental tool used to measure the depth of students' learning in the present study, and which is described in more detail on pages 28–35, later in this chapter.

Biggs (1999) defines *institutionalised* learning as the result of three interacting factors: the student's level of engagement, the academic orientation of the student, and the degree of learning activity that is stimulated by the teacher. He explains that differentiators in learning are what the student brings to a lesson, the teacher input, and the teaching context.

In 1979, Saljo (cited in Marton & Saljo, 1984) conducted a study involving individual interviews and learning sessions to identify different conceptions of learning. When discussing learning, all of the adults in their study understood it in the sense of academic learning. Their study produced five qualitatively different conceptions of academic learning:

1. An increase of knowledge;
2. Memorising;
3. Acquisition of facts, procedures, etc., which are retained and/or put into practice;
4. Abstraction of meaning from knowledge or facts;
5. Interpreting knowledge or facts to better understand reality.

These conceptions are cumulative. Conceptions 1–3 demonstrate quantitative change, while conceptions 4 and 5 demonstrate qualitative change. The quantitative conceptions are part of the qualitative conceptions, therefore people who are learning in a qualitative way, will have, at some point, gained knowledge in a quantitative way (Biggs & Telfer, 1987). Saljo's findings were corroborated by similar results from a study conducted by Giorgi (1986, cited in Marton, Dall'Alba, and Beaty, 1993), which unbeknownst to the researcher, followed a very similar methodology to Saljo's earlier work.

In 1993, Marton, Dall'Alba, and Beaty published results from a longitudinal study that followed the experiences of a group of students at the Open University of Britain. Over the course of their studies, the students were interviewed about their conceptions of learning. This study identified the same

five conceptions as Saljo and Giorgi's studies as well as a sixth conception of learning – changing as a person. This conception supports Marton and Ramsden's (1988) view of learning being how a person interacts with the world.

2.3.2 Approaches to Learning

John Biggs began to research the way students approach learning in the mid 1960s (Biggs, 1987). He hypothesized that the way a person goes about learning impacts on their learning performance. Biggs invented a Likert scale questionnaire called the Study Behaviour Questionnaire (SBQ) to identify the ways students went about their learning. Over time, Biggs carried out extensive evidence-based modifications to the SBQ, eventually recognizing a relationship between the student's motive to learn, and the strategy that he or she used. Biggs claimed that different combinations of motive and strategy correlated to three different approaches to learning – 'Utilising', 'Internalising', and 'Achieving'.

Meanwhile, Marton and Saljo (1976) conducted a phenomenography study that focused on qualitative differences in the way that students went about learning. Phenomenography is a term that was coined by Marton in 1981 (Marton & Saljo, 1997) to describe the examination of the qualitatively different ways in which people experience and conceptualise phenomena in the world around them. In Marton and Saljo's study, the phenomenon of learning was examined (Marton, Dall'Alba, and Beaty, 1993). Marton and Saljo asked a group of students to read academic articles. They then asked the students what they had learned, and how they had gone about learning it. They analysed the students' responses and identified two distinct ways that students went about the learning task – a "surface" level of processing which focused on the words in the text, and a "deep" level of processing which focused on what the text was about. Students using a deep approach looked for relationships within the text, between the text and the real world, between the text and the learner, or between the text and its underlying structure. Marton and Saljo found that the approach that a student took when reading the articles depended on what the learner intended to gain from the learning experience (Biggs, 1996). Students who wanted to understand the author's purpose, read the text for meaning, and

students aiming to recall key phrases or memorise details in the text (in anticipation of test questions) focused on words and sentences.

In 1979, Entwhistle, Hanley, and Hounsell (cited in Biggs, 1987) factor-analysed questionnaire results from almost 800 students in two British universities. They found three different approaches to learning – 'Understanding', 'Reproducing', and 'Achieving' which parallel remarkably with Biggs' findings.

Across these studies, the terminology may have been different, but the findings were uncannily similar. Over time, the terms 'surface', 'deep', and 'achieving' were settled upon and are now commonly used in present-day literature in this field (Marton and Saljo, 1997).

Surface Approach

A surface approach is about quantity, without quality (Ramsden, 1992; Marton & Booth, 1997). Learners using a surface approach see learning as a means to an end. Biggs and Moore (1993) describe it as "corner-cutting". The learner carefully balances the risk of failure with working just as hard as they need to. Their choice of approach is based on extrinsic motivation such as passing a test or avoiding being kicked out of school (Marton & Saljo, 1997; Biggs & Moore, 1993). Students using this approach will often resent the learning experience, but still participate for fear of failing.

Surface-motivated learners do not engage fully with the learning experience. They see the components of the learning task as unrelated to themselves, their lives, or the real world and often learn through memorisation or rote (Biggs, 1991, Ramsden, 1988). They focus on what Marton calls the 'signs' of learning. Signs include the words used and isolated elements (Biggs, 1999). This focus prevents them from seeing what the signs signify such as interconnections between the elements, or the meanings and implications of what is being learnt (Biggs & Moore, 1993).

A learner who has adopted a surface approach sees the task as something that *has* to be done, fails to reflect on the learning experience, and worries about the time that the task takes (Biggs, 1987).

Deep Approach

The deep approach is about quantity *and* quality (Ramsden, 1992). A learner using this approach requires a foundation of relevant content knowledge and uses strategies that optimise learning so that they can conceptualise the learning experience at an abstract level (Biggs, 1996). The learner engages with the learning task with an intention to understand. They will be genuinely interested in and curious about the subject matter and the task enough to be self-motivated to learn more about it (Prosser & Trigwell, 1999; Biggs & Moore, 1993). This personal commitment to learning means that the student relates the learning experience to personally meaningful contexts, to existing prior knowledge, or to their understanding of how the world works (Biggs & Moore, 1993; Biggs, 1999; Prosser & Trigwell, 1999; Marton & Booth, 1997). Marton and Saljo (1984) describe the deep approach to learning as "the best, indeed the only way to *understand* learning materials" (p. 46).

A learner who has adopted a deep approach to a particular learning experience is likely to also:

- feel challenged and involved in the learning experience;
- look beyond the 'signs' and below the surface of the task;
- see the parts of the learning task making up a whole and seek to find relationships between the parts;
- use optimal strategies for handling the learning task;
- reflect on the learning experience; and
- be prepared to invest time and effort in the learning experience.

(Biggs & Moore, 1993; Prosser & Trigwell, 1999; Ramsden, 1992; Biggs, 1987).

Achieving Approach

Like the surface approach, the achieving approach is focused on the product rather than the process and learning that occurs along the way. Learners using an achieving approach are extrinsically motivated by achieving, which is usually measured in the form of good marks (Biggs, 1991). Biggs and Moore (1993) go so far as to say that achieving students' focus is on the ego trip obtained from high grades and winning prizes. They will work as efficiently as they can to make sure that they achieve rather than to ensure that they gain an in-depth

understanding of the content of the learning experience. Generally a learner who uses an achieving approach has outstanding study skills, organisational skills, and time management skills.

Deep and surface approaches are mutually exclusive, but learners using an achieving approach will also be using a deep or surface approach (Biggs, 1991). For example, a learner who rote learns in an organised way is using a surface-achieving approach and a learner who reads for meaning in an organised way is using a deep-achieving approach (Biggs, 1987). Biggs (1987) claims that school students tend only to see the deep approach as related to achieving.

Students who choose to use a surface or an achieving approach to learning are often responding to 'contextual effects' (Ramsden, 1992). In school, students not only learn the content of the curriculum, but they also learn how to please their teachers and how to get good marks. Ramsden calls this 'contextual effects'. These effects lead students to use surface or achieving approaches – to learn for their teachers, and not for themselves.

2.3.3 Motives and Strategies

A student's approach to learning is defined by a combination of strategy and motive in relation to learning tasks. The strategy is the way they go about their learning and the motive is the reasons for adopting the chosen strategy (Prosser & Triggwell, 1999; Biggs, 1987). The motives for learning influence the choice of strategies (Prosser & Trigwell, 1999). For example, a student who has decided that he or she is happy to just pass a test, may rote learn just as much as is needed to pass. Another student who is intrinsically interested in a topic, will try to understand it as well as he or she can (Biggs, 1991). The same student will use different approaches for different learning experiences depending on his or her motives for each learning experience, just as different students will use different approaches for the same learning experience, also dependent on his or her motives for learning (Prosser & Trigwell, 1999). This concept of motive and strategy was first discovered by Marton and Saljo (1976), and has since been refined.

Table 2.2 (adapted from Biggs & Moore, 1993) shows example combinations of motives and strategies related to each of the three approaches to learning.

	Motive	Strategy
Surface	I want to have fun.	Just do the minimal amount of work necessary
Deep	I want to learn.	Engage in the learning experience in-depth
Achieving	I want top marks.	Be cost effective in use of time

Table 2.2: Strategies and Motives for Learning Approaches

2.3.4 Approaches to Learning and Learning Outcomes

Several research studies have found evidence that the outcomes of students' learning are associated with the approaches they use. *What* students learn is associated with *how* they go about learning it. Students who use a deep approach to learning have better learning outcomes than students who use a surface or achieving approach (Ramsden, 1992; Biggs, 1991; Prosser & Trigwell, 1999; Marton & Saljo, 1997). The early research conducted by Marton and Saljo (1976), which required students to respond to literature, found that students who applied a surface approach to learning produced the least meaningful responses and students who applied a deep approach to learning produced the most comprehensive responses. A quantitative study (Prosser and Trigwell, 1999), focusing on learning of first year physics students in two universities, showed that students who used a deep approach had better results than students who used a surface approach.

A study by Van Rossum and Schenk (1984) also required students to read and respond to a text. They used the SOLO Taxonomy to classify the results. They found that students who used a deep approach achieved a high level of understanding (as measured using the SOLO Taxonomy) and students who used

a surface approach scored lower. They then correlated the students' approaches to learning with their conceptions of learning which revealed that most students who used a surface approach saw learning as increasing knowledge or memorisation, and students who used a deep approach saw learning as understanding reality and applying meaning.

Dahlgren (1988, cited in Prosser & Trigwell, 1999) conducted a longitudinal study that focused on the longevity of learning. The research team gave economics students an open-ended question about the equilibrium in an economic system. When analysing the results they categorized answers into four different levels of understanding. They revisited the same students two years later and found that the students who had originally demonstrated a higher level of understanding also had considerably higher retention levels of the content.

When conducting further research about the relationship between students' approaches to learning and their learning outcomes, Marton and Booth (1997) noted a limitation of this kind of research that needs to be taken into consideration. They highlighted the fact that if a student does not bring appropriate prior knowledge to a test situation, their opportunity to demonstrate a deep approach to learning is very limited. Students need to have the quantitative knowledge required to answer the question if they are ever going to demonstrate a qualitative approach to learning.

A review of the literature revealed very few studies that focus on in-depth learning with gifted students. Bachor and Hattie (in review) suggest that students with high ability and achievement are likely to be better learners and have deeper conceptions of learning, therefore requiring teaching strategies that will foster deeper understanding. A study conducted by Maguire (1988), with the purpose of evaluating gifted programmes, involved a group of students in a gifted programme and a group of similar ability students in a regular classroom. Both groups were required to complete two writing tasks and three mathematics tasks which were analysed for depth of understanding using the SOLO Taxonomy. Maguire expected that the students in the gifted programme would score higher than the students in the regular classroom. The results of the study showed little difference between the depth of understanding in the two groups. When tying the results back to the original purpose for the study, Maguire

concluded that the gifted programme was not yet succeeding. Maguire's study, and indeed his conclusion, assume that gifted students in a programme that encourages in-depth learning will outperform their like-ability peers.

2.3.5 Underachieving Gifted Students

One group of students who are potentially capable of in-depth learning but do not demonstrate it is underachieving gifted students. Moltzen (1996[1]) defines underachievement as "unfulfilled potential" (p. 408). Clark (1992) argues that because most gifted students are not consistently challenged at school, they do not perform up to capability. In other words, they underachieve. They may be showing adequate progress by using a surface-achieving or a deep-achieving approach, but they are still underachieving in relation to their full potential. Gross (1993, cited in Moltzen, 1996[1]) believes that students behaving in this way often go unnoticed as they are still achieving at an accepted, and sometimes above-average level. They may be working at levels above their peer group, but this level is below what they are really capable of. Because their learning approach goes unnoticed and their learning outcomes are accepted, there is little incentive for underachieving gifted students to use a deep learning approach.

2.3.6 Teaching for a Deep Approach to Learning

Ultimately, a learner decides what approach they will take towards a particular learning experience, however this decision can be influenced by factors in the learning environment (Prosser & Trigwell, 1999). Good teaching is about facilitating learning experiences that increase the probability that students will adopt a deep approach to learning and minimize the probability of students using a surface approach (Ramsden, 1992; Biggs, 1991; Biggs, 1999). Hattie, Clinton, Thompson, and Schmidt-Davis (1997, cited in Hattie & Purdie, 1998) observed 'highly accomplished' teachers to explore the effects of teaching on students, particularly the depth of their learning. They concluded that expert teachers were more likely to encourage deep approaches to learning and that these teachers provided structured lessons, feedback, and a level of challenge that supported students' attainment of deep processing. Table 2.3 outlines

factors that encourage surface and deep approaches to learning (Ramsden, 1992; Prosser & Trigwell, 1999; Biggs & Moore, 1993; Biggs, 1999; and Ramsden, 1988).

Surface Approach	Deep Approach
• the offering of extrinsic motivation; • an uninviting or 'cold' learning environment; • learning experiences and assessment methods that require a low level of thinking; • lack of time or other pressures that increase anxiety; • poor or no feedback; • lack of interest in or prior knowledge of the topic of study; • previous experience of educational settings that encourage a surface approach to learning.	• a 'warm' classroom climate with a teacher/student relationship that involves care, encouragement, commitment, and interest; • an integrated curriculum that involves real-world issues and problem-based learning and which encourages curiosity; • learning experiences that are related to what students are interested in (to capitalize on their intrinsic motivation); • clearly stated learning outcomes and expectations; • focused feedback related to the learning task and learning outcomes; • adequate time in which to complete learning tasks; • learning experiences that have relevance in the real world; • teaching and assessment methods that foster meaningful and long-term interest in learning experiences; • students having a say in the content and methods of learning experiences; • previous experience of educational settings that encourage a deep approach to learning.

Table 2.3: Encouraging Surface and Deep Approaches to Learning

Trigwell and Prosser claim that to improve the quality of learning, it is *more* important to encourage a deep approach to learning than to discourage a surface approach (1991). To improve the quality of students' learning, teachers need to work with students to improve the quality of the approaches they take to their learning. This may require substantial changes to the context in which learning takes place (Millar, Prosser, & Sefton, 1989).

Teachers need to teach students how to go about learning (Marton & Saljo, 1997), but this is by no means easy. To change a learner's approach, one must change the learner's motive for learning. A second research study conducted by Marton (1976, cited in Marton & Saljo, 1997) began by identifying the questions that students using a deep approach ask themselves when analysing a piece of text. Marton then set up a learning task in which students *had* to answer these questions, thus attempting to "force" students to use a deep approach to learning. The outcome was that the students engaged in an achieving approach, rather than a deep approach. The major finding from this study showed that students will adapt themselves and their approaches to learning to the demands that they are exposed to, demonstrating the strength of the learners' motives over their approach to learning.

Teaching often overestimates the importance of transmitting information and procedures to students and underestimates the importance of helping students to change their ways of thinking and understanding (Ramsden, 1988; Biggs, 1996). Gow and Kember (1993) conducted a study which sought to discover whether conceptions of teaching exist and whether they are related to student learning outcomes. The study was conducted through semi-structured interviews with lecturers at a polytechnic. Their research identified two main orientations to teaching – learning facilitation and knowledge transmission. They found that teachers who saw teaching as knowledge transmission discouraged students from using a deep approach, while teachers who saw teaching as facilitating student learning were less likely to persuade surface approaches.

Teachers can also provide specific training for students in how to approach complex tasks (Biggs, 1996). However, Biggs cautions that arming students with a collection of deep strategies will only be useful if the classroom

teaching and particularly the assessment context *require* the student to use deep approaches. Teacher expectations play a vital role in encouraging students to use deep approaches. If you can get a good mark with a surface or achieving approach, why bother with a deep approach? (Biggs, 1996; Ramsden, 1992).

2.3.7 Links to Gifted Education

This literature review has found extensive theory on how to teach for in-depth learning and how to teach gifted students so that they can work towards their full potential. However, there seems to be little theory concerning the overlap between these two areas. Table 2.4 outlines teaching methods or conditions of learning that are presented as being beneficial for both in-depth learning and meeting the learning needs of gifted students.

Method or Condition	**Deep Learning Reference**	**Teaching Gifted Reference**
Questioning	Biggs, 1999; Ramsden, 1988	Maker & Neilson, 1996; Maker, 1982; Daniels, 1997
Small-group work	Biggs & Moore, 1993	Van Tassel-Baska, 1994; Purcel et al, 2002
Timely and constructive feedback	Prosser & Trigwell, 1999	Van Tassel-Baska, 1994; Hattie & Bachor, in review
An integrated curriculum involving open-ended real-world projects, problems, and experiences	Biggs, 1999	Bellanca & Fogerty, 1990; Van Tassel-Baska, 1994; Maker, 1982
Intrinsic motivation or commitment to learning	Biggs and Moore, 1993; Biggs, 1987	Renzulli, 1986
A high level of challenge	Hattie, Clinton, Thompson, & Schmidt-Davis, 1997, cited in Hattie & Purdie, 1998	Ministry of Education, 2000
Students input into the content, process, and products of learning experiences	Ramsden, 1988	Maker, 1982
Teaching and assessment methods that foster meaningful and long-term interest in learning	Biggs & Moore, 1993	Ministry of Education, 2000
Teaching metacognitive skills	Biggs, 1987	Renzulli, 1977

Table 2.4: Teaching for In-depth Learning and Teaching of Gifted

2.3.8 Conclusion

This section has defined learning as both a quantitative and qualitative change in what a learner knows. It has explored three approaches to learning – surface, achieving, and deep, and the combination of motive and strategy that dictates which approach a learner takes when faced with a learning task. The literature review has revealed that students who take a deep approach to their learning are more likely to have better learning outcomes. Approaches to learning can be influenced, therefore teachers who want to improve their students' learning outcomes, should aim to support students in using a deep approach. Ways to encourage students to use deep learning approaches have been explored, and will be used to inform teaching strategies in the present study.

2.4 Measuring Depth of Learning

The purpose of this section is to gain a better understanding of how depth of learning can be measured. It examines Piaget's stage theory and the assumptions on which his theory is based. This is then aligned with the SOLO Taxonomy, a tool developed by Biggs and Collis (1982), which can be applied to different learning tasks to measure the depth of students' learning. SOLO is examined in detail, with explanations about how it was developed and how it can be used. Similarities and differences between the SOLO Taxonomy and Bloom's Taxonomy, which readers may be more familiar with, are also outlined.

2.4.1 Stages of Cognitive Development

Piaget's theories around learning and cognition have had a major influence on the teaching profession. He developed the Stages of Cognitive Development Model when exploring how young children think (Peterson, 1989). Piaget's four stages of cognitive development are:

1. Sensorimotor stage: intelligence in this stage is demonstrated through overt behaviour in response to the physical and social world. Knowledge of the world is based on physical interactions and personal experiences.
2. Pre-operational stage: intelligence is demonstrated through the ability to think about objects, words, and other symbols and to manipulate symbols

in the context of playing, moral awareness, and social interactions. Children at this stage devise illogical explanations for everyday phenomenon.

3. Concrete operational stage: intelligence is demonstrated through the logical and systematic manipulation of symbols related to tangible objects and events. The child develops the ability to reason. This stage is sometimes divided into three substages – early concrete, middle concrete, and early formal (Biggs & Collis, 1982). The difference is, at the early concrete stage, a child can only handle one set of symbols or operations, for example, to measure height, whereas at the middle concrete stage the child can integrate more than one set of symbols or operations, for example, to measure height and width in order to calculate area. At the early formal stage, the child demonstrates abstract thinking and can generalize within the confines of his or her own experiences.
4. Formal operational stage: intelligence is demonstrated through the ability to demonstrate logic and rational thinking in relation to abstract concepts. At this stage a person can theorize and generalize beyond their own experiences. This stage requires the ability to:
    a. consider all possible options related to a problem;
    b. consider a number of variables at one time and draw relations between them;
    c. think about hypothetical and intangible processes and phenomenon (Peterson, 1989).

Piaget believed that biological development is the drive behind a shift from one level to another. He acknowledged that some individuals may never reach the formal operational stage. Research conducted by Kuhn, Langer, Kohlberger & Hann (1977, cited in Huitt & Hummel, 2003) found that development through the first three stages aligned with biological development but that only 30-35% of adults reached the formal operational stage. Their study concluded that, as well as maturation, a special environment is required for people to move into this final stage.

Piaget's stage theory is based on the following assumptions:

1. Individuals proceed through the stages in an irreversible sequence.

2. Stages and substages are stable. Once an individual reaches a stage, he or she will operate at that stage, and not at an earlier one.
3. An individual will operate at the same stage in all tasks, so it is possible to predict what stage he or she will perform at in a given task by observing their performance in another task.
4. There are some exceptions to points 2 and 3. Piaget calls these exceptions *decalages*, for example some people will only demonstrate formal operational thinking in fields of particular interest to them.
5. Individuals remain at one stage until he or she reaches the next stage (Biggs & Collis, 1982).

Whether taken verbatim, or modified, Piaget's theory of cognitive development has had a vast impact on other theory around education and child development (Peterson, 1989). The SOLO Taxonomy is a case in point (Dahlgren, 1984).

2.4.2 The SOLO Taxonomy

The SOLO Taxonomy (Structure of the Observed Learning Outcome) was developed by Biggs and Collis (1982). They analysed work from hundreds of students at different ages and across a range of subjects. In doing so, they detected recurring patterns in students' thinking, but also found that stage theory did not hold. They found that as students learn, the outcomes of their learning have similar stages of increasing structural complexity. Their study showed that learners display a consistent sequence in the way they go about learning. This sequence applies over a large variety of tasks (particularly school based tasks). But, Biggs and Collis's research also showed that students did not consistently operate at the same stage in different tasks. For example, a student may be operating at the early concrete stage in reading, but the early formal stage in mathematics. The theory that underpins the SOLO Taxonomy aligns with Piaget's work in that it recognise s that everybody moves through a series of stages as their learning becomes more advanced, but is at odds with Piaget in that SOLO is based on the assumption that a person can be performing at different stages in different tasks, at the same time.

