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Primary Teachers’ Understanding of the Linguistic and Visual Modes of Scientific Informational Texts

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This thesis is submitted in partial fulfilment of the requirements for the degree of Master of Education (Research)

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June 2015
AUTHOR’S DECLARATION

This is to certify that:

I. This thesis comprises only my original work towards the Master of Education (Research) Degree.

II. Due acknowledgement has been made in the text to all other material used.

III. The thesis does not exceed the word length for this degree.

IV. No part of this work has been used for the award of another degree.

V. This thesis meets the University of Sydney’s Human Research Ethics Committee (HREC) requirements for the conduct of research.

Name: Rayanne Shakra

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Date: 26/03/2015
Acknowledgements

In the name of God, the gracious the merciful. First and foremost, I wish to thank God for giving me the patience and perseverance to pursue this research.

I wish to acknowledge the help of a few people who, without their expert insights and professional inputs, this thesis never would have come together. I would like to thank Dr Christine Preston for her invaluable suggestions on the pedagogical issues around scientific texts; Professor Alyson Simpson for the constant feedback that she consistently provided; Professor Geoff Williams for his valuable insights and explanation of semiotics and SFL; Dr Rachel Wilson’s positive reinforcement during the beginning of this journey which was enough to get me going. A big thank you to the participating teachers and schools. I would also like to thank the team at the Faculty of Education and Social Work’s office of Doctoral Studies namely, Venice Jureidini for her hard work, warm-hearted comments and encouragement.

There is no way that this thesis would have ever seen the end of its journey without the help and guidance of my supervisor, Dr Jon Callow. No words of thanks will do you justice. Your patience, expertise and diligence along the way were key to making sure that this study reached its full potential. The amount of knowledge and learning I gained from you along the way made this an invaluable journey.

Finally, a big thank you to my family. To my loving husband who encouraged me throughout the whole course. Your love and support was motivating enough to keep me going. To my three beautiful children who sacrificed their ‘mummy time’ because mummy had important homework. Ayah my dear, Judy my angel and Ali my precious baby born in the midst of this passage, nothing is more important than you. I hope I make you all proud.
Primary Teachers’ Understanding of the Linguistic and Visual Modes of Scientific Informational Texts

Abstract

Informational texts have the potential to engage students in both literacy and scientific enquiry. The question of including more of these books in teacher’s daily literacy blocks has been widely debated in the literacy field; with scholars arguing that teachers’ own knowledge of the language and graphics of these texts plays an important role in how they use and present these texts to their students. The purpose of this thesis was to provide baseline information about primary school teacher’s understandings of the linguistic and graphical features of scientific informational texts. This thesis addressed the issue of how teachers understand scientific informational texts multimodally, with special attention to the pedagogical implications of these texts. This study utilized a qualitative design with a case study form of enquiry to examine the way six K-2 primary school teachers understood scientific informational texts linguistically and visually, and how they incorporated these modes of meaning into their literacy teaching. Data was collected through semi-structured interviews, textual and visual annotations. Data was analyzed according to theories of multiliteracies, systemic functional linguistics, social semiotics and multimodality.

This study found that teachers were capable of describing the linguistic aspects of these texts and the multimodal interactions that occur between the text and the graphics. Although there were similarities in how these teachers pedagogically addressed these texts, differences were found as the way they explained and discussed the graphics. The thesis shed light on two under-researched areas within the field of informational texts. Firstly, how teachers present and use these texts with younger students. Secondly, it provided insights into how teachers understood the language and multimodal aspects of such texts.

Keywords: scientific informational text, graphics, multiliteracies, systemic functional linguistics, social semiotics, multimodality, pedagogical implications, early stage 1 class, stage 1 classes, primary school teachers
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1.0 Introduction

“The kinds of readers and writers children become will be crucially influenced by the kinds of texts they are given access to and the kinds of interactions around those texts they experience”.
(Unsworth, 2001, p. 183)

Literacy research suggests that a person’s literacy development is more highly impacted by the type and amount of experience one has with text in all its forms and modes (Duke, 2000; The New London Group, 1996; 2000; Unsworth, 2001). In order for a person to succeed within their educational contexts and their daily lives, they must be capable of interpreting information (Ness, 2011). Some literacy experts recommend that informational texts should be introduced in the early primary grades in order to provide ample opportunity for students to interact with them (Christie, 1987; Duke, 2000; Pappas, 1991; Unsworth, 1991). Research by Yopp & Yopp (2012) suggests that children who are not provided with sufficient opportunity to work with informational texts in their early years of schooling, may become unprepared to move on to more complex text structures in later grades.

Informational texts teach about the natural and social world with the intention of communicating accurate information (Duke, 2000). The use of informative texts provides children with knowledge about the real world (Saul & Dieckman, 2005), and a rich context for enhancing their schemata (Moss, 1992). An example of an informational text is the scientific text, since it provides the reader with factual information about the world and environment around them (Duke, 2000; Pappas, 2006).

As students progress in their academic life, the types of texts and reading that they will encounter will also progress from everyday common-sense and spoken discourse, to more specialised uncommon-sense and written-like discourses (Macken-Horarik, Love, Unsworth, 2011). The challenge to scaffold children to control the
distinctive grammatical features and text structures of the more specialized curriculum areas (Unsworth, 1997) as they progress in their school years, is no small issue for teachers.

The implementation of the new NSW English syllabus K-10 took place in the 2014 academic year (Board of Studies NSW, 2013). The types of texts that teachers are to use within their classrooms are categorized into ‘imaginative’ and ‘informative’ (Board of Studies NSW, 2013, p. 44). This categorization suggests that teachers who teach students from kindergarten to grade three, also known as the early stage 1 and stage 1 grades in the NSW syllabus document (Board of Studies NSW, 2013), should present their young students with a balanced literacy program. This program should incorporate both literary and informational texts equally, and at the same time present a wide range of instructional topics.

Scientific informational texts rely heavily on the visual appeal, and recently the pages of these books have come to resemble websites (Dresang, 1999; Pantaleo, 2007), inviting students to interact with the page wherever their curiosity and gaze takes them, especially when most of these texts are not temporally organised (Kerper, 2003). Scientific images, known as graphics, work alongside the language mode in providing meaning and most scientific texts for children are thus considered as multimodal (Lemke, 1998).

Teachers need to explicitly teach their students about how to construct meaning from informational texts (Coleman & McTigue, 2013). These texts combine written and visual texts meaning that teachers need to teach students how to create meaning from multiple sign systems in order to allow them to understand; and thus explain the meanings sparked by the image and text interactions (Albers, 2008; Jewitt & Oyama,
How teachers model and teach scientific informational texts to their students is dependent on how they understand these texts.

1.1 Purpose of the Proposed Study

The new Australian curriculum urges teachers to integrate multimodal texts into their daily schedules (Callow, 2013; Cloonan, 2011). However, the curriculum remains lacking in the detailed articulation and features of multimodal texts (Cloonan, 2011), assuming that teachers are equipped with relevant background knowledge to integrate these features into their English and literacy teaching.

Drawing on theories of multiliteracies, multimodality and social semiotics, this study explored the linguistic and visual knowledge of six early stage 1 and stage 1 teacher participants as they read and annotated two double spread pages taken from a children’s scientific informational text. The research also sought to explore how teachers used specific metalanguage to teach their students about the features of these texts.

1.2 Research Questions

This study aims to answer the following research question:

How do primary school teachers understand the interrelation between the visual and written modes of meaning in scientific informational texts written for K-2 students?

The following questions were used to guide the research:

1) What linguistic and genre elements do teachers distinguish within K-2 scientific informational texts?

2) How would they explain the relationship between the graphics and the text in these factual texts?

3) How do primary school teachers interpret the graphics in a chosen K-2 scientific informational text?
4) How would they teach their own students about the graphics in the chosen text?

5) How would they teach their own students about the relationship between graphics and text?

### 1.3 Organization of the Thesis

Chapter one introduces a rationale for the study, via a discussion of the importance of providing young students within the early stage 1 and stage 1 grades, with opportunities to use, and become familiar with, scientific informational texts. This chapter includes an overview of the issues, statement of the problem, purpose of the study, the research questions and organization of the study.

Chapter two introduces the theoretical frameworks that were utilised within the study in order to analyse the data. It also presents research around scientific informational texts including the linguistic, visual, multimodal and pedagogical research that has been undertaken within this field of study.

Chapter three describes the research methodology through a description of qualitative research design and case study methodology. Furthermore, it presents the philosophical assumptions, the modes and procedures for data collection and the detailed process for data analysis.

Chapter four details the data collection, results, and also presents a discussion of the themes generated during the data collection phase.

Chapter five presents the conclusions that were drawn with an emphasis on teachers’ linguistic and visual understanding of scientific informational texts, teachers’ pedagogical uses of these texts within early stage 1 and stage 1 classrooms, the limitations of the study, and recommendations for future research.
2.0 Theoretical Framework and Literature Review

This chapter presents the rationale for the study, with an overview of key concepts from social semiotics, multiliteracies, systemic functional linguistics and the multimodal features of scientific informational texts.

2.1 Social Semiotics

Social semiotic theory is “the study of sign systems - in other words, … the study of meaning in its most general sense” (Halliday & Hasan, 1989, p. 4), but meaning cannot be studied without its’ social context, therefore it is a theory concerned with meaning (Kress, 2010) and how these meanings are created within a social system. It derives from the theory of semiotics. The main emphasis of semiotics is placed on the ‘concept of the sign’ (Chandler, 2002). Foregrounded in the work of Swiss linguist Ferdinand De Saussure (1974), semiotics is based on the notion that meaning making is manifested in the negotiation of symbols, or in Saussure’s terms, signs. The sign, according to Saussure, results from the arbitrary relationship between a concept and its associated sound-image, also known as the signified and the signifier. The signified is the concept of the linguistic entity being represented, and the signifier is the material form of the sign (Chandler, 2002). Saussure defines ‘materiality’ not in its physical sense as it is in reality, but as the “impression that it makes on our senses” (Bally, De Saussure, Sechehaye & Riedlinger, 1974, p.78).

According to Saussure, a sign is meaningful only if it functions within a system (Chandler, 2002). The value of the sign is dependent upon its relations with other signs working alongside each other within systems. Therefore, a sign must belong to a system for example, cultural systems around social behaviours, or how we dress and view art. Signs cannot be comprehended in isolation from this system.
Saussure divided language into two categories - ‘langue’ and ‘parole’. Langue consists of the general rules underlying the linguistic system and is considered to be the structural system of language. Parole consists of the particular act of speaking, drawing or writing produced by the speaker or author.

Saussure recognised that there was an intimate relationship between langue and parole, but noted “their interdependence does not prevent their being two absolutely different things” (Saussure, 1966, as cited in Hassan, 2009, p.10). According to Saussure, the system ‘langue’ was pre-given by society, and people in their instances of use could not change the structures and elements that determined this system.

In Language as a Social Semiotic, Halliday’s view of system and instance are derived respectively from Saussure’s langue and parole classification. However, Halliday (1999, p.8) views system and instance as “the same thing seen from different points of view”. As an example, Halliday (1991) provides the analogy of climate and weather, where climate represents langue and weather represents parole. He states that where climate is a generalization of weather patterns accumulated over decades, weather is an actual instance of this climate. Climate as a system can inform us probabilistically of what the weather, which is an instance, will be like in a particular time. Similarly, the overall meaning-potential of a semiotic system affords and constrains the types of meanings that can be made at any particular instance within a text.

Halliday’s view of meaning-making takes on a social perspective view (Halliday, 1978). Halliday’s interest lies within how the culture defines what is appropriate in interaction. Every semiotic system evolves in ways that allow it to accomplish the meanings of a particular culture (Halliday, 1978; Kress & VanLeeuwen, 1996). According to social semiotics, instantiation can thus be generalized to semiotic
modes other than language, such as visuals and gestures. The visual system can also be conceived as an accumulated meaning potential occurring from every instance of image use within a culture (Kress & VanLeeuwen, 1996).

Science texts in general combine different semiotic systems to instantiate scientific knowledge. In particular, children’s scientific informational texts instantiate scientific meanings through the intermeshing of different semiotic systems (Pappas, 2006). These instances of scientific knowledge are realized through the technical vocabulary and specialized meanings chosen by the author. Scientific knowledge is highly abstract and thus realized in the metalanguage or interpretation of the scientific process, and not in the scientific process itself (Halliday, 1991).

The semiotic system language, both spoken and written, is organised hierarchically into strata. Each stratum consists of “systems of choice” (Matthiessen & Halliday, 2004, p. 22), and are linked together by realisation. This concept describes how social purposes and contexts are dynamically realized as specific social actions and meanings (Christie, 2008). The three strata are first, the phonology/graphology. In children’s scientific informational texts these are the sounds and letters that make up a word in order for it to be read out. Second, is the lexicogrammar which in children’s scientific informational texts, denotes the technical vocabulary, related specifically to the scientific concept being discussed. Third is semantics. The semantic level of abstraction deals with the scientific meanings within these texts. These three strata are related by realization.

Halliday’s work on social semiotics takes into account that “language not only serves to facilitate and support other modes of social action that constitute its environment, but also actively creates an environment of its own, so making possible all the imaginative modes of meaning” (Halliday, 1978, p. 2-3). From here the work on
social semiotics can be seen to have provided many of the foundations underlying a multiliteracies perspective.

2.2 Multiliteracies

The traditional definition of literacy as the ability to read and write printed text can no longer cater for the constantly evolving multimodal and globalized world students now live in. Over the past 20 years, literacy researchers have signalled the need for a change in literacy education to account for the changing semiotic landscape of the classroom (Coiro, Knobel, Lankshear & Leu, 2008; Cole & Pullen, 2010; Cope & Kalantzis, 2000; Locke, 2010; Luke & Freebody, 2000; New London Group, 1996; Unsworth, 2001).

Multiliteracies is a term coined by the New London Group (1996) in light of globalization and the mounting influence of technological communication. In 1996, advocates of this theory argued that the time had come for literacy to engage diverse, multilayered learners’ identities (New London Group, 1996). Multiliteracies theorists reasoned that many students have been denied a number of opportunities because literacy has been “restricted to formalized, monolingual, monocultural, and rule-governed forms of language” (New London Group, 1996, p.61). Even though it has been nearly twenty years since it was coined, still the relevance of using this framework is that it provides an influential definition of texts that use more than one mode of representation, as with scientific informational texts which include verbal text and graphics.

Multiliteracies recognises that proficiency in academic literacy is just one way of being literate, and that the scope of literacy pedagogy must be broadened to value multiple modes of representation and a variety of text forms. Drawing on the concept of
‘design’ to describe the codes and conventions of meaning making modes, the multiliteracies theory reconceptualises literacy pedagogy in light of the increasingly sophisticated multimodality of texts. To be multiliterate, students must be competent in six meaning making designs. Five are modal designs, the linguistic, spatial, auditory, visual and gestural. The sixth design is the multimodal meaning making design, which incorporates two or more of the other five modes (New London Group, 1996; 2000).

There have been various critiques of the multiliteracies approach. As with any pedagogical theory, multiliteracies was criticised by some educators on differing levels during its formulation (Cameron, 2000; Leander & Boldt, 2013; Pennycook, 1996; Prain, 1997; Trimbur, 2001). In a critical review Pennycook (1996), while praising the content of multiliteracies, reflected critically on the pedagogy and the terms used such as ‘design’, ‘designing’, and the ‘redesigned’ panning the preciseness and lack of concretisation. Furthermore, Prain (1997) argued the contradiction of The New London Group claiming that they rejected stable systems of grammar, while at the same time asserting that their use of systemic functional linguistics and discourse analysis, which posits that the stability of the meaning making elements remains fixed. In a more current critique, Leander & Boldt (2013) argue that this theory places “heavy emphasis” (p.43) on students’ redesigned texts. These texts are often formed by the deliberate intervention of teachers. They state that the theory does little to include students’ interests and passions towards texts. According to them, these texts are “domesticated” (p.43) into the school curriculum and will cause students to become resistant towards them. Researchers working on multiliteracies (Cope & Kalantzis, 2000; Kalantzis & Cope, 2005) have responded to the earlier criticisms by refining some aspects of multimodal metalinguistic descriptions.
Three of the six multiliteracies designs are particularly appropriate to investigate teachers’ understanding of scientific informational texts which comprises the main research question of this thesis. These are the linguistic, the visual, and the multimodal designs (New London Group, 2000). The multiliteracies framework acknowledges the connection between the linguistic and visual elements presented within scientific texts. Children’s texts in general make use of the different modes in order to present their content to the young reader. Scientific informational texts written for young audiences are no exception. They favour the use of multiple modes to explain and inform children about scientific content (Pappas, 2006). This is the broader theoretical foundation basis on which this study interpreted teachers’ understandings of these texts, and how these aspects interconnect through multimodality; therefore utilising three of the six multiliteracy elements within this project, namely, the linguistic, the visual and the multimodal elements.

The theoretical framework of multiliteracies needed a grammar to explicate each mode along with their multimodal combinations. Scholars from the multiliteracies group drew on an approach to communication and language called systemic functional linguistics. In conceptualising what teachers need in order to provide students with the tools to learn about multiliteracies, the New London Group (2000) supported the use and development of a functional way of understanding how all the modes or designs work, both independently and in combination.

The following sections will provide an overview of the Systemic Functional Linguistics framework. They will look at how scientific informational texts are organized linguistically and visually, according to Systemic Functional Linguistics. The first section begins by defining the linguistic elements within scientific informational
texts.

2.3 Systemic Functional Linguistics – The Linguistic Mode

Systemic functional linguistics (henceforth SFL) involves the social development of grammar to permit verbal text analysis and interpretation. Systemic functional linguists emphasise that language is a system of signs or meanings understood according to its affiliation with social structure (Halliday, 1978; Hasan & Halliday, 1985).