In their research, Biggs and Collis measured two main changes in the way people learn: quantitative, as the amount of detail in a student's response increases; and qualitative, as that detail becomes integrated into a structural pattern. Their study found that the quantitative changes occur first, then the learning changes qualitatively (Biggs, 1999). This is in keeping with Saljo's findings (1979, cited in Marton & Saljo, 1997) in his study that involved interviews with adults about their conceptions of learning.

Stages in the SOLO Taxonomy

The SOLO Taxonomy identifies five stages, the middle three of which fit into Piaget's concrete operational stage.

1. **Prestructural** – A learner operating at a prestructural stage may engage in preliminary preparation for learning, but the task itself is not attended to appropriately. The learner does not demonstrate any understanding of what is required. They may have misinterpreted the task.
2. **Unistructural** – A learner operating at the unistructural level will attend to one aspect of the learning task in isolation. They demonstrate minimal understanding of the concept. A unistructural response is typically short and lacks detail.
3. **Multistructural** – A learner operating at this stage will demonstrate understanding of several aspects of the learning task but does not relate them to each other. The student understands the boundaries of the learning experience, but has not yet grasped the systems or relationships within it. Curriculum objectives at the multistructural level may require a student to classify, describe, list, or narrate (Biggs, 1999).
4. **Relational** – At this level, several aspects of the learning task are integrated into a coherent whole and the concept can be applied to familiar problems or situations. Curriculum objectives at the relational level may require students to understand, apply, integrate, compare and contrast, or explain the cause of something (Biggs & Moore, 1993).
5. **Extended abstract** – Extended abstract involves radical restructuring of material or new, higher-order thinking (Biggs & Moore, 1993). Here, the student can generalize the coherent whole to an abstract level. Students

operating at this stage usually demonstrate more abstract thinking than instructional purposes initially require. Extended abstract calls for open-ended curriculum objectives such as to generate, hypothesize, theorize, or reflect (Biggs, 1999). Like Piaget's formal operational stage, some people never operate at the extended abstract level of SOLO (Biggs & Collis, 1982).

Each stage of the SOLO Taxonomy builds on (and adds value to) the previous one. The taxonomy describes a hierarchy, where each level of learning becomes the foundation on which further learning is built (Biggs, 1999). The prestructural, unistructural, and multistructural stages are known as the Quantitative Phase. At these stages, the amount of detail in the response increases. The relational and extended abstract stages are called the Qualitative Phase. During this phase the detail in the response is structured and is used to gain and create meaning (Biggs, 1999). Learners who are demonstrating understanding in the Qualitative Phase could be said to be demonstrating in-depth learning (Hattie & Purdie, 1998; Biggs & Moore, 1993). Biggs and Moore (1993) also refer to the unistructural, multistructural, and relational stages of the taxonomy as the "target mode". Learners operating at the prestructural stage fall short of the target mode and learners operating at the extended abstract stage have superseded it.

Like approaches to learning, the levels of the SOLO Taxonomy are task specific, that is, a learner can operate at different levels on the taxonomy for different learning tasks (Biggs & Moore, 1993). However, Hattie and Purdie (1998) claim that a students' level of processing or depth of understanding in one content area can be generalised across other content areas.

A study conducted by Collis and Davey (1986) surveyed year 7 (11–12 year olds) and year 9 (13–14 year olds) students to find out realistic expectations for the SOLO levels that students at these ages could be working at. The study involved learning experiences in the areas of biology, chemistry, physics, and geology. Overall, the most common level of responding in year 7 was unistructural and in year 9 was multistructural. Biggs and Moore (1993) conclude that the relational level is typically reached well after primary school. A year 6 student would not be expected for the most part to go beyond

multistructural responses, although they state that some students might do so, especially in mathematics.

A review of the literature only found one study that had used the SOLO Taxonomy with gifted students (Maguire, 1988), and, as the purpose of that study had been to evaluate the effectiveness of a gifted programme, it did not provide conclusive evidence as to reasonable levels of expectation for gifted students' performances as measured by the taxonomy.

How the SOLO Taxonomy is Used

The SOLO Taxonomy was originally developed as an assessment tool to construct tests that measure depth of learning. Biggs and Collis (1982) claimed that SOLO was "the only instrument available for assessing quality retrospectively in an objective and systematic way that is also easily understandable by both teacher and student" (p. XI). The taxonomy makes it possible to identify in broad terms the stage at which a student is currently operating in relation to a particular topic (Biggs & Lam, 1989). As an assessment tool, the taxonomy can be used either to classify responses to open-ended questions, or to structure objective-type items in the ordered outcome-format of the levels of the taxonomy (Collis & Davey, 1986; Hattie & Purdie, 1998). Biggs and Collis (1982) claim that it is relatively easy to identify and categorise test items against the SOLO Taxonomy. To test this theory, they used two assessors to grade a number of history questions against the taxonomy and found that both judges coded 79% of the items correctly, 11% at one level difference, and only 9% at more than one level difference.

SOLO can also be used to formulate teaching objectives, to develop learning outcomes, to guide lesson planning, and to evaluate teaching and learning (Biggs, 1999; Hattie & Purdie, 1998). Using SOLO to state curriculum objectives enables teachers to state the level of expected performance in qualitative terms at a given year level on a topic-by-topic basis (Biggs & Moore, 1993). Students and teachers can speak about depth of learning and learning outcomes in a common language across year levels and topics. This is a valuable quality for both teaching and assessment (Biggs & Lam, 1989).

The taxonomy has been used extensively, with noted success, in higher education and to a lesser extent in primary and secondary schools (Prosser & Trigwell, 1999; Ramsden, 1992). A number of studies conducted in the 1990s used SOLO to measure the depth of students' understanding. In 1995, Tang and Biggs (1995, cited in Prosser & Trigwell, 1999) used SOLO to monitor conceptual change and a further study by Tang (1998, cited in Prosser & Trigwell, 1999) focused on collaborative learning. A study by Boulton-Lewis and Dart (1994, cited in Prosser & Trigwell, 1999) used SOLO to analyse assessment data and Wong (1994, cited in Biggs, 1999) used SOLO to structure a year 10 mathematics test. Research by Hazel, Prosser, & Trigwell (1996, cited in Prosser & Trigwell, 1999) used the SOLO Taxonomy to measure students' prior and post understanding of photosynthesis. SOLO has been used in other content areas such as poetry, history, and geography (Hattie & Purdie, 1998).

Considerations When Using SOLO to Measure Depth of Learning

In developing a test to measure students' depth of understanding, it is important that the test is based on content that the students have been exposed to at an in-depth level (Parke, Hare, & Brimicombe, 2002). Hattie, Clinton, Thompson and Schmidt-Davis (1997, cited in Hattie & Purdie, 1998) found that expert teachers "structure lessons to allow the opportunity for deep processing, set tasks that encourage the development of deep processing, and provide feedback and challenge for students to attain deep processing" (p 54). It is important that the teacher provides students with the supports that they require to demonstrate in-depth learning, or to perform at the qualitative phases of the taxonomy.

It is also important to ensure that when devising a test that is comprised of several questions at different levels of the taxonomy, the answer to a more difficult question is not dependent on getting a lower level question correct (Hattie & Purdie, 1998), or that this is at least accounted for in the way the test is administered and marked.

A surface approach or lower level SOLO score does not mean that a student is less intelligent than another student who uses a deep approach or scores more highly on the same assessment task. Rather, this may reflect that he

or she was less interested in the task, brought less prior knowledge to the task, or had a different perception of the motive behind the task (Biggs, 1987).

2.4.3 Taxonomy of Educational Objectives

Another taxonomy which bears some similarities with SOLO is the Taxonomy of Educational Objectives, more commonly known as Bloom's Taxonomy (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). Bloom's taxonomy was developed for evaluating they quality of students' output and is, currently, the most widespread and influential tool used for this purpose (Biggs & Collis, 1982). Bloom's Taxonomy provides a set of criteria that measures complexities of thinking. It can be applied to any subject area and any level of the curriculum. The levels of the taxonomy are hierarchical, therefore achieving at each higher level is dependent on achievement at the levels below. The six levels (from lowest to highest) are knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, et al, 1956).

Bloom's Taxonomy is used to evaluate the quality of students' learning outcomes (Maker and Neilson, 1996). It is also used by teachers to design activities that will evoke the kinds of thinking required at each level of the taxonomy. When used as an evaluative tool, the products of students' learning are measured against the six levels of the taxonomy. Effective testing of students' learning using Bloom's assumes that the context of learning is known to the student, that testing follows teaching instruction, and that the levels of the taxonomy are hierarchical, that is, that they become increasingly more difficult and require mastery of the lower levels (Hattie & Purdie, 1998).

SOLO Compared with Bloom's Taxonomy

There are a number of similarities between SOLO and Bloom's taxonomy. Both taxonomies are designed to evaluate the quality of students' learning. They both contain hierarchical levels and assume that students will progress through the levels in a prescribed order. Both SOLO and Bloom's require the student and teacher to be familiar with the learning context, and assessment questions aligned with both taxonomies are expected to follow prior teaching of the content (Hattie, 2000).

There are also differences between the two taxonomies, which make them suitable for different purposes. Bloom's taxonomy assumes that the question and the answer will be at the same level of the taxonomy while a question and answer associated with the SOLO Taxonomy can be at different levels (Hattie, 2000). Therefore, the question could be at the unistructural level but the student could provide a very deep response. Another major difference is that the Bloom's taxonomy is based on the foundation of "knowledge" as its lowest level, whilst knowledge is not separated out in SOLO, rather it is assumed as an essential dimension across all levels, or is recognised as absent should the response be prestructural (Hattie, 2000). Ennis, (1985, cited in Hattie, 2000) claims that the SOLO Taxonomy provides a useful criteria for judging outcomes whereas Bloom's does not.

Bloom's taxonomy was not developed specifically for use with gifted students, however, educators of gifted advocate that more time should be spent on higher-order thinking skills with gifted students and Bloom's taxonomy is widely used for this purpose (Maker and Neilson, 1996; Ministry of Education, 2000). As previously mentioned, there is little evidence in the literature of SOLO being used with gifted, however, when looking at the features of the taxonomy and the learning needs of gifted students, there are obvious correlations that could indicate that SOLO is under-utilised in the field of gifted education.

2.4.4 Conclusion

Piaget's stages of cognitive development outline a series of stages that learners progress through. This theory has laid the foundation for many more recent studies, including that of Biggs and Collis (1982), the authors of the SOLO Taxonomy. The taxonomy accepts that learners move through different stages of congnitive development, but also claim that a learner may be at different stages in different learning tasks or learning contexts. They developed the SOLO Taxonomy as an evaluative tool to ascertain what stage a learner is at in any given learning task. They equate the stages of their taxonomy with depth of understanding. The literature review only found one study reporting on the use of SOLO with gifted students, however this analysis has highlighted a number of qualities in the taxonomy that may be of value in the field of gifted education.

There are a number of similarities between the newer SOLO Taxonomy and, the older and more widely known, Bloom's Taxonomy. However, the authors of SOLO and critics of the taxonomies, claim that Bloom's has a number of limitations that make it a less versatile and less accurate evaluative tool than the SOLO Taxonomy. As it has been heralded as a useful tool for measuring depth of understanding, the SOLO Taxonomy will be used as an evaluative tool for measuring the depth of students' learning in the present study.

2.5 Summary of Literature Review

Conclusions drawn from this literature review which can inform ways to measure the depth of students' understanding, inform ways to foster more in-depth learning, and which highlight the value of the present study include:

- There is a limited amount of research focusing on the development of in-depth learning with gifted students.
- Gifted students have unique learning needs, which require curriculum differentiation. Programmes for gifted should include instruction in critical and creative thinking, problem solving, and in-depth thinking.
- Gifted students can be expected to use higher-order thinking skills more readily and to think more deeply than their same-aged peers.
- All learners adopt one of three approaches to learning when faced with a task – surface, achieving, or deep. All approaches are dictated by a combination of motive and strategy.
- Relationships can be drawn between approaches and learning outcomes.
- Approaches to learning can be influenced, therefore, students should be encouraged to use a deep approach to learning which may, in turn, have a positive effect on learning outcomes.
- There are many strategies that teachers can implement to encourage their students to adopt a deep approach to learning.
- The SOLO Taxonomy is a tool that can be used to evaluate the quality of students' output, and draw conclusions about the depth of their understanding in different tasks.

These conclusions have been used to guide the methodology and design of the intervention in the present study.

Chapter Three: Methodology

3.1 Introduction

This study aimed to explore the notion of deep understanding, to find ways to measure the depth of students' learning, and to implement an intervention that would increase the depth of gifted students' learning.

The research began with a literature review, which revealed a number of strategies that are recognised to encourage students to think more deeply. At the outset, students involved in the study were asked to complete a questionnaire to determine their perceptions of the strategies that their teacher used to foster deep learning. A formal test was then administered to measure the depth of students' learning in three curriculum areas: maths, social studies, and reading. These areas were chosen as they were recognised as a suitable combination to give a broad picture of the students' abilities across the wider curriculum. As a result of the questionnaire and formal test results, an intervention consisting of appropriate strategies was implemented over a ten-week period, during which time a detailed research diary was kept by the teacher/researcher. At the end of the intervention period, the students completed the questionnaire again and another formal test was administered to measure change in the depth of students' learning as a result of the intervention.

3.2 Research Method

This study could have been conducted as a case study or as an action research project undertaken by a teacher/researcher. The features and suitability of these research methods are discussed below and the rationale behind choosing action research over case study is explained.

3.2.1 Case Study

Case study in education is the gathering of enough information about a person, school, or programme to effectively understand how it operates or functions (Berg, 2001; Stake, 1995). Like other methods of qualitative research, a case study provides a description, understanding, and explanation (Hamel,

Dufour, & Fortin, 1993). Case study is generally the preferred method of research when investigating "how" and "why" questions, when the researcher has little control over the case, and when the study has a contemporary focus within a real-life context (Yin, 1994; Bassey, 1999). A case study "cannot manipulate relevant behaviours" associated with the case (Poskitt, 2002, p. 144).

The researcher must carefully define the object of a case study, otherwise known as the case, prior to conducting the study (Hamel et al, 1993). In education, a case is usually a person, school, or programme (Stake, 1995). If this research had been conducted as a case study, the case would have been the class of gifted students.

A case study can involve either a single case or multiple cases. The decision of which to use is dictated by the nature of the case and the research questions (Yin, 1994). This study would have been a single-case study, however if multiple classes were involved in the research, a multiple case study could have been conducted with each of the classes being a separate case.

There are three types of single-case study: critical case, unique case, and revelatory case (Yin, 1994). A critical case tests a well-formulated theory. A unique case is the study of a case of which there is only one, for example, a rare disease. A revelatory case is the investigation of a case which has been previously inaccessible (Yin, 1994). A study on the depth of students' learning would be a critical case study as it explores the previously formulated theory that students can be taught to think more deeply (Ramsden, 1992; Biggs, 1991; Prosser & Trigwell, 1999; Marton & Saljo, 1997).

Case studies can be intrinsic, instrumental, and/or collective (Stake, 1995). Intrinsic case studies are driven by the researcher's desire to gain a better understanding of a particular case. Instrumental case studies are driven by the researcher's intention to gain a better understanding of an issue (which is associated with the case). Collective case studies are the study of more than one instrumental case with the intention of better understanding a theory about a broader context. These case "types" are not mutually exclusive (Stake, 1995). Had this research been conducted as a case study, it would have been a combination of intrinsic and instrumental – the teacher/researcher wanted to better understand how her students' learn and to find ways to improve their

learning outcomes. (The limitations of case study design in relation to this project are discussed on pages 40–41.)

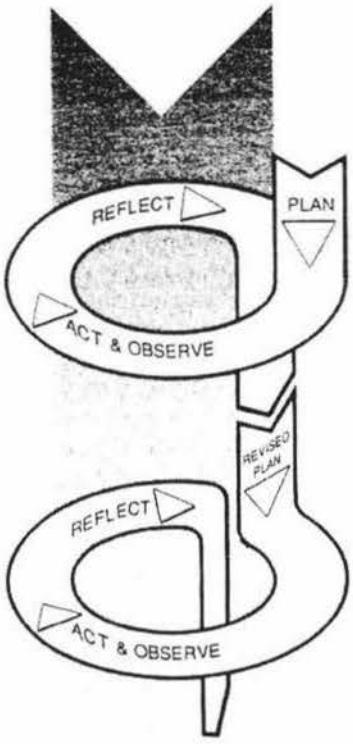
3.2.2 Action Research

Action research involves the systematic collection and analysis of data in an effort to bring about positive social change. It is site based and usually emerges as a result of a concern of the researcher or a stakeholder (Berg, 2001). In an education context, action research may focus on a system, curriculum content, or methods of planning, teaching, learning, and assessment. The research is typically designed and conducted by practitioners who analyse data, make a plan, and implement the plan to improve their own practice. The researcher plays an active role in trying to bring about positive change.

There are many action research models with differing methodologies or areas of emphasis. Carr and Kemmis (1986) suggest that for a study to be recognised as action research it must meet the following conditions:

- The subject matter is a social practice in need of improvement;
- The project follows a systematic, cyclical process of interrelated stages; and
- The study involves those associated with the practice at each stage of the cycle, gradually widening participation as the study progresses.

The action research cycle generally involves the following stages: planning, acting, observing, and reflection (Kemmis & McTaggart, 1988) as depicted in Figure 3.1. Data gathering is an important aspect of the action and observation phase, but may also be necessary to inform the planning and reflection phases. The action research plan acts as a guide rather than a restraint and, once the project is up and running, the phases become more fluid and may occur simultaneously.



(Kemmis and McTaggart, 1988)
Figure 3.1: Cycles of Action Research

The scope of school-based action research can range from one teacher to a school community (Calhoun, 1993). **Teacher research** focuses on changes in one classroom carried out by an individual teacher. The impact of the study will not necessarily reach beyond the classroom. **Collaborative research** is conducted by two or more educators in an attempt to bring about change in one or more classrooms, class levels, or departments. The impact of this type of study will at least reach the classrooms that it involves, and may go further. **Schoolwide action research** reflects a collective interest from the entire school community. This type of action research is often "led from the top" and has the potential to impact schoolwide restructure and change (Calhoun, 1993). The present study is an example of teacher research as it is set in just one classroom and is conducted by one teacher/researcher. To expand beyond this and collaborate with other teachers would be a logical next step.

Some theorists, such as Kemmis and McTaggart (1988), argue that action research should always involve a collaborative group, however Ferrance (2000)

explains that action research can legitimately be conducted by individuals or by a team. Calhoun's (1993) definition of teacher research also implies that action research can be conducted by an individual teacher.

There are three main types of action research (Masters, 2000): scientific-technical, practical-deliberative, and critical-emancipatory. **Scientific-technical** action research involves research around a pre-defined problem. The researcher and the practitioner are different people. The researcher identifies the problem and a suitable intervention, then the practitioner implements the intervention. Change brought about from scientific-technical action research is often predictable and short-lived. In **practical-deliberative** action research the researcher and practitioner identify a problem and design the intervention together. It requires a sound communication flow between the two and recognises that the practitioner brings invaluable knowledge and experience to the research study. The risk of scientific-technical action research is that the change that is brought about is connected to the individuals involved, so if they leave, the intervention may not be continued. **Critical-emancipatory** action research aims to bridge the gap between a problem encountered by the practioner in his or her immediate setting and up-to-date theory, in order to solve the problem. This is achieved through raising the collective consciousness of all involved. This type of action research can have a positive impact on both theory and practice. The researcher and practitioner are likely to be one-in-the-same person or people. Critical-emancipatory action research is embedded in a practical situation and can result in long-lasting, positive change (Masters, 2000).

3.2.3 Most Appropriate Research Method

Having considered both action research and case study in light of the purpose and intended outcomes of the research, action research was chosen as the research method with which to conduct this study for the following reasons:

- The aim was to answer the following questions: "What strategies can be used with gifted students to effectively foster in-depth learning?" and "What influence does the implementation of these strategies have on the depth of gifted students' learning?" These questions are more readily aligned with

action research, which is based on "what" questions rather than case study, which asks "how" or "why" questions (Yin, 1994).

- The study would be conducted by a teacher/researcher who had "control" over the case (her students). In a case study, the researcher has little control over the case (Yin, 1994) whereas a certain amount of control is necessary for action research so that change can be brought about (Carr & Kemmis, 1986).
- The research would be based on a problem that the teacher/researcher had identified in her own teaching practice. A solution to this problem would result in positive change, which is the aim of action research (Berg, 2001). To bring about this change, it would be necessary to not only investigate and understand the problem, as case study might do (Stake, 1995), but also to manipulate the situation. Such manipulation is not akin to the case study methodology (Poskitt, 2002).
- The purpose of action research is to examine practical problems in a social setting with the intention of bringing about positive change (Elliott, 1978). Unlike other research methods, action research theories are validated through practice, rather than validated independently then applied to practice. The proposed study would require the researcher to examine and validate her practice during the course of teaching.

3.2.4 The Deakin Model of Action Research

This study utilized Kemmis and McTaggart's *Deakin Model of Action Research* (1988). This model was selected for this study due to its simplicity and strong focus on action early in the cycle. Each cycle in the Deakin Model follows these four steps:

- to develop a plan of action to improve what is already happening;
- to act to implement the plan;
- to observe the effects of action in the context in which it occurs; and
- to reflect on these effects as a basis for further planning and subsequent action.

True action research involves a succession of cycles.

The Deakin Model is a critical-emancipatory form of action research, with the classroom context providing a practical situation in which positive change

can be brought about by the teacher/researcher. Due to the fact that research of this nature encourages the application of theory in a practical setting, this type of research was seen as the best approach in order to bring about long-lasting, positive change.

The following section outlines the structure of this research study in relation to the stages of the Deakin Model.

To develop a plan of action to improve what is already happening

A literature review was conducted to find out more about:

- the learning needs of gifted students;
- strategies associated with fostering in-depth learning; and
- ways to define and measure the depth of students' learning.

Having identified strategies that foster deeper learning through the literature review, a questionnaire was designed to determine which of the recommended strategies were being used by the teacher/researcher.

A pencil and paper test formulated using the SOLO (Structure of the Observed Learning Outcome) Taxonomy (Biggs & Collis, 1982) was designed and administered to measure the depth of the students' learning in the areas of maths, social studies, and reading.