Language, according to SFL, functions through two contexts: the context of culture and the context of situation (Butt, Fahey, Feez, Spinks & Yallop, 2006). According to the first category, language users employ language for specific situations and purposes in relation to cultural norms. The second category deals with the use of language in a particular situation. In SFL the core unit of meaning is the clause and three types of meaning are used in order to analyse verbal texts: the ideational meanings, the interpersonal meanings and the textual meanings (Halliday, 1994; Halliday & Matthiessien, 2004).

The ideational metafunction involves the organisation and representation of participants’ performance under certain circumstances. The importance of this metafunction is that it allows us to understand the relationships inherent in clauses. This metafunction is classified into two subfunctions, where content or ideas are concerned with the experiental subfunction, and the logical relationships embedded within ideas are subclassified as the logical metafunction (Bloor & Bloor, 2013).

The experiental meaning “classifies the world into domains of experience such as consciousness, happening and doing, and being and having” (Unsworth, 2001, p. 38). These domains denote the mental and verbal processes, the material process type and
the relational process type respectively (Unsworth, 2001). Grammatical realisations of this metafunction are the lexical items that represent processes, participants and circumstances. Processes include material, mental, and verbal. Participants denote those who are actors and goals within material processes, sensors and phenomenons in mental processes, and speakers and listeners in the verbal processes. Circumstances are realised by the adverbs and adverbial phrases (Halliday, 1994).

Children’s scientific informational texts make use of the material and relational processes abundantly (Pappas, 2006). Material processes in children’s scientific informational texts are used in order to show how experiences are construed in the external world, and describe processes of doing and happening. Table 1 provides a SFL transitivity analysis of a clause taken from a scientific informational text suitable for young children. Relational processes serve to identify and characterize participants. The relational processes are further divided into processes of ‘being’ (attributive) and ‘having’ (possessive) (Matthiessen & Halliday, 2004). Table 2 provides a SFL transitivity analysis of a relational process taken from “My Body” (Pinnington & Lamprell, 2012), a scientific informational text suitable for young children.

An example of a material process taken from a children’s scientific informational text is the following clause: Hair grows on almost every part of your body.

Table 1

*Transitivity analysis of a material process using SFL*

<table>
<thead>
<tr>
<th>participant: actor</th>
<th>process:material</th>
<th>Circumstance of location: Spatial location</th>
<th>your body</th>
</tr>
</thead>
<tbody>
<tr>
<td>hair</td>
<td>grows</td>
<td>on almost every part of your body</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>participant: actor</th>
<th>process:material</th>
<th>Circumstance of location: Spatial location</th>
<th>your body</th>
</tr>
</thead>
<tbody>
<tr>
<td>hair</td>
<td>grows</td>
<td>on almost every part of your body</td>
<td></td>
</tr>
</tbody>
</table>
An example of a relational process: your skin gets more wrinkly as you get older.

Table 2

Transitivity analysis of a relational process using SFL

<table>
<thead>
<tr>
<th>your skin</th>
<th>gets</th>
<th>more wrinkly</th>
<th>as you get older</th>
</tr>
</thead>
<tbody>
<tr>
<td>carrier: possessor</td>
<td>process: relational: attributive</td>
<td>attribute: possessed</td>
<td>adverbial clause of time</td>
</tr>
</tbody>
</table>

The interpersonal metafunction represents the meanings within written or spoken text chosen by a writer or a speaker to construct relationships amongst the participants, namely the author and the reader, or the speaker and the interlocutor. This metafunction is realized grammatically by mood structures, which show the point of view of the author or speaker through declaratives, interrogatives and imperatives. It is also realized through the modality and the tense expressed by the verbal operators (Unsworth, 2001).

Children’s scientific informational texts are quite often written with factual declarative sentences. They present the subject matter in an objective manner. An example taken from “My Body” is “your skin protects your insides and keeps your body at the right temperature” (Pinnington & Lamprell, 2012). According to Pappas (2006) scientific informational texts make use of the general pronouns “everyone” and “your” in order to generalise the topic and not present a personal stance. The tense of the verbs is mostly the timeless present, which is seen as an indicator of factual information.

Modality represents the degree of inclination, obligation, probability or usuality
(Unsworth, 2001). Modality is expressed through modal operators or auxiliaries to form an arguable proposition presented as indeterminacy. Children’s scientific informational texts aim to provide accurate factual information (Duke, 2000) thus narrowing the use of modals within these texts. The limited use of modals in scientific informational texts intensifies their scientific modality.

The textual metafunction involves the organisational and cohesive patterns within a text. These patterns are organised grammatically by the theme / rheme system. The theme is usually the subject found at the beginning of a clause, the rheme is the rest of the clause which builds up around the theme (Halliday, 1994). Cohesion in children’s scientific verbal texts is established through co-referentiality (Pappas, 2006) “Your bones keep your body parts together and help you move. They help protect your insides, too” (Pinnington & Lamprell, 2012). Since ‘your bones’ and ‘they’ are identical in reference, their co-referentiality makes up a cohesive tie. Pronouns are used abundantly in children’s scientific informational texts eliminating the continuous need for repetition. Cohesion is also established through conjunctions, for example the use of ‘and’ for addition, and temporal relations or causal relations, for example explanations or procedures.

In *Language as Social Semiotics* Halliday (1978) argues persuasively that SFL is a theory of social semiotics. Semiotics, elaborated on in the previous section, is the study of signs. How people use language and the social functions they put it to, shapes its semiotic resources. From here, SFL has lent itself useful to the study of non-linguistic modes of communication like gesture (Hood, 2007), music (VanLeeuwen, 1999), and visuals (Kress & VanLeeuwen, 1996; 2006), which shall be elaborated on in the next section.
2.4 Functional Semiotics – The Visual Mode

The work of Kress & Van Leeuwen (1996; 2006) and their functional “Grammar of Visual Design”, offers a model of visual grammar, which is drawn primarily from work in systemic functional linguistics. This model allows for the analytical and critical viewing of visual images, and adopts from systemic functional linguistics the same meta-functional organization of meaning-making resources (Unsworth, 2001).

The first metafunction conceptualises that images realize representations of material reality. In doing so, they construe ideational meanings and the circumstances in which they occur. Examples of such images in scientific informational texts are those that “classify”; these images organize participants into certain categories (Unsworth, 2001). Another example is the scientific diagrams that adopt abstract pictorial symbols like the diagram of the layers of skin in DPS1 (see appendix E).

The second metafunction conceptualises interactive meaning. It positions the readers in regards to the text. Photographs are found abundantly within the science domain and many scientific informational texts use photographs to depict aspects of realism and naturalism. These photographs also depend on colour to create strong effects on the reader.

The third metafunction deals with compositional meaning. Compositional meaning is concerned with how the information value is distributed among the verbal text and image. When reading a scientific informational text we cannot assume that it should be read from left to right as with written English language. These texts rely heavily on images and visual emphasis that allow them to be positioned anywhere on the page from left to right or top to bottom (Unsworth, 2001).
Students nowadays make meaning in multimodal ways by comprehending the written word as well as visual elements (New London Group, 1996). Multimodal learning theory (Jewitt, 2008; Kress, 2003) recognizes the shift in literacy and literacy learning between writing and images (Kress, 2003).

Each mode has its own affordances and thus is better suited for some tasks but not others. In a scientific informational text, language affords a way of expressing scientific ideas or concepts that is different to that afforded by images (Kress, 1997). Knowledge of each mode’s affordances and limitations within the context of their culture is what allows us to choose one mode over the other to suitably express a message (Jewitt & Kress, 2003; Unsworth, 2001). Scientific informational texts deploy both the linguistic and visual mode when communicating their message to the reader by interacting and complementing one another in an integral way to convey the global message.

2.5 Multimodal nature of Science Informative Texts

The theory of multimodality is grounded in social semiotics. Social semiotics is the study of how people design and interpret meanings, and how the modes interrelate together in texts to create overall meaning (Kress, 2010). Complementing the multiliteracies theoretical approach (New London Group, 2000), multimodal theory acknowledges that meaning making can no longer be accepted simply as a linguistic process, but is a multi-semiotic one.

Multimodality highlights the importance of taking into account other semiotic systems beyond language (Iedema, 2003). The relationship between multimodality and social semiotics lies within the depiction of the sign systems as modes, which are also considered resources for meaning (Kress, 1988). Embraced within the multiliteracies
theory, multimodality accounts for the multiplicity of meaning-making modes and how they work together in communicative acts for the sole purpose of meaning-making.

Jewitt and Kress (2003) argue that modes “rarely, if ever, occur alone” (p. 2). This is the first assumption that underlies multimodality (Iedema, 2003; Jewitt & Kress, 2003). Meaning making is not solely reliant on one mode, rather “each plays a discrete role in the whole” (Jewitt, 2008, p. 247). The second assumption is that all modes have the same significance in a representation. Multimodality emphasizes the simultaneous synthesis of all the modes within a semiotic representation. Therefore, any one mode can rarely function on its own within any communication and thus multimodality assumes a “process of synaesthesia” (Kress, 2003, p. 36). The third assumption assumes that while all modes are synthesized simultaneously, some are fit for particular tasks than others, because “not every mode will be equally usable for a particular task” (Jewitt & Kress, 2003, p. 3).

When applying an understanding of multimodality to the area of scientific representations of knowledge for young children, a number of issues are important to consider. Children’s scientific informational texts particularly utilise the importance of graphics, whether illustrations, charts or photographs, as a means of helping students to understand and comprehend the technicality of the vocabulary within them (Fingeret, 2012). They also include “minor text” such as labels, captions, keys, dialogue or other wording found in illustration (Unsworth, 2001), which Pappas (2006) terms as “illustration extensions”.

For the purpose of this research study, the term ‘graphics’ will be used to refer to the visuals of science informational text (Fingeret, 2012). Fingeret (2012) defines a graphic as “a picture or image of any kind that conveys information. It is not merely a decorative illustration or other type of image, although it may be aesthetically pleasing”
For example, a map of Sydney, a water cycle, a timeline showing how fossils are formed. These graphics are presented in a range of media and design layouts (Hassett & Curwood, 2009). The use of graphics is notable in scientific informational texts as they provide students with concrete ways of looking at concepts and processes (Unsworth, 2001).

These visual features are also crucial in helping children to make links between the linguistic and visual texts. The synergistic relationship between the linguistic and the visual modes of scientific informational texts (Lemke, 1998; Unsworth, 2010) indicates that these texts employ multimodal representations. This synergistic interaction between the text and the visuals in scientific informational texts provides students with enhanced understandings of content that cannot be established by a single mode on its own. According to Kress (2001), “What is taken in one mode interacts with what is taken in other modes via other senses” (p. 7). Therefore, scientific knowledge cannot be achieved through a monomodal process, but a multimodal one.

Scientific informational texts written for children are multimodal because they make use of their visual design features to support children’s understanding of concrete and abstract ideas and concepts, rendering visual literacy as an important skill for children as well as adults to acquire (Kress and Van Leeuwen, 2006).

Pappas (2006) argues that learning to read scientific texts requires the reader to make sense of the words, images and the relationship between them, and in doing so develops a process of constructing scientific meanings from multimodal signs (Kress, 2001). Therefore, when students in the primary years make meaning of scientific texts they engage in using multiple sources of representation (Pappas, 2006). Visuals and print are combined to make meaning, and it is vital for students to understand how the resources of language and image can be deployed independently and interactively.
Teachers must be capable of facilitating students’ knowledge and understanding of the image and verbal text relationship (Britsch, 2013).

Multimodality and social semiotics have been applied across a range of educational studies. The area of informational texts, particularly scientific texts, has been the focus of a number of studies over the past fifteen years. These include students’ understanding of the importance and value of combining scientific visuals with writing (McTigue & Flowers, 2011), young students capability of producing scientific informational text including verbal text along with visual representations, explanation processes and comparisons of ideas (Bradley & Donovan, 2010; Coleman, Bradley & Donovan, 2012); scientific informational texts use of both linguistic and visual features in an interrelated and complex way allowing for their multimodal designs (Gill, 2009; Pappas, 2006; Unsworth, 1997); children’s comprehension processes prompted by graphics in scientific informational text (Norman, 2012); and students’ representations of science content primarily in visuals (Kress, 2000). The summary of the research above shows that young students can understand the importance of interrelating visuals with language within scientific texts, but still need explicit instruction in how to analyse and interpret them.

Research on scientific informational texts within the early years of schooling is still quite limited. Two studies that were found to be particularly pertinent for this research focus on work in early years setting. Smolkin and Donovan (2004) contend that in order for students to have a better understanding of scientific informational texts, teachers must present both the visual and the verbal content, not just the verbal content alone. This “enhanced comprehension” (p. 207) is attained from the conceptual understanding garnered from both modes, where each mode adds information not necessarily communicated in the other. In a second study to explore whether or not
young students are able to express multimodal understandings of scientific informational texts, Varelas, Pappas and the ISLE Team (2006) demonstrated using a social semiotics perspective, that young students are in fact able to comprehend multimodal features of science concepts through the interplay of both the verbal and visual modes. They were specifically found to use the modes in relation to each other through redundancy (where the linguistic and visual mode correspond completely or partially), complementarity (a new element is introduced in either the visual or linguistic mode) and elaboration (one mode explicates the other without introducing any new elements) (Kress & VanLeeuwen, 1996; 2006; Unsworth, 2001; 2010).

Classroom based research on the use of scientific texts has implications for current teacher professional knowledge and practice. The new NSW English syllabus, which was implemented in the 2014 school year requires that teachers use both literary and information texts within their classrooms (Board of Studies, 2013), but fails to provide a detailed description of each of the terms. While previous NSW syllabus (Board of Studies, 1998) outlined various factual text types, the new syllabus uses the broad category of ‘informative’. This assumes that teachers will have some knowledge about various information text types and how to teach them in the classroom.

Given that the previously cited research on children’s multimodal scientific texts shows their complexity (Pappas, 2006), teachers’ own knowledge about how these types of texts make meaning will play an important part in their literacy teaching. This study examined the way Australian primary school teachers’ understand scientific informational texts linguistically and visually, and how they interrelated and incorporated these modes of meaning into their literacy teaching.
Research on the pedagogical methods for teaching scientific informational texts is still in its infancy. The next sections will discuss the available literature around the pedagogical applications of scientific informational texts.

2.6 Understanding and Teaching About the Linguistic Mode of Science Information Texts

Knowledge about written language plays a key role when working with multimodal science texts. Science discourse is known as “expert” or “uncommon-sense” knowledge (Unsworth, 1991). Scientific informational texts have a high lexical density and rely on grammatical metaphors or nominalizations (Unsworth, 1997). Scientific informational texts supply children with specialized vocabulary that are related to the concept that is being examined; in doing so these texts empower the young readers with lexis which will be of great use as they move along in their schooling. They also call upon different types and levels of comprehension (Donovan & Smolkin, 2002). Cohesion in scientific informational texts is established through co-classification chains where classes of nouns are referred to with a pronoun “them” and “their”. These texts employ the use of the timeless present tense and the relational processes of attribution, identifying and possessiveness (Pappas, 1991).

Researchers have long called on teachers and educators to include scientific discourse early on in students’ schooling (Christie, 1989; Lemke, 1990; Pappas, 1991; Unsworth, 1991). As early as 1987, Frances Christie pointed out the importance of initiating primary students into scientific discourse, with Donaldson (1989) and Unsworth (1991) likening the situation of providing young children with access to a scientific English, which may afford them the tools necessary for the written mode of language as they move forward in their schooling (Unsworth, 1991). In a more recent
study Pappas (2006) claimed, “Children cannot truly learn science unless they also learn the distinctive language of science” (p. 246).

In much earlier research, Pappas (1993) drew significant attention to the abilities of kindergarteners to comprehend informational texts. Her study shed light on how these students were not only capable of sustaining the functional features of co-classification within the informational texts, but were also capable of differentiating between the specific lexis of narratives and that of informational texts. Pappas noted that the students were very successful in re-enacting the discourse patterns of these texts and pretend read them with as much skill as they would narratives. Thus, in order to broaden students’ use of scientific language, according to the study findings, it is essential that teachers allow their students chances to interact and use scientific informational texts just as they would narratives. Even though the study was undertaken in one school in the United States, henceforth the USA, and on a small number of young students, nevertheless the findings shed light on a then neglected area within literacy research. It showed that young children in the early primary grades have the capability to learn the distinct features of informational texts if they are provided with opportunities to interact with them.

Children not only comprehend scientific informational texts, they also have the ability to reproduce or re-enact them. In a study with twenty students from a year 1 classroom, Moss (1997) showed that eighteen were capable of producing accurate retellings of the informational texts that were read to them at a level of 3 or more out of 5 on the challenging richness of retelling scale. Both the Pappas (1993) and the Moss (1997) studies provide teachers and educators with incentives to provide students with opportunities to work and interact with informational texts.
A growing number of studies have provided evidence of the benefits of exposing primary children to informational text (Maloch, 2008; Maloch & Bomer 2013a, 2013b; Morrow, Pressley, Smith & Smith, 1997; Pappas, 2006; Saul & Dieckmann, 2005; Unsworth, 1991, 1997). However, other studies across primary grades have demonstrated that there is very minimal exposure to informational texts signifying that teachers choose far less informational texts than narrative ones (Christie, 1987; Duke, 2000; Jeong, Gaffney, & Choi, 2010; Ness, 2011; Unsworth, 1991). The seminal work of Duke (2000) in the USA argued that minimal exposure to informational books within the early primary grades could be seen as a threat to the students’ “semiotic capital” (p. 255) later on in their academic lives. Duke (2000) observed twenty year 1 classrooms in the Boston area and found that on average only 3.6 minutes per day were dedicated to explicit teaching of informational texts.