Due to the proposal taking longer than expected to gain ethical approval, this initial data gathering did not take place until the end of Term 3 which shortened the length of time available for implementation of appropriate strategies.

The next step was to analyse and draw conclusions from the data. This enabled the teacher/researcher to recognise strategies that she used least often (as perceived by the students), which became the focus for improved teaching.

Data from the formal test were used to draw general conclusions about the depth of the students' learning. Due to the delay in starting, the data were analysed quickly so that the action plan could be implemented immediately. This left a ten-week term to implement the intervention. The initial plan had been based on twenty weeks of intervention. It was therefore recognised that ten weeks may not be long enough to bring about the expected change.

To act to implement the plan

For the last term of the school year, the teacher/researcher incorporated the identified strategies into her teaching. She modified her teaching in an attempt to give the students more opportunities and more support to engage in deeper learning and to study topics at a more in-depth level. A detailed research diary was used by the teacher/researcher to record information about her use of the four focus strategies.

To observe the effects of action in the context in which it occurs

After ten weeks, the impact of the strategies that were employed in relation to the depth of the students' learning was measured. This involved a second round of data gathering. The students completed the questionnaire a second time, a second formal test was administered (which was of a similar design to the first but with different content), and the research diary was completed.

To reflect on these effects as a basis for further planning and subsequent action

At this stage, data from all three sources were analyzed to measure the impact of the intervention. Data from each source were first looked at in isolation then analyzed for relationships between the different sources.

Action research requires a spiral back to planning which, in this case, could be based on the observed change brought about by the use of identified strategies and new problems or areas that could be improved that are associated with this change (Kemmis & McTaggart, 1988). Due to time restrictions, this thesis only records one cycle of the action research spiral, but recommendations for further cycles are detailed in chapter six (pages 110–111).

3.3 Data Gathering Instruments

As with any research model, the nature of the action research problem or research questions should determine the methods of data gathering. Of specific interest to the researcher of this study, was to find a reliable tool to measure the depth of students' learning and a way to identify strategies being used by the

teacher that influence the depth of students' understandings (if they are influenced at all). The data gathering tools for this thesis were chosen from a range of methods recommended for action research (Berg, 2001; Merriam, 1988; Yin, 1994; Bassey, 1999). They included:

- A questionnaire developed specifically for the purpose of this study which contained Likert scale questions and questions requiring open-ended responses;
- Formal tests developed by the researcher using the SOLO Taxonomy (Biggs & Collis, 1982) as a framework;
- A research diary kept by the teacher/researcher over the course of the intervention.

3.3.1 Questionnaire

A questionnaire was developed and administered to determine the students' perceptions about the strategies used by their teacher that help them to think more deeply. This was administered both pre- and post-intervention. Data from the questionnaires were used to find out and reflect on what was happening in the classroom at the outset of the study and again when observing and measuring the impact of the intervention. An example of a completed questionnaire can be found in Appendix A.

A Likert scale is a rating scale that is designed to assess opinions that can be placed along a continuum. Respondents consider the choices and select one that best reflects their feelings (Buchanan & Feldhusen, 1991). The teacher/researcher made a conscious decision to have four choices on the continuum for this study due to the age of the audience (too many more may have been confusing) and to avoid having a neutral position. An even number of options required the students to take a stand on every item (Buchanan & Feldhusen, 1991).

The questionnaire listed sixteen strategies that were identified through the literature review as ways to encourage students to apply a deep approach to learning which is proven to have a positive impact on learning outcomes (Ramsden, 1992; Prosser & Trigwell, 1999; Biggs & Moore, 1993; Biggs, 1999; Ramsden, 1988). Some items have been stated in a more simple way than in the

literature or have been teased out to make the meaning clearer to the students. They are in no particular order.

The items on the questionnaire related to quality of teaching but the students provided reference to the regularity of their use, therefore providing quantitative data. The data were analyzed to ascertain the degree of use for each item and to identify trends and areas of weakness. The students were also asked to comment on how each strategy was implemented. These open-ended responses were used to ascertain teaching methods that the students responded positively to.

3.3.2 Formal Tests

Formal tests were used to measure the depth of students' learning both pre- and post-intervention. Examples of a completed pre-intervention test can be found in Appendix B, and a completed post-intervention test can be found in Appendix C.

The test questions were criteria-referenced based on the SOLO Taxonomy. The taxonomy provides a five-stage framework for constructing and analyzing responses to questions in relation to the depth of understanding of the question (Biggs & Collis, 1982). The assessor graded each response either by the number of ideas it contained (prestructural, unistructural, or multistructural) or the relationships drawn between ideas (relational or extended abstract) (Hattie, 2000). The prestructural, unistructural, and multistructural stages are known as the Quantitative Phase when the amount of detail in the response increases. The relational and extended abstract stages are called the Qualitative Phase, during which the detail in the response becomes more structured and meaningful (Biggs, 1999). Students who are demonstrating understanding in the Qualitative Phase could be said to be demonstrating in-depth learning (Hattie & Purdie, 1998). The use of the SOLO Taxonomy criteria in this study was based on these assumptions, which are substantiated by the literature cited. (See pages 28–35 for more detail.)

The taxonomy can be used across different curriculum areas and at different levels (Biggs & Collis, 1982). As this study was aiming to improve the depth of students' understanding in general, rather than in just one curriculum

area, the tests were made up of three 'testlets' covering maths, reading, and social studies. Hattie and Purdie (1998) note several advantages to this approach: data from several testlets is more stable than data from one test alone; results from testlets can be investigated separately but also combine to provide an overall picture of the student's performance; change over time can be measured by using formative and summative testing; and, if using computer adaptive testing procedures (CAT), sequential testlets can be administered at appropriate levels according to results from prior testlets.

For the purpose of this study, the test questions were structured to elicit answers that could be matched to the levels of the taxonomy according to the depth of understanding that the students' demonstrated. As discussed in the literature review (see page 28), a measure of the depth of students' learning is time and task specific (Biggs & Moore, 1993) however Hattie and Purdie (1998) claim that if the taxonomy is used across several content areas, the results can be used to form a statement about a students' general depth of understanding. Results from the tests for this study were used to gain a general picture of the levels of students' thinking.

It was necessary to have different content in the two tests. Both tests were based on content that the students had been learning about in class (Parke, Hare, & Brimicombe, 2002). Every attempt was made to keep other variables the same, for example, the layout of the test papers, the instructions given by the administrator, test conditions, and the time allowed to complete each section of the tests. Time recommendations were made for each question, but students were given more time if they needed it (Ramsden, 1992). The students were given the option to tape-record one answer on each test to overcome the "writing barrier" for those who find writing challenging.

3.3.3 Research Diary

The analysis of documentation, such as a research diary, is beneficial to qualitative study because it can be reviewed repeatedly with minimal intrusion, it does not have to be created specifically for the study (although in this case it was), it can contain accurate references and details of events, and it can provide a broad coverage over time (Yin, 1994). Documentation has been criticized for

being subjective in relation to selection of documents and author bias (Yin, 1994), however, Berg (2001) argues that the subjectivity related to author bias gives a researcher access to insights that might otherwise not be accessible.

After the pre-intervention data gathering, the teacher/researcher analyzed the questionnaire data to ascertain which strategies were used least and most often and how they were used. The strategies used least often were of most interest to the teacher/researcher as improvement in these areas was recognised as a possible key to improving students' learning outcomes. These strategies formed the framework of the intervention. During the course of the intervention, a research diary was kept. The teacher/researcher kept diary records on a weekly basis about her use of the four focus strategies. The main purpose of the diary to was to provide a record of the intervention that was undertaken. Example entries from the diary can be found in Appendix D.

3.3.4 Triangulation

Triangulation involves gathering data from at least three different sources (Berg, 2001). Triangulation is necessary to validate the data collected. Data triangulation, which involves using multiple sources of information, and method triangulation, which involves multiple data gathering techniques, should be used to produce convergent lines of enquiry (Merriam, 1988). Convergent lines of enquiry are found when data from the different methods and sources are compared and contrasted. This study uses three different data gathering techniques – formal tests, questionnaires, and a research diary, all of which include multiple sources.

3.4 The Sample

The study involved a research group of fourteen students who had been identified as gifted and who attended a gifted education programme at a suburban New Zealand school. The students were all aged between 8 and 11 years at the outset of the study. They were identified through the Gifted Kids Programme (GKP) identification process, which requires students to have demonstrated abilities or potential that make it likely that they will thrive in the GKP environment. The inclusion of both demonstrated and potential

performance is in line with recommendations from the Ministry of Education (2002). GKP uses multiple identification methods (Best, 2004). Research-based subjective methods include self, peer, teacher, and parent nominations, which usually are administered using observational checklists or interviews (Hook, 2004). Other measures include work samples and student records. Students are also observed in a responsive learning environment, which involves the "setting up of challenging learning experiences that encourage those with special abilities to surface" (Ministry of Education, 2000, p. 28). This multi-method approach is inclusive of different learning styles or disabilities, and cultural and socio-economic backgrounds (Hook, 2004).

At the beginning of the study, the teacher/researcher's class consisted of sixteen students. All were informed of the research and invited to participate by way of a covering letter from the lead teacher and a trustee of the programme, accompanied by information sheets and consent forms. One student chose not to participate and another did not return his consent forms, therefore could not be included in the sample. This left a total of fourteen participants. One student was away for both the pre- and post-intervention data gathering (a different student on each day) therefore data from these methods only include thirteen students each time. All fourteen were involved in the intervention.

Table 3.1 represents a breakdown of the sample according to year group and gender.

	Girls	Boys
Year 4	1	0
Year 5	1	7
Year 6	2	3

Table 3.1: Sample Composition

The sample includes the following ethnic groups: Pakeha, Maori, Chinese, Cambodian, and Finish. All students in the sample spoke and read English fluently.

3.5 Procedure

This section outlines the procedures that were followed when conducting the research.

3.5.1 Introductory Session

The principal at the school where the programme is based, spent 45 minutes with the teacher/researcher's class explaining the purpose and aims for the research, how the students could be involved, and what would be expected of them. It was stressed that participation was purely voluntary and that written consent from both the students and their caregivers would be required if they were to participate in the research. The students were also given the opportunity to ask questions. The teacher/researcher was not present at this session but the principal followed an information sheet that had been prepared by the researcher.

Within a few days, each student received a package in the post which included:

- A covering letter from a GKP trustee and the lead teacher at the GKP unit;
- An information sheet and consent form for the student;
- An information sheet and consent form for his or her caregiver/s;
- A stamped, self-addressed envelope for the return of the consent forms.

Consent forms were either posted back or brought to school over the following weeks. The teacher/researcher called students and caregivers who had not returned their forms to check if they wanted to participate and to offer replacement forms if necessary.

3.5.2 Pre-intervention Data Gathering

Pre-intervention data gathering was undertaken on 9th September, 2003. It involved the completion of a questionnaire and a formal test. Ethics approval stipulated that a person other than the teacher/researcher administer the questionnaire and test. A relieving teacher was employed for this purpose and the teacher/researcher was not present. The sample group was divided into two smaller groups, who took turn-about on research work with the administrator and their regular work in their classroom with the teacher.

Questionnaire: Participants in each group completed the questionnaire at the same time and were given 15 minutes to do so. Students were asked to label their questionnaire with a unique identifier, rather than their name, so that their responses were anonymous but could be linked to other data on which they used the same unique identifier. (This placed a limitation on the research in that it was not possible to use the data to respond to individual learning needs identified in the data gathering process, but it was a necessary requirement to ensure validity.) It was explained to the students that they could either work through the questionnaire at their own pace, or work through it with the administrator. The administrator read each item aloud and gave the students time to complete it. If students asked for clarification on a particular item, the item was orally reworded and/or an example was given. When students were finished, their questionnaires were collected for analysis.

Formal test: Participants in each group completed the formal test at the same time, although some worked through it more quickly than others. Students were asked to label their test paper with the same unique identifier that they had used on the questionnaire. For each of the three testlets, the administrator read the instructions aloud, and talked the students through the criteria. The students were given the opportunity to ask questions about what was required of them. They were told the timeframe within which they were expected to complete each testlet, but were allowed additional time if this was necessary. The test took approximately 50 minutes in total to complete. When students had completed their test, it was collected for analysis and they returned to class.

3.5.3 Analysis of Data and Intervention Planning

The next step was to analyse the data from both the questionnaires and the formal tests and the results were used to design the intervention. A series of codes for classifying the research data was devised. Results from the analysis are discussed in-depth in the Results Chapter.

Based on these results, the teacher/researcher adopted the "plus one" strategy (Biggs & Collis, 1982). This aims to move students up one level on the SOLO Taxonomy.

Questionnaire: Data from the pre-intervention questionnaire showed that the following strategies were used least often (as perceived by the students) and therefore should form the focus for the teacher/researcher during the intervention:

- At GKP, we learn about real world topics and I have opportunities to solve real world problems.
- When we start a new topic, my GKP teacher finds out what I already know about it.
- My GKP teacher encourages me to be curious and ask questions.
- At GKP, I learn about how to learn and how to make my learning better.

The comments on the questionnaire were analysed using a content analysis approach, to identify strategies that the students recognised as being supportive of their learning.

At this stage, the researcher committed to improving her use of the strategies listed above in her everyday classroom practice, over the following ten weeks (until the end of Term 4 when the post-intervention test would be administered). Her intention was to encourage her students to use a deep approach to learning and, in turn, improve the depth of their learning.

3.5.4 Intervention

The intervention began in week one of Term 4. It was not instruction that happened over and above regular teaching and learning. Rather the teacher/researcher changed the way she taught throughout the day to incorporate the strategies that could foster deeper learning, which had been identified as lacking in her practice.

Over the course of Term 4, the teacher/researcher kept a diary to record her actions and reflections in relation to the four focus strategies. There were nine diary entries in total (one for each teaching day of the term). Appendix D contains one diary entry from early in the intervention and another from later.

3.5.5 Post-intervention Data Gathering

The post-intervention data gathering was administered on 2nd December, 2003 and consisted of the same questionnaire that had been administered pre-

intervention and a second formal test designed using the SOLO Taxonomy. The procedure was very similar to the pre-intervention data gathering. The same relieving teacher administered the data gathering, the teacher/researcher was not present, and the group was divided into two smaller groups who took turn-about to complete the research requirements. For the administration of both the questionnaire and the test, conditions replicated those for the pre-intervention assessment. Due to unforeseen circumstances, it was necessary to move the first group from one room to another part way through the testing. As the students were working on different parts of the test, it was impossible to tell if this impacted the results.

Questionnaire: The post-intervention questionnaire was administered in exactly the same way as the pre-intervention. Students were asked to use the same unique identifier so that the data could be analysed comparatively. It was a little quicker the second time as students were already familiar with the administration procedure and the content.

Formal test: The second formal test had different content from the first but the testlets had been constructed in the same manner. The same administration guidelines were followed. Students were given the same level of support from the administrator although the second test took slightly longer as the maths testlet was more involved (but not expected to be more difficult) than the maths testlet in the previous test. Once again, the students marked their papers with their unique identifier. When they had completed their test, it was collected and the students returned to class.

3.5.6 Analysis of Data

At this stage, the data from the post-intervention questionnaire and test were marked and coded. The teacher/researcher found the results from the second test more difficult to match to the SOLO criteria and felt it necessary to have a sample of the results moderated to ensure reliability of the allocated levels. A sample of the data (the pre- and post-tests from four students) was given to an advisor in gifted education to mark.

Data from the formal tests and questionnaires were analysed to measure change in the teacher/researchers' practice (as perceived by the students) and

change in the depth of the students' understanding in maths, reading, and social studies. The teacher/researcher identified response patterns such as relationships between:

- pre- and post-intervention data;
- SOLO levels in different curriculum areas; and
- responses to the questionnaire and SOLO levels.

Diary entries were presented as qualitative information. This did not provide statistical evidence to support data from other sources but it provided confirmation of what the intervention involved and gave opportunity to discuss which elements of the intervention may have been effective in improving the depth of students' learning. An attempt was made to highlight relationships between the students' questionnaire results and the research diary in regards to the four strategies that the teacher/researcher had chosen to focus on. Conclusions from the data were then related back to the research questions and findings in the literature review.

3.6 Ethical Considerations

Researchers are expected to collect and analyze data and report on findings in a truthful manner and should not deceive others intentionally or unintentionally. A researcher must recognise a person's initial ownership of data and respect their dignity and privacy (Bassey, 1993). A researcher must also take precautions to minimize bias (Macintyre, 2000). Action researchers should pay particular attention to ethical principles as their research involves bringing about positive change in a pre-established social setting. If they fail to do so, they could jeopardize the improvement process or, even worse, damage the existing setting and practices (Kemmis & McTaggart, 1988).

Due to the nature of this research, a proposal went before the College of Education Ethics Committee, seeking their approval. The proposal had been formulated following MUHEC Code of Ethical Conduct for Research, Teaching and Evaluations Involving Human Participants (2003). The initial proposal was returned to the researcher with recommendations for major amendments. The committee's concerns were mostly related to the conflict of interest associated with action research conducted by a teacher/researcher. The researcher was

given the option to make the recommended amendments and to resubmit to the College of Education Ethics Committee or to submit the proposal to the Massey University Human Ethics Committee (MUHEC). An amended proposal was resubmitted to the College Committee, which was accepted based on the proviso that minor changes were made under the guidance of the research supervisors. These changes were discussed and made immediately. Gaining ethical approval took a lot longer than the researcher had initially anticipated, therefore the data gathering phase was shortened.

3.6.1 Bias

The role of teacher/researcher is complex. The teacher/researcher should aim to collect objective evidence, however because she knows her students well, this is not easy. Knowing the students and her own practice well can help to formulate useful and relevant research questions and to understand the students' responses to the study. However, this familiarity can also prevent the teacher/researcher from seeing 'clearly' as a stranger would. The teacher may well bring preconceived assumptions about the students and their abilities and find it difficult to see beyond these (Macintyre, 2000).

Another potential for bias, related to the teacher-student relationship is the temptation for students to anticipate the kinds of answers the teacher/researcher wants and to reply accordingly (Macintyre, 2000).

It is not possible to eliminate bias entirely, as it is inherent in all qualitative research, but safe guards can be put in place to enforce reliability of the study (Berg, 2001). The following procedures were followed to safe guard against bias in the present study:

- data sources and data gathering methods were triangulated (Berg, 2001);
- a person neutral to the research and the participants introduced the study to them;
- a person neutral to the research and the participants administered the questionnaire and the formal tests;
- a sample of the data which had been analyzed by the teacher/researcher was moderated;

- the students labeled their formal tests and questionnaires with unique identifiers rather than their names; and
- the study was closely supervised.

3.6.2 Reliability

For studies to be trusted and believed, researchers need to present findings that "ring true to readers, educators, and other researchers" (Merriam, 1988, p. 164). Reliability means that if another researcher was to duplicate the investigation, the results would be the same (Macintyre, 2001). The following steps were taken to maximize reliability in this study:

- Items on the questionnaire were cross-checked with related literature to ensure that they were recognised strategies for improving the depth of students' learning;
- Data from the formal tests was verified against references to the SOLO Taxonomy and related literature;
- The researcher had the data and conclusions examined by her supervisors to see that logical conclusions were being drawn from the data (Berg, 2001).

3.6.3 Validity

Internal validity aims to eliminate the risk of subjectivity (Merriam, 1988). External validity is related to generalisability. Opportunities to generalize research findings from action research are limited because they stem from problems specific to a particular setting, aim to change the behaviours of research participants, and are receptive to variables, influences, and change within the research environment. However, findings from an action research study such as this may be useful for other teachers who have recognised a similar problem in their education setting.

For the purposes of this study, validity was addressed by the following measures:

- The purpose of the research and research questions were stated clearly at the outset of the study and a coherent link was maintained between the purpose of the study, the data collected, and the conclusions reported (Yin, 1994);

- The researcher ensured that data collection, analysis, and recording methods could be justified as suitable to achieve the purpose of the study and to answer the research questions. This process established a chain of evidence (Yin, 1994).
- Multiple data gathering techniques and sources of information were used to produce convergent lines of enquiry through data and method triangulation (Merriam, 1988).
- The questionnaire and formal tests were submitted to the study supervisors for scrutiny prior to use.
- A draft of the action research report was distributed for review to the principal and trustees of GKP and the research supervisors prior to publication.

3.6.4 Permission Sought

Written permission was sought from the GKP trustees to conduct this research. The researcher made herself available to discuss the purpose, methodology, and possible implication of the research. Permission was sought from GKP for information and testing opportunities pertinent to the purpose of the study.

3.6.5 Informed Consent

Written consent was sought from all potential participants and their caregivers. Information sheets and consent forms were sent to all students in the class and their caregivers. The information sheet for caregivers (see Appendix E) outlined the purpose and aims of the research study, the procedures used for sample selection and data gathering and analysis, expectations of participants, and the rights of participants. It was stressed that participation was strictly voluntary and gave caregivers assurance that participants could withdraw or ask questions at any time during the study. It also included contact details for the researcher and the supervisors. A more "kid-friendly" version of this information sheet was prepared for the students. This can be found in Appendix F. Students and their caregivers were provided with a stamped, self-addressed envelope and asked to return the consent forms within seven days. Caregivers of

students who had not returned the forms by the due date were called to confirm whether or not their child would be participating and to offer to send replacement forms. Every effort was made to avoid educational and academic jargon in correspondence with students, caregivers, and GKP trustees and to ensure that the research process was as user-friendly and non-threatening as possible.

Non-participants

Students who chose not to participate in the research were not involved in the formal data gathering procedures. These students were assured that nonparticipation would in no way affect their studies or treatment towards them from the teacher/researcher and would not result in being excluded from GKP.

Non-participants were still involved in the intervention as it was a means to improve the teacher's everyday classroom practice, which would have taken place regardless of the study. Good teaching involves the identification of students' learning needs and subsequent planning and teaching in response to the identified needs. Ongoing assessment should measure the impact of the teaching and be used to identify new learning needs (Hattie & Jaeger, 1998, cited in Bachor & Hattie, in review).

3.6.6 Conflict of Interest

The teacher/researcher recognised that, by assuming both the teacher and researcher role, there was a potential conflict of interest in conducting this study. To overcome this conflict, the following safe guards were put in place:

- The initial approach to caregivers of potential participants came from the lead teacher and a GKP trustee;
- The principal of GKP's host school, someone neutral to the research and the students, explained the research to the class and answered any questions they had;
- A relieving teacher withdrew participants to administer the questionnaire and the formal tests, without the teacher/researcher present. Students who were not participating in the research remained in the classroom;

- Students who chose not to participate were in no way penalised academically or socially and their choice to not participate did not effect their relationship with there teacher or peers in any way;
- Data collection was limited to approximately two and a half hours of class time, keeping impingement on learning time to an absolute minimum. As the data gathering informed future teaching and learning, it was considered as valuable as regular assessment; and
- All data analysis took place outside of teaching time.