A decade later, Jeong et al. (2010) conducted a similar study to Duke’s (2000) in 15 primary grade classrooms. Jeong et al. (2010) used the same data collection procedures as the Duke (2000) study. They found that although a slight increase of informational texts were being presented and used within the early primary grades, narrative texts still dominated the second, third and fourth grades. Ness (2011) surveyed 318 teachers in order to provide an updated insight into whether or not teachers are still presented with instructional challenges when it comes to teaching students in the primary grades about informational texts. Ness found that an average of 33% of the books in the classroom libraries were informational and that teachers spent an average of 32 minutes a day with informational texts. Both the Jeong et al. (2010) and the Ness (2011) study demonstrated that while teachers in these later studies had an increased use of informational texts compared to the Duke (2000) study, these teachers were still
far from understanding the rich literacy opportunities, including multimodal and vocabulary implications, that these books bring into the primary classrooms.

In a quest to try and enhance their understanding of primary teachers’ perspectives towards science information texts, Smolkin and Donovan (2001) set up a half-day workshop in order to investigate the types of texts teachers used during science instruction, along with their assumptions about these texts. Teachers kept on stating that these books were too difficult to read out to their students, as well as boring and “unfun” (p. 435). The participant teachers were tempted to choose scientific information books that were presented in a story genre format claiming that these would be more fun and appealing to their students. In doing so, the researchers noted that the teachers were not attending to the functional grammatical, nor the generic features of these books. Even though the study was quite small with only a handful of participants, nevertheless, Smolkin and Donovan’s work here suggests that teachers need training in selecting and using informational texts in their literacy lessons.

In Australia, limited research studies have looked at how teachers incorporate linguistic knowledge into practice, and the research that does exist indicates the inadequacy of teachers’ grammatical knowledge and its teaching (Hammond & Macken-Horarik, 2001; Harper & Rennie, 2009; Jones & Chen, 2012; Myhill, 2005).

From the literature reviewed here, it can be argued that the complexity of the language of scientific informational texts needs to be explicitly taught to primary school children, and if the understanding of language by teachers is not supported by their abilities to use a common metalanguage to talk and explain these texts, then students’ development in comprehending the language of science texts may be limited (Macken-Horarik, Love, Unsworth, 2011). With this in mind, this research sought to take a closer look at how teachers interpret language features within a scientific informational text,
thus providing researchers and educators with more information on how language is being used and shared within teaching contexts.

2.7 Understanding and Teaching About the Visual Mode of Science

Information Texts for Children

Working alongside knowledge about written language is the visual mode of scientific informational texts. Work on visual literacy is steadily growing (Styles & Arizpe, 2003; Callow, 2010; Walsh, 2003). The way that many people read, experience, and construct beliefs about the world is highly impacted by images and other visual representations (Albers, 2008).

Many researchers have provided definitions of visual literacy, (Kirrane, 1992; Simpson, 2005; Sinatra 1986; Stokes, 2001; Wileman, 1993). According to Wileman (1993), visual literacy is “the ability to read, interpret and understand information presented in pictorial or graphical images” (p. 114). Sinatra (1986) equalled visual messages to their written counterparts, in that they both convey particular messages using particular styles, and are both readily understandable by the viewer. Stokes (2001) notes that visuals in the different content areas yield positive learning results, and adds that they are not effective unless teachers carefully plan how to use them efficiently in the classroom. Teachers who educate their students to understand visual meanings empower their students with tools that are necessary for the changing educational environment. These definitions link powerfully to the theory of multiliteracies (New London Group 1996; 2000), since students and teachers alike now have to be competent in more than just the linguistic mode of communication in order to thrive within their educational settings.

Systemic functional linguistics has provided some very helpful concepts for
analyzing and understanding how images construe meanings, as shown in an earlier section of this thesis, therefore this study will seek to use this grammar. The study will also draw on other studies that use some different theoretical backgrounds and terminologies, for example, as stated earlier in this chapter the term graphics as defined by Fingeret (2012) will be used. Multimodality emphasizes the interrelatedness of modes of meaning. The Australian curriculum urges teachers to integrate multimodal texts into their teaching. The curriculum provides explicit references to multimodal texts along with visuals and other modes of communication throughout the content descriptions in each one of the three English strands - language, literature and literacy (ACARA, 2013). The application of this knowledge in the classroom is also a focus of this study. Currently there are a limited number of studies which detail this type of work in Australian contexts (Cloonan, 2011; Callow, 1999; Walsh, 2003), but the limited studies suggest more research is necessary to better understand how multimodal texts, particularly in primary science, are used in the classroom.

In NSW, teachers are expected to address graphical representations and provide explicit scaffolding for their students of the varying types of graphics presented to them in informational texts. The NSW syllabus document (2013) states that students in early stage 1 and stage 1 be made familiar with both literary and informative texts; yet the specific term graphics is only mentioned within the stage 1 content descriptor of ‘Understand and apply knowledge of language forms and features’ as being able to understand simple explanations in diagrammatic form; and proceeds to provide teachers with examples of these as being flowcharts, hierarchies and life cycles (NSW English syllabus, 2013, p. 66).

To date little is known about how teachers present graphical information to
primary age students when reading scientific informational texts. The most salient studies for this research focused on observations in the primary grades. For example, the observation of a primary grade teachers’ reading from a science text allowed researchers Smolkin and Donovan (2004) to note that students were rarely guided through the navigation of the multiple graphics. Even though the science book displayed a multi-graphic layout with cross-sectional diagrams and a map, the teacher focused the students’ attention to the most salient graphic without addressing the meaning that the other visuals presented to the students’ understanding (Smolkin & Donovan, 2004).

In a more recent attempt to identify how teachers present science graphics to their primary students, Coleman, McTigue and Smolkin (2011) surveyed 388 teachers across the USA asking them to provide details on how they applied graphical instruction in their classrooms. The findings showed that 65% of the respondents used pointing as a means of instructing students about the graphics. This finding also shows that teachers’ explicit teaching of graphics is still limited. It also sheds light on their limited knowledge of how to explicitly teach about graphics.

Similar research in Australian contexts is limited, hence the need to explore it further. While there are some studies that focus on the analysis of science texts for children (Unsworth, 1997), there are currently no specific studies on how teachers in early years classrooms teach about the multimodal nature of scientific texts. The forthcoming section discusses some pedagogical practices of scientific informational texts.
2.7.1 Pedagogical Practices

Graphics have not always been prominent within children’s scientific informational texts. Scientific informational texts now offer an equal display of verbal and visual information, creating a shift towards a more multimodal approach (Callow, 2010; Kress, 2003). This multimodal shift possesses endemic challenges for most young readers who have limited science experience (McTigue & Slough, 2010). Teachers need to be prepared for pedagogical changes in how much and what types of support students need (Callow, 2010; Roberts, Norman, Morrison, Martin & Knight, 2013).

A number of studies argue that most students will not be able to understand the synergistic visual-verbal relationship without providing them with the skills and knowledge to do so (Callow, 2010; Coleman, Bradley, & Donovan, 2012; Coleman & McTigue, 2013; Gill, 2009; McTigue & Flowers, 2011). These studies encourage teachers to explicitly point out the various graphical and linguistic features in texts as they explain and critique them in their classrooms. They also need to explicitly detail how the multimodal features might be used effectively and purposefully in students’ own design and text creation (Callow, 2010).

According to Coleman & McTigue (2013), teachers should help children use and understand scientific informational texts by explicitly explaining and showing them how to navigate these visually complex texts. They also suggest that explicit instruction in the coordination of the visual and linguistic modes is needed for students to be able to unpack both these modes. They stress that teachers need to emphasize the importance of the visual information and should model to their students how this information is interpreted. Roberts et al. (2013) also propose a number of techniques similar to those that are used for teaching about print and which teachers can use to explicitly teach
about graphics. One common technique that researchers stress is providing students with opportunities to create and produce scientific informational texts themselves (Coleman, Bradley, & Donovan, 2012; Coleman & McTigue, 2013; Roberts et al. 2013).

Students should be provided with the skills to read and comprehend both the graphics and language in scientific informational texts early on in their schooling. In some cases, teachers were found to inadvertently steer their students away from looking at the graphics in an effort to have them look at the words (Roberts et al., 2013). The importance of teachers’ own knowledge of the context, purpose, and visual and textual features of the text plays an important role in how students are taught to understand multimodal texts (Macken-Horarik, Love, Unsworth, 2011).

2.8 Generic Structural Potential of Scientific Texts

The work on genre has been greatly influenced by work in systemic functional linguistics (Hasan & Halliday, 1985). Functional linguists have studied the regularities that arise in texts – oral and written - within their contexts from a social semiotic view, and have discussed the structural elements within these texts. Genres are social acts (Pappas, 2006). Halliday argues that language should be studied and understood in terms of its uses and functions in society (Pappas, 2006). According to Halliday, language changes according to ‘register’ where meaning is realized in language and shaped in terms of the context; where the field (topic of writing in this case science), the ‘mode’ (medium of communication in this study it is written), and the ‘tenor’ (style of the discourse) are all involved (Hasan & Halliday, 1985).

Building on the theory of register, Hasan (1985) proposed a theory for generic analysis. The features of register (also known as contextual configuration), were used in her analysis, to make predictions about the linguistic text structure, the sequencing, and
the ordering of the elements within a genre. She also proposed that every genre has a
generic structure potential made up of a combination of three elements placed in a
linear fashion and a certain order or sequence. These elements are either obligatory
(they define the genre to which a verbal text belongs), optional (these elements may
account for the variations in verbal texts that belong to the same genre), and recursive.

Pappas (2006) identified the obligatory and optional global elements realized by
particular elements within scientific informational texts for children. She built her
analysis using Hasan’s (1985) generic structural potential (GSP) theory to describe the
various possible realizations of the genre. Pappas identified four obligatory elements
within scientific informational texts and eight optional elements. These are presented in
figure 1 adapted from Pappas 2006. For a GSP analysis of the scientific informational
text used within this study see appendix A.

\[
\text{(PRE)} \ ^* \ [\ < \ TP > \ ^* \ (< \ DA > \ ^* \ (< \ CE > \ ^* \ (< \ CC > ))) \ ] \ ^* \ (HV) \ ^* \ (EI) \ ^* \ FS \ ^* \ (AD) \ ^* \ (A) \ ^* \ (RC) \ ^* \\
\sim \ (< \ ILLEXT > )
\]

PRE: prelude (optional)
TP: topic presentation \textbf{(obligatory)}
DA: Description of Attributes \textbf{(obligatory)}
CE: Characteristic events \textbf{(obligatory)}
CC: Category comparison (optional)
HV: Historical Vignette (optional)
EI: Experimental idea (optional)
FS: final summary \textbf{(obligatory)}
AD: addendum (optional)
A: Afterward (optional)
RC: recapitulation (optional)
ILLEXT: illustration extension (optional)

\textit{Figure 1. Generic Structure Potential adapted from Pappas 2006.}
Martin and his colleagues (1987) critiqued Hasans’ classification of genre and register and provided an alternative formulation. Martin, Christie, & Rothery (1987) asserted that genre shapes the language choices in a verbal text according to the context of culture, and not the context of situation.

According to Martin et al. (1987), genre is a ‘staged, goal oriented social process’. Martin, Christie, & Rothery explicate this definition by stating that genres are social because “members of a culture interact with each other to achieve them; as goal-oriented, because they have evolved to get things done; and as staged, because it usually takes more than one step for participants to achieve their goals” (Martin et al., 1987, p. 51).

Martin’s genre model has been very influential on literacy education and literacy pedagogy within Australia (Christie, 2008). This model was applied to educational contexts in order to extrapolate the most common genres along with their generic structures or stages (Unsworth, 2001). For example, in work on the verbal texts of science, meanings are distinguished through the specific language used and which corresponds with the genre chosen to present the scientific meanings (Martin, 1989).

Mastering the most frequently appearing generic forms is considered to be an important part of schooling (Cope & Kalantzis, 1993; Martin, 1989). Genre theory provides a model that stresses the explicit teaching and identification of the stages of the target verbal text or ‘genre’ (Christie, 2008). According to Pappas (2006) the way that a particular book realizes the properties of the global text structure potential may be an important factor for primary grade students, especially in the early stages of learning about its structure and uses.
Pappas’ generic structural potential of scientific informational texts was utilised when considering children’s science books as a whole. Pappas’ framework enables the recognition of a typical “scientific informational book” as opposed to any other book containing scientific content. Her framework provided a criteria which helped to select an early primary grade level scientific informational text. It also provided a criteria for the verbal text as the basis for the teacher interviews which will be elaborated on in chapter 3. These texts are often made up of smaller examples of different genres or text types and often accompany graphics. Pappas’ framework acknowledges these smaller generic structures as illustration extensions. Therefore, in order to analyse the different genres on each page Martin’s genre theory was incorporated (appendix A). Teamed with Pappas’ framework, Martin’s genre theory will also be adopted as part of the analysis for this research.

As such, the focus of this research project was to explore how primary teachers understood the interrelation between the visual and written modes of meaning within children’s scientific informational texts, and how they presented and taught these texts in their early year’s classrooms. The literature suggests that graphics play a prominent role in scientific informational texts created for young children (Fingeret, 2012; Pappas, 2006), yet little research exists on instructional approaches to teaching children how to comprehend graphics (Roberts et al., 2013).
3.0 Methodology

3.1 Introduction

The purpose of this study was to discover how six participant teachers understood and presented pedagogically, the language and graphical features of scientific informational texts within their early stage 1 and stage 1 classroom. Due to this purpose, the research adopted a qualitative approach guided by an interpretive case study method of inquiry (Merriam, 1998; Yin, 2003). The researcher took on an enquiry role rather than a participatory one.

3.2 Philosophical Assumptions

There are several philosophical assumptions that underpin qualitative research (Creswell, 2007). Three of these assumptions most closely guided this study: the ontological assumption (reality as seen by participants is subjective and multiple), the axiological assumption (the research is based on the values and biases that the researcher brings into the study), and the methodological assumption (the researcher uses inductive logic and works with particulars in context before generalizing), (Creswell, 2007).

Qualitative research is most often situated within an interpretive paradigm (Merriam, 2009). A paradigm is the worldview that the researcher takes on to further shape their research (Creswell, 2007). The researcher’s beliefs and feelings about the world and their ideas about how it should be studied guides qualitative research. The paradigm closely aligned with this study is that of the constructivist/interpretive (Creswell, 2007). Interpretive paradigms assume that there are multiple realities of single events (Merriam, 2009). In lending itself naturally to case study designs this paradigm focuses on the specific constructed realities that are provided through the participants themselves.
3.3 Choosing a Qualitative Design

The aim of the study was to gain an in-depth understanding of how primary teachers teach with multimodal science texts in their classrooms, with an emphasis on the visual metalanguage. Thus a qualitative method of inquiry was suitable. The focus and scope of the project precluded classroom observations. The use of a small scale study was appropriate to the scope of the Master of Education criteria.

The qualitative design allowed for the focus on the interpretation of the multimodal elements that the participant teachers brought to the study. It attempts to understand how the teachers interpret and then teach about science texts (Merriam, 1998). Qualitative research allowed the researcher to delve into the experiences of the teachers and to draw on their direct experience and understanding of ‘how’ and ‘why’ they used the graphics of science text within their classrooms (Maxwell, 2005). The interpretive case study allowed for an in-depth understanding of what constitutes teachers’ knowledge about language, graphics and multimodality in science information texts. Interpretivism, aligned with the study in determining how each teacher interacted with the linguistic and visual elements of the scientific informational texts. Interpretivists believe that there are multiple and subjective realities rather than measured ones (Merriam, 2009). Each participant brought into the study their own subjective interpretation of the stimulus that they were presented with. This paradigm is appropriate to reveal how teachers use and interpret the artefacts presented to them (Cohen, Manion & Morrison, 2011).

3.4 Choosing Case Study

The case study was chosen as the main methodology of enquiry (Yin, 2003; Creswell, 2007). According to Creswell (2007) “case study research is a qualitative approach in which the investigator explores a bounded system (a case) or multiple
bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information” (p. 73). The issue presented within the research question can only be addressed by studying kindergarten through grade two primary school teachers and their multimodal understanding and pedagogical use of scientific informational texts within their classes, thus these sources were considered as a singular bounded case study.

Case study research is dependent upon extended, first-hand data collected from the natural environment of the bounded system (Merriam, 2009). This design was chosen because it provides the researcher with insights into ‘how’ primary grade teachers understand and present the multimodal aspects of scientific informational texts. In addition, a case study was chosen because it allows for the interpretation of the phenomenon under investigation; in this case the teachers’ understanding and presentation of multimodal scientific informational texts, rather than hypothesis testing (Merriam, 2009).

3.5 Participants

As a small-scale case study research project using a qualitative research methodology, non-probability sampling was used to select the participants for the study (Neuman, 2003). Since the research had a specific purpose of allocating teachers with certain specific and predefined criteria, then it was appropriate to use purposive sampling (Neuman, 2003).

The use of purposive sampling was decided upon because of its ability to select participants who were capable of providing the research with in-depth investigation about how teachers understand scientific informational texts, linguistically and visually. Two primary schools were invited to take part in the project. School principals invited members of their kindergarten to grade two staff to participate in the study. Participant
information sheets detailing the study and procedures were handed out (see appendix H). Teachers who were interested were given a participant consent form (see appendix G). Three teachers from each school volunteered to participate in the project. Table 3 provides a demographic detailed summary of the participating teachers.