First and foremost, throughout the study, the teacher/researcher was focused on the fact that her role as teacher came before her role as researcher.

3.6.7 Confidentiality

Setting: Due to the unique disposition of the Gifted Kids Programme, it would be near impossible to protect its identity, therefore no attempt was made to do so. The actual class was not formally identified, but as the researcher only teaches one class, this is easy to deduce.

Participants: Every attempt was made to keep participants' identity confidential, however this could not be guaranteed, particularly due to the small sample size and the fact that the class as a whole is easily identifiable. Confidentiality, but not anonymity was assured. Participants created their own unique identifiers, which were used on all data collection tools and when it has been necessary to use a name in this thesis, participants have been referred to by their self-selected unique identifier.

3.6.8 Ethical Issues and Data Gathering

The following procedures were undertaken in relation to each data-gathering instrument:

Formal tests:

- Written consent was sought from all students and their caregivers before the tests were administered;
- Date, time, and location for the tests was arranged with the students and the GKP staff prior to administration; and
- Test questions were developed for the purpose of the research project only.

Questionnaires:

- Written consent was sought from students and their caregivers before the questionnaires were administered;
- Questionnaires were completed during school time; and
- All questionnaire items were directly associated with the purpose of the study and the research questions.

Research diary:

- Events were recorded honestly and with all necessary detail; and
- Events were not recorded out of context.

Information obtained from the research diary, the formal tests, or the questionnaires has not breached other ethical obligations as outlined elsewhere in this thesis.

3.7 Conclusion

This chapter discussed the methodology of this action research project. It outlined the context and purpose of the study. Action research was described in-depth and justification for the use of action research in this study was explained. The chapter described how each of the stages of the action research cycle was implemented and how ethical considerations were handled. Reliability and validity factors were discussed and related to the methods of data gathering used in this study.

In conclusion, the aim of this study has been to better understand the notion of deep learning, to measure the depth of students' thinking, and to implement an intervention that would increase the depth of gifted students'

learning. The action research method has enabled the teacher/researcher to explore this field in-depth and to apply this new learning to her teaching in an attempt to bring about positive change.

Chapter Four: Results

4.1 Introduction

This chapter presents quantitative and qualitative data. Results fall into three areas:

- formal test results, which used the SOLO Taxonomy to measure the depth of students' learning in three curriculum areas, and to gain a picture of how the depth of their learning changed over time;
- questionnaire results which showed the frequency of strategies that promote in-depth learning used by the teacher/researcher and open-ended responses to how these strategies were implemented (as perceived by the students); and
- the research diary which was kept by the teacher/researcher over the duration of the intervention providing qualitative data on how she implemented deep-thinking strategies, during the intervention period.

First, results from each of these data gathering methods are presented in isolation and when appropriate, parallels are drawn between pre- and post-intervention data. Then relationships are identified across the three sources of data.

4.2 Formal Tests

These results include data from the formal tests administered in September, at the outset of the project, and in December, after the intervention had been completed. Each of the two tests was made up of three testlets covering reading, maths, and social studies. Table 4.1 shows the results for each student from all six testlets. The table includes the students' unique identifiers and the SOLO level at which their testlets were graded. As the aim of testing across three areas was to gain a "general" picture of the depth of each student's understanding, a mean score has been calculated for each student across the three curriculum areas. This provides two mean scores for each student, one for the pre-intervention test, and one for the post-intervention test. These scores can be compared to indicate change over time. For the purpose of this study, the figures cited in the data align with the levels of the SOLO Taxonomy as follows:

0-1	prestructural
1.01-2	unistructural
2.01-3	multistructural
3.01-4	relational
4.01-5	extended abstract

September					December			
Unique ID	Social Studies	Maths	Reading	Mean score	Social Studies	Maths	Reading	Mean score
Sam	2.00	3.00	2.00	2.33	2.00	2.00	2.00	2.00
Grace	3.00	4.00	2.00	3.00				
Mespot	3.00	4.00	3.00	3.33	4.00	4.00	4.00	4.00
Mark	4.00	3.00	3.00	3.33	4.00	4.00	3.00	3.67
Aladin	3.00	5.00	2.00	3.33	3.00	2.00	3.00	2.67
Jake	2.00	3.00	2.00	2.33	1.00	1.00	2.00	1.33
Anna	3.00	4.00	1.00	2.67	2.00	3.00	3.00	2.67
Eve	2.00	3.00	1.00	2.00	4.00	2.00	3.00	3.00
Kranza	3.00	4.00	3.00	3.33	3.00	3.00	3.00	3.00
Jack	3.00	3.00	2.00	2.67	2.00	5.00	4.00	3.67
Henri	3.00	4.00	3.00	3.33	3.00	4.00	4.00	3.67
Jemima	4.00	3.00	2.00	3.00	4.00	4.00	3.00	3.67
Daredevil					3.00	1.00	2.00	2.00
Shannen	3.00	3.00	3.00	3.00	4.00	4.00	3.00	3.67

Table 4.1: Formal Test Results

"Daredevil" was absent on the day of pre-intervention testing and "Grace" was absent on the day of post-intervention testing, however they both participated in the action research project, so their results for the one test they sat have been included.

As shown on Table 4.1, most students were operating at either the unistructural or multistructural levels of the SOLO Taxonomy in both the pre- and post-intervention tests, and of the total seventy-eight testlet answers, fifty-four were at either multistructural or higher.

4.2.1 Comparison of Formal Tests Results by Student

By comparing the pre-intervention and post-intervention mean scores for each student on Table 4.1, it is evident that seven students' mean scores

increased, four students' mean scores decreased, and one student's mean score remained the same. (A comparison was not possible for "Daredevil" and "Grace" as there was only one set of data for each of them.)

The students' mean scores improved or decreased by different amounts. The average amount by which students' scores improved was 0.66 of a SOLO Taxonomy level whereas the average amount by which students' scores decreased was 0.44 of a SOLO Taxonomy level. This indicates that more students showed an improvement than not, and the amount by which their score improved was more than the amount by which other students' scores decreased. The trend is in favour of students improving, however this result must not be over-interpreted.

It was the teacher/researcher's intention to adopt the "plus one" principle, (Biggs & Collis, 1982), that is to move each student up one SOLO Taxonomy level, over the ten-week intervention period. (As the intervention period had been shortened from twenty to ten weeks, it was acknowledged that such an improvement might be unrealistic.) Comparing students' pre-intervention and post-intervention results, four students' mean scores showed an improvement of one SOLO Taxonomy level, four students' mean scores showed a decrease of one SOLO Taxonomy level, and three students' mean scores showed no or little change.

4.2.2 Comparison of Formal Tests Results by Curriculum Area

Formal test results have also been analysed by curriculum area. Chart 4.1 shows the mean score for each curriculum area for both the pre-intervention and post-intervention tests.

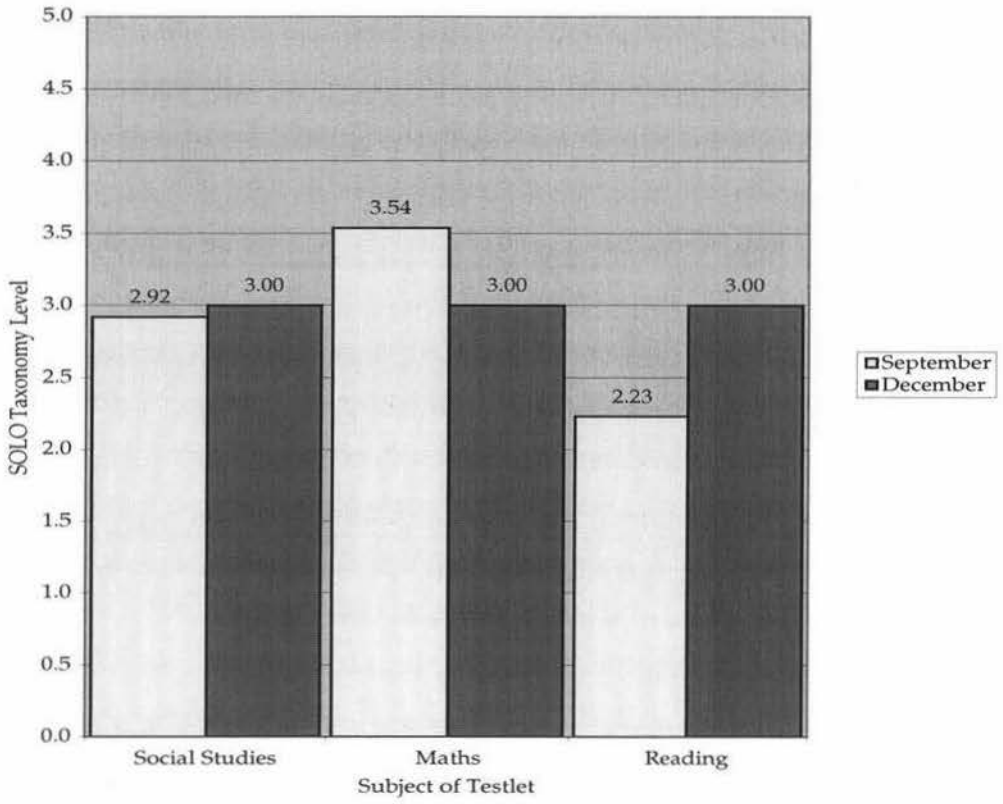


Chart 4.1: Formal Test Results Comparison

Chart 4.1 shows a slight increase of 0.08 when comparing the pre-intervention and post-intervention mean scores for the social studies testlets. The chart also shows a decrease in mean scores from pre-intervention to post-intervention of 0.54 in the maths testlets and an increase of 0.77 in the reading testlets. A desired result would have shown an increase in all three curriculum areas, however, rather than a uniform increase, the actual results show inconsistency.

4.3 Questionnaires

This section presents results from the identical questionnaires that were administered pre-intervention in September and post-intervention in December. The questionnaire was designed to find out from students which deep-thinking

strategies they thought their teacher used in the classroom programme and how often they were used.

For ease of presentation, each strategy (question) in the questionnaire has been abbreviated, for example, Big ideas = At GKP, we study big ideas that I am interested in; Real world application = At GKP, we learn about real world topics and I have opportunities to solve real world problems; and so on. Appendix G lists each of the strategies with their corresponding abbreviation.

When completing the Likert-scale questions, students circled the response option (never, hardly ever, sometimes, or often) that they felt best reflected each strategy. To analyse the results, each of the response options was equated to a number:

Never	1	Sometimes	3
Hardly ever	2	Often	4

4.3.1 Pre-intervention Questionnaire Results

Following the system described above, the students' responses to the pre-intervention questionnaire are presented on Table 4.2. A mean score from the responses to each question has been calculated.

Unique ID	Big Ideas	Real world application	Have prior knowledge	Elicit prior knowledge	Related to future	Care	Listened to	Feedback	Purposeful learning	Small-group work	Adequate time	Curiosity/ questions	Metacognition	Relaxed	Intrinsic motivation	Responsible for learning
Sam	3	1	2	2	4	4	4	3	3	3	3	4	2	3	3	2
Grace	3	3	4	3	3	4	3	4	3	4	3	2	3	3	4	4
Mespot	3	3	4	3	4	3	3	3	2	4	4	3	3	3	3	4
Mark	3	3	2	4	3	4	4	4	3	3	3	3	3	3	3	4
Aladin	3	2	4	4	3	4	4	4	3	4	4	4	3	4	4	4
Jake	3	4	1	4	4	4	4	4	2	4	3	3	3	3	4	4
Anna	3	n/a	2	1	3	3	4	4	3	2	3	2	3	3	4	3
Eve	3	2	4	3	3	3	3	3	3	3	3	3	2	3	3	3
Kranza	3	2	3	2	2	4	4	4	3	3	4	2	2	3	3	4
Jack	4	n/a	4	2	4	4	4	4	4	3	3	3	4	4	4	4
Henri	3	2	4	2	3	4	4	4	4	2	3	2	3	4	3	3
Jemima	4	3	3	2	3	4	4	4	3	1	4	3	2	4	4	3
Daredevil																
Shannen	3	3	2	3	3	4	4	4	3	4	3	4	3	2	4	3
Mean score	3.15	2.55	3.00	2.69	3.23	3.77	3.77	3.77	3.00	3.08	3.31	2.92	2.77	3.23	3.54	3.46

Table 4.2: Results From Pre-intervention Questionnaire

Two students' responses to "Real world application" have been graded as "n/a" as they either did not circle any response options or circled more than one response option. There are no responses from "Daredevil" for this questionnaire as he/she was absent on the day of data gathering, however "Daredevil" did participate in the ongoing research project.

As shown on Table 4.2, around 85% of all responses in this questionnaire were either "sometimes" or "often" and mean scores ranged from 2.55 to 3.77.

The four lowest mean score have been highlighted on the table.
The strategies that they represent are:

- At GKP we learn about real world topics and I have opportunities to solve real world problems;

- When we start a new topic, my GKP teacher finds out what I already know about it;
- My GKP teacher encourages me to be curious and ask questions; and
- At GKP, I learn about how to learn and how to make my learning better.

These strategies were recognised as those that most needed improvement and therefore formed the focus for the intervention that ensued over the following ten weeks.

Open-ended Responses on Pre-intervention Questionnaire

The questionnaire also asked students to comment on how their teacher went about implementing each strategy or to give an example of a way that the strategy had been implemented. Students' responses to this component of the questionnaire were varied in their usefulness. Students often answered with a curriculum area or a topic of study, which was not helpful in identifying what the teacher actually did that made a difference to their learning. Table 4.3 presents comments from the students' questionnaires. It excludes feedback that was not constructive for the purpose of this study. Some of the concepts in the strategies were difficult for students to give concrete examples. Because of this, some strategies elicited no useful open-ended responses, therefore these strategies have not been included in the table. The four intervention strategies have been shaded on the table.

Strategy:	Students' feedback:
At GKP, we learn about real world topics and I have opportunities to solve real world problems.	• When we read about statements in the paper and work out how to solve them. • We used to look in the newspapers ...
At GKP, we study topics that I already know a little bit about.	• [We ask] known/unknown questions. (This is a question for which the questioner knows the question, but not the answer.)

When we start a new topic, my GKP teacher finds out what I already know about it.	[My teacher] asks us to brainstorm what we already know.
I feel like my GKP teacher cares about me and my learning.	• She helped me find the "wow" factor in my piece of writing. • [She] puts her attention to us inside and outside. • She makes sure I know what to do. • Because she explains it and wants us to understand what she has said.
I feel like my GKP teacher listens to me.	• She helps me with my ideas by expanding them. • She listens to anyone in the class. • When I ask questions, she listens. • When I have an idea, I'm asked to tell somebody. • She lets us have our say. • Whenever we say something she will always let us say it. • Like when I ask a question.
My GKP teacher talks to me and gives me written feedback about my learning and how to make it better.	• [She] gives feedback to me. Sometimes good comments, usually how to make it better. • Family treasures pages – my teacher gave me written feedback. ("Family Treasures" was a written contribution from each student to a book for public display.) • She writes a paragraph on what we need to improve on. • For English, she always writes in my book and writes how to make it better. • She writes about our work heaps and tells us what she thinks is wrong or good.
I know why we do	• Mini admin so we can know about today. (Mini

what we do in class at GKP.	admin is an introduction to what we have lined up for the day.) • [She] explained why we did "Night of the Notables" and the English work. ("Night of the Notables" was a study of eminent people.)
At GKP, I have enough time to think, and to finish the things that I've started.	• When we go onto another topic, she will give us extra time if we haven't finished the previous one.
My GKP teacher encourages me to be curious and ask questions.	• She tells me to look at the situation from another point of view. • She gives us time to ask questions if we are stuck. • She asked us to ask questions with [De Bono's] thinking hats.
At GKP, I learn about how to learn and how to make my learning better.	• When she gives me feedback in my work. • With De Bono's Thinking Hats – she always asks us to use them. • I just get feedback in my work and it tells me what is wrong and what I need to do.
I'm relaxed at GKP. (Not anxious.)	• I feel relaxed when the teacher helps me.
At GKP, I feel like I'm responsible for my own learning.	• I make the decisions on my own learning with help from [my teacher].

Table 4.3: Open-ended Responses in Pre-intervention Questionnaire

These open-ended responses allowed the teacher/researcher to identify strategies that the students were most conscious of and the ways that they saw these strategies being implemented. In analyzing their responses, several themes emerged: clarity of instructions; two-way communication; and written feedback. It was recognised that this could be useful information when looking at ways to

implement the four focus strategies during the intervention. There were three strategies in particular that received several comments about how the teacher implemented them.

Students commented on their teacher paying close attention to them and making sure that they knew what to do. This indicated that they responded to clear instructions related to their immediate learning needs.

A number of students indicated that they felt listened to when they had an idea or were asked a question. One student said that he/she is encouraged to share his/her ideas with others. This revealed that the students valued two-way communication for both sharing their understanding or points of view, listening to others, and asking questions.

Several students were aware of the value of the written feedback they had received and acknowledged that this gave them direction in their future learning. It did seem evident that students were not aware of receiving feedback about their learning in other ways, for example through discussion with their teacher or peers.

The open-ended responses could also be used to identify the students' perceptions of how the four intervention strategies had been implemented. (These strategies have been shaded on Table 4.3.)

Reading the newspaper was the only opportunity commented on by students that encouraged them to learn about real world topics and solve real world problems. This is seen as a valid experience, but the teacher/researcher recognises that it should not be the only avenue for providing experience with real-world problems.

One student recognised brainstorming prior knowledge as a way of finding out what was already known about a topic. This had been used because it was a quick way to find out what students knew, and when operating a one-day-per-week class, the teacher/researcher felt it was important to dedicate as much time to teaching and learning as possible, and to find efficient ways to conduct assessment.

When commenting on opportunities to ask questions and be curious, students referred to looking at situations from different points of view, to being given adequate time, and to using De Bono's Thinking Hats. These observations

were quite varied and indicated to the teacher/researcher that possibly there was no one way that stood out for students as effective for encouraging questioning and curiosity. This could also indicate the students' awareness that their teacher implemented this strategy in a variety of ways.

The comments elicited from "At GKP, I learn about how to learn and how to make my learning better" were surprising to the researcher. This strategy had actually been referring to metacognition. The teacher/researcher had not used this term as she knew that many of her students did not know what it meant, however it appears that the wording of this item led students astray, as their comments did not really relate to metacognition. In hindsight, a description of learning how to *think* and how to improve their *thinking* may have elicited more useful information.

4.3.2 Post-intervention Questionnaire Results

The same questionnaire was implemented for a second time in December, at the end of the intervention period. The students' responses are outlined in Table 4.4. Like Table 4.2, each response option has been allocated a corresponding number (1=never, 2= hardly ever, 3 = sometimes, 4 = often) and a mean score has been calculated for each question. The mean scores for the four intervention strategies have been highlighted.

Unique ID	Big Ideas	Real world application	Have prior knowledge	Elicit prior knowledge	Related to future	Care	Listened to	Feedback	Purposeful learning	Small-group work	Adequate time	Curiosity/ questions	Metacognition	Relaxed	Intrinsic motivation	Responsible for learning
Sam	3	2	4	2	3	4	4	4	4	3	2	3	3	4	4	2
Grace																
Mespot	3	2	4	3	3	4	3	3	3	4	3	4	3	3	3	4
Mark	3	3	2	4	4	4	4	4	3	4	3	3	2	3	4	4
Aladin	3	2	4	4	4	4	4	3	3	4	3	4	2	4	4	4
Jake	4	4	1	1	4	4	4	4	4	1	1	1	4	1	4	1
Anna	4	2	3	3	3	3	3	4	2	4	3	3	3	3	3	3
Eve	3	2	3	3	3	4	3	3	3	3	3	3	3	4	2	4
Kranza	3	3	4	4	2	4	4	4	2	3	3	2	2	2	3	3
Jack	3	2	3	2	4	4	3	4	4	2	4	3	2	4	3	4
Henri	3	3	3	4	4	4	4	4	4	4	4	4	3	4	4	4
Jemima	4	3	3	2	3	4	4	4	3	3	4	4	2	2	4	4
Daredevil	3	3	2	3	2	4	3	4	3	3	3	3	3	3	3	3
Shannen	4	2	3	3	3	4	4	4	3	3	3	4	4	2	3	3
Mean score	3.31	2.54	3.00	2.92	3.23	3.92	3.62	3.77	3.15	3.15	3.00	3.15	2.77	3.00	3.38	3.31

Table 4.4: Results From Post-intervention Questionnaire

"Grace" was absent on the day of data gathering, therefore there is no data recorded for him/her.

. As in the pre-intervention questionnaire results, around 85% of results in the second questionnaire were either "sometimes" or "often". Mean scores ranged from 2.54 to 3.92. (The range in the pre-intervention questionnaire results was 2.55 to 3.77.)

Open-ended Responses from Post-intervention Questionnaire

Table 4.5 outlines the students' open-ended responses to how the strategies were implemented. As with results from the pre-intervention questionnaire, responses that were not constructive for the purpose of this study and strategies that elicited no useful feedback have not been included. On Table 4.5, the four focus strategies have been highlighted.

Strategy:	Students' feedback:
At GKP, we learn about real world topics and I have opportunities to solve real world problems.	• Hot Off the Press – we look at world topics and try to solve them. ("Hot Off the Press" is a study of news in the media.) • Hot Off the Press - with [De Bono's] thinking hats.
When we start a new topic, my GKP teacher finds out what I already know about it.	• Most topics we do – she asks us as a class. • She might give us a test.
I feel like my GKP teacher cares about me and my learning.	• She watches out for me. • She always helps me when I have a problem. • When learning and working, she helps me think of more ideas. • She gives me advice. • [She] gives [me] advice when I'm stuck.
I feel like my GKP teacher listens to me.	• Asking questions and discussing with the class. • We get the "What's on Top" time and we can ask her questions any time. ("What's on Top" is a short discussion first thing in the morning that gives the students' an opportunity to off load any worries and to let the class know how they are feeling.) • I can tell when she looks at me when I'm talking, and other students.