Table 3
**Demographic Details of Participants**

<table>
<thead>
<tr>
<th>Participant and school</th>
<th>Grades currently teaching</th>
<th>Years of teaching experience</th>
<th>Background information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant 1 School A</td>
<td>Kindergarten/year 1 composite class</td>
<td>3 years</td>
<td>Attended visual literacy workshops and lectures.</td>
</tr>
<tr>
<td>Participant 2 School A</td>
<td>kindergarten</td>
<td>3 years</td>
<td>Started off as a casual at the same school teaching 5/6 composite class.</td>
</tr>
<tr>
<td>Participant 3 School A</td>
<td>2</td>
<td>2 years</td>
<td>Finding this year challenging due to the large range of learning abilities between students.</td>
</tr>
<tr>
<td>Participant 4 School B</td>
<td>2/3 composite class</td>
<td>8 years</td>
<td>Taught all the primary grades from 1 to 6. Currently assistant principal.</td>
</tr>
<tr>
<td>Participant 5 School B</td>
<td>Year 1</td>
<td>Six months</td>
<td>Previously worked as a cultural worker for the German government researching online documents.</td>
</tr>
<tr>
<td>Participant 6 School B</td>
<td>Kindergarten/year 1 composite class</td>
<td>15 years</td>
<td>Taught all the classes between kindergarten and year 6. Currently relieving as an Assistant Principal.</td>
</tr>
</tbody>
</table>
3.6 Site and Context

Two schools were selected for the research located in the greater Sydney region. Both schools were coeducational with a diverse socio cultural population. The site of the study was on the participating school grounds. The hours chosen for the study were at the end of a typical school day, in periods that did not conflict with classes or study time.

3.7 Data Collection Methods

Qualitative case study research designs employ “multiple sources of information” (Creswell, 2007) in order to allow rich detailed data to be collected and analysed. Data for this qualitative study was collected through semi-structured interviews, annotated texts, interview observation and field notes. Data was collected in the second school term over two non-consecutive weeks.

3.7.1 Semi-structured interviews.

The first source of data was the semi-structured interview (appendix B). According to Merriam (2009) interviewing is necessary when the researcher seeks to understand how participants make sense and interpret certain artefacts within the world around them. Interviews allowed the researcher to delve into the participants’ understandings and interpretations of the linguistic and visual modes within scientific informational texts. It also allowed the researcher to gain insights into how teachers have used these books in their daily literacy routines in the past.

The interview was conducted face-to-face, one with each participant. Interview questions were used to identify participants’ understandings of language and graphical features of scientific informational books, and the interrelation of these modes. The semi-structured nature was chosen because it allowed the researcher to clarify the questions during the interviews. Semi-structured interviews are also flexible and
adaptable and allowed the researcher to gain understanding through participants’ non-verbal cues (Creswell, 2012; Merriam, 2009).

3.7.2 Annotated pages of science information books.

On completion of the semi-structured interview, teachers were given a scientific informational text and asked to read through it. A variety of texts were considered for the study, many of which were suitable. The scientific informational text “My Body” (Pinnington & Lamprell, 2012) was chosen because it met the following criteria; first the topic was found to be appropriate for an early stage 1 and stage 1 (5-8 year old) audience. Second, it followed Pappas’ (2006) generic structure. Third, it reflected recent layout styles of informational texts (Pantaleo, 2007). Fourth, it had a clear selection of multimodal elements such as diagrams, photographs, framing and text. Fifth, it also embedded various genres such as explanation and description. Finally it was published by a well-known and trustworthy publisher, and the author is a credible children’s non-fiction writer.

The participants were advised to read the first ten pages and to take into consideration all the graphical features on the pages. The researcher then chose a page and showed the participants what was meant by annotation. Teachers were then asked to annotate linguistic and graphical features from three pages including one double page spread from the scientific informational book. They were also asked to make verbal observations as they annotated.

The semi-structured interview questions 1, 2, 3 and 4 were revisited after the annotations (see appendix B) in order to contextualise the use of the specific annotated text. The written annotations were also a means of recording data.
3.7.3 **Interview Observations.**

Qualitative research adopts interview observation quite frequently (Maxwell, 2005) as it allows the researcher to gain understanding through participants’ non-verbal cues as they explain their ideas and insights in the interview. Observation was also used as the participants analysed and annotated the scientific informational texts provided for them.

3.8 **Recording the Data**

3.8.1 **Field notes.**

Jotted notes provided the researcher with short, temporary memory triggers that helped in the data analysis. Another form of notes that were used was the Direct Observation Notes, which were written as soon as the researcher left the field (Neuman, 2003).

3.8.2 **Audio taping.**

All interviews and observations were audio recorded to provide extra reliability. Audio taping was also used to help in keeping the researchers observations accurate.

3.9 **Qualitative Data Analysis**

The qualitative data collected was assessed through a five staged model proposed by LeCompte (2000). The data collection procedure and analysis were concurrent. Data was organised and transcribed as soon as it was collected. The analysis utilised the following staged structure:

The first stage was to organize and arrange the raw data into files based on their type (field notes, annotations, interview), and research category (linguistic analyses, verbal analyses, image/language analyses, pedagogical implications). The files were dated and labelled, so as to compare them against the research questions in order to
identify any gaps or missing pieces of data. This stage allowed for an initial assessment of the scope and depth of the data sets.

The second stage was to perform repeated readings of the raw data collected to identify specific items relevant to the research questions (Creswell, 2012). Teachers’ annotations were constantly compared (Boeije, 2002) to one another in order to determine similarities and differences between the analyses. The researcher conducted a formal analysis of the textual, visual and multimodal features of the texts prior to the study. The participants’ annotations were also compared to the formal analysis provided by the researcher (appendices C and D). This allowed identification of the specific linguistic and visual items relevant to the research questions 1 and 3.

In this stage the researcher scanned the data for frequency and recurrence of the items related to the social semiotic framework adopted for the study. Two types of data were analysed. First the textual, visual and multimodal features that were identified by the participants were compared to an SFL informed analysis completed by the researcher (appendices C and D). Second, relevant data pertaining to the pedagogical implications and applications of the textual, visual and multimodal features in the classroom were elicited from the participants. These implications were coded under emerging themes and participant declaration of new items not found within the framework addressed.

The third stage was to organize the initial items into groups or categories by assigning codes adapted from the theoretical framework. The items were categorised according to the systemic analysis extrapolated from the theoretical frameworks using both functional grammar (Halliday, 1985) and functional semiotics (Unsworth, 1997; Kress & VanLeeuwen, 1996; 2006), as well as pedagogical themes. After comparison
of the participants’ annotations to each other, labels were provided in an attempt to name the similarities and differences between the raw data using the formal annotation.

The research acknowledged that new or emergent codes might emerge in stage two and these were also taken into consideration within the categorization of the items. The interviews attempted to reveal these emergent codes along with the predetermined ones. The emergent codes included the ways that teachers stated they used and explained scientific informational texts in their classrooms. Each interview was coded under major headings.

In the fourth step, codes were used to assemble patterns or themes between the data. The data obtained from the participants were read and analysed for similarity between the items, co-occurrence, sequence and triangulation. The final step was to interpret the patterns in order to answer the research questions 2, 4 & 5.

3.10 Validity and Reliability

Triangulation was incorporated in the study through the collection of a number of different data sources and methods in order to give more credibility to the conclusions, and to provide a broader understanding of the research issues (Creswell, 2012). Triangulation among different data sources includes the use of multiple and different data collection strategies (Creswell, 2012). The researcher incorporated semi-structured interviews with participants’ annotations and observations in order to accurately document the findings (Creswell, 2012). Reliability was achieved by cross checking the different data sources for stability or recurring themes and by comparing them to the semiotic framework adopted (Neuman, 2003).
4.0 Results and Discussion

This chapter presents the findings of the data collected from the semi-structured interviews, the textual and visual annotations and the post annotation questions. From the analysis of the data sets, pertinent themes specific to the research questions are discussed below.

4.1 Semi-Structured Interviews

The semi-structured interviews were transcribed, read, coded into themes and then assembled into categories (Creswell, 2007). The following results and discussions present the themes that emerged from the data for the six participants. Most of the themes generated from the interviews aligned with previous literature, as discussed earlier in chapter two, on teachers’ attitudes towards using scientific informational texts within early primary grades. The relevance of teachers’ attitudes and willingness to use these texts in their classrooms plays an important role in how they understand and present them to their students.

4.1.1 Reservations and concerns about using scientific informational texts.

Participants 1, 2, 3 and 4 showed some reservations in using scientific informational texts especially during their literacy periods, because they saw them as too detailed to be taught in the early years. Participants 5 and 6 identified some apprehension regarding the use of scientific informational texts in their literacy periods, but this did not seem to have an impact on their willingness to use them. They explained that it was not an easy task to teach these texts and that these types of texts were too difficult for their students.

The findings that some participants held reservations and concerns about teaching these texts in their literacy hours reflected prior research in the field (Duke, 2000; Jeong et al., 2010). Participants in this study had concerns about the detailed
images on the pages and the mixing of real photographs with diagrams. They also thought that the use of captions and labels along with the photographs and diagrams would be a bit overwhelming for their students.

Four participants emphasized the importance of having and using graphics in scientific informational texts, and two participants even noted that explicitly teaching them to the students would provide beneficial outcomes. As will be noticeable in a later section of this chapter, after the participants were given the chance to read through the scientific informational text a noticeable change of attitude is presented by the teachers’ responses. This inconsistency across their responses shows that these participants have not come across scientific informational texts that are suitable to be read, discussed and taught within their literacy sessions.

4.1.2 Prominence of the narrative.

Four out of the six participants stated that they preferred the narrative to informational texts, especially scientific informational texts within their literacy periods. Even the two participants who mentioned that they read just as many informational texts, only recalled “atypical” informational texts (Pappas, 2006) when asked for some specific titles. For example, one of the participants who mentioned that a scientific informational text would be read out to the class once a day within any subject area, then proceeded to name “The Boy Who Loved Math: The improbable life of Paul Erdos” as an informational text. The text is written in a biographical form and according to Pappas (2006) is considered an atypical information text because it does not follow the generic structural potential of typical scientific informational texts. This participant stated that, “any book that provides information is an information book”.

This finding resonates with previous studies undertaken in the USA that teachers prefer to use narrative texts with their students (Duke, 2000; Smolkin &
Donovan, 2001). From the interviews, participants were found to prefer narratives, or information written in the narrative genre to typical informational texts (Pappas, 2006). This was justified by some of the participants who stated that their students preferred the narrative and would get confused if they were presented with a different genre. This justification by participants 1, 2 and 3 parallels with the ones made by the USA teachers in previous studies (Pappas, 1993; Duke, 2000).

Drawing on a social semiotic perspective, Pappas (1993) argued that it is detrimental to restrict children’s thinking abilities solely in narratives. If these teachers continue to privilege the narrative genre they will limit their students’ potential to learn about the various genres. Perhaps a reason for this favour is that they are not as confident in explaining and teaching informational texts as they are narratives.

4.1.3 Teachers’ perceptions about the linguistic and graphic challenges of scientific informational texts.

Another common theme found amongst the participants that is consistent with the literature, was their opinion that scientific informational texts are too difficult for their students. Two participants explicitly stated this opinion, while the others made remarks about how they would not present “super detailed” texts that are filled with both verbal text and graphics. All six participants seemed very confident that their students would not be able to handle these texts. Participants 4 and 6 in particular spoke about the arrows used in scientific informational texts in general, and how their students would get confused when interpreting the arrows of a lifecycle and those of labels. They explained that the graphic of a lifecycle in general took them quite a while to clearly explain to their students.
Another common assumption inherent within participants’ comments was that the specialised lexis of these texts would be too difficult to explain and thus would not be comprehended clearly by their students. Participant 3 suggested that:

Scientific informational texts contain too many hard words; I just can’t see my students comprehending them. It would take a lot of time and work to explain those kinds of very science-related concepts to them.

These comments point to the participants’ belief that early stage one and stage one students are incapable of mastering the specialised language of scientific language.

The reason that this view may be problematic is because prior studies have found that children in the early years of schooling are capable of understanding the specialised vocabulary of these texts when presented to them appropriately (Pappas, 1991;1993). Children are also capable of comprehending the differing visuals that accompany scientific informational texts (Smolkin and Donovan, 2004). Smolkin and Donovan (2001) argue that teachers’ own confidence and knowledge about these texts plays a crucial role in how they present and teach them to their students. The results of teachers’ own knowledge, discussed later in this chapter, also sheds further light on this area.

4.1.4 Availability of scientific informational texts.

The literature on the availability of scientific informational texts specifically for the primary classes shows that there has been an increase of this particular genre within the past decade (Coleman et al., 2012; Gill, 2009). The participants in this study seemed unaware of the growing number of informational texts available. They just mentioned general science themes of books that they had read about to their students. Participants 1, 2 and 3 stated that they would access scientific informational texts through their school librarian. The librarian would provide them with all the texts that were available
within the school library which relate to the science theme that they would be teaching, and are suitable for their students. Participant 2 explained that:

I would be lost as to whether the books that I find are suitable for my students or not. I don’t want to risk the chance of choosing books that are above my students’ current learning level; that’s why the best way to choose them is to ask our librarian.

Participants four and six mentioned that they were lucky enough to have a small library within their classroom. The presence of their own private libraries allowed them to choose scientific informational texts that they found most suitable for both the theme of the lesson and the learning level of their students. Participant 6 explained:

I have different learning levels ranging from very low to very high, I worked really hard during term one to assess my students’ learning levels and to find books that are suitable for each level. The library in my classroom is custom made to suit all my students. That’s why I try to make do with what I have in the classroom.

Participant five identified using mainly on-line sources for her science lessons. She found that her students interacted more with the lesson and demonstrated more understanding when she presented the scientific concepts such as lifecycles through online science texts. She provided examples of a few webpages that had content related to the major science themes that were assigned for her classroom during the year. One of these webpages was “brain pop” which she mentioned “is a wonderful interactive site that keeps my students busy and is suitable for all levels within my classroom”.

The use of scientific informational texts is linked directly to their availability within the school and classroom libraries. The use of these texts is also tied to teachers’ attitudes towards using these books with their early stage 1 and stage 1 students. Teachers’ lack of expectation that their students will enjoy and comprehend scientific informational texts during literacy periods plays a crucial role in which texts they present and use with their students (Smolkin & Donovan, 2001).
The participants in this study seemed to assume that their students would enjoy reading and discussing mainly narrative genres within their literacy sessions. This assumption seems to be based on the preconception that scientific informational texts are to be presented and taught only in science sessions.

The interviews provided insights into how teachers view scientific informational texts and whether or not they were using them within their literacy lessons. The data revealed that participants held some reservations and concerns about using these texts within their literacy periods. They were also more likely to choose and present the narrative genre more than typical informational texts (Pappas, 2006). Teachers in this study believed that these texts were too difficult for their students linguistically and graphically and they also believed that there were limited numbers of typical information books (Pappas, 2006) suitable for their students.

4.2 Results of Annotations

Participants were asked to annotate two double page spreads, henceforth DPS1 and DPS2 chosen from “My Body” (Pinnington & Lamprell, 2012), (Appendix E and F respectively). They were asked to annotate the textual mode of meaning, the visual mode of meaning, and the multimodal meanings that were established through the integration of these two modes. The annotations were used to complement the interviews. Teachers provided significant textual and oral data as they annotated the double page spreads presented to them. This data supplemented the results of the post-annotation interviews where having completed the analysis of the pages, teachers were asked how they would teach such a text to their students (see appendix B). Teachers were thus presented with a context to work with. Participants found it easier at times to provide oral annotations and explanations along with their written ones, so these were transcribed and taken into consideration within the analysis process. The participants’
annotations were compared to each other in order to map the common themes that were presented. Then they were compared to a formal analysis undertaken by the researcher (appendices C and D). Predetermined codes from SFL (Halliday, 1994) were used to analyse the textual annotations, and predetermined codes adapted from Kress and VanLeeuwen (1996; 2006) for the visual annotations (see appendices C and D for the predetermined codes that were used in the analysis). The following presents the findings and results of the participants’ understanding of these modes within scientific informational texts.

4.2.1 Textual annotations.

The results were coded using the SFL metafunctions and selective grammatical features that Pappas (2006) identified as relevant to scientific informational texts. The structure of the text was analysed drawing on Pappas’ (2006) work. The specific aspects of the three metafunctions ideational (processes and technical lexis), interpersonal (mood and modality) and textual (theme/rheme and references) were analysed for the study. Pappas (2006) noted the use of specific functional grammatical features within a corpus of scientific informational texts. The data analysis of this study shed light on these features within the participants’ textual annotations. Teachers in this study were found to have some basic knowledge, although limited, around the functional uses of language.

4.2.1.1. Ideational meanings.

4.2.1.1.a. Processes. According to Pappas (2006) as discussed previously within the literature review, scientific informational texts generally use material and relational processes in order to represent the two obligatory stages of distribution of attributes and characteristic events. This was clearly observable within the main verbal texts of both spreads. Three of the six participants noted the use of processes within the main verbal
texts on both double page spreads. One of the six participants mistakenly noted that the explanation sequence about breathing DPS 2 used “relational processes” instead of material processes to show relationships between the different steps of breathing. The other two participants annotated the following action processes - ‘grows, protects and breathes’ within both texts DPS1 and DPS2.

Even though it was used incorrectly, only participant 5 used a functional label while the other two participants made no mention of any functional metalanguage although they did use traditional grammatical terms such as verbs, adjectives and nouns. This may be due to their limited knowledge about the different processes and how they function within texts in general (Macken-Horarik, Love & Unsworth, 2011).

4.2.1.1.b. Technical Lexis. Scientific informational texts make use of specialised vocabulary related to the topic being discussed (Donovan & Smolkin, 2002). Scientific informational texts written for older students have a high lexical density (Unsworth, 1997), while those written for a younger audience have limited technical lexis. All six participants identified this feature within both texts DPS1 and DPS2. Each one of them mentioned the use of technical language. Participants 1 and 6 circled the lexical items temperature, protects, breathe and oxygen across both DPS1 and DPS2, and noted above them that these were technical language. Participants 2 and 3 noted that even though the verbal texts contained technical language the particular lexis used was not too challenging for their students. They mentioned that their students would have no problem understanding these terms. In contrast to this claim, participants 4 and 5 mentioned that some of the vocabulary would be a bit difficult for their students and would need a lot of explaining.

The technical and specialised lexis within these texts will be troublesome to the young readers’ comprehension of these texts if teachers do not attend to it appropriately
(Donovan & Smolkin, 2002; Unsworth, 1997). Teachers must be capable of identifying and explaining the specialised vocabulary adequately and in ways that will be beneficial to the age group of their students. Of interest was that the teachers thought the lexis was not too challenging. This finding presents a clear contradiction between teachers’ comments on the difficulty of the lexis earlier in the interviews when they were given the opportunity to read through the book initially for the first interview section. This finding perhaps shows that with concentration, teachers can actually consider the challenges of the texts that they may use.

4.2.1.2. Interpersonal meanings.

4.2.1.2. a. Mood. The clauses of scientific informational texts differ to other genres in that they are generally factual, objective statements. All but one participant noted that the sentences were simple and factual. Participant 2 noted that the main verbal texts were descriptive statements consistent with the formal analysis undertaken by the researcher, where most of these statements were found to be descriptive and declarative. Participant 1 and 4 commented that this factual content did not add any personal or subjective information and hence adds to the objectivity of the clauses. Participant 5 noted that the main verbal texts were written in the third person, but unlike the other four participants this participant noted that it was “a bit personal” in comparison to other informational texts due to the use of the personal pronouns you and your. This participant seemed unaware of the use of pronouns within these texts to generalise the topic.

4.2.1.2. b. Modality. Children’s scientific informational texts are written in a medium to high scientific modality. Modal verbs are seldom found within them, heightening the scientific modality of these texts. Three participants noted the use of the interrogative alongside the salient picture of the three children in the ‘Hair’ text as
inappropriate to the scientific modality of the text. Participant 2 explicitly stated that the interrogative was not related to the scientific information provided in the verbal text. Participant 4 also noted that the verbal text was scientific and argued that the use of the interrogative would distract from the overall purpose of the page.

This finding signifies that teachers were aware of some of the important grammatical features of scientific informational texts. They were quick to notice that the scientific tenor was not very high within the verbal text because it was written for a young audience. While scientific informational texts for older students would be characterized by a higher scientific modality, those written for a younger audience tend to cline towards a medium to low scientific modality (Unsworth, 2001).

The knowledge displayed in the interpersonal analysis supports the findings that these participants did in fact have some ‘functional’ concepts in their knowledge, albeit limited by lack of specific metalanguage.

4.2.1.3. Textual meanings.

4.2.1.3.a. Theme/ Rheme. Theme/rheme is particular to genres. Clauses in most scientific informational texts that belong to either the description or report genre start off by presenting the main topic being discussed, known as Theme, which may be a single noun or a more complex noun group. The rest of the information that builds around the main topic is the rheme (Halliday, 1994). Another common genre found in scientific informational texts is the explanation. This genre uses theme as part of signalling unfolding processes in a sequence. For example, the sequential explanation on DPS2; each clause in the accompanying verbal text begins with each of the themes Air, It and Oxygen respectively. The rest of each clause is the rheme. The clause of the verbal texts in the two double page spreads utilised the theme/ rheme structure (see appendices C and D). Only one participant, however, discussed this concept. Participant
4 mentioned that if she were teaching writing using this text, she would point out to the students that generally the topic would be the first word of the sentence.

In the semi-structured interviews participants 1, 5 and 6 mentioned that they would attend to the structure of the verbal text, developing this statement to explain that the structure includes the use of the title and the topic as the first word in the paragraph. The annotations however, revealed that none of the participants attended to this feature.

Teachers’ knowledge of the structure of scientific informational texts plays a crucial role in how they explain them to their students. Teachers should have knowledge on the theme/rheme aspect in order to explain to their students how a scientific informational text utilises a particular theme to present and organise the concepts that are presented. Teachers would thus be able to develop their students’ genre knowledge along with the awareness about lexicogrammar and textual resources (Unsworth, 1997; 2001).

4.2.1.3.b. Reference. Children’s scientific informational texts make use of co-classification chains where classes of nouns are referred to with a pronoun “them” and “their” in order to eliminate the need for continuous repetition (Pappas, 2006). The texts that were provided to the participants made use of this feature. For example, “Your hair isn’t alive. That’s why it doesn’t hurt when it is cut”. Even though three of the participants mentioned the use of the personal pronouns you and your, only two participants actually noted that the purpose of using these pronouns was to prevent repetition. Participant 6 stated that the use of the pronouns was to allow the students to relate to the scientific concepts of skin and hair on a personal basis.

The finding that only two participants were able to elicit the use of pronouns in the verbal text could be due to the length of the verbal text itself. The verbal texts in younger children’s scientific informational texts are generally limited in length
rendering the use of referencing not as obvious as it would be in scientific informational texts written for adolescents or adults.

4.2.2. Results of genre analysis.

Within the Australian educational context, Martin’s genre theory has been very influential in the literacy domain (Christie, 2008). Participants within this study did not attend to the generic features of the text within their annotations. This finding contrasts to the finding of the interview questions, where most of them mentioned different genres related to informational texts in general. This may have been due to the nature of the task which did not specify which text levels they might annotate. Participant 3 mentioned the use of scientific genres as informational texts, but narrowed them to descriptive genres. Participant 4 had been working on historical recounts about the Australian way of life. Participant 5 stated that she used the recount to explain informational texts to the students. This participant also mentioned that she would introduce historical recounts within subject areas other than literacy, for example math and HSIE. Participant 6 mentioned the use of more than one informational genre including recounts, explanations, procedures and advertisements.

Overall, the participants in this study were capable of distinguishing many of the linguistic and genre elements that make up scientific informational texts. Even though participants provided minimal data on some functional labels, they distinguished most of them and pointed them out within their annotations. Literacy researchers have argued that teachers’ grammatical knowledge needs to be more effective in order for them to effectively teach it to their students (Hammond & Macken-Horarik, 2001; Harper & Rennie, 2009; Jones & Chen, 2012). Current research has shown that teachers’ knowledge and use of language is directly related to their effectiveness in executing this knowledge within their classrooms (Jones & Chen, 2012).
Participants in this study also showed an understanding of the different genres that may be used to write informational texts. Lacking was their ability to execute this knowledge within their annotations. Researchers argue the importance of explicitly teaching the generic features of different texts to students in order for them to master the structure of the most frequently appearing text types (Christie, 2008; Cope & Kalantzis, 1993; Martin, 1989; Pappas, 2006). This result is significant as it could mean that the teachers within this study may not be providing their students with explicit explanations of the different text types that make up scientific informational texts.

In the next section, the results for the participant teachers’ knowledge about visuals are presented. The final sections will bring the visual and verbal analysis together.

4.2.3 Visual annotations.

The visual annotations were coded using Kress and VanLeeuwen’s (2006) visual grammar extrapolated from SFL (see appendices E and F). These predetermined codes fall under the following three meanings - the representational, the interactive and the compositional meanings found within visually multimodal texts. While a full analysis was undertaken across the data, only the most relevant results, as pertaining to the research questions, were presented and discussed due to the word limitations.

4.2.3.1 Representational meanings.

4.2.3.1.a. Visual representation. Children’s scientific informational texts make use of both narrative and conceptual structures of representation. Narrative processes are identified by the action and reactional processes. The visuals of narrative processes make use of the vectors either from participants/objects or eyelines respectively (Kress & VanLeeuwen, 2006). Classificatory and analytical processes however represent conceptual processes rather than actions (Kress & VanLeeuwen, 2006). All the
participants noted the use of processes within both double page spreads either implicitly or explicitly. All but one explicitly noted that the explanation sequence on DPS2 used the visuals to show the reader how the breathing process takes place. Participant 5 developed this by stating that the visuals of the sequence DPS2 show steps and relationships. Participant 6 did not attend to the visuals of the sequence DPS2, but mentioned that the boy with the cross section of the lungs DPS2 had his mouth open indicating that he is breathing. This was considered an implicit statement referring to the process of breathing represented within the visual. As for DPS1, only one participant mentioned that the visual representing the cross section of the skin was used to show how the layers of the skin work. As for action vectors, these were not attended to within the annotations. The only mention of vectors was from participant 2 during the oral observations where she mentioned that the hairs represented on the layers of the skin cross section in the DPS1 formed vectors aimed at the main verbal text directing the reader towards it. However, her identification of vectors was not on a particular process, but directionality of a reading path.

Overall, participants provided comments on the processes presented within some visuals. However, they did not label specific types of processes presented by these visuals. This finding shows that participants are aware of the importance of explaining the meanings represented within the graphics of scientific informational texts. Teachers’ knowledge of the processes of visuals are important because they provide students with tools to analyse the way the actors and goals in a graphic, act towards one another (Kress & VanLeeuwen, 2006).

4.2. 3.1 b. Accuracy of analytical images. Analytical images may in some cases provide accuracy as to the size and relative location of the possessive attributes (Kress & VanLeeuwen, 1996). This was clearly presented within the cross section of the lungs
in DPS2 where an analytical diagram of the lungs was presented within the body of the boy breathing. The diagram of the lungs was accurately represented according to its size and location. Both participants 4 and 6 noted this feature of the cross section of the lungs. They both noted in their annotations that this image provides the reader with the location of the lungs and what they look like.

Scientific informational texts are generally factual texts and must provide accurate information to their readers. The finding that two participants were capable of noting that the graphic of the lung is accurate according to location and size may be an indicator that the participant teachers are not aware of the importance of deliberately deriving specific details and information from visuals that are not found within the verbal text.

4.2. 3.2 Interactive meanings.

4.2.3.2 a. Visual demands and offers. Graphics within children’s scientific informational text may be naturalistic photographs or diagrams. In the case of naturalistic photographs, these graphics may present human participants whose gaze is either directly aimed at the reader, or at some other phenomenon within the graphic (Unsworth, 2001). Diagrams that do not present human participants generally offer a more objective engagement (Unsworth, 2001). Three participants noted the use of the demands and offers that form the interactive meanings. Both participants 1 and 6 mentioned explicitly that the photograph of the three children on DPS1 was a demand. Both participants focused mainly on the blonde girl within the picture. Participant 1 also noted that the boy in the call out box DPS1 was an offer. Participant 2 mentioned that the boy in the call out box DPS1 was looking away from the reader but did not state any specific visual metalanguage related to this phenomenon. Participant 1 was the
only participant to also note that in DPS2 the graphic of the boy with the cross section was a demand.

While these three participants noted the use of “demand” and “offer” implicitly or explicitly, only two of them made the connection to the purpose and meaning of these terms. Participant 2 noted that the boy in the call out box on DPS1 was looking away from the reader and up at the hands holding the scissors in order to lead the readers’ eyes towards the main phenomenon being presented. Participant 6 mentioned that the blonde girl on DPS1 was smiling at the readers inviting them to look at her and interact with the picture.

Participants who understood offer or demand may be more likely to use this knowledge to support young readers when teaching scientific informational texts. In terms of pedagogy, while some teachers understood verbal and visual elements, it did not necessarily flow into them saying that they would use it explicitly when teaching. Of interest in the pedagogical section later on in this section, was that some teachers did not explicitly link back to the knowledge they demonstrated in this section.

4.2.3.2. b. Social distance. In scientific informational texts, shot distances are likely to be used to highlight the features and details of the scientific phenomenon being presented rather than an emotional connection with the viewer. Four participants noted the social distance of some of the graphics. Participants 1 and 3 both mentioned that the graphic of the three children on DPS1 was a close up. They both also noted that the visual of the girl on DPS2 was a close up shot. Participant 1 went on to mention that the sequence DPS2 was also a close up shot, and that the main visual of the boy was a medium shot. Participants 3 and 5 also noted that the cross section of the skin on DPS1 was a close up shot. Participant 2 mentioned that the graphic of the goosebumps on DPS1 was a close up shot.
An important finding was that these four participants also understood that these shots served to highlight the details. They noted that this was to enable the reader to see these details magnified in order for the students to comprehend the concept being presented within the text.

4.2.3. 2. c. Point of view. Children’s scientific informational texts may make use of cross sections, which are pictured from differing angles in order to provide the most accurate representations for their readers (Pappas, 2006). These graphics use side and frontal planes at eye level views in order to present their participants to the reader. The purpose of the author in using an eye level view in graphics other than cross sections and diagrams is to create a friendly and equal status with the reader (Unsworth, 2001). Participant 2 was the only participant to mention this interpersonal feature within the annotations. This participant mentioned that the graphic of the three children on DPS1 was at eye level with the reader, and that the children were all smiling. This participant also noted that the graphic of the boy in the breathing page is at eye level with the reader. Participant 2 made the point of mentioning that the purpose of these visuals was to engage the students with the text and to provide points of comparison between them and the visuals being presented.

4.2.3. 2. d. Modality. Unlike the verbal text, graphics within children’s scientific informational texts often do not aim at presenting their readers with high degrees of scientific modality, and hence utilise more realistic photographs. Diagrammatical representations are represented with low scientific modality in order to allow for the young readers’ understanding and comprehension of the topic being studied. For example the coloured cross section of the skin on DPS1 presents the young reader with a colourful diagram of the layers of the skin. Four participants mentioned some characteristics about the modality of the texts and added that the use of real
photographs along with “cartoonish diagrams” was confusing to both them and the student. Participant 2 elaborated on this idea further by stating that “I wouldn’t know where to start explaining whether to let them relate to the photos of the children or to directly explain the scientific concepts in the diagrams.” Only participant 6 noted that the use of the diagrams and labels added to the scientific modality of these texts.

Scientific informational texts are concerned with the description of an objective world (Kress & VanLeeuwen, 1996). The fact that four of the participants in this study found the use of real photographs mixed with scientific diagrams confusing, was interesting. Most scientific informational texts for children use this style in order to attract the young readers’ attention to the text (Kress & VanLeeuwen 1996; 2006; Pappas, 2006; Unsworth, 1997). These texts aim at providing scientific concepts in an objective manner; the blending of realism with scientific diagrams was not intended to confuse the reader; on the contrary this mix was used to enhance the young readers’ comprehension of the text (Kress & Bezemer, 2009).

4.2. 3.3. Compositional meanings.

4.2.3. 3. a. Framing and borders. The disconnection of an element within a visual composition from the other elements on the page by a frameline or framing device, signifies that these elements will be read as separate and independent (Kress & VanLeeuwen, 1996). For example, the call out boxes or the steps of the explanation sequence DPS2. The use of framing and strongly bolded headings were used to separate information across the book. Two participants mentioned the use of framing and borders within these texts. Participant 2 noted that a red box separating the visuals from the rest of the verbal text framed the page. This participant also noted that a strong red line was used to divide the different sections and “to provide a more interesting layout” and that in the breathing text DPS2, the red line running across the top border was
acting like a vector guiding the reader to the caption and its accompanying visual drawn on the borderline. Participant 6 mentioned that the headings bordered the text and were in bold to enable the reader to quickly access the information.

The pages of scientific informational texts usually contain detailed information on a given topic or topics. The finding that only two participants pointed out the use of framing and borders may be associated with the fact that most of these texts do not have a set layout. The pages of most children’s scientific informational texts have no obvious entry and exit points for the reader to follow. Nevertheless, framing and borders play an important role within these texts as they allow for the separation of the different pieces of information (Kress & Bezemer, 2009).

4.2. 3.3. b. Salience. Kress and VanLeeuwen suggest many factors which may be used to create salience; for example the size of the element, its colour, its position on the page, its sharpness and its contrast against background (Kress & VanLeeuwen, 1996; 2006; Unsworth, 2001). Within any particular scientific informational text, any element may be made salient due to these factors. All the participants except for participant 5 noted in their annotations what initially drew them to the page. For example, participants 2 and 3 mentioned that they would straight away look at the visual of the three children due to its size. Looking at DPS1 participants 1 and 6 noted that the blonde girl in the visual of the three children was the salient visual with participant 1 using the word salient. Participant 4 gave a differing opinion in that this participant noted that the main verbal text stood out more than the other features and she would look at that first before moving over to the visuals. On the second page spread (breathing), participants 1 and 2 mentioned that the boy with the cross section of the lungs was the salient image on the page. Participants 3 and 6 stated that they would start with this visual first. Participants provided a variety of justifications of why these
elements were salient to them. Their justifications drew on the factors provided by Kress and VanLeeuwen, 2006. Participant 3 justified the choice of this visual by stating that it drew his attention due to its size. Participant 4 mentioned that the use of strong bold type font and larger letters, and participant 6 mentioned that the use of colour was the main factor in catching her attention.

4.2.3. 3. c. Reading path. A reading path usually begins from the most salient semiotic elements to the least (Unsworth, 2001). Over the past decade most children’s texts have undergone what Dresang (1999) termed as a “Radical Change.” She explained that texts have come to employ non-sequential and multilayered aspects. This format employs both written and visual elements which are presented to the reader in a nonlinear fashion creating “multiplicity of reading paths” (Kress & Bezemer, 2010 p. 23). Participants were asked to note in order the reading path that they would point out to their students as they read the book with them. Each participant mentioned a different reading pathway since not all of them identified a common element within the double page spreads. When asked what reading path they might follow on the page of DPS1, participants 1 (see figure 2), 2 and 3 stated that their reading paths would begin from the visual of the three children in DPS1. Participants 1 and 3 (figure 4) both noted that they would move from the graphics to the main verbal text, while participant 2 (figure 3) would move directly from the graphic of the children to the title. Participants 2 and 3 would then move down to the call out box, and then to the caption. Participant 1 noted that she would move down to the caption, without moving to the call out box. This participant also mentioned that she would then move to the timeline and read it from left to right.
Figure 2. Reading path of DPS1 for participant 1.