	• When she looks at me when I'm talking.
My GKP teacher talks to me and gives me written feedback about my learning and how to make it better.	• By marking my book and talking to me. • She marks our work and leaves comments. • She always puts notes on my written work or tells me. • When she wrote feedback on my story about my treasure. • In one-on-one conferences.
At GKP, I have enough time to think, and to finish the things that I've started.	• She lets us work through lunch. • I have the opportunity to do work at home.
My GKP teacher encourages me to be curious and ask questions.	• In my ignorance log. (An "Ignorance Log" which is a notebook in which to record known/unknown questions.) • When we do an ignorance [log].
At GKP, I learn about how to learn and how to make my learning better.	• [De Bono's] blue thinking hat. • When [my teacher] gives me feedback.
At GKP, I feel like I'm responsible for my own learning.	• If I make a mistake, I fix it.

Table 4.5: Open-ended Responses in Post-intervention Questionnaire

The students' open-ended responses on the post-intervention questionnaires were not very different from the comments on the pre-intervention questionnaires. This was somewhat unexpected. In general, it was the same strategies that elicited useful feedback. This is not surprising in that some strategies were easier to provide comment on than others.

The purpose of this second questionnaire was primarily to focus on the students' responses to the use of the four focus strategies, however it was important that the teachers' use of other strategies had not declined at the expense of this focus. The students' comments indicate that the standard had not slipped, but did not indicate improvement in variety in the ways that the focus strategies were implemented either. In the case of the students receiving feedback, once again a number of students referred to receiving written feedback, however, this time, one student also commented on having one-on-one conferences with his/her teacher, which could indicate an increased awareness of different ways to implement this strategy.

In regard to the focus strategies, in some cases, change had been observed and commented on by the students.

Feedback on "At GKP, we learn about real world topics and I have opportunities to solve real world problems" saw very little change. The students once again refered to media studies, however one student did comment on the use of De Bono's Thinking Hats as a structured means of learning.

"When we start a new topic, my GKP teacher finds out what I already know about it" elicited just two useful comments. One student commented that finding out about prior knowledge happens for most topics but is usually done as a class. A second student commented on the use of pre-tests. Brainstorming was not mentioned.

"My GKP teacher encourages me to be curious and ask questions" elicited two comments about the use of ignorance logging. The use of an ignorance log is a more structured approach to teaching questioning and is good for helping students to ask quality questions to which they are genuinely interested in finding the answers (Whitte, 2002).

One of the responses to "At GKP, I learn about how to learn and how to make my learning better" refers to the use of De Bono's blue thinking hat, which

is used for metacognition. This interested the teacher/researcher because, although they had been learning how to use the blue hat, she did not feel that it had been very successful. This could indicate that at least one student had understood the use for this particular hat.

4.3.3 Comparison of Questionnaire Results

One of the expectations of this action research project was to improve the teacher/researcher's use of the four focus strategies. It was expected that, in turn, this would encourage the students to use a deep approach to learning and improve their learning outcomes. Chart 4.2 compares the mean scores for the intervention strategies from the pre-intervention questionnaire with the mean scores from the post-intervention questionnaire.

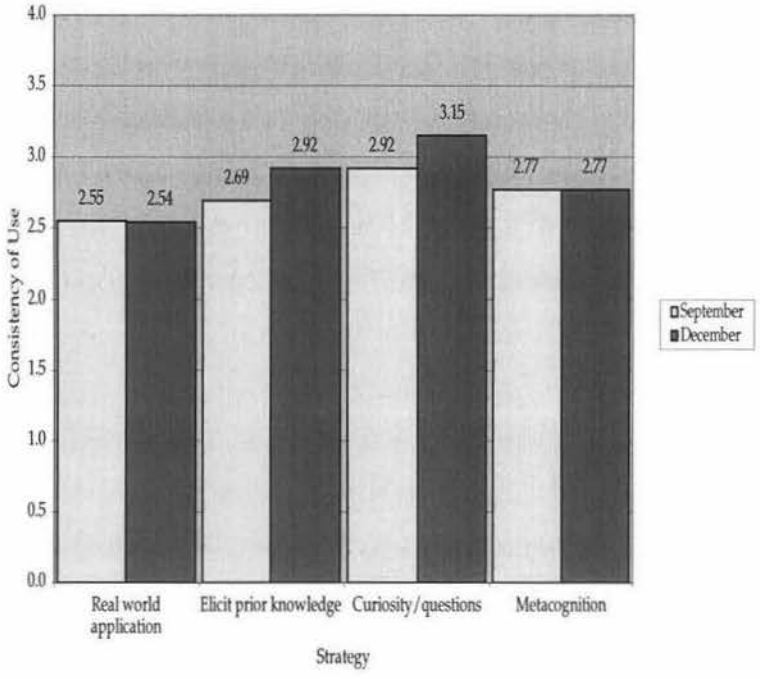


Chart 4.2: Questionnaire Results for Focus Strategies

As shown on Chart 4.2, some improvement can be seen in 'Elicit prior knowledge' and 'Curiosity/questions' but little or no change for 'Real world application' and 'Metacognition'.

Table 4.6 highlights the difference between mean scores for pre- and post-intervention results for the four focus strategies and also presents the change as a percentage.

Strategy	Difference	Percentage
At GKP, we learn about real world topics and I have opportunities to solve real world problems.	-0.1	-2.5%
When we start a new topic, my GKP teacher finds out what I already know about it.	+0.24	6%
My GKP teacher encourages me to be curious and ask questions.	+0.23	6%
At GKP, I learn about how to learn and how to make my learning better.	0.0	0%

Table 4.6: Comparison of Pre- and Post-intervention Questionnaire Results

In support of the information presented in Chart 4.2, Table 4.6 shows a 6% improvement for two of the focus strategies and a slight decrease or no change for the other two strategies.

4.4 Research Diary

During the course of the intervention, the teacher/researcher kept detailed accounts of how the four focus strategies were implemented in her classroom programme. Examples of complete entries for two days can be found in Appendix D. A summary of how each of the four strategies was implemented over the ten-week intervention is presented below. These lists were compiled by highlighting the main ideas from the nine diary entries. If a strategy was implemented in the same way on different days, it has only been listed once.

The items in the list under each strategy have been grouped by content, rather than chronology.

At GKP, we learn about real-world topics and I have opportunities to solve real world problems.

- identified real-world problems as reported by the media, brainstormed solutions, and debated ethics (in groups);
- identified real-world problems as reported by the media, stated who the issue was a problem for, and brainstormed solutions from different points of view (in groups);
- identified "stepping stones" (good things) and "stumbling blocks" (bad things) as reported by the media and discussed what contributed to these events;
- discussed how "stepping stones" and "stumbling blocks" are viewed differently by different people and that different people might solve "stumbling blocks" in different ways;
- problem solved when modifying stained glass windows;
- decided as a group what their prize giving item should be;
- problem solved around the prize giving item;
- shared solutions to prize giving problems and debated which would work best.

When we start a new topic, my GKP teacher finds out what I already know about it.

- self-evaluated against Gardiner's Multiple Intelligences;
- identified strengths in critical, caring, and creative thinking;
- self-evaluated use of ICT, Thinkers' Keys, and Habits of Mind;
- whole-class brainstorm on what they already knew about preserving food;
- used Inspiration to brainstorm all that they know about their self-selected research topics (some groups just did this orally);
- cross checked content of brainstorms with known/unknown questions to make sure there were no overlaps;
- orally shared with the class what they knew about conventions of poetry;

- made connections between the content of a poem and their own experiences;
- orally checked out prior knowledge before a French lesson;
- found out what the students had done when I had been away for a day;
- discussed what to expect of EOTC trip before going, in an attempt to identify the students' areas of strength.

My GKP teacher encourages me to be curious and ask questions.

- recorded known/unknown questions in ignorance logs;
- asked questions about different food-preservation methods;
- asked questions of each other about their food preservation presentations;
- recorded known/unknown questions about food preservation in ignorance logs and charted on wall;
- asked questions related to modifying stained glass windows;
- explored the difference between closed and open questions.

Note: in all cases, students were also encouraged and/or helped to find answers to their questions.

At GKP, I learn about how to learn and how to make my learning better.

- identified characteristics of individual learning styles through Gardner's Multiple Intelligence self-evaluations;
- listed "must dos" for remainder of term;
- identified tasks that are date dependent, prioritized, and charted a calendar for the remainder of the term;
- modelled how to plan a research project which is based on known/unknown questions and aligned with the curriculum;
- used a "think aloud" strategy to show students how to tie their research project back to the curriculum documents;
- discussed things that support and/or affect learning and identified positive influences.

It is evident that an attempt was made to find various ways to implement each of the four focus strategies across different curriculum areas. In some cases, a strategy would be implemented one day, and then built on the next, so that

students could use prior learning as a foundation for taking their learning further.

4.5 Links Between Questionnaires and Research Diary

By cross-referencing the questionnaire responses and the research diary, parallels could be drawn, however the relationship between the two was not as obvious as had been expected.

4.5.1 Pre-intervention Questionnaire

One of the purposes of analyzing the students' open-ended responses to all of the questions in the pre-intervention questionnaire, was to identify things that the students responded to that could be used to improve the use of the four focus strategies. By comparing this analysis with the research diary, it should be possible to see if this information was reflected in the teacher/researcher's teaching.

The questionnaire analysis revealed that the students responded to clear instructions that related to where they were at in their learning. This is difficult to identify from the above list due to its summarized nature. The teacher attempted to make the purpose of lessons explicit and to give clear instructions that the students could relate to their learning needs. The fact that all of the focus strategies were implemented over several days demonstrates that new learning was built on the teacher's understanding of what the students had gained from previous lessons.

The questionnaire analysis also revealed that the students valued two-way communication for sharing their understanding or points of view, listening to others, and asking questions. Particularly when learning about real-world topics and solving real-world problems, the students often worked in discussion groups. They would share their ideas in a small group, and then report their findings back to the class and the teacher. Sometimes, these discussions involved debate in which the students could present their knowledge and points of view, and were also required to listen to others. The research diary information related to being curious and asking questions, reveals that the students were

given many opportunities to ask questions of themselves, of others, and of their teacher.

Another common thread in the open-ended responses from the pre-intervention questionnaire was in relation to receiving written feedback. As this is quite specific, yet was not one of the four focus strategies, it is not reflected in the research diary, however, responses to "My teacher talks to me and gives me written feedback about my learning and how to make it better" in the post-intervention questionnaire indicate that the teacher continued to provide written feedback as well as one-on-one conferences.

4.5.2 Post-intervention Questionnaire

It was predicted that the descriptions in the research diary about the teacher/researcher's implementation of the four focus strategies would be reflected in the students' open-ended responses to these strategies in the post-intervention questionnaire, however the links are tenuous. The students' comments do appear to be in line with the research diary, however they only touch on a small amount of what is recorded in the diary. The links for each strategy are discussed below.

At GKP, we learn about real world topics and I have opportunities to solve real world problems.

The students did comment on the study of problems in the media which is strongly reflected in the research diary, however the teacher/researcher also reported on problem solving in relation to making stained glass windows and organizing a prize-giving item. Neither of these was commented on by the students.

When we start a new topic, my GKP teacher finds out what I already know about it.

The students commented on doing this as a class, and taking a test. The research diary corroborated finding out what the students know as a whole class activity, however did not comment on administering any pre-tests. The diary

also detailed various self-evaluation exercises and brainstorming as ways that prior knowledge was sought.

My GKP teacher encourages me to be curious and ask questions.

The two student comments related to this strategy were both about ignorance logging. This is reflected in the research diary in relation to general questions and questions related to food preservation. The teacher/researcher also reported on oral questioning of themselves and each other, asking questions when problem solving on their stained glass window study, and exploring open and closed questions.

At GKP, I learn about how to learn and how to make my learning better.

Students commented on teacher feedback and the use of De Bono's blue thinking hat. Because the teacher and students' interpretation of this strategy had been different, it was not surprising that the students' responses and the research diary bore little resemblance. The teacher reported on organizing learning time and tasks, planning for research, and identifying supports and challenges for learning. None of these were evident in the students' comments.

4.6 Links Between Formal Tests and Questionnaires

The key expected outcome of this action research project was to improve the depth of participating students' learning, and it was expected that this would be reflected in the formal test results. To influence the depth of her students' learning, the teacher/researcher set out to improve her own teaching. So, theoretically, it was expected that an analysis of trends in comparative data from the pre- and post-intervention questionnaires (related to her teaching) and trends in comparative data from the pre- and post-intervention formal tests (related to their learning) would be similar. In turn, this analysis was expected to show a relationship between change in the teachers' use of the focus strategies (and thus a change in the quality of her teaching), and change in the students' learning, by the end of the intervention.

As shown in Chart 4.1 (page 64), a comparison of pre- and post-intervention data from the formal tests is inconclusive. Students' mean scores

improved by a minimal amount in social studies, improved more convincingly in reading, but declined in maths. Chart 4.2 and Table 4.6 (on pages 76 and 77 respectively) show that little change was recorded in the frequency of the teachers' use of the four focus strategies, implying that in relation to these strategies, there was no change in the quality of her teaching. Although this result seems logical, it is not what was desired or expected.

4.7 Conclusion

This study explores both the notion of measuring and influencing the depth of students' learning, and improving the quality of teaching in relation to developing students' abilities to think deeply. In relation to these two themes, the following conclusions can be drawn from the results:

Measuring and influencing the depth of students' learning

- Results from both the pre and post-intervention tests showed that most students were operating at either the unistructural or multistructural levels, both of which fall into the Quantitative Phase of the SOLO Taxonomy (Biggs & Collis, 1982).
- There was some improvement in the depth of the students' learning over the intervention period, as measured using the formal tests, but the improvement was not as consistent or convincing as was hoped for.

Improving the quality of teaching

- Questionnaire results for the pre-intervention questionnaire allowed the teacher/researcher to identify the following strategies, which required improvement: At GKP, we learn about real world topics and I have opportunities to solve real world problems; When we start a new topic, my GKP teacher finds out what I already know about it; My GKP teacher encourages me to be curious and ask questions; and At GKP, I learn about how to learn and how to make my learning better. These formed the focus of the intervention.

- The post-intervention questionnaire data showed some increase in the frequency of use of these strategies, while maintaining the standard of use of the other strategies too.

Relationships between these results and themes and existing literature are discussed in the following chapter.

Chapter Five: Discussion

5.1 Introduction

This chapter discusses and interprets the findings from this action research project. It explores trends that have emerged from the findings and discusses these trends in relation to existing literature. A lack of existing research around the depth of students' learning in the field of gifted education was noted in the literature review and has become more apparent in writing this chapter. This, on the one hand, makes it difficult to corroborate or dispute the findings of the present study, but, on the other hand, demonstrates a need for more research in this area and indicates that the present study is in some way unique.

The chapter first discusses the two emerging themes:

- Measuring and influencing the depth of students' learning: This section focuses on how the results from the present study align with the findings of other studies that have explored in-depth learning;
- Improving the quality of teaching: This section focuses on the suitability of the chosen intervention for encouraging in-depth learning. It discusses elements of the teacher/researcher's professional learning that may have affected the design of the intervention and, in turn, the results of the study.

A discussion around the research questions on which this study was based, the implications of this study, and possible areas for a further action research cycle are introduced in the final chapter.

5.2 Measuring and Influencing the Depth of Students' Learning

5.2.1 Introduction

In the results of the present study, the following key ideas related to measuring and influencing the depth of students' learning arose:

- Most students were operating in the Quantitative Phase of the SOLO Taxonomy (Biggs & Collis, 1982); and

- There was a minimal amount of improvement in the depth of students' learning over the intervention period.

The discussion that follows examines these key ideas in relation to literature both in the fields of gifted education and deep approaches to learning.

5.2.2 Depth of Students' Learning

The literature stresses the need to teach gifted students how to think and suggests that an effective programme for gifted students will promote more in-depth learning (Bachor & Hattie, in review; Van Tassel Baska, 1994). This having been said, a review of the literature revealed a lack of research on gifted programmes that focus on deep understanding and little evidence of teachers' measuring the depth of gifted students' learning or identifying the approach (surface, achieving, or deep) that students' apply to their learning.

Results from both the pre- and post-intervention tests showed that most students were operating at either the unistructural or multistructural levels of the SOLO Taxonomy (Biggs & Collis, 1982). These levels fall into the Quantitative Phase, which measures the amount of detail in a student's response. They fall short of the Qualitative Phase (the relational and extended abstract levels) in which the degree of complexity of an answer increases and students are said to be exhibiting in-depth learning (Hattie & Purdie, 1998; Biggs & Moore, 1993). These findings signaled to the teacher/researcher that, in general, her students were not demonstrating in-depth understanding, even after the intervention. This led her to query whether her expectations of her students were realistic and whether the results from the present study fall in line with achievement levels as reported in existing studies.

Research conducted by Collis and Davey (1986) tested 11–12 and 13–14 year old students to find out realistic levels of the SOLO Taxonomy which students of these ages could be expected to be operating at. The study involved learning experiences related to science. Overall, the most common level of responding for 11–12 year olds was unistructural and for 13–14 year olds was multistructural. In a conclusion of Collis and Davey's research, Biggs and Moore (1993) suggest that the relational level (one up from multistructural) is typically reached well after primary school. An 11–12 year old student would not be

expected to go beyond multistructural responses, although they state that some students might do so. Biggs and Collis (1982), the authors of the SOLO Taxonomy, state "in most content areas, for most students at [an elementary] level of schooling , multistructural responses may be considered adequate since they indicate the concrete understanding of a few basic concepts" (p. 164). The students in the present study were aged between eight and eleven years. One might deduce that the sample group in the present study showed higher achievement levels than the aforementioned recommendations. However, all of the students in the present study had been identified as gifted, so therefore could have the potential to outperform their same age peers (Ministry of Education, 2000). Out of a total of seventy eight testlet answers assessed, fifty four were at either a multistructural level or higher. This would indicate that the gifted students in this study did display a higher level of in-depth learning than what is stated in the literature as a realistic expectation for regular learners.

5.2.3 Change in Depth of Students' Learning

Literature on students' approaches to learning suggests that students who use a deep approach are more likely to produce learning outcomes that demonstrate more in-depth understanding than students who use surface or achieving approaches (Ramsden, 1992; Biggs, 1991; Prosser & Trigwell, 1999; Marton & Saljo, 1997). Prosser & Trigwell (1999) found that teachers who encouraged and supported their students to use a deep approach to learning, achieved higher learning outcomes from their students.

Based on this theory, the teacher/researcher identified sixteen strategies that support students in using a deep approach to learning. (A list of the strategies can be found in Appendix G.) With emphasis on four particular strategies, but still with the others in mind, the intervention was designed to improve the teacher/researcher's teaching so that she encouraged more of her students to use a deep approach to their learning, more often.

In theory, if the intervention had worked, and students were applying a deep approach to their learning more often, post-intervention test results would have shown improvement. However, the findings of the present study were not consistent with Prosser and Trigwell's findings (1999). When comparing the pre-

intervention and post-intervention results, the change in the overall depth of the students' learning was inconsistent and not always positive. This could indicate a number of things, therefore it was important not to jump to conclusions, before further analysis and discussion.

This lack of improvement could signify that, although the effort was made, there was not enough improvement in the quality of teaching to encourage deeper learning, therefore the students' approaches to learning, and subsequently their learning outcomes, were not influenced in a positive way.

A further review of literature around elements necessary for effective professional learning for teachers, indicated that there was room for improvement in the design and implementation of the action research process. This is discussed in more detail later in this chapter, beginning on page 99.

Results from the questionnaire, which was used to get student feedback on the teacher's use of the sixteen identified strategies, showed that, according to the students, there was actually little room for improvement in her teaching, so any change could be too subtle to be reflected in results from such a small sample size. In both the pre-intervention and post-intervention results, around eighty five percent of the responses indicated that the teacher/researcher "sometimes" or "always" demonstrated the strategies outlined in the questionnaire. So, according to the students' perceptions, the teacher applied strategies that encourage students to use deep approaches to learning. The fact that 85% of responses to the pre-intervention survey rated the teacher highly, indicates that there was limited room for improvement in her teaching (as perceived by the students and in relation to these strategies only). This could go some way to explaining the lack of improvement in the students' test results, although, due to the small sample size, it is important not to over-generalize.

5.2.4 Depth of Students' Learning by Curriculum Area

An interesting outcome from measuring the depth of students' learning in three different curriculum areas was the varying levels of in-depth understanding. The mean scores by curriculum area from the pre-intervention test (reading 2.23, social studies 2.92, and maths 3.54) align with Biggs and Moore's (1993) findings that students may demonstrate more in-depth learning

in mathematics than in other curriculum areas. However, this pattern does not carry over to the post-intervention test results, which indicated an equal mean score for maths, social studies, and reading (3.00). A comparison of pre- and post-intervention results could indicate that the depth of students' learning in social studies remained relatively unchanged, decreased in maths, and improved in reading. However, this appears to be a very simplistic interpretation, and with a small sample size and such little change in the mean scores, may be reading too much into the results.

The decline in mean scores for maths was a little alarming, however, this could be a reflection of more difficult content in the post-intervention maths testlet than the pre-intervention testlet. The teacher/researcher had been careful to avoid such a situation, following recommendations by the authors of the SOLO Taxonomy (Biggs & Collis, 1982) when devising the testlets. A conclusion to this suspicion would require further investigation of the pre- and post-intervention testlets by an assessor other than the teacher/researcher herself. This would be a necessary requirement before using the testlets again.

The overall lowest mean score (2.23=low unistructural) was in the pre-intervention reading testlet. The researcher has been unable to locate any literature that discusses the likelihood of reading results being lower than other curriculum areas. However, Biggs and Collis (1982), who have themselves conducted tests which require students to respond to poetry, as was the case in the present study, note that this kind of response is prone to "affective involvement" (p.103). That is, a student may present a prestructural or unistructural response to a poem that they are not interested in, but could then turn around and deliver an extended abstract response to a poem that they like. Biggs and Collis go on to say, that the same "affective involvement" may be a barrier to students achieving understanding at a relational or extended abstract level, that they can be taught more about the poem but that an affective response needs to come from within, and cannot necessarily be taught. However, research in the area of gifted education could lead one to believe that this is not relevant to gifted learners. Silverman (1993) argues:

> "Giftedness has an emotional as well as a cognitive substructure: cognitive complexity gives rise to emotional depth. Gifted children not only *think* differently from their peers, they also *feel* differently." (p. 3)

In support of Silverman, a list of affective characteristics of gifted students by Moltzen (1996[2]) includes "emotional sensitivity", "advanced sense of humour", "advanced moral reasoning", "empathy", and "an interest in social issues", all of which would help a student to better appreciate a poem and therefore possibly produce an in-depth response to it.