Figure 3. Reading path of DPS1 for participant 2.
Participants 4 and 5 mentioned a very different reading path. Participant 4 (figure 5) started from the main verbal text, then moved over to the interrogative, then the visual of the three children and finally to the caption. This participant moved directly to the main verbal text on the second part of the spread and gradually worked her way downwards through the visuals. Participant 5 (figure 6) mentioned that she would start with the title ‘Hair’ then move down to the main verbal text and then the call out box of the boy. She then mentioned that she would move over to the title on the second page of DPS1 ‘Skin’ down to the main verbal text then the cross section and finally to the timeline text.

Figure 4. Reading path of DPS1 for participant 3.
Participant 6 (figure 7) noted that she would start with the title then move down to the visual of the three children and finally talk about the main verbal text. As with participants 2 (figure 3) and participant 3 (figure 4) she did not mention any clear reading path for the second page of the DPS1. These three participants moved directly from the first single page ‘Hair’ on DPS1 to the second DPS ‘Breathing’. These participants may have chosen not to move onto the next single page because it has more scientific concepts graphically and verbally.
Figure 7. Reading path of DPS1 for participant 6.

On DPS2 participants 1, 2, 4 and 5 mentioned that they would work with the sequence in the order that it is placed in looking at the visuals and then the captions, following the red arrows. Consistent with the formal analysis, participants 3 and 6 mentioned that they would start from the visual of the boy who was also analysed by the researcher as the salient visual on the page.

Notably, each participant explicitly mentioned that they would choose their reading path according to the purpose of the lesson. It may be argued that reading paths are linked not only to the purpose of design, but also to the pedagogical purpose of the text. As discussed earlier in this section, this finding is important given that prior research has indicated that scientific informational texts in general have come to resemble webpages (Pantaleo, 2007; Unsworth, 2001). This change in the nature of texts produced new ways of reading them (Bezemer & Kress, 2010).

It was found that only participants 4 and 5 mentioned that they would read out the cross section of the layers of skin. The other participants reading paths did not traverse this graphic. This could be because these graphics present multilayers of verbal text and visual elements and would need tedious work explaining and presenting them.
to young students. Some teachers, as will be discussed in later sections, mentioned that they found some of the graphics irrelevant to the topics or too complex, and so tended not to incorporate them within their annotations because they would not explain them to their students. Graphics in scientific informational texts are not used arbitrarily (Fingeret, 2012). Authors use the graphics in harmony with the linguistic elements to provide the overall meaning intended. On one hand, when teachers read these texts for specific purposes, they most probably would choose to focus only on the relevant features, and may not look at all the features on a page. On the other hand, with such a small amount of text on these pages, not attending to all of it may seem to be a limitation to impose.

On a final note the participants showed some basic albeit limited knowledge within their annotations around the functional labels of the graphics. Although at times they were able of orally explaining the function of the graphics, they were limited in using the appropriate metalanguage.

4.3. Multimodal analysis and discussion

This section presents the multimodal themes that the participants noted and a discussion around each one. The coding process is linked to the interview questions 7 and 8 (in appendix B), the post annotation interview questions 3 and 4 (in appendix B) and the formal analysis of the visual and verbal data. It was analysed according to Kress and VanLeeuwen’s (1996; 2006) visual grammar. It was found that the participants made strong links between the visual and textual around ideational meanings, more than they did with the other two metafunctions.

4.3.1. Ideational text/image meanings.

4.3.1. a. Processes. Children’s scientific informational texts make use of both linguistic and visual processes (Pappas, 2006). It was found that all six participants
provided limited identification of visual processes in contrast to the linguistic processes. Only two participants identified the visuals in the sequence on DPS2 as presenting the process of breathing. Participant 5 elaborated further by stating that, “the process uses both the symbols and images to show the steps of breathing.” This participant used the word “symbols” to indicate the use of labels and captions implying this participant’s limited knowledge in the use of appropriate visual metalanguage.

The participants provided limited identification of processes compared to the formal analysis. Participants did not identify any of the visual processes according to their functional labels and purposes. It could be that they overlooked the importance of the visual processes in favour of the written ones. On one hand, this could be due to their inability to negotiate the combined meaning presented by both the written and visual text. On the other hand, it could be due to the fact that there were more apparent processes in the verbal text than the visual one.

4.3.1. b. Concurrence. Defined by Kress and VanLeeuwen (1996) as the relationship between verbal text and image where both modes correspond completely or partially. An example within the sample texts can be seen through the use of labels and captions that accompany the graphics. This textual/visual relationship was evident within all six annotations. Participants 1 and 2 mentioned that generally the graphics and verbal text work well together throughout the book in order to provide the main message to the readers. Participant 3 noted that the goosebumps visual in DPS1 supported the verbal text accompanying it. This participant also noted that the cross section of the skin DPS1 added more information in the visuals rather than in the verbal text. Participant 4 noted that the visual of the three children provided examples of different hair types to add meaning to the verbal text. This participant also noted that the timeline added meaning to the verbal text accompanying it. Participants 5 and 6
only noted the concurrent features in DPS2. Both these participants noted that the cross section of the lungs helps the reader to understand the information in the main verbal text. Participant 5 went further to illustrate that the graphics of the cross section, and the explanation sequence on the page “organise a lot of information in small space.” When asked to elaborate on this comment she said that if one was to interpret linguistically the graphics, “you’d end up with a whole page; the graphics help to provide a lot of information in a short space.” Participant 6 also noted that the sequence visuals and captions give the same information affirming that, “the image and text support each other.”

Concurrence in scientific informational texts allows the construction of scientific meaning at the intersection of the verbal and visual texts (Unsworth, 2010) in a synergistic manner (Lemke, 1998). In scientific informational texts each mode may instantiate the other as shown in figure 8 adapted from Unsworth (2010). An example of instantiation in the sample texts can be seen in the timeline in DPS1. Each element on the timeline in DPS1 is an instantiation of the main verbal text that accompanies it. The teachers in this study were well aware of this important concept and as shown in the findings they all provided details of how each mode plays a role in instantiating the meaning provided in the other. Nevertheless, it was found that even though participants used both the visual and linguistic modes in tandem within their annotations to define the meanings that they found within these texts, they still showed limited ability to explicate how the modes within these texts work interactively with each other to provide the meanings intended by the author.
4.3.1. **c. Complementarity.** In a multimodal text new meanings and elements can be introduced in either the visual or linguistic mode without deploying the other mode. The two modes in this case act independently to provide parallel information where “the picture does not illustrate the story but continues it” (Kress & VanLeeuwen, 1996, p. 118). Scientific informational texts in general use representations from each of the visual and linguistic modes individually, so that each mode augments information not communicated in the other (Smolkin & Donovan, 2004). Figure 9 adapted from Unsworth (2010) demonstrates the relationship between complementarity and how each mode extends information on behalf of the other. Three of the six participants noted that some of the graphics in DPS1 presented new information that could not be found within the accompanying verbal text. Participant 2 noted that the picture of the three children on DPS1, provided information on the differing types and colours of hair. She explained that “this information is not found in the text - it can only be deduced from the graphics”. Participant 4 indicated that both the call out box and cross section on DPS1 provided additional information to the main verbal text on the layers of the skin. Participant 6 mentioned that the verbal text accompanying the visuals in DPS1 provided insufficient information as to the concept being presented. Elaborating further, this participant mentioned that the main verbal text on DPS1 did not provide enough information on how the hair grows; instead it used the graphics to provide this meaning.
In children’s scientific informational texts the graphics add meaning to the verbal text and vice versa (Smolkin & Donovan, 2004), by providing different representations. However, when combined together the visual and the written meanings contribute to the overall meaning within the text (Unsworth, 2010). The negotiation of this multimodal feature within scientific informational texts is not easily accessible to the young reader. Despite the fact that some of the teachers in this study distinguished this relation between the verbal text and the visual one, their ability to clearly explain these relations, verbally and written, was in need of support.

![Diagram](image)

Figure 9. Ideational Complementarity adapted from Unsworth (2010, p. 282).

4.3.2. Interactive text/image meanings.

From the post annotation interviews, all six participants pointed out that the text was appropriate for their students in early stage 1 and stage 1. They all noted that the visuals along with the accompanying verbal text would attract their young students’ interests and thus create a high level of involvement between the students and the text.

It was interesting that the participants noted this feature because it contrasted remarkably with the interview data, discussed earlier in this section, where most of the participants stated that these texts presented limited options in regards to topics for their young students. They also noted that these texts would be too difficult to present to their students within literacy sessions. One important factor teachers should be aware of when choosing scientific informational text for young students is appropriateness of
content (Donovan & Smolkin, 2002). The pages of this particular scientific informational text presented factual information using realistic photographs of children and a low scientific modality in order to attract the young readers’ attention.

Some participants noted that the colour scheme complemented the topic and verbal text. Participant 1 noted that the colours were attractive to the students and that they “matched the text” meaning that the use of colour matched, to an extent, most of the body parts that were being discussed.

This finding is significant in that it shows the importance of time as well as knowledge needed to interpret a text both for teachers and students. Participants were found to be more aware of the genre and tended to make more informed comments after reading the text thoroughly and having time to reflect, as opposed to the comments they provided at the beginning of the interviews. This could perhaps mean that the participants were using scientific informational texts that might be considered unsuitable for the young age groups that they teach.

4.3.3 Compositional text/image meanings.

Compositional meanings in multimodal texts are produced when coherence within the text is achieved by the combination of the visual and verbal texts (Kress & VanLeeuwen, 2006). All six participants noted that the placement of the visual and verbal information on each page presented difficulty in regards to the reading path. In contrast to the visual annotations where participant 4 mentioned that the main text on both DPS spreads was more salient than the images, and participant 5 did not even attend to the element of salience, both these participants agreed with the others that the visuals were salient in comparison to the verbal text. The participants in this study did not attend to any other compositional feature. The inconsistency presented by both participants 4 and 5 within the data and the limited data provided by the rest of the
participants on the multimodal features, may perhaps mean that these participants need assistance in understanding how both the visual and linguistic modes complement one another to provide coherence within scientific informational texts.

The texts limited use of framing and borderlines created a compositional collaboration between the visual and written modes. The intermeshing of these modes provided the text with a high level of coherence and unity (Kress & VanLeeuwen, 2006). Significantly, only participant 2 noted this feature of framing and borders. This participant mentioned that for each part of a verbal text, there was a visual to accompany it, and this visual was either framed to show its importance or unframed making it a part of the main verbal text.

The participant teachers’ limited attention to the compositional feature could mean that they are unaware of how scientific informational texts use varying visual and verbal semiotic resources to socially construct the scientific meanings (Unsworth, 1997). If teachers in general, do not understand how the linguistic and visual resources are deployed independently and interactively, they will not be able to apprentice their students into understanding how the varying modes, namely linguistic and visual, work together to present differing interpretations of phenomenon. The next section will reveal the results of the participants’ pedagogical implications.

4.4. Pedagogical Implications Results

This section focuses on the research sub questions to do with teaching students about the graphics and multimodal features of scientific informational texts. After transcribing and reading the interview data, themes were coded and assembled into categories (Creswell, 2007). The following results and discussion emerged from the data.

4.4.1. Explicitly explaining the multimodal factors.
All six participants noted that they would have to teach the graphics within the double page spreads explicitly. Participant 4 stated that if she were to show her students the graphics without any instructional practice they would not be able to understand them on their own. Participant 6 mentioned that even with the captions and labels, she still was unsure that her students would be able to understand the purpose of the graphics without explicit explanation from her. Participants 1, 2 and 3 found the graphics to be very detailed and said that they would need to do a lot of explaining and modelling for their students to comprehend the concepts represented by them. Participant 5 noted that she would focus on why these texts use different mediums to present the visuals. For example, she stated that she would explain why a diagram was used as opposed to a photograph in the diagram of the cross section of the skin on DPS1. All six participants also mentioned that they would need to explain that the captions and labels were related to the diagrams and visuals. They also stated that they would need to explain to the students how to read the graphics and their accompanying verbal texts in order for their students to gain maximum comprehension.

The participant teachers in this study acknowledged the importance of providing their young students with the skills and explicit instruction necessary for them to understand these visually complex texts. This finding builds on previous research undertaken by Coleman & McTigue (2013), which suggests that teachers should help children use and understand scientific informational texts by explicitly explaining and showing them how to navigate these visually complex texts. These researchers recommended that explicit instruction in the coordination of the visual and linguistic modes is needed for students, stressing that teachers need to highlight and model the importance of the visual information. Most children have difficulty in understanding how the visuals represent specialised technical knowledge (Coleman & McTigue, 2013;
Unsworth, 1997), and teachers should be careful to gradually apprentice their students into learning how to read both the verbal text and the graphics.

The resources the participant teachers suggested that they would use, in order to explicitly explain and teach about the multimodal features were group work, technology and pointing. Each one of these resources is discussed briefly in the following section.

4.4. 1.a. Group work. Five out of the six participants explained that they would divide their students up into groups depending on their comprehension abilities. Even though the sixth participant did not divide the students into smaller groups, nevertheless it was mentioned that the whole class would work with the teacher as one group.

Group work itself is not a pedagogical approach. It is an organisational structure in which specific pedagogy must then be used. For example, teachers mentioned that they would use group work during guided reading.

4.4. 1.b. Use of Technology. Overall, participants demonstrated a strong interest in technology and its use within the classroom. Participants 5 and 6 described how the different modes of representation accounted for better comprehension of scientific informational texts. When asked how they would present the graphics of scientific informational texts to their students, all the participants stated that they would put them up on the smart board. Three participants used interactive science websites and one mentioned using Youtube clips related to the graphics that were being presented within the text, in order for the students to understand how these graphics work.

The use of different media within the classroom in order to teach certain concepts echoes the pledge of The New London Group (1996; 2000) for teachers and educators to shift away from monomodal ways of teaching to more multimodal ones. However, the teachers in this study did not relate the use of technology to multimodal teaching.
4.4. 1.c. Pointing out the graphics. Participants of this study paralleled their USA counterparts in using pointing as a main method of discussing the graphics in a scientific informational text. All six participants mentioned that they would point to the graphics and the verbal text related to it. Participant 4 mentioned that she would point out the graphic and move her finger across the page to its accompanying label or caption. Participant 5 mentioned that when she discussed the lifecycle with the students, she pointed around with her finger from one arrow to the next so the students could understand how the cycle was moving. The other participants just mentioned that they would point to the graphics on the page, but not explain them to the students.

This finding is important since the participants in this study seemed unaware of how to explicitly present the graphics of scientific informational texts and so confined their methods to pointing. Pointing, according to Coleman, McTigue and Smolkin (2010) was also the USA teachers’ most commonly reported instructional practice. While pointing to the graphics may draw students’ attention to them, research has shown that it is an insufficient instructional practice (Coleman, McTigue and Smolkin, 2010). According to these researchers, this practice does little to support the young learners’ deeper comprehension of the aim and purpose of the visual.

4.4. 2. Deriving information from graphics.

Participants 3, 4 and 5 noted that they would model to the students how to interpret information from scientific informational texts. They mentioned that deliberately pointing them out to the students would only direct the students’ attention towards them, but not allow them to actually understand how these graphics provided information. They explained that they would choose one of the graphics on the page and clarify to their students what it signified. They would thus explain to their students how this
information was of importance in relation to the topic they were discussing. Participants 4 and 5 discussed how they had to teach their students to interpret information from a life cycle. They both mentioned that their students were incapable of understanding the information within this graphical form on their own. According to participant 4, students were “Looking for clues in the writing to understand what this picture was talking about.” These two participants said that they had to model to their students a few lifecycles and teach them how to derive the information intended.

This finding links to the participants’ multimodal knowledge. They are in effect teaching aspects of multimodality in limited ways. Coleman and McTigue (2013) argue that students cannot be expected to effortlessly move back and forth through the graphics in scientific informational texts without being coached as to how they are supposed to derive the information that is presented.

4.4. 3. Students creating graphics.

Some researchers claim that students should be asked to create their own informational texts because it is one way of allowing the children to use and learn about the different graphical representations (Coleman, Bradley & Donovan, 2012; Roberts et al., 2012). The theme which emerged within the data by only two participants was that they would allow their students to author and illustrate their own scientific informational texts. Participant 5 mentioned that she would ask her students every term to write a short informational book about one of the science topics that they had taken during the term. She mentioned that, since the graphics were discussed and their importance made clear during the term, students were encouraged to present their own graphics within their books. However, she mentioned that when assessing her students’ work, she would only look for accurate content within the verbal text because to her, “it’s enough for me that they would actually try to draw a lifecycle or a timeline.”
Participant 6 also mentioned that she would provide her students with a context related to what they had been studying during the term and would ask them to draw a graphic in order to explain it further for the reader. These two participants went one step further than the others by asking their students to construct their own graphics.

Another important pedagogical implication that the participants in this study overlooked was the use of this method to teach the different genres of graphics to their young students (McTigue & Flowers, 2011). None of the teachers showed explicit awareness about the connection between creating graphics and developing student understanding about how to read and write multimodal texts. For example, teachers can teach diagrams by having students visually produce genres of graphics like a sequential explanation, for example the timeline on DPS 1. The production of graphics by students may help them to understand the abstract conventions that distinguish these graphics from pictures in literary texts (McTigue & Flowers, 2011). Learners should be taught how to actively reproduce these graphics within their particular contexts.
5.0 Conclusion

5.1 Overview

This research makes a significant contribution to the existing body of literature into the use of scientific informational texts within early stage 1 and stage 1 classrooms. As outlined in the Methodology chapter, the objectives of this study were to uncover primary teachers’ understandings of scientific informational texts including their recommendations and perspectives on teaching these texts within the early grades classrooms. To achieve this aim, the research questions were concerned with: how participants understood scientific informational texts linguistically and visually, how they interpret the multimodal elements of these texts, and how participants would teach their students about the graphics, and the multimodal relationships within a chosen scientific informational text.

This research has generated some important findings about the participating teachers’ understandings and teaching methods of scientific informational texts set in the Australian primary school context. All the participants showed understandings of the structures of these texts. They also noted the importance of providing students with opportunities to interact with scientific informational texts within literacy periods. These findings are summarised in this chapter with reference to the implications for research and practice. Recommendations for how future research can shed additional light on the pedagogical uses and understandings of informational texts within literacy periods, in the context of early educational settings are also discussed, as the results have a strong impetus for further examination of the key themes that emerged. The chapter concludes by identifying the limitations of this research.
5.2 Summary of Major Findings

As the previous chapter has highlighted this research has generated various themes around teachers’ knowledge of the linguistic, visual and multimodal aspects encountered within scientific informational texts that add to the body of knowledge around scientific informational texts and their use by early stage 1 and stage 1 teachers within literacy periods especially within the Australian context where very limited study on this issue exists. Macken-Horarik (2011) stresses that the importance of teachers’ own knowledge of the context, purpose, and visual and textual features of the text plays an important role in how students are taught to understand multimodal texts.

This research has generated important findings on how the participating teachers understand scientific informational texts linguistically and visually. Participants in this study showed some basic, albeit limited knowledge of the linguistic features of scientific informational texts. All six were capable of identifying most of the structural elements as per Pappas (2006). They noted the use of co-referentiality, material processes and illustration extensions expressed by labels, captions and fact boxes. In terms of functional grammar, participants noted limited features related to each of the three metafunctions. Even though teachers were capable of showing their knowledge about how a scientific informational text works functionally, in most cases they lacked the ability to provide the correct functional label for the feature they were describing. The teachers used traditional grammatical labels more than they did functional labels.

Additionally, all of the participant teachers mentioned orally within the interviews, the differing genres that contribute to scientific informational texts. However, the results showed that even though teachers were knowledgeable about the different text types and their uses, they did not refer to them as a key part of the pedagogical practices they reported.
All participants were capable of identifying the different scientific graphics within these texts and were well aware of their importance. However, most of the participants lacked the ability to articulate the specific metalanguage related to the visual grammar. Except for two participants, the teachers were not familiar with most of the metalanguage related to visual grammar. The other four participants explained the role of the graphics functionally and noted that they would help enhance the students’ comprehension of the text.

The participants’ multimodal knowledge around scientific informational texts was still in need of support. Teachers identified the functional role of the linguistic and visual features within these texts, but found it difficult to bring these features together in order to explain the text as a whole. As with the visual metalanguage, teachers also were in need of assistance with the specific metalanguage when they explicated the multimodal relationship between the verbal and visual texts.

Moreover, teachers also were in need of help with pedagogical strategies around teaching these texts within literacy sessions. None of the implications that were provided by the teachers reflected intentional use of both the linguistic and visual modes to explicate the features of scientific informational texts to their students. Furthermore, the multiliteracies pedagogy was not found within any of the teachers’ pedagogical implications. The teachers noted the organizational structures that they would place the children in when teaching them about these texts and provided very limited pedagogical approaches. Consistent with a previous study in which the teachers used pedagogical methods that were considered basic and incapable of dealing with the challenges presented within the multimodal elements of scientific informational texts (Coleman, McTigue, Smolkin, 2011).
5.3 Recommendations and Future Research

The current study raised a number of implications for research, policy and practice within the education sector. Firstly, whilst the majority of the participants noted that they used scientific informational texts widely within their classrooms, the findings uncovered that they preferred the narrative during literacy periods. This could be a sign that these teachers are still unaware of the importance of incorporating scientific informational texts within their literacy periods. It is recommended that future professional development courses encourage and provide ongoing professional knowledge about using all types of texts, building on pre-service training and continuing with in-service teacher training courses.

The study revealed that while teachers’ knowledge of the functional, visual and genre elements of scientific informational texts was relevant, their use of the specific metalanguage to describe the differing aspects of these elements was still in need of development. The participating teachers’ showed their understanding of the multimodal knowledge by explaining some relations between the graphics and the verbal text, but as with the linguistic and visual, the use of a common metalanguage was problematic. Future teacher training programs and professional development courses should look into providing teachers with ongoing lectures and workshops on developing the metalanguage needed in order for them to clearly discuss the linguistic and visual elements with their students. Policy makers should provide the necessary metalinguistic terms that accompany the multimodal requirements of the syllabus.

The finding that the participant teachers’ pedagogical strategies were limited was significant to this study’s findings. The data revealed limited themes as to how these participants would actually teach their students scientific informational texts within literacy periods. A recommendation to overcome this barrier would be to provide
teachers with methodologies on teaching information texts within literacy blocks. Literacy teaching courses should also take this into consideration and provide future teachers with methodologies for informational text and graphics.

The current study provided many possibilities for future research opportunities. Most obvious would be to conduct a similar qualitative research at different schools and with different teachers within the Sydney region, and across the varying Australian states to see if the results of this study are consistent with the results in other schools.

A similar study could also be replicated with the older classes in order to find out whether they were in need of more exposure to these texts earlier on in their schooling. This could prove useful to observe how teachers in the older grades teach and present these texts.

Another important area that should be considered for future research is classroom observations of teachers using scientific informational texts. An investigation of the language that teachers use during their discussion of these texts and the pedagogical practices they used, would enhance and complement this current study, which was based on reported teaching practices rather than classroom observations.

5.4 Limitations

The small-scale study was a limitation to the project. The lack of generalizability of this study due to the use of purposeful sampling allowed the findings to only represent the teachers in the case study. The study aimed at providing an in-depth understanding of how six teachers understood the interrelations of modes within science storybooks, and how they explained and used the illustrations within them to scaffold students’ comprehension of scientific concepts in the early stages.
Another limitation was the inability of the researcher to observe the teachers as they applied their knowledge of graphics in science information books and scaffolded students’ learning and use of them.
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Sinatra, R. (1986). *Visual Literacy Connections to Thinking, Reading and Writing*: ERIC.


7.0 Appendices

7.1 Appendix A - Generic structural potential of “My Body” according to Pappas (2006)

*Topic Presentation (Introduces or presents the topic of the book)*

Your body is amazing. Can you name all its parts?

Here are the parts you would see if you looked under your skin.

*Interspersed Distributive attributes (Describes the attributes of the class or topic of the book through relational processes) and Characteristic events (expresses the characteristic, habitual, or typical processes regarding the topic)*

Hair grows on almost every part of your body. It protects you and keeps you warm.

Your skin protects your insides and keeps your body at the right temperature.

Your bones keep your body parts together and help you move. They help protect your insides, too.

Your brain controls what you think, feel, and do. It sends and receives messages to and from your body.

You breathe air to get the oxygen your body needs.

Breathing out gets rid of waste your body doesn’t need.

Oxygen in your lungs goes into your blood. Your heart pumps blood all around your body.

Your senses help make you aware of the world around you.

You hear sounds through your ears. Your ears also help you balance.

Your eyes send messages to your brain about what you see.

You touch things with your skin to find out how they feel.

You have lots of tiny bumps on your tongue. These tell you what your food tastes like.

You smell with your nose. Smelling food helps your sense of taste.
Food gives you energy. Energy is the power your body needs to do its job.

You need to take care of your body to stay healthy. How many of these things do you do?

A baby starts inside a woman’s body. It grows and grows until it is ready to be born.

Your body is always changing. It will take 18 years for you to become an adult.

**Final Summary (short and somehow ties into the title of the text)**

Your body knows when it is not well. It works hard to make itself better.

**Illustration Extensions (interspersed and consists of wording that explicates the illustrative objects or displays in the book)**

The graphics on each page within the book function as illustration extensions including the text that accompanies them.
7.2 Appendix B - Semi-structured interview questions

1) What does a typical literacy hour entail in your classroom?

2) What kinds of texts do you read to/with your students during literacy periods?

3) How many times a week might you read information texts (books or screen based) to your class? Can you name some?

4) When reading a text, whether literary or informational, how do you discuss the visual elements with your students? Can you give some examples?

5) How would you present the graphics of informational texts to your students? What aspects would you point out?

6) What visual features might you focus on?

7) How would you model to your students the relationship between graphics and the text?

8) How would you explain to your students the relationship between the text and the graphics?

Participants will be shown an informational book appropriate for early stage 1 and stage 1 students. They will be allowed time to browse and read it silently.

Participants will then be asked to annotate linguistically and visually one double-page spread of the book.

The following interview questions will thus be revisited after the annotations:

1) How would you present the graphics of informational texts to your students? What aspects would you point out?

2) What visual features might you focus on?

3) How would you model to your students the relationship between graphics and the text?
4) How would you explain to your students the relationship between the text and the graphics?

7.3 Appendix C - Formal analysis undertaken by the researcher for the first double page spread Hair and Skin (see appendix E)

Each page on DPS1 was analysed separately since two different topics ‘Hair’ and ‘Skin’ were presented with clear reading paths and layouts.

Table 4

*Formal Analysis of DPS1*

<table>
<thead>
<tr>
<th>Visual Representational/Ideational Meanings</th>
<th>Multimodal meanings</th>
<th>Written Ideational Meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hair</strong> Visual Representation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are two distinct visuals on this page - the visual with the three children and the caption with the little boy getting his hair cut. Both images are transactional since there is no obvious action being established. The three children present the viewer with a non transactional image, the children are depicted as the reactors since strong vectors depart from their eyes suggesting they are staring and smiling at something/someone across but no explicit phenomena is presented. The little boy in the caption is a transactional reaction image since strong vectors depart from his upward gaze towards the hands that are cutting his hair, the boy is the reactor and the hands are the phenomena.</td>
<td>How do image and text work together to create meaning? <strong>Hair</strong> The picture of the three children complements the main text. It augments information not provided in the main text about the different types and colours of hair. The accompanying interrogative aims to present the information in a concrete way to the young readers by allowing them to observe their own hair. The picture in the call out box extends on the text in that the text provides information about cutting hair and the picture shows a boy looking up with a scared or worried look. <strong>Skin</strong> The main text provides the young reader with two main attributes of skin (protection - the right temperature) both are not</td>
<td><strong>Hair</strong> Processes The text represents the distribution of attributes and characteristic event stages of the broad genre to which Pappas defines these books. These stages are interspersed and are identifiable by the heavy use of material and relational processes within the genre. The use of the material processes (grows-protects-keeps) and the actors (hair- it- it ellipsis) and goals (your body-you). The relational process in the caption under the visual in the call out box (isn’t- doesn’t- is) the carriers (your hair-it) and the attributes (alive- hurt-cut). <strong>Technical lexis</strong> The text is short and does not contain many lexical items as it is written for a young audience, also the</td>
</tr>
</tbody>
</table>
Skin

**Visual Directionality**

On the second half of the page spread the young viewer is presented with three different images. Two of these present part whole relationships where the horizontal timeline depicts a material event of how a persons’ skin changes and wrinkles with age. The timeline uses photographs of real hands at different stages of a persons’ life. The cross section presents the viewer with a structured analytical image because all the parts and the different layers of the skin are labelled. The child’s hand, which has a magnifying glass and a strong red arrow, presents the young viewer with a material process suggesting magnification, the arrow points towards the cross section, which thus describes and magnifies the layers of the skin. The hand works as the carrier in the image and the structured analytical image is the possessive attribute.

The caption accompanying the visual of the goosebumps is an unstructured analytical image since the picture is presented on the page with no labels to explain what each feature in the image represents.

The relational process is clear in the text above the timeline (gets-get) the carriers are (your skin-you) and the attributes are (more wrinkly-older).

Technical lexis

This text has a slightly higher amount of technical lexis than the one preceding it (Hair) due to the presence of technical vocabulary (skin-temperature-goose bumps-wrinkly-older). Also the labelled parts of the cross section provide technical lexis (tough outer layer-fatty layer).

---

**Interactive Meanings**

**Hair**

*Interaction: Visual ‘demands’ and ‘offers’.*

The call out box of the little boy getting his hair cut provides the viewer with an

---

**How does image and text shape our feelings and interactions?**

**Hair**

The factual text is objective and provides no interpersonal relationship.

---

**Interpersonal Meanings**

**Hair**

*Mood*

The clauses within this text are all in the declarative mood. They give the young reader
offer as his gaze is directed away from the viewer towards the phenomena. The three children are looking straight at the viewer demanding his/her attention.

Social distance
The faces of the children are clearly depicted through the close-up shot. The boy in the call out box presents the viewer with a close up shot where only his eyes are shown and the body and hands of the phenomena are presented.

Point of view
Both visuals of the children and the little boy are taken from a frontal plane, which is at eye level, and parallel with the young viewer suggesting a sense of equality. The friendly smiles and stares invite the young readers to a friendly interaction with them.

Modality
The high quality colour photographs depict a sense of realism since the colours are naturalistic, highly saturated and diversified. The decontextualisation of the photographs contributes to lowering the naturalistic modality to a medium-high. The scientific modality of the visuals is low due to the presence of a medium-high naturalistic modality.

Skin
Interaction: visual ‘demands’ and ‘offers’
All three visuals on the page are offers as there are no human faces depicted.

Social distance
All the visuals on the page
to the reader, the visual of the three children on the other hand shows them smiling in a friendly way at the viewer suggesting interaction with them. We can deduce that the boy in the call out box looking up at his hair being cut is scared that it might hurt. This can only be deduced by looking at the visual and reading the accompanying text.

Skin
The cross section works to complement the scientific attributes related to the concept of skin and not found within the main text. Each (main text and visuals) works on its own to provide the young reader with various ways of learning about the attributes of their skin in a factual and declarative way without any subjectivity.

The visual in the timeline is also a decontextualized hand, which can belong to anyone. It provides the young reader with the same information that is in the text directly above it, thus working concurrently with its text, again without adding any subjective or personal information. The visuals along with the main and minor texts work together to provide the low-medium scientific modality to the text.

Tense
All the verbs are in the timeless present tense (grows- protects- keeps- is- does).

Modality
Modality is expressed through the use of (is- doesn’t- isn’t). The interrogative mood ‘what colour is your hair?’ placed near the salient photograph of the children suggests for some interaction by the young viewer with the pictures. These elements (modal verbs and interrogatives) cause to lower the scientific modality of the text.

Skin
Mood
As with the other text all the sentences are factual, objective and declarative. They work to provide factual information to the young viewer. No interrogatives are present.

Tense
The tense of the verbiage is that of the timeless present tense (protects- keeps- raise-gets-get).

Modality
The scientific modality of the text is high because all the clauses are factual declaratives and there are no modal verbs within any of the clauses. No emotional language is
are close-up shots in order for the young viewer to see the scientific process involved in each one.

**Modality**
The goose bump and timeline visuals have a medium-high naturalistic modality due to the high quality photograph and high colour saturation, causing the scientific modality to become quite low. The cross section provides a medium scientific modality because it is presenting the viewer with the differing layers within a person’s skin, which could not otherwise be seen by the viewer’s eye. The whole visual of the hand with the magnifying glass and the arrow directing the viewer to the cross section presents the viewer with a material process of ‘magnification’.

<table>
<thead>
<tr>
<th>Compositional Meaning</th>
<th>How does the layout of the image and text guide impact the reader/viewer?</th>
<th>Textual Meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hair</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Layout</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The photographs are in the given position suggesting that the young viewer is likely to be familiar with them. The text and the call out box are placed in the new position suggesting that this is new information to the reader.</td>
<td><strong>Hair</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Framing and borders</strong></td>
<td>A strong red line frames the double page providing a border for the text and visuals. The single word heading is provided above the red border, distinguishing it strongly from the rest of the elements (this is consistent within the book).</td>
<td><strong>Theme and rheme</strong></td>
</tr>
<tr>
<td><strong>Skin</strong></td>
<td></td>
<td><strong>Cohesive links</strong></td>
</tr>
<tr>
<td>The visual of the cross section is the most salient on the page due to its size and colour diversity. Each element on the page is present.</td>
<td>The use of personal pronouns within this text acts also as a cohesive link (it- your).</td>
<td></td>
</tr>
</tbody>
</table>

**Hair**

*Theme and rheme*
All the clauses in the text start with a topical theme introducing the participant (Hair- It- Your hair- the hair- what colour). The rest of each clause functions as the rheme.

*Cohesive links*
Cohesion is established through addition (and).

*Reference*
The use of personal pronouns within this text acts also as a cohesive link (it- your).

**Skin**

*Theme and rheme*
The clauses in this text
A red border distinctly frames the call out box. This makes it stand out in that it provides extra information, which might be of some interest to the young reader and at the same time still related to the main idea of the text (hair). The three children are placed on the left of the page framing the main text and the rest of the page.

**Salience and reading path**
The size and direct frontal gaze of the three children suggests their salience in comparison to the other elements on the page. The young viewers reading path may start from this visual and move across the page to the main text or call out box.

**Skin**

**Layout**
The visuals are placed in varying positions, suggesting that the layout maybe a triptych. Although the presence of the main text and salient drawing of the layers of skin is in the real position, it provides information that is not directly accessible to the naked eye. The cross section and main text are placed in the ideal position with respect to the timeline; these elements provide a broad explanation and a conceptual view of the attributes of skin. The timeline is in the real position, it provides the young reader with a real and observable phenomena.