A further review of the literature did not reveal any research on the use of SOLO in social studies that could corroborate or dispute the findings in this study, however the fact that the improvement was so slight (from a mean score of 2.92 to 3.00), could indicate that the teacher had very little success in influencing the depth of her students' learning in this area.

5.2.5 "Plus One" Strategy

The teacher/researcher had some success in implementing the "plus one" strategy. Four out of twelve students' mean scores demonstrated an improvement of one SOLO Taxonomy level, which is the goal of "plus one". (The total of twelve students discounts the two students who only sat one test.) The SOLO authors (Biggs and Collis, 1982) recommend that, to achieve "plus one", the teacher should first identify what level students are working at on a particular topic, then pitch instruction at one level higher. If instruction is not pitched at an appropriate level, the students' learning outcomes may not be optimal.

> "If [instruction] is pitched at the same level, or lower, then the student would not be learning to handle a more complex structure, and if it is higher than one level, the student may not be able to comprehend the point being made." (Biggs & Collis, 1982, p. 172)

Due to the requirement to use unique identifiers rather than students' names (therefore keeping students' identity anonymous), the teacher/researcher

could not know which individual students were performing at which levels. This meant she could not devise instruction to meet their individual learning needs.

The teacher/researcher did note that twenty out of the total thirty-nine results from the pre-intervention test were at the multistructural level of the SOLO Taxonomy. This is on the cusp of the Quantitative and Qualitative phases. (See page 30 in the Literature Review for further explanation.) Of these twenty responses, eight moved to relational or extended abstract in the post-intervention results. Some thought has gone into whether or not this might be a more difficult transition for students to make than transitions between other SOLO levels, such as from unistructural to multistructural where the students only need to know more of the same. However, the researcher did not find any literature to back up this theory. Collis and Biggs (1991) say that the transition to multistructural involves the following:

> "... understanding or integration of what is known into a coherent system wherein the parts are inter-related. This inter-relation comes about as a result of an ability to form an overviewing principle which can be derived from the information given." (p. 196)

This does appear to be a difficult transition for 8–11 year olds to make, however, more research would be necessary before concluding that this is why several students did not proceed from multistructural to relational.

5.2.6 Conclusion

This section has highlighted the fact that, although the literature calls for in-depth learning in gifted programmes, there is very little evidence of this. The present study has had some success in measuring and improving the depth of gifted students' learning, however the measured improvement was minimal.

In conclusion, several parallels can be drawn between the results from the present study and other research that has used SOLO to measure the depth of students' learning. Although limited improvement was noted in the present study, it appears that this could be a result of the students' ages, how the

intervention was designed and implemented, and the short time period over which it was conducted. This section has also discussed the special nature of gifted students, concluding that the students in the present study performed better than regular students in other studies, but that due to their gifted abilities, this was a logical outcome.

5.3 Improving the Quality of Teaching

5.3.1 Introduction

As highlighted in the conclusion of the results chapter (page 83), improving the quality of teaching is an emerging theme in this research. The following key ideas, evident in the results, contribute to this theme:

- Of the sixteen strategies identified that encourage in-depth learning, the following four required improvement: At GKP, we learn about real-world topics and I have opportunities to solve real-world problems; When we start a new topic, my GKP teacher finds out what I already know about it; My GKP teacher encourages me to be curious and ask questions; and At GKP, I learn about how to learn and how to make my learning better; and
- There was some increase in the frequency of use of these focus strategies and the standard of use of the other strategies was also maintained.

The following discussion looks at these key ideas in relation to existing literature. This section also discusses the strengths and weaknesses of the design and implementation of the action research project in relation to recommendations for quality teacher learning. Incidentally, parallels between recommendations for ways to teach in-depth learning and recommendations for ways to teach gifted students also became apparent and are discussed in this section.

5.3.2 Focus Strategies for Intervention

Having isolated four strategies that were in need of improvement, it was then necessary to think about how these strategies contributed to deeper learning and to find ways to implement them. The following section discusses

the theory that underpins each of the focus strategies and aligns this with the action taken in the present study.

At GKP, we learn about real-world topics and have opportunities to solve real-world problems.

The focus on real-world topics and problems in the present study follows recommendations from Biggs (1999) who has found that learning based on real-world problems or topics, requires students to question, speculate, and to generate solutions. All of these behaviours are also akin to the use of a deep approach to learning.

The notion of real-world topics and problems can be interpreted in many different ways. To provide her students with opportunities to investigate real-world topics and solve real-world problems, it was necessary for the teacher/researcher to define this concept.

Seaman (2003) provides examples of real-world topics and problems that are current or historic events which may or may not be of particular importance to the students but give them real situations to apply skills that they have learnt. One of Seaman's examples of real-world problem solving is to have students calculate the earnings-per-second for Michael Spinks and Mike Tyson in their showdown for the heavyweight-boxing crown. Although it is a real-world event, the students may have no prior knowledge of or interest in it. As these are also prerequisites for learning opportunities that will foster deeper learning (Biggs & Moore, 1993), the teacher/researcher felt that this type of real-world topic would not be appropriate for this study.

Research conducted by Boullion and Gomez (2001) looked at the impact of a focus on real-world problems coupled with school-community partnerships in a science context. They define real-world problems as being "current, unsolved, and of consequence" and see them as a way of providing "meaningful and intellectually challenging" learning opportunities (p. 879). Their study involved two fifth-grade (Year 6) classes researching environmental problems and helping with a clean up in a particular stretch of the Chicago River, which was close to their school. The nature of such a study not only aligns with many of the other recommendations for nurturing deeper learning, such as an integrated

curriculum and learning experiences that lever off intrinsic motivation (Biggs, 1987), but it also aligns with many features of good learning for gifted students which include open-ended learning experiences (Maker, 1982) and the study of themes (in this case, conservation) within which students can choose sub-topics to study at a more in-depth level (Roberts & Roberts, 2001).

The teacher/researcher in the present study, believes that this would be the best kind of real-world topic or problem to foster deeper thinking skills with gifted students, however this is an approach that can take several weeks or terms in a five-day-a-week setting. It would be particularly difficult to implement in GKP's one-day-school model. (The limitations of a one-day-school model, in relation to this action research project, are discussed later in this chapter on page 102).

In an article entitled "Letting Children Take the Lead in Class", Andrede and Hakim (1995) write about either bringing real-world topics and problems into the class for the students to study and solve or helping the students to study and solve real-world problems that arise within the classroom itself. Features of Andrede and Hakim's work that are relevant to teaching for deeper understanding include students finding real-world problems and taking responsibility for them , students working in small groups to discuss and solve problems, and students having ample time to work through problems and come to logical conclusions.

Of the three approaches to teaching real-world topics and problems discussed here, the real-world learning that occurred in the present study, most closely aligns with the work of Andrede and Hakim (1995). In some cases the teacher brought real-world learning opportunities into the class, for example "Hot Off the Press" lessons, and in other cases students were involved in real-world problem solving in relation to their learning, such as making stained glass windows and preparing their prize-giving item. The teacher/researcher recognise s the value of this type of learning but also sees that learning experiences such as those reported by Boullion and Gomez (2001) could be another powerful way to implement this strategy.

My GKP teacher encourages me to be curious and ask questions.

Of the four strategies, this was the one in which the students' feedback showed the most positive improvement in their teacher's work and produced the closest relationship between the students' open-ended questionnaire responses and the research diary. In the post-intervention questionnaire, eleven out of thirteen students reported that their teacher used this strategy "sometimes" or "often" and the use of known/unknown questions and ignorance logs, which stem from the work of Marlys Witte (2002), were dominant comments in their open-ended responses. Most of the teacher/researcher's comments in the research diary were also around these two tools.

The value of a focus on questioning and curiosity is well documented in the literature. In the gifted arena, questioning is seen as a key stimulus for curiosity and creativity (Daniels, 1997). Jamie McKenzie (2003) refers to questions as "the most powerful tools we have for making decisions and solving problems – for inventing, changing, and improving our lives as well as the lives of others" (p. 2). His view is supported by the work of Biggs (1999) and Ramsden (1988), both of whom relate questioning or curiosity to a deep approach to learning. Biggs (1999) states: "when using the deep approach ... students come with questions they want answered" (p. 16). This was the catalyst for including this strategy in the student questionnaire. Ramsden's (1988) view focuses on making learning meaningful:

> "If teaching does not encourage students' curiosity and does not allow for these processes, we should not be shocked if students display a desperate desire to memorize authoritative statements, nor if they develop a view of science or literature as an inexplicable mystery irrelevant to everyday concerns." (p. 26)

It was this work of Ramsden's that led the teacher/researcher to approach this strategy in the way that she did. The use of "ignorance logging" and asking "known/unknown" questions both support students in only asking questions that they do not already know the answers to, and asking questions about topics that they are genuinely interested in and therefore want to find answers for. This

approach gives the students intrinsic motivation and ownership of their learning, both of which are strategies recommended for encouraging deep learning (Biggs, 1987). The teacher/researcher also placed emphasis on and provided time for students to find the answers to their questions. This approach is supported by Biggs's (1991) view that one aim of encouraging deep learning is to "maximize understanding so that curiosity is satisfied" (p. 18). Had students been encouraged to be curious and ask questions but not had opportunities to find answers to their questions, their curiosity would not have been satisfied and the question-asking process would have been pointless. The positive feedback from students on the post-intervention questionnaire goes some way to supporting this approach to encourage students to be curious and ask questions.

When we start a new topic, my GKP teacher finds out what I already know about it.

This strategy is intrinsically tied up with another strategy in this study: "At GKP, we study topics that I already know a little bit about". Biggs discusses the need to study topics that students have some prior knowledge of (1999) when encouraging a deep learning approach. He explains that a student with limited prior knowledge of a topic is unlikely to use a deep approach but that a student who has a fair amount of prior knowledge and is very interested in the topic has essential prerequisites for deep learning (1999).

The distinction between students having prior knowledge and teachers eliciting it may seem subtle, but it is important.

> "If teachers don't know what the students already know, how can they arrange appropriate encounters? If they do not make use of what students already know, are they not discarding a most useful resource?" (Ramsden, 1988, p. 22)

Because of the close relationship between these two strategies, the teacher/researcher was somewhat surprised to see that their mean scores were quite different in the pre-intervention questionnaire – 3.00 for students having prior knowledge, and 2.69 for the teacher eliciting the prior knowledge. Only

two of the thirteen students who completed the questionnaire gave the same response for these two questions, which could indicate that the subtle distinction between them was not lost on the sample group.

This result accentuated the need to focus on eliciting prior knowledge, which is supported in the literature. Ramsden (1988) recommends that teachers use diagnostic procedures to monitor student learning and to find out what they know about a topic. Prosser and Trigwell (1999) stress the need to not only find out about students' prior knowledge and experiences in relation to lesson-content, but also to try to gain an understanding of students' perceptions of their learning situation.

The research diary includes references to diagnostic testing prior to beginning both new topics and particular lessons, as well as several self-assessment tasks based on how students see themselves as learners, for example, a self-evaluation against Gardiner's Multiple Intelligences and self-identification of strengths in critical, caring, and creative thinking. At first, the teacher/researcher was unsure as to whether these self-assessments could be classed as eliciting prior knowledge, but on reading Prosser and Trigwell's (1999) recommendations, it seemed appropriate. It gave her an insight into the skills and strengths that the students saw that they brought to different learning situations.

Ramsden (1988) recommends both asking questions in class and more formal assessment procedures as suitable means of eliciting prior knowledge. The research diary and students' open-ended responses suggest that a stronger emphasis was placed on informal approaches to eliciting prior knowledge than formal test procedures. Due to time restrictions brought about by a one-day-school-model, this was a conscious action on the part of the teacher/researcher. She recognise s that, under other circumstances, a more balanced approach may have had a greater impact on student learning.

In the post-intervention results, the mean score for students *having* prior knowledge remained at 3.00 and the mean score for *eliciting* prior knowledge increased to 2.92. Six out of thirteen students gave the same response for the two strategies. This could indicate that the teacher had some success in tapping

into the students' prior knowledge more successfully by the end of the intervention period.

At GKP, I learn about how to learn and how to make my learning better.

Metacognition is recognised as a necessary prerequisite to using a deep approach to learning (Biggs, 1987). It is also seen as a key characteristic of gifted students (Cheng, 1993) and a skill-set to focus on in gifted programmes (Renzulli, 1977).

As previously mentioned, this strategy was referring to the students' use of metacognition, however, students' open-ended responses indicated that the strategy was misinterpreted. Therefore, the results from the questionnaire should be discussed with some caution. Blakey and Spence (1990) define metacognition as "thinking about thinking" or "knowing what we know and what we don't" (p. 1). Georghiades (2004) uses the phrase "thinking about one's thinking" (p. 1) to describe metacognition, but then later in his study he refers to students' having the ability to "learn how to learn" (p. 366). This latter example aligns with the phrasing used in the students' questionnaire. The teacher/researcher had used this phrase as she felt it was the easiest way to define metacognition for her students, but their open-ended responses showed that the students had associated it with receiving feedback about what they needed to improve in their work, rather than understanding the processes that they use to think and learn.

Although, due to this misinterpretation, the questionnaire results for this strategy are somewhat unreliable, a review of the literature around how to teach metacognition bears a positive relationship with teaching methods used by the teacher/researcher in the present study. Blakey and Spence (1990) recommend six approaches to teaching metacognition. Table 5.1 aligns these approaches with learning experiences that are either reported in the students' open-ended responses to the questionnaires or in the research diary.

Blakey and Spence (1990) Recommendation	**Evidence in Present Study**
1. Identifying "what you know" and "what you don't know"	• Eliciting prior knowledge before beginning new topics • Asking known/unknown questions and ignorance logging • Choosing individual research topics
2. Talking about thinking	• Teacher using think-aloud strategy when showing students how to plan using the curriculum documents
3. Keeping a thinking journal	(Not used in this study.)
4. Planning and self-regulation	• Planning individual research projects • Discussing priorities for the term and how best to manage time in class
5. Debriefing the thinking process	(Not used in this study.)
6. Self-evaluation	• Self-evaluation related to Gardner's Multiple Intelligences and students' use of ICT, Thinkers' Keys, and Habits of Mind, and identifying strengths in critical, caring, and creative thinking

Table 5.1: Approaches to Teaching Metacognition

The usefulness of this analysis is twofold. It clearly shows that the teacher did provide the students with learning opportunities that involved metacognition, even though this may not have been evident in the questionnaire results for that particular strategy. It also clearly identifies areas for future improvement – having students keep a thinking journal and debriefing the thinking process with students.

5.3.3 Elements of Effective Teacher-learning Processes

It appears evident that an effort was made to plan and implement an intervention that would have a positive impact on students' engagement in in-depth learning, however the results do not provide conclusive evidence of any increase. To gain a better understanding of why the present study did not produce the desired results in terms of improving the depth of students' learning, it became necessary to step back from the focus on teaching for in-depth learning, and to look at the elements that need to be present in teacher learning to improve teaching to the point where it will have a positive impact on student learning.

Birman, Desimone, Porter, and Garet (2000) suggest that to bring about effective change in teachers' practice, the following six elements need to be considered:

Form – The teacher-learning process should be a 'reform' activity, which focuses on where the teacher is currently at and aims to move them forward. Examples of 'reform' activities include study groups, teacher networks, mentoring relationships, or individual research projects. It does not include attendance at one-off workshops or conferences. As an individual action research project, the present study is a 'reform' activity, however the lack of collegial support, which is a characteristic of all of the other examples listed above, is noted. This is discussed later in this section.

Duration – this condition refers to both the length of time over which the teacher-learning process was spread, *and* the amount of hours that were spent. Birman, et al. (2000) recommend that a project such as the present study should be conducted over a full year. They claim that the longer the time, the better quality and more sustainable the change in both quality of teaching and improved learning outcomes for students. Robertson and Allan (1999) reiterate Birman, et al.'s recommendation and add that, although a lengthier period of time is desirable, a time limitation or schedule can also provide enough pressure for teacher-learners to be accountable to results. As iterated earlier, the teacher/researcher was aware that inadequate time may be a mitigating factor which influenced the results of the present study. As the literature indicates, it seems unrealistic to expect a remarkable amount of change in ten weeks of a one-

day school programme. This should be addressed in any continuation of this action research project.

Participation – Teacher learning is more likely to have a positive impact on students' learning outcomes, when the teacher has been learning alongside colleagues or has had a 'knowledgeable other' to guide proceedings. Robertson and Allan (1999) note the following advantages of collegial teacher learning: opportunities for critical reflection, exposure to new skills and knowledge, reflective discussions that challenge values and beliefs, and support and encouragement from other learners. Moffett (2000) states that "more than almost any other factor, the sense of a professional community in schools enhances student achievement" (p. 36). There was a notable absence of collegial support in the present study. Although the teacher/researcher received encouragement from her colleagues and supervisors, she did not have anybody to learn alongside or to learn from. Nobody questioned her teaching methods or directed her to information that would help frame her actions. More support in this area could have had an influence on the content of the intervention.

Content focus – Quality teacher learning should involve improving teachers' content knowledge. This should target a specific subject area or a subject-specific teaching method. Teacher learning should be planned and should require teachers to think deeply about why they work in the way they do and how their actions impact on student learning outcomes. This was evident in the present study to a certain degree, but there are some areas of particular weakness. The teacher/researcher had undertaken an extensive literature review, informing her about approaches to learning, strategies for encouraging students to engage in a deep approach to learning, how these two areas are relevant in gifted education, and ways to measure the depth of students' learning. However, once the four weakest strategies had been identified and become the focus for the intervention, a more intensive literature review should have been carried out to find the best ways to implement these strategies. Some information was used, but her actions were not soundly informed by 'best practice'. Part of the reason for this was that each of the focuses was a huge field in itself, so given the limited amount of time, an extensive literature review on each of the strategies became unrealistic. Therefore, the intervention, on the

most part, was informed by the teacher/researcher's prior knowledge and a limited amount of research on how best to implement the strategies. A stronger content-focus could have led to a better informed and more robust intervention.

Active learning – Teachers need to be actively engaged in the analysis of teaching and learning, such as reviewing students' work or receiving feedback from other teachers, and in applying new skills that they have learnt. Stigler and Hiebert (1999) recommend that teachers analyse both their own teaching practice and the practice of others. They need to be exposed to alternative ways of teaching so that they know what else to do when elements of their teaching prove ineffective or when they receive negative judgment from a 'knowledgeable other'. There was a great deal of active learning in the present study in terms of the teacher/researcher looking critically at her teaching practice, looking critically at the learning outcomes of her students, and seeking information about how to improve both her practice and students' learning outcomes. Had this been taken further to include feedback from colleagues or a 'knowledgeable other' and had the intervention been better informed, active learning may have been even more prevalent.

Coherence – Effective teacher learning should bear some relation to knowledge and experiences that the teacher brings to the learning situation, reflect a need that she/he sees as relevant for the present time and into the future, and take into account other expectations that the teacher is subject to. As the present study was designed around a concern that the teacher/researcher had and saw as highly important, there was a great deal of coherence in the present study. However, because the research was carried out in isolation from colleagues, the teacher/researcher had to maintain a focus on the aims of her action research project as well as take part in professional learning as deemed important by GKP. Although GKP valued and supported the action research project, there was no immediate coherence between the action research focus and the GKP professional learning focus.

As the above analysis shows, there were many good qualities in the present study in terms of its value as a vehicle for teacher learning, however there were also some areas in which the design and implementation of the

intervention could have been improved, which may have resulted in a more positive influence on student learning outcomes.

5.3.4 One-day School Model

As previously mentioned, this study was conducted in a one-day school, that is, a school that the students only attend one day per week. A one-day school is an example of a pullout programme designed to provide gifted and talented students with opportunities to interact with like-minded peers in an emotionally safe and intellectually challenging learning environment (Riley, Bevan-Brown, Bicknell, Carroll-Lind, and Kearney, 2003). Benefits of pullout programmes, such as a one-day school, include improvement in academic achievement, critical and creative thinking, problem solving skills, and motivation to set and pursue goals (Moon & Feldhusen, 1994; Vaughn, Feldhusen, and Asher, 1991, cited in Riley, et al., 2003).

There are a number of disadvantages to one-day-school models. One of the key disadvantages is fragmented instruction (Cox & Daniel, 1984, cited in Riley, et al. 2003). When students and their teacher only meet for one day in seven, it can be challenging to pick up where they last left off and some methods of instruction which require continuity can be inappropriate (Winner,1996). Pullout programmes sometimes lack continuity and do not allow students enough time to engage in in-depth study.

The teacher/researcher found that the one-day school model did hinder the research and placed some limitations on expected outcomes of the study. She and her students experienced frustration from the lack of continuity and time spent each week getting back "up to speed" from the previous week.

5.3.5 Conclusion

This section has highlighted that although a great deal of effort went into the intervention and that it did align with recommendations as to how to teach for deeper learning, the impact that it had on students' learning outcomes was minimal. Therefore, it became necessary to question how the design and implementation of the intervention was informed. The design of the action research model in terms of professional learning for the teacher/researcher was

critiqued in relation to theory in this area. This analysis revealed strengths in terms of a focus on active learning and content but weaknesses in the areas of duration and collegial support. This analysis forms the basis of recommendations for a further cycle in the action research model for this project. The discussion also touched on the fact that the very nature of the one-day school in which the study took place, also bore constraints on the action research project.

5.4 Summary of Discussion

The students in the present study displayed a higher capacity for in-depth learning than that recommended in other studies as realistic for regular learners of the same age. However, the depth in students' learning did not improve a great deal as a result of the intervention, as was expected. It was clear that the selection of strategies to focus on in the intervention were based on sound, theoretical evidence, but closer scrutiny of the teacher/researcher's professional learning in relation to the design and implementation of the intervention highlighted some weaknesses, such as a lack of collegial support and an unrealistic intervention duration. These weaknesses could, to a certain extent, be responsible for the lack of positive impact on the students' learning outcomes in relation to in-depth learning. They could also inform changes for further action research cycles, recommendations for which are discussed on pages 110–111.

The next, and final, chapter of this thesis discusses how this study contributes to the current body of literature around the depth of gifted students' learning. It acknowledges the limitations of this study, aligns the findings with the research questions on which the study was based, and makes recommendations for both further action research cycles and general research related to improving the depth of gifted students' learning.

Chapter Six: Limitations, Implications, and Recommendations

6.1 Introduction

This was a small-scale action research project. It was conducted over a limited duration, with a sample size of fourteen, and in just one field of study. Therefore, implications and recommendations presented in this chapter should be regarded with caution. The present study does contribute new evidence to the wider body of literature on fostering deeper learning with gifted students. However, more large scale investigations are still needed, in particular research that addresses the challenges and limitations of the present study. This chapter aligns the findings with the original research questions, outlines limitations of the present study and takes these into consideration when making recommendations for further action research cycles. This chapter also suggests areas for further research beyond the scope of continuation of this action research project.

6.2 Contribution to Current Body of Literature

A vast body of literature has been reviewed in this study. There is a wide range of literature around in-depth learning. There is also a lot of existing theory about how best to meet the learning needs of gifted students.

In general, the two themes identified in this study, 'Measuring and influencing the depth of students' learning' and 'Improving the quality of teaching', and their related findings, confirm key issues that feature in current research into gifted education and teaching for in-depth learning.

Little evidence was found, in existing literature, of studies that combine the fields of gifted education and in-depth learning. There seems to have been very little exploration into ways to foster deeper learning with gifted students. This would suggest that the present study is somewhat unique. Although the small-scale nature of the study cautions one against generalizing the results, the study demonstrated the following points, which had not been found by the teacher/researcher in a review of related literature:

- The gifted students in the present study produced work at higher SOLO Taxonomy levels than had been found as reasonable for their same-aged peers in another study (Collis & Davey, 1986);
- Using the strategy-based intervention described, the teacher/researcher had limited success improving gifted students learning outcomes in relation to in-depth learning;
- The gifted students in the present study were able to recognise some features of their teachers' approach to teaching that encourage in-depth learning, and could give her feedback on her use of particular strategies.

This research also highlighted many similarities in teaching methods recommended for gifted education and teaching methods recommended for fostering deeper learning. It seems that, in existing literature, little attention has been paid to the relationship between the two fields. This was an incidental finding in the present study, but certainly an area worthy of further pursuit.

6.3 Limitations of the Research

The teacher/researcher recognised a number of limitations in this research. These limitations have placed restrictions on the generalisability of the results beyond the scope of this study. It has also been important to keep these limitations in mind when drawing conclusions from the study, considering the contribution that it has made to research in this area, and making recommendations for future research in this field.

6.3.1 Sample Size

The first limitation relates to the size of the sample. Fourteen students participated in the study, one of whom only participated in the pre-intervention data gathering and one of whom only participated in the post-intervention data gathering. Although the sample size was beyond the teacher/researcher's control, as it was all of the students in her class who had agreed to participate in the research, she recognised that it was too small to draw generalisable conclusions from the study. It made statistical analysis difficult, and meant that although the students' formal tests and questionnaires were to be anonymous, at times the teacher/researcher knew whose work she was reading.

6.3.2 Anonymity

In relation to sample size, the teacher/researcher questioned whether anonymity was the best approach for such a study. Teachers should be aware of students' learning needs and should tailor instruction to meet them, however, gathering work samples under pseudonyms makes it impossible to identify and target individual students' learning needs. What seems to be a *necessary* limitation from a researcher's perspective, appears to be in conflict with recommended teaching practice, and therefore an *unsuitable* limitation from a teacher's perspective.

6.3.3 Open-ended Questionnaire Responses

The use of a questionnaire to gather students' perceptions of the quality of teaching has also raised some issues in this study. In the open-ended response sections of the questionnaires, the students often answered with a curriculum area or a topic of study, which was not helpful in identifying what the teacher actually did that made a difference to their learning. This meant that the students' responses to this component of the questionnaire were varied in their usefulness. Further analysis also revealed that the students' open-ended responses only touched on a small amount of what was recorded in the teacher's research diary.

After considering the underlying concepts of the strategies in the questionnaire further, the teacher/researcher concluded that they were quite complex and that it was ambitious to expect the students to understand the concepts well enough to provide reliable comment. For example, one of the questionnaire items is "At GKP, we learn about real-world topics and have opportunities to solve real-world problems." The students' open-ended responses referred only to looking at real-world problems in media studies. They overlooked problems that they themselves had experienced and found solutions to. In order to overcome this limitation, another data-gathering method could have been used with or instead of the questionnaire. An alternative method may have elicited clearer or more accurate information from the students about the teacher/researcher's use of the focus strategies.

Alternatives could include focus group interviews with students or having a 'knowledgeable other' observe the teacher with a focus on the identified strategies.

6.3.4 Recommended Teacher-learning Processes

The design and implementation of this study did not provide the teacher/researcher with a robust framework within which to conduct an effective intervention around fostering in-depth learning. As discussed in detail in the discussion chapter, there were flaws in the action research design, such as too short a duration over which the study was conducted, a lack of collegial support to aid professional and reflective discussion around the teacher/researcher's teaching, and an inconsistent commitment to existing theory to inform the teacher/researcher's practice. In reflection, it has become clear to the teacher/researcher that some of these limitations could have been overcome and could be addressed in future action research cycles.

6.3.5 Action Research Cycle

The scope of this study was limited to one cycle in the action research model. This cycle enabled the teacher/researcher to begin to understand the complexities of bringing about change in teachers' practice and of fostering in-depth learning. A further cycle was not possible within the constraints of this study, but would clearly be desirable. Suggestions for what data could be collected and what different teaching strategies could occur in subsequent cycles of action research are outlined later in this chapter on pages 110–111.

6.4 Research Questions

The teacher/researcher embarked on this study to improve the depth of learning of the gifted students' in her class. She established the following two questions to guide this research:

- What strategies can be used with gifted students to effectively foster in-depth learning?
- What influence does the implementation of these strategies have on the depth of gifted students' learning?

This section discusses the answers to these questions as they relate to the findings in the present study.

What strategies can be used with gifted students to effectively foster deeper learning?

The answer to this question became evident through the literature review and through the research investigation. The teacher/researcher found an extensive base of theory around students' approaches to learning and the relationship between learning approaches and learning outcomes. A number of theorists recommended ways to encourage students to use a deep approach to learning, and as a result, help students to engage in deeper understanding. From this theory, the teacher/researcher extracted sixteen strategies for encouraging students to engage in in-depth learning and applied them in her teaching. The strategies were:

1. Students studying "big ideas" that they are interested in;
2. Students learning about real-world topics and having opportunities to solve real-world problems;
3. Students studying topics that they already know a little bit about;
4. When starting a new topic, finding out what the students already know about it;
5. Students believing that they will use what they are learning in the future;
6. Students feeling like their teacher cares about them and their learning;
7. Students feeling listened to;
8. Teacher talking to students and giving them written feedback about their learning and how to make it better;
9. Students knowing why they do what they do in class;
10. Students having opportunities to work in small groups with their peers;
11. Students having enough time to think, and to finish things that they've started;
12. Teacher encouraging students to be curious and to ask questions;
13. Students learning about metacognition;
14. Students being relaxed (not anxious);

15. Students wanting to learn for themselves, rather than for rewards or good marks; and
16. Students being responsible for their own learning.

What influence does the implementation of these strategies have on the depth of gifted students' learning?

Finding the answer to this question was an involved process which produced less conclusive results. The teacher/researcher first measured the depth of her students' learning, finding that most often, most students operated at the unistructural or multistrucutral levels of the SOLO Taxonomy. Then, using the sixteen identified strategies, the teacher/research surveyed her class to determine how well they were implemented. The questionnaire highlighted four strategies that needed improvement, so, using this evidence, she made a conscious effort to incorporate them into her teaching over the next school term. She was also cautious to maintain use of the other strategies, too. At the end of this intervention, the depth of students' learning was again tested, and they were surveyed a second time in relation to their teacher's use of strategies that foster in-depth learning. Results from the post-intervention test, which measured the depth of students' learning, showed that, still, most students operated at the unistructural or multistrucutral levels, most of the time. This indicated that the implementation of the identified strategies had limited success in improving the depth of students' learning.

Further discussion around the results, and possible reasons for this, has been centred on both the strategies that were used and the design and implementation of the action research project. The discussion chapter of this thesis explained that the inconclusive results may not be due to inaccurate identification of appropriate teaching methods to encourage deeper learning, but more due to the design and implementation of the intervention itself.

Given that there was *some* change in the depth of students' learning measured in the present study, and that there is strong evidence to indicate that the sixteen identified strategies are key to encouraging in-depth learning, the present research may have gone some way to answering this second question. However, a conclusive answer has not been achieved, and further research is

recommended. This could take the form of further cycles of the present action research project (which overcomes the limitations if the present study) or research in another form.

6.5 Recommendations for Further Research

This study has gone some way to contributing to the body of knowledge that currently exists around fostering in-depth learning with gifted students. It also seems evident, that it has only scratched the surface of a field that has been under-explored and that there is scope for far more extensive research in this area.

6.5.1 Action Research

Further cycles of the present action research project could go some way towards improving the depth of learning of the sample group, and providing further guidance as how to best foster in-depth learning with gifted students. As previously mentioned, to overcome the constraints of this first cycle, a number of changes would need to be made to the design. Also, to make further cycles worthwhile, an extended focus would need to be considered.

Recommendations for further cycles of the action research model as related to the present study include:

- Make it collaborative with other teachers. This could extend the scope of the project from one class to many and encourage collegial learning amongst a group of teachers;
- Have a stronger focus on content-knowledge around encouraging in-depth thinking amongst the group of teachers, so that all action is well informed and moves teachers beyond what they already know;
- Reconsider the use of a questionnaire to gather feedback about quality of teaching. Alternatives could include focus group interviews or teacher-to-teacher observations;
- Explore ways to use the SOLO Taxonomy as a teaching tool as well as an assessment tool;

- Limit the scope of the project to focus on one curriculum area so that targeted teaching strategies can be more specific and their impact more easily measured; and
- Extend the duration of the intervention. Without determining other contributing factors, it is not realistic to be more specific, but the length of time over which the study is conducted should be adequate for change to be brought about and for it to impact on students' learning.

6.5.2 General Research

The present study has touched on a number of interesting areas for further research. These include:

- Further exploration into realistic expectations for the depth of learning demonstrated by gifted students;
- Research that explores the difference between a teachers' influence on the depth of gifted students' learning in a one-day-school model and in a fulltime gifted education programme, or with gifted students in a regular school; and
- Further research into the overlap between teaching methods that are recommended for gifted students and teaching methods that are recommended for fostering in-depth learning. A relationship between the two has been uncovered in the present study but was not explored in detail. Focused research in this area could lead to better meeting the learning needs of gifted students.

6.6 Conclusion

Although only one of the two research questions was answered conclusively, and the study has identified many more areas for exploration, the outcome of this research has still been positive. It may not have achieved what it set out to do, but has resulted in other successes.

> "The single most important determinant of success for a student is the knowledge and skills of that child's teachers" (Goldberg, 2001, p. 689).

As a result of this project, the teacher/researcher is a more informed and reflective practitioner. Despite her lack of success in improving the depth of their learning, she has maintained high expectations of her students, and will continue to look for new ways to improve her teaching and the learning outcomes of the gifted students she teaches.

The research has explored and highlighted significant relationships between ways to teach gifted for maximum effect, and ways to encourage students to use a deep approach to learning. It may act as a springboard for further research in these areas, emphasizing the impact of teachers' actions on the learning outcomes of their students.

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Appendix A: Completed Questionnaire Example

Unique identifier: Mark Date: 9th of September

DEEPER THINKING QUESTIONNAIRE

Circle the word that best represents your feelings about each statement. If you answer "often" or "sometimes" and can think of an example, please write it on the lines below the statement. All of these questions are about GKP, not your regular school.

1. At GKP, we study "big ideas" that I am interested in.

Often (Sometimes) Hardly ever Never

Night of the Notables and Family Treasures.

2. At GKP, we learn about real world topics and I have opportunities to solve real world problems.

Often (Sometimes) Hardly ever Never

When we read about statements in the paper and worked out [illegible]

3. At GKP, we study topics that I already know a little bit about.

Often Sometimes (Hardly ever) Never

We do Chess and most people know things about chess.

4. When we start a new topic, my GKP teacher finds out what I already know about it.

(Often) Sometimes Hardly ever Never

Miss Young asked us what we know about our Family Treasure.

1

Unique identifier: Mark Date: 9th of Septem

5. I believe that I will use what I learn at GKP in the future.

Often (Sometimes) Hardly ever Never

I will use the maths stuff and English stuff we do.

6. I feel like my GKP teacher cares about me and my learning.

(Often) Sometimes Hardly ever Never

She is always helping us when we're stuck like when we do hard English work

7. I feel like my GKP teacher listens to me.

(Often) Sometimes Hardly ever Never

When ever we say something she will always let us say it

8. My GKP teacher talks to me and gives me written feedback about my learning and how to make it better.

(Often) Sometimes Hardly ever Never

For English work she always writes in my book and writes how to make it better

9. I know why we do what we do in class at GKP.

Often (Sometimes) Hardly ever Never

Miss Young explained why we did Night of the Notables and the English work.

2

Unique identifier: Mark Date: 9th of September

10. At GKP, I have opportunities to work in small groups with other students.

Often (Sometimes) Hardly ever Never

When we did the science work on pressing food.

11. At GKP, I have enough time to think, and to finish things that I've started.

Often (Sometimes) Hardly ever Never

Miss Young always gave us heaps of time to finish NON

12. My GKP teacher encourages me to be curious and ask questions.

Often (Sometimes) Hardly ever Never

She asked us to ask questions with the thinking Hats

13. At GKP, I learn about how to learn and how to make my learning better.

Often (Sometimes) Hardly ever Never

With De Bono's Thinking Hats she always asks us to use them

14. I'm relaxed at GKP. (Not anxious.)

Often (Sometimes) Hardly ever Never

I was anxious about NON but nothing else

Unique identifier: Mark Date: 9th of September

15. At GKP, I want to learn for myself. (Not for rewards or good marks.)

Often (Sometimes) Hardly ever Never

For maths and stained glass art I wanted to learn how to do it.

16. At GKP, I feel like I'm responsible for my own learning.

(Often) Sometimes Hardly ever Never

I think that if I didn't put in the effort I wouldn't learn as much

Appendix B: Completed Pre-intervention Formal Test Example

Unique identifier:_____ Date:_____

SOCIAL STUDIES

Your answer will be graded on this criteria:

Grade	Stage	The answer:
1	Prestructural	– just repeats the question – is not related to the question – there is no answer
2	Unistructural	– includes one idea that has been learnt in class
3	Multistructural	– includes several ideas that have been learnt in class but doesn't tie the ideas together
4	Relational	– includes several ideas that have been learnt in class and ties the ideas together – may look at two sides of an idea or piece of information
5	Extended Abstract	– includes several ideas that have been learnt in class plus new ideas – ties ideas together in a logical way – may look at two sides of an idea or a piece of information and states a preference for one side or the other based on good reason – may question the question

NOTES:
Background knowledge: The students studied a notable person of their choice in terms 1 and 2 of this year. This study was in preparation for "The Night of the Notables" at which the students hosted an exhibition in which they displayed their work about their notable person and attended in character. The children did a lot of initial work on what a notable person is and learnt more about this as they researched their chosen person. The class also shared a lot of information in discussion and written work so the students know about other notables who they can use as examples.

Administration: The test administrator will discuss the above criteria with the students prior to writing their answer independently. They will not be expected to read and understand the criteria independently. The students will be told that they should write to the best of their ability and that they will be graded on the content of their writing and not on spelling, grammar, or presentation. They will be given 10 minutes to write their answer.

2

Unique identifier: Mespot Date: 9.9.03

SOCIAL STUDIES

How has your notable person made a unique contribution to society?

Write your answer here:

My notable is a brave, peace-loving, Mongolian warlord who led his people kindly in the hostile land of Mongolia. He wrote a fantastic Code of laws that he called the Great Yasa. He cared for his people and always trusted them in battle. The Mongolians still obey the Great Yasa and he is printed on their bank notes.

Unique identifier:_____ Date:_____

MATHS: ALGEBRA

As you answer these questions, remember:
- Letters such as *n* or *q* will always be a whole number.
- Signs such as * or o will always be +, –, X, or ÷
- Make your answers clear and show how you worked them out.
- You may use a calculator but you must still show your working.

Note: you may be penalized if you don't show your working (except for questions 1,2, and 3).

The problems are sorted in the levels of the SOLO Taxonomy. As you work your way through the problems, you will be working your way through the levels of the SOLO Taxonomy.

NOTES:
Background knowledge: The students have been learning about algebraic equations equivalent to questions 1-6. The teacher/researchers expectation is that more capable students will be able to transfer their knowledge to answer the more difficult questions. They have been taught BODMAS and have been shown how to show their working.

Administration: The above instructions will be discussed with the students prior to completing the test independently by the test administrator. They will not be expected to read and understand the instructions independently. The students will be told that the questions get progressively more difficult and that they should attempt as many of the questions as they can. They will be given 15 minutes to complete the test.

Unique identifier: MeSpot Date: 9.9.02

MATHS: ALGEBRA

SOLO Level: Unistructural		
	Question and Working	**Answer**
1.	5 + 4 = ?	9 ✓
2.	If $q = 8 \overset{11}{+} 3$, then q = ?	$q = 11$ ✓
3.	If $7 \overset{-}{*} 5 = 2$, then * = ?	* = − ✓
SOLO Level: Multistructural		
	Question and Working	**Answer**
4.	If $n = (3 \overset{12}{\times} 4) \div 2$, then n = ?	$n = 6$ ✓
5.	If $(5 \overset{+}{*} 3) \overset{+}{*} 6 = 14$, then * = ?	* = + ✓
6.	If $8 \overset{-}{*} 3 = 5 \overset{\times}{o} 1$, then * = ? and o = ?	* = − 1/2 o = × or ÷
SOLO Level: Relational		
	Question and Working	**Answer**
7.	If $(8 \overset{\div}{o} 4) \overset{+}{o} 1 = 12 \overset{-}{*} (6 \overset{\times}{*} 2)$, then o = ? and * = ?	o = + ✓ * = −
8.	$(40 \times 50) \overset{200}{\div} 100 = (40 \times 25) \div 50$ Is this statement true or false?	False ✓
SOLO Level: Extended Abstract		
	Question and Working	**Answer**
9.	If $(a \overset{0+}{*} 4) \overset{+}{*} 3 = 7$, then * = ? and a = ?	a = 0 1/2 OR: * = + a = 14 * = −
10.	$7 \overset{-}{*} 6 = 5 \overset{-}{*} 4$ Is this statement true or false?	* = − 1/2 True If * = − then the statement is true. Otherwise false.

5

Unique identifier:_____ Date:_____

READING

You may either:
- write your answer in the space provided
- write or draw some ideas in the space provided then record your answer onto a tape
- record your answer onto a tape.

Your answer may comment on:
- the poet's message
- the words that the poet has chosen to use
- the literary features of poetry such as metaphor, simile, personification, alliteration
- structural features such as rhyme or rhythm
- the feeling that is portrayed in the poem
- your interpretation of the poem.

Your answer will be graded on the following criteria:

	Stage	The answer:
1	Pre-structural	– just repeats the question – shows no understanding of the poem – there is no answer
2	Uni-structural	– repeats part of the poem (but doesn't show an understanding of it) – shows that you understand one feature used in the poem
3	Multi-structural	– shows some understanding of the poet's message – shows that you understand two or more features used in the poem – does not make connections between features and meaning – may paraphrase part of the poem
4	Relational	– shows that you understand most or all of the poem – makes connections between two or more features used in the poem and the meaning that they help to convey –discusses why particular features were used by the poet – may discuss more than one interpretation of all or part of the poem
5	Extended Abstract	– shows an understanding of the poet's overall message (not just pieces in isolation) – shows an understanding of how the features are used in the poem to convey the poet's message – includes new ideas that have not been previously discussed in class – may discuss more than one interpretation of all or part of the poem giving evidence for each – may question the question

NOTES:
Background knowledge: Early in the year the class studied a piece of prose and wrote their own. This piece has many similar features such as alliteration, metaphor, and simile and ties into our current topic study "Preservation". The students have experience orally recording onto audio tape.

Administration: The above instructions and criteria will be discussed with the students prior to writing or recording their answer. They will not be expected to read and

understand the instructions and criteria independently. The students may need to wait their turn if too many choose to record their answer onto audio tape. The prose will be read aloud to them once. They will be given 15 minutes to write their answers. Students who have not had time to record their answer in that time will be given extra time.

Students have been given the choice of writing or recording to overcome the writing barrier for students who find this challenging or are turned off by it. The researcher will listen to the tapes and transcribe the answers herself.

Unique identifier: Mespot Date: 9.9.03

READING

Journal in My Mind

In my attic lies a journal of memories.
Hopes, dreams, laughter, tears,
Sitting, collecting dust.

Sometimes life stirs them up.
Good memories and bad memories,
Come to life like dust in a breeze.

The fun ones, they make me laugh.
The sad and painful ones see me cry.
They all pull on my heart.

I treasure this journal, strive to preserve it.
Some chapters I shelve, others I share without shame,
Lest they (and I) be forgotten.

Anonomus

What do you understand from this piece of prose?

The attic is his brain with hopes, dreams and memories. Good memories and bad memories come and go with different feelings. He protects his memories and gives away some of them. He is trying to tell us to protect our memories

7

Appendix C: Completed Post-intervention Formal Test Example

Unique identifier: _____ Date: _____

SOCIAL STUDIES

Your Social Studies answer will be graded on this criteria:

Grade	Stage	The answer:
1	Prestructural	– just repeats the question – is not related to the question – there is no answer
2	Unistructural	– includes one idea
3	Multistructural	– includes several ideas but doesn't tie the ideas together
4	Relational	– includes several ideas and ties the ideas together – may look at two sides of an idea or piece of information
5	Extended Abstract	– includes several ideas including information that is beyond what was taught or discussed in class – ties the ideas together in a logical way – may look at two sides of an idea or a piece of information and states a preference for one side or the other based on good reason – may question the question

2

Unique identifier: Henri Date: 2/12/03

SOCIAL STUDIES

Explain the significance of the family treasure that you studied this term.

Write your answer here:

My family treasure is the symbol of my belonging to Finland and all my extended family live there. It helps me remember all my cousins, Aunts, Uncles, Grandmothers and Grandfathers. It is a symbol of belonging there and a reminder to us that we are going to go back to live there in some time. It is very significant because it is a symbol of the past of my family and that we are and have always been Finnish.

Unique identifier: Henri Date: 2/12/03

MATHS: MEASUREMENT and NUMBER

As you answer these questions remember:
- Read the questions carefully and make sure that you do every part of every question.
- **After each section, put your hand up so that your answer can be marked then continue.**
- You may use a calculator but you must still show your working.
- Include measurements in answers such as cm, cm^2, m, or $.
- Make your answers clear and show how you worked them out.

Note: you may be penalized if you don't show your working.

The task is sorted in the levels of the SOLO Taxonomy. As you work your way through the problems, you will be working your way through the levels of the SOLO Taxonomy.

Unique identifier: Henri Date: 2/12/03

MATHS: MEASUREMENT and NUMBER

Unistructural Measure and calculate the area and perimeter of the shapes in *Figure A* using the formulas below.

	Rectangle	Triangle	Circle
Perimeter	2h+2b	a+b+c	$2\Pi r$
Area	bXh	(bXh)/2	Πr^2

Remember: Π=3.14

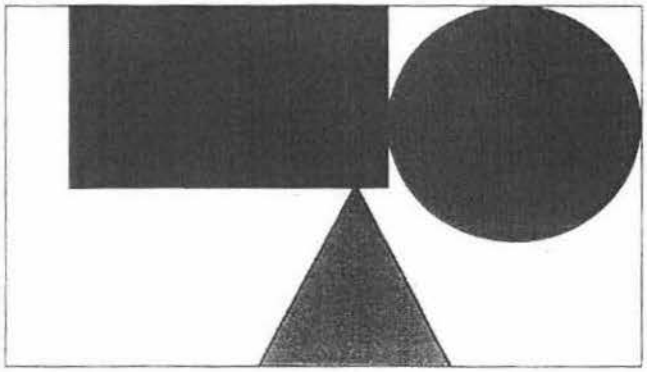

Figure A

Write your answers and working here:

Shape	Perimeter	Area
Rectangle	10+6=16 cm ✓ 16mm	3×5 15 cm^2 ✓
Triangle	3.2 3.4 +13.4 9.8cm 9.8 cm ✓	3×3=9 9÷2= 4.5 cm^2 ✓
Circle	3.14 × 2 6.28 12.56 cm ✓	2^2=2×2 4 12.56 cm^2 ✓ 3.14×4=12.56

5

Unique identifier: Henri Date: 2/12/03

Multistructural Measure the area and outline of the shapes in *Figure B*.

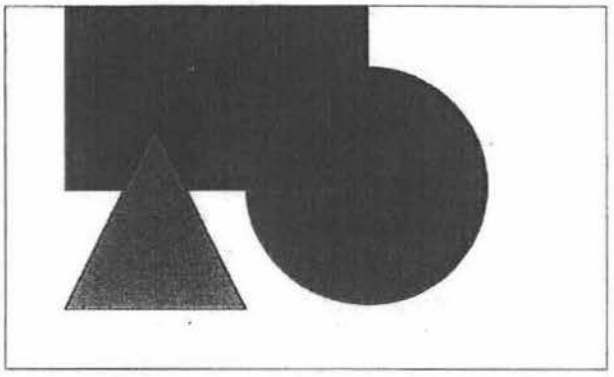

Figure B

Write your answers and working here:

Shape	Outline	Area
Rectangle	3×2=6 6+5=11 11+3=14 14+2=16cm 14+1=15cm	5×3=15 1×1=1 15-1=14 cm2
Triangle	3.4+3.4+3=9.8 cm	3×3=9 9÷2= 4.5 cm²
Circle	2×3.14=6.28 9.42cm 6.28÷2= 12.56 -3.14 3.14 2	r²=2×2=4 3.14×4=12.56 9.42 cm²

Relational Using the prices below, cost the stained glass window in *Figure B*.

	Lead	Green	Blue	Orange
Price	$2 per metre	$0.80 per cm²	$0.75 per cm²	$0.35 per cm²
Working	17.2 9.8 35	4.5 ×.8 $3.60	14 ×.75 70 +980	9.42 ×.35 14710 +27260
Answer	$0.3552	$3.60	$10.50	$31.970
Total cost for window in *Figure B*:				$53.30

error in multiplication

$624

(based on flame of 16cm² above)

Unique identifier: Henri Date: 2/12/03

Extended abstract Modify the window in *Figure B* at least two different ways, then recalculate its cost.

Modifications **may** include:
- Adding a new shape (not a circle, rectangle, or triangle)
- Moving one of the existing shapes
- Adding a background color

Other colour costs: Red = \$0.75 per cm^2, Purple = \$0.60 per cm^2, White = \$0.25 per cm^2

Draw your modified window on *Figure C*.

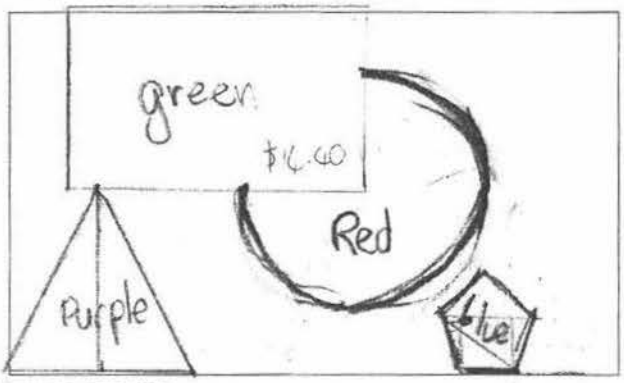

Figure C

Cost calculations:
Show your working and answer here:

15 green 9.42 cm^2 Red 1.465 blue
4.5 cm^2 purple
40.42 cm lead

.4

.12 − .03 = .09

2 10 16 8 9.42 + 5 = 40.42

0.525 + 0.12 = .645 + .48 = 1.125 + .25 = 1.375 + .09 = 1.465

Total cost for window in *Figure C*:

Lead \$0.4042 green \$12 \$16.40 Red \$7.065 Purple \$2.70 blue \$1.09875

Unique identifier: Henri Date: 2/12/03

READING

You may either write your answer in the space provided, write or draw some ideas then record your answer onto a tape, or record your answer onto a tape.

Your answer may comment on:
- your understanding of the poem;
- the words that the poet has chosen to use;
- the literary features of poetry such as metaphor, simile, personification, alliteration;
- structural features such as rhyme or rhythm;
- the feeling that is portrayed in the poem.

Your answer will be graded on the following criteria:

	Stage	The answer:
1	Pre-structural	– just repeats the question – shows no understanding of the poem – there is no answer
2	Unistructural	– repeats part of the poem (but doesn't show an understanding of it) – shows understanding of one feature of the poem
3	Multistructural	– shows some understanding of the poem – shows understanding of two or more features used in the poem – does not make connections between the poem, self, and GKP – may paraphrase part of the poem
4	Relational	– makes connections between the poem, self, and GKP – shows an understanding of most or all of the poem –discusses why particular features were used by the poet – may discuss more than one interpretation of all or part of the poem
5	Extended Abstract	– shows an understanding of the poet's overall message (not just pieces in isolation) and relates to self and GKP **and** – includes new ideas that have not been previously discussed in class – may discuss more than one interpretation of all or part of the poem giving evidence for each – may question the question

Unique identifier: Henri Date: 2/12/03

READING

Stepping Stones

Isn't it strange that princes and kings
and clowns that caper in sawdust rings
and simple folks like you and me
are builders of eternity?

To each is given a bag of tools,
a shapeless mass, and a set of rules,
and each must make, before life has flown,
a stumbling block or a stepping stone.

Analyze *Stepping Stones* and discuss how it is meaningful to yourself and to GKP.

The message behind Isn't it strange that princes and kings and clowns that caper in sawdust rings and simple folks like you and me are builders of eternity is that everyon effects the future. The tools are the persons life the shapeless mass is the body and the rules are the limits of the body. The message behind and each must make, before life has flown a stumbling block or a stepping stone. is that every one makes good things for the world or creates problems and bad things for the world before their life runs out. This is meaningful to me because everyone affects the future and it's meaningful to GKP because GKP is a good thing to the world.

Appendix D: Diary Entry Examples

7th October (week 1, term 4)

At GKP we learn about real world topics and I have opportunities to solve real world problems.

We began the day with "Hot Off the Press". The students were divided into groups of 2-3 and given a double page spread of the newspaper. They were asked to identify two world-problems and to brainstorm at least three solutions to each problem. They then shared their findings and ideas with the rest of the class. This raised topical debate over ethical issues.

When we start a new topic, my GKP teacher finds out what I already know about it.

Today I began gathering data from the students for their school reports. This is not strictly finding out what the students know at the beginning of a topic but was useful data for me to have, particularly for the 9 students that I will retain next year. It will help to give me direction for their learning needs. Data that will be gathered over the next few weeks includes: self-evaluations of Gardiner's multiple intelligences, self-evaluation related to critical, creative, and caring thinking, and self-evaluations of progress in French.

My GKP teacher encourages me to be curious and ask questions.

Throughout the year, the students have been introduced to Ignorance Logs and have kept these question logs with varying degrees of success. (An Ignorance Log is a journal of questions referred to as "known/unknown questions" –we know the question but not the answer.) The students were asked to record their 3 best, unanswered known/unknown questions in their school report. On reflection of the questions that they recorded, we will revisit this next week as some of the questions were either trivial questions, e.g., why is the sky blue?, simple, closed questions, e.g., who is the principal of GKP?, or known/known questions, e.g., when did Henry Ford die? (Known/known question = know the question and know the answer.)

At GKP, I learn about how to learn and how to make my learning better.

As mentioned above, for reports we collected data on students' perceptions of their own learning in relation to Gardiner's Multiple Intelligences. The students identified characteristics of their own learning, which were categorized by the eight intelligences. This allows the students to identify how they learn and drew their attention to strategies, aids, or environments that help their learning or that match their individual learning style.

18th November (week 7, term 4)

At GKP we learn about real world topics and I have opportunities to solve real world problems.

The students shared their solutions to the problems that I had left – some they found harder than others. We tried things out, agreed on some things and changed others, and eventually pulled together a rough outline of what we would do and how it would look. This was an excellent example of co-operative group problem solving in which the students' communication was excellent and they were highly motivated to sort through the issues to make their dance work. We still had the problem of turning the kids ideas into a choreographed chess game. Due to time restrictions, their solution was that I would do it for them, and due to time restrictions, I agreed!

When we start a new topic, my GKP teacher finds out what I already know about it.

We didn't start any new topics today but I took 15-20 minutes in the morning to find out what the kids had done last week, how they felt about their progress, what they felt good about, any problems that they had, etc. This was important to a) acknowledge that they worked hard and made progress when I wasn't here, and b) for me to find out where they are up to and where to take them next.

Next week we will be at Brookfield in Wainuiomata for 2 days of EOTC doing activities such as kayaking, orienteering, rock climbing, abseiling, camp cooking, etc. We spent time today discussing the EOTC activities, what would be required of the students for each activity and their prior experience with them. This was a good opportunity for students to recognise strengths in our class group and people who may need additional support in some activities. We went on to identify risks with the different activities and what we could do to avoid or minimize these.

My GKP teacher encourages me to be curious and ask questions.

No lessons specifically around this, although some students continue to answer the questions in their Individual topic Ignorance Logs. 2 students have independently started their own Ignorance Log, unrelated to any topics being studied in class.

At GKP, I learn about how to learn and how to make my learning better.

Three students have still not finished their planning for their Independent topics and as we will only have one day of class time left, after today, they need to be moving quickly onto their research. I felt it still beneficial for these students to do the planning (albeit simplified) so worked with them as a group to model how to extract the Achievement Objectives from the curriculum documents. (This is what they were finding most difficult.) I used a "think –aloud" strategy to do so, for example, "I know that snakes are a living thing and that living things will be in the Science Curriculum. I'm going to look in the contents to see

which would b the most likely section to find snakes in." Together we found Making Sense of the Living World, turned to the level 3 Achievement Objectivess, and found an appropriate curriculum objective. I did this for one AO for each student, then guided them to do a second one each, themselves.

Appendix E: Caregivers' Information Sheet

[printed on Massey University letterhead]

Fostering Deeper Thinking With Gifted Kids:
An Action Research Project

INFORMATION SHEET
Caregivers

Researcher Introduction

The proposed research will be undertaken by Joanne Young under the supervision of Dr. Tracy Riley and Dr. Jenny Poskitt.

Researcher:	*Supervisor 1:*	*Supervisor 2:*
Joanne Young PO Box 12567 Thorndon Wellington Ph 04 475 5908 Joanne@learningmedia.co.nz Employment status: Editor/project manager at Learning Media (4 days per week); Teacher at the Gifted Kids Programme (1 day per week)	Dr. Tracy Riley Department of Teaching and Learning Massey University Private Bag 11-222 Palmerston North Ph 06 801 5799 x 8625 T.L.Riley@massey.ac.nz	Dr. Jenny Poskitt Department of Teaching and Learning Massey University Private Bag 11-222 Palmerston North Ph 06 801 5799 x 8835 J.M.Poskitt@massey.ac.nz

This project is the thesis component of a Masters in Education degree. The project is an action research study with the following aims:
- to identify tools and strategies that can be used effectively with gifted students to foster deeper thinking skills;
- to implement these tools and strategies to encourage students to think more deeply.

Participant Recruitment

All students in the Tuesday class at the Rata Street Unit of the Gifted Kids Programme (GKP) are invited to participate in this study. There will be up to 16 participant in the research sample. Participation is strictly voluntary.

Project Procedures

The research will be conducted between July 2003 and June 2004. The research will first determine the depth of students' thinking using a test written by the researcher, based on the SOLO (Structure of the Observed Learning Outcome) taxonomy. Participants will also be asked to complete a Likert Scale questionnaire about strategies and tools that foster deeper thinking. Then, tools and strategies that have been identified by the researcher as appropriate for

developing deeper thinking skills will be implemented in the classroom. After 1 to 2 terms (10-20 days at GKP) participants will take another test based on the SOLO Taxonomy and complete the Likert Scale questionnaire for a second time. Documentation and artifacts, such as the teachers' planning and evaluations, students' exercise books and reflective journals, student creations, and assessment records, will also be used to determine what tools and strategies are being used in the classroom and to determine the depth of students' thinking.

During the research study, data will be held by the researcher and will not be distributed beyond the researcher and supervisors. Data will be held for a period of 5 years, after which it will be destroyed.

The research findings will be published as a thesis. This will be available for research participants and their caregivers either from the researcher, from the Massey University Library, or from the GKP trustees. A summary of the research findings will be made available to participants and their caregivers on completion of the study. The data collected will be used for the purpose of the thesis only.

Preserving Confidentiality and Anonymity

The Gifted Kids Programme: GKP and the Rata Street School Unit will be named in the research report. Due to the unique nature of GKP, it would be near impossible to keep its identity confidential. The actual class will not be formally identified, but as the researcher only teaches one class, this will be easy to deduce. A general description of the class such as location, roll, age of students, and cultural demographics will be included in the thesis as well as an outline of GKP's philosophy, educational aims, and methods of identification.

Participants: When it is necessary to use a name, participants will be referred to by a pseudonym. Participants will be given the opportunity to create their own pseudonym, otherwise one will be provided to them. Every attempt will be made to keep participants' identity confidential however this cannot be guaranteed, particularly due to the small sample size (maximum of 16) and the fact that the class as a whole is easily identified.

Participant Involvement

GKP Trustees involvement: GKP trustees are required to give formal consent for the research to be undertaken at GKP and for the researcher to have access to student records for the purposes of the research. The researcher will provide them with regular updates on research progress and provide copies of the SOLO tests and Likert scale questionnaire prior to use with participants. Should the researcher find any new tools and/or strategies to foster deeper thinking, she will communicate these to the GKP trustees and senior staff prior to implementation. The trustees will have the opportunity to read the final thesis before submission and a summary report will be made available to the trustees. If any publication or presentation opportunities arise as a result of the research, the researcher will seek the approval of the GKP trustees.

Student involvement: Students who choose to participate in the research study will be asked to:

- Make class work, discussions, evaluations, reflective journals, and assessment data available to the researcher. This is regular class work, discussions, evaluations, reflective journals, and assessment that students will be doing regardless of the research study.
- Complete a Likert Scale questionnaire about strategies and tools used by his/her teacher, to foster deeper thinking. This questionnaire will be completed twice during the study and is estimated to take no longer than 15 minutes to complete.
- Take a written test, designed by the researcher, which will be based on the SOLO (Structure of the Observed Learning Outcome) Taxonomy. The test will be based on content that is being/has been studied in class and will use questions that aim to elicit answers that show indepth thinking. Students will take two tests during the study. Each test is estimated to take no longer than 40 minutes to complete. Students will have the option of recording their answers to one section of the test on audio-tape. They will have the right to turn the recording device off at any time.

The research will also utilize information in the teacher's planning, evaluation, and assessment records which will include information about the students in her class.

Participant's Rights

Students and their caregivers will have the right to:

- decline to participate
- decline to answer any particular question
- withdraw from the study at any time
- ask questions about the study at any time during participation
- provide information on the understanding that their name will not be used unless they give permission to the researcher
- be given access to a summary of the project findings when it is concluded.

Students who choose not to participate (or whose caregivers chose for them not to participate) or who choose to withdraw from the study will not be penalized in any way. Students in this situation will attend GKP as usual.

If you have any questions about the study or if you have any questions regarding the students' rights as research participants, please don't hesitate to contact either the researcher or supervisors.

Appendix F: Students' Information Sheet

[printed on Massey University letterhead]

Fostering Deeper Thinking With Gifted Kids:
An Action Research Project

INFORMATION SHEET
Students

Who's doing the research and what's it about?

The researcher for this project is Joanne Young. Her supervisors are Tracy Riley and Jenny Poskitt. If you want to ask them questions about the research, here are their contact details:

Researcher:	*Supervisor 1:*	*Supervisor 2:*
Joanne Young PO Box 12567 Thorndon Wellington Ph 04 475 5908 Joanne@learningmedia.co.nz	Dr. Tracy Riley Department of Teaching and Learning Massey University Private Bag 11-222 Palmerston North Ph 06 801 5799 x 8625 T.L.Riley@massey.ac.nz	Dr. Jenny Poskitt Department of Teaching and Learning Massey University Private Bag 11-222 Palmerston North Ph 06 801 5799 x 8835 J.M.Poskitt@massey.ac.nz

This project is part of a Masters in Education degree. It's an action research study that is trying to:
- find ways of teaching and learning that will help gifted kids to develop deeper thinking skills;
- encourage gifted kids to think more deeply.

Who's the research about?

All students in the Tuesday class at the Rata Street Unit of the Gifted Kids Programme (GKP) are invited to participate in this study. There will be up to 16 participants. You don't have to participate.

How will it be done?

This research will be done between July 2003 and June 2004. The researcher will first find out how deeply her students' think. You will sit a short test which includes a reading, a maths, and a social studies question. You will also be asked to fill in a questionnaire about how your teacher at GKP helps you to think deeply. Then, if the test and questionnaire show that you could think more deeply, your teacher will try some new strategies to help you with this. After 1–2 terms (10–20 days at GKP) you will take another test and do the questionnaire again. The researcher will also use her planning and evaluations, your exercise books and reflective journals, things that you've created, and her assessment

records, to find out how deeply you and your classmates are thinking and how she can help you with this.

During the study, data will be held by the researcher and will not be shown to anybody except her supervisors. She will keep it for 5 years, then it will be destroyed. It will only be used for this project.

The research will be published as a thesis. You and your caregivers will be able to get a copy of this either from the researcher, from the Massey University Library, or from the GKP trustees. At the end of the study, you will be given a summary of the research report.

Who will know that I'm involved?
GKP and the Rata Street School Unit will be named in the research report. The actual class will not be named but because the researcher only teaches one class, this will be easy to figure out. A general description of the class including where it is, how many students there are, the age of the students, and what cultures they are from will be included in the report. It will also talk about GKP's beliefs, their mission statement, and how they choose students for the programme.

When it is necessary to use a name, you will use a pseudonym. A pseudonym is a made-up name that is used to keep your true identity a secret. You will be able to choose your own pseudonym or one can be made up for you. The researcher will try her hardest to make sure that your identity is kept secret but this can't be guaranteed.

What will I have to do?

If you choose to be involved in the research study, you will be asked to:
- Let the researcher use your class work, discussions, evaluations, reflective journals, and assessment data for her study.
- Fill in a questionnaire about how your teacher helps you to think deeply. You will do the same questionnaire twice during the study. It should take you between 10 and 15 minutes to do.
- Sit a short test which includes a reading, a maths, and a social studies question. The test will be about topics that you have been learning about. The questions have been carefully written to allow you to give indepth answers if you can. You will take one test at the beginning of the study and another one at the end. The test will take around 40 minutes to do. You will be able to tape-record your answer to the reading question if you want to.

What are my rights?
You can:
- choose to not be a part of the study or to not answer one or more questions in the study;
- withdraw from the study at any time;
- ask questions about the study at any time;
- trust that your name will not be used unless you give permission to the researcher;

- have a summary of the project findings when it is finished.

If you or your caregivers don't want you to be a part of the study or you choose to withdraw from the study you won't be penalized in any way or treated any differently by your teacher. You will attend GKP as usual.

If you have any questions about the study please ask either the researcher or supervisors.

Appendix G: Deep-Learning Strategies and Corresponding Abbreviations

Q1	At GKP, we study "big ideas" that I am interested in.	Big ideas
Q2	At GKP, we learn about real world topics and I have opportunities to solve real world problems.	Real world application
Q3	At GKP, we study topics that I already know a little bit about.	Have prior knowledge
Q4	When we start a new topic, my GKP teacher finds out what I already know about it.	Elicit prior knowledge
Q5	I believe that I will use what I learn at GKP in the future.	Related to future
Q6	I feel like my GKP teacher cares about me and my learning.	Care
Q7	I feel like my GKP teacher listens to me.	Listened to
Q8	My GKP teacher talks to me and gives me written feedback about my learning and how to make it better.	Feedback
Q9	I know why we do what we do in class at GKP.	Purposeful learning
Q10	At GKP, I have opportunities to work in small groups with other students.	Small-group work
Q11	At GKP, I have enough time to think, and to finish things that I've started.	Adequate time
Q12	My GKP teacher encourages me to be curious and ask questions.	Curiosity/questions
Q13	At GKP, I learn how to learn and how to make my learning better.	Metacognition
Q14	I'm relaxed at GKP. (Not anxious.)	Relaxed
Q15	At GKP, I want to learn for myself. (Not for rewards or good marks.)	Intrinsic motivation
Q16	At GKP, I feel like I'm responsible for my own learning.	Responsible for learning