**Framing and borders**
A strong red line frames the timeline to distinguish it from the other. The reading path may start at the cross section and traverse over to the main text and then the goose bumps visual with its little caption over to the text related to the timeline. Books that present scientific information in a multimodal manner tend to invite the reader to enter the page at any level and starting with any element. The linguistic and visual aspects in these texts have the same chances at starting the reading path for their audiences.

Also start with topical themes introducing the topic that is to be described (your skin-goose bumps). The rest of each clause is the rheme. **Cohesive links**
Cohesion is established within the text through addition (and) and the use of the comma. **Reference**
The use of the general pronoun (you-your) is typical of scientific informational texts for children. Also the ellipsis ‘and (it)’ refers to the noun ‘your skin’.
from the other elements. A red border also distinctly frames the visual of the goose bumps making it distinct and clear to the young observer. The magnified image of the layers of skin is not framed and suggests a continuous link between the main text and the cross section.

**Salience and reading path**
The size of the cross-section and its diversified colour system suggests that it is the salient visual on the page. One reading path suggested for the young viewer may start from the hand with the red arrow aiding to direct the viewer towards the rest of the elements. Another reading path may be from the timeline and upwards, traversing the cross section or goose bump visual and continuing onto the main text.
7.4 Appendix D - Formal analysis for the second double page spread Breathing

(see appendix G)

Table 5

Formal Analysis of DPS2

<table>
<thead>
<tr>
<th>Visual Representational/Ideational Meanings</th>
<th>Multimodal meanings</th>
<th>Written Ideational Meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Visual Representation</strong></td>
<td>How do image and text work together to create meaning?</td>
<td></td>
</tr>
<tr>
<td>There are five distinct graphics within this double page spread. The first is the reactional non-transactional image of the boy. The boy is presented as the reactor since he is looking at something but no phenomena is depicted. The second is the inclusive analytic graphic of the cross section of the lungs. It presents some of the possessive attributes of the lungs through labels but leaves most of the carrier, which in this case is the lung, unaccounted for. The third is the graphic that represents the process of breathing and how oxygen is delivered to the blood. It is made up of three inclusive analytical images linked together temporally by strong red arrows. The arrow heads indicate the direction of movement of the participants, which in this case are the particles of air. The fourth is the graphic of the girl, which like the graphic of the boy, is also a reactional transactional image since strong downward vectors depart from the girls eyes towards</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Processes</em></td>
<td>The use of the material processes (breathe-enters-goes- passes -gets rid) along with their actors (air- it (air)- oxygen) and goals (your body- your windpipe-your blood) is a typical feature of scientific informational texts. There is a relational process in the following clause found in the caption next to the graphic of the girl (your breath is warm and wet). In this clause the relational process is (is), the carrier is (your breath) and the attributes are (warm- wet).</td>
<td></td>
</tr>
<tr>
<td><strong>Technical lexis</strong></td>
<td>This text has a slightly high amount of technical lexis even though the graphics take up most of the double page spread due to the presence of technical vocabulary,(breathe-oxygen- air- windpipe-lungs- waste- mists). Also the labelled parts of the cross section provide technical lexis (windpipe-lung).</td>
<td></td>
</tr>
</tbody>
</table>
the little water drops on the mirror. The girl is depicted as the reactor and the mirror is the phenomena. The fifth graphic is that of the diagram of the boy taking a deep breath at the top of the page above the graphic of the girl. This is a non-transactional action visual in that strong vectors from the boy’s body leaning backwards suggest that he is involved in a process (taking a deep breath) but no goal is present.

Accuracy of analytical images
The structured analytical cross section of the lungs is topographical because it can be read as accurately scaling down the dimensions and relative location of the lungs and its parts.

Interactive Meanings

Interaction: Visual ‘demands’ and ‘offers’
The boy is looking straight at the viewer demanding his/her attention. The graphics of the breathing process and movement of oxygen into the blood are offers as there are no human faces depicted.

The graphic of the girl provides the viewer with an offer as her gaze is directed away from the viewer

How does image and text shape our feelings and interactions?
The factual text is objective and provides no interpersonal relationship to the reader, the visual of the boy on the other hand shows him smiling in a friendly way at the viewer suggesting interaction with them while at the same time taking a deep breath. We can deduce that the girl is looking at the mist

Interpersonal Meanings

Mood
The clauses within this text are all in the declarative mood. They give the young reader factual, objective statements.

Tense
All the verbs are in the timeless present tense
towards the phenomena.

**Social distance**
The face of the boy is clearly depicted through the medium shot. The graphics showing the breathing process are close-up shots in order for the young viewer to see the scientific process involved in each one. The girl in the graphic is presented to the viewer through a close-up shot, which clearly shows her features and action of breathing onto the mirror.

**Point of view**
Both graphics of the children are taken from a frontal plane, which is at eye level, and parallel with the young viewer suggesting a sense of equality. The friendly smile and stare on the boy invite the young readers for a friendly interaction.

**Modality**
The high quality colour photographs depict a sense of realism since the colours are naturalistic, highly saturated and diversified. The decontextualisation of the photographs contributes to lowering the naturalistic modality to a medium-high. The scientific modality of the graphics is low due to the presence of a medium-high naturalistic modality. The cross section of the lungs also provides a low scientific modality because of the choice of colour; it is blue and this impacts on the

<table>
<thead>
<tr>
<th>Towards the phenomena.</th>
<th>that she has made with her warm breath on the mirror. This can only be deduced by looking at the visual and reading the accompanying text.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social distance</strong></td>
<td>The face of the boy is clearly depicted through the medium shot. The graphics showing the breathing process are close-up shots in order for the young viewer to see the scientific process involved in each one. The girl in the graphic is presented to the viewer through a close-up shot, which clearly shows her features and action of breathing onto the mirror.</td>
</tr>
<tr>
<td><strong>Point of view</strong></td>
<td>Both graphics of the children are taken from a frontal plane, which is at eye level, and parallel with the young viewer suggesting a sense of equality. The friendly smile and stare on the boy invite the young readers for a friendly interaction.</td>
</tr>
<tr>
<td><strong>Modality</strong></td>
<td>The high quality colour photographs depict a sense of realism since the colours are naturalistic, highly saturated and diversified. The decontextualisation of the photographs contributes to lowering the naturalistic modality to a medium-high. The scientific modality of the graphics is low due to the presence of a medium-high naturalistic modality. The cross section of the lungs also provides a low scientific modality because of the choice of colour; it is blue and this impacts on the</td>
</tr>
</tbody>
</table>

**Modality**
The imperative mood “Try breathing onto a mirror” placed near the photograph of the girl’s face suggest for some interaction by the young viewer with the text, in that the author is asking them to do something in order to elaborate on a point made in the text. These elements (modal verbs and imperatives) lowers the scientific modality of the text. No emotional language is present.
scientific modality. The process graphic also provides the reader with low scientific modality due to the choice of colour.

**Compositional Meaning**

**Layout**
The graphics are placed in varying positions, suggesting no given and new.

**Framing and borders**
A strong red line frames the double page providing a border for the text and graphics. The single word heading is provided above the red border, distinguishing it strongly from the rest of the elements (this is consistent within the book). A red border distinctly frames each one of the visuals in the breathing process graphic. This makes it stand out in that it provides extra information, which might be of some interest to the young reader and at the same time still related to the main idea of the text (how our body gets oxygen).

The boy is placed on the left of the page framing the main text and the rest of the page. The magnified image is not framed and suggests a continuous link between the main text and the graphic of the breathing process.

The cross section is clearly framed within the boy's upper body section. The graphic of the girl is clearly framed between two red lines.

The diagram of the boy standing on the red border line clearly stands out in that

**How does the layout of the image and text guide the reader/viewer?**

The photograph of the smiling boy is more salient than the main text due to its size and colour. This assumes that the young readers' reading path will start from this visual and may traverse over to the process graphic before the main text, due to its size and colour scheme.

Each element on the page is framed and distinct from the other. The reading path may start at the graphic of the boy with the cross section and traverse over to the graphic of the girl, then the main text and finally the graphic of the process. Books that present scientific information in a multimodal manner tend to invite the reader to enter the page at any level and start with any element.

The linguistic and visual aspects in these texts have the same chances at starting the reading path for their audiences.

**Textual Meanings**

**Theme and rheme**
All the clauses in the text start with a topical theme introducing the participant (You breathe- Air- It (air)- Oxygen- Breathing out). The rest of each clause functions as the rheme.

**Cohesive links**
Cohesion is established through consequential conjunctive relations. For example in the following clause, You breathe air (in order to) get the Oxygen your body needs, the writer provides a purpose for breathing air.

Another cohesive link used is the temporal relation of succession. This is implicitly found in the captions that accompany the three visuals that make up the process of breathing. Each clause is a succession of the one before it.

The caption accompanying the graphic of the girl also contains a consequential conjunctive relation (because).

**Reference**
The use of personal pronouns within this text acts also as a cohesive link (it- your).
this graphic is distinct from the rest of the main graphics on the page spread. This diagram is unframed.

**Salience and reading path**
As with all informational texts for children, the graphics are always the more salient due to their number, size and colour scheme. In this text it seems that all three main graphics are equivalent in salience due to these aspects. This means that the young reader is invited to interact and start reading any one of the graphics on the double page spread.
Hair
Hair grows on almost every part of your body. It protects you and keeps you warm.

Skin
Your skin protects your insides and keeps your body at the right temperature.

Figure 10. Double page spread 1 Hair and Skin.
Breathing

You breathe air to get the oxygen your body needs.

Air enters your body through your mouth and nose.

It goes down through your windpipe into your lungs.

Oxygen from the air passes from your lungs into your blood.

Breathing out gets rid of waste your body doesn’t need.

Figure 11. Double page spread 2 Breathing.
PARTICIPANT CONSENT FORM

I, .........................................................................................................................[PRINT NAME], give consent to my participation in the research project

Title: Primary Teachers’ Understanding of the Linguistic and Visual Modes of Scientific Informational Texts

In giving my consent I acknowledge that:

1. The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.

2. I have read the Participant Information Statement and have been given the opportunity to discuss the information and my involvement in the project with the researcher/s.

3. I understand that being in this study is completely voluntary – I am not under any obligation to consent.

4. I understand that my involvement is strictly confidential. I understand that any research data gathered from the results of the study may be published, however no information about me will be used in any way that is identifiable.

5. I understand that I can withdraw from the study at any time, without affecting my relationship with the researcher(s) or the University of Sydney, now or in the future.

6. I understand that I can stop the interview at any time if I do not wish to continue, the audio recording will be erased and the information provided will not be included in the study.
7. I consent to:
   - Audio-recording YES ☐  NO ☐
   - Receiving Feedback YES ☐  NO ☐

If you answered YES to the “Receiving Feedback” question, please provide your details i.e. mailing address, email address.

**Feedback Option**

**Address:** __________________________________________________________

_______________________________________________________

**Email:** __________________________________________________________

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

Signature

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

Please PRINT name

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

Date
Title: Primary Teachers’ Understanding of the Linguistic and Visual Modes of Scientific Informational Texts

PARTICIPANT INFORMATION STATEMENT

(1) What is the study about?

You are invited to participate in a study designed to explore how teachers use informational texts in their classrooms. The focus is specifically on how teachers relate the images and text together to form the overall multimodal message of the text, and how they use and explain these texts to their students.

(2) Who is carrying out the study?

The study is being conducted by Dr. Jon Callow, lecturer at the University of Sydney and Rayanne Shakra, Master of Education research student at the University of Sydney.

(3) What does the study involve?

As a participant you will be given an opportunity to annotate an informational text, appropriate for stage 1, chosen by the investigator, followed by a short interview. The annotations will provide the study with insightful information as to how you understand the linguistic and visual features within these texts. The interviews will explore how you contextualise informational texts in your literacy teaching, as well as how you present and teach these texts to your students. The study will take place on school grounds in hours that are suitable to you. The interviews will be audio recorded.

(4) How much time will the study take?

The teachers will participate in a 10-15 minute session annotating an informational text, followed by a 20 minute interview.

(5) Can I withdraw from the study?

Being in this study is completely voluntary - you are not under any obligation to consent and - if you do consent - you can withdraw at any time without affecting your relationship with The University of Sydney.
You may stop the interview at any time if you do not wish to continue, the audio recording will be erased and the information provided will not be included in the study.

(6) Will anyone else know the results?

All aspects of the study, including results, will be strictly confidential and only the researchers will have access to information on participants. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

(7) Will the study benefit me?

Research on both multimodality and informational texts in the early primary grades is still fairly new. How teachers use and present these texts to their students is developing. Your participation will add to this field and provide important information on the pedagogical implications along with the language that is used to teach these texts to younger students. You will be given a report at the end of the study with the concluding results that will be of benefit to you when using these texts, especially since the new NSW syllabus encourages teachers to use informative texts in the early grades. No monetary compensation will be provided to any participant nor are there any costs.

(8) Can I tell other people about the study?

This study is not confidential. You may discuss your participation with other people.

(9) What if I require further information about the study or my involvement in it?

When you have read this information, Dr. Jon Callow can discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact Dr. Jon Callow, lecturer at the faculty of education and social work, on +61 2 9351 2613

(10) What if I have a complaint or any concerns?

Any person with concerns or complaints about the conduct of a research study can contact The Manager, Human Ethics Administration, University of Sydney on +61 2 8627 8176 (Telephone); +61 2 8627 8177 (Facsimile) or ro.humanethics@sydney.edu.au (Email).

This information sheet is for you to keep
Appendix I – Human Research Ethics Approval

Research integrity
Human Research Ethics Committee

Thursday, 3 April 2014

Dr Jonathan Callow
Education Faculty Admin; Faculty of Education & Social Work
Email: jon.callow@sydney.edu.au

Dear Jonathan,

I am pleased to inform you that the University of Sydney Humanities Low Risk Subcommittee has approved your project entitled “Primary Teachers Understanding of the Linguistic and Visual Modes of Scientific Informational Texts”.

Details of the approval are as follows:

Project No.: 2014/009
Approval Date: 3 April 2014
First Annual Report Due: 3 April 2015

Authorised Personnel: Callow Jonathan; Shakra Kayanne;

Documents Approved:

<table>
<thead>
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<tbody>
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<td>Interview Questions</td>
<td>semi-structured interview questions</td>
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<td>21/01/2014</td>
<td>Participant Consent Form</td>
<td>Participant Consent form</td>
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<tr>
<td>27/01/2014</td>
<td>Participant Info Statement</td>
<td>Participant information sheet</td>
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<td>26/03/2014</td>
<td>Recruitment Letter/Email</td>
<td>Updated recruitment letter to</td>
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<td>Recruitment Letter/Email</td>
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<td>principals</td>
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HREC approval is valid for four (4) years from the approval date stated in this letter and is granted pending the following conditions being met:

Special Condition/s of Approval

- It will be a condition of approval that all necessary permission is received and kept on file from all school principals and the Department of Education (SERAP) prior to research commencing.

Conditions of Approval

- Continuing compliance with the National Statement on Ethical Conduct in Research Involving Humans.

- Provision of an annual report on this research to the Human Research Ethics Committee from the approval date and at the completion of the study. Failure to submit reports will result in withdrawal of ethics approval for the project.

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Research integrity
Research Portfolio
Level 8, Jane Fox Russell
The University of Sydney
NSW 2006 Australia

T: +61 2 6027 0111
F: +61 2 6037 8177
E: m.humanethics@sydney.edu.au
sydney.edu.au

ABN 52 007 195 659
CRICOS 00023A
• All serious and unexpected adverse events should be reported to the HREC within 72 hours.

• All unforeseen events that might affect continued ethical acceptability of the project should be reported to the HREC as soon as possible.

• Any changes to the project including changes to research personnel must be approved by the HREC before the research project can proceed.

• Note that for student research projects, a copy of this letter must be included in the candidate’s thesis.

Chief Investigator / Supervisor’s responsibilities:

1. You must retain copies of all signed Consent Forms (if applicable) and provide these to the HREC on request.

2. It is your responsibility to provide a copy of this letter to any internal/external granting agencies if requested.

Please do not hesitate to contact Research Integrity (Human Ethics) should you require further information or clarification.

Yours sincerely

[Signature]

Associate Professor Judith Cashmore
Chair
Humanities Low Risk Subcommittee

[This HREC is constituted and operates in accordance with the National Health and Medical Research Council’s (NHMRC) National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007) and the CPMP/ICH Note for Guidance on Good Clinical Practice.]
7.10 Appendix J – SERAP Approval

Mrs Rayanne Shakra
46A Noble Avenue
STRATHFIELD NSW 2135

Dear Mrs Shakra

I refer to your application to conduct a research project in NSW government schools entitled: *Primary Teachers' Understanding of the Linguistic and Visual Modes of Scientific Informational Texts.* I am pleased to inform you that your application has been approved. You may contact principals of the nominated schools to seek their participation. You should include a copy of this letter with the documents you send to schools.

This approval will remain valid until 3 April 2015.

The following researchers or research assistants have fulfilled the Working with Children screening requirements to interact with or observe children for the purposes of this research for the period indicated:

<table>
<thead>
<tr>
<th>Name</th>
<th>Approval expires</th>
</tr>
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<tbody>
<tr>
<td>Rayanne Shakra</td>
<td>22/01/2019</td>
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</table>

I draw your attention to the following requirements for all researchers in NSW government schools:

- School principals have the right to withdraw the school from the study at any time. The approval of the principal for the specific method of gathering information must also be sought.
- The privacy of the school and the students is to be protected.
- The participation of teachers and students must be voluntary and must be at the school’s convenience.
- Any proposal to publish the outcomes of the study should be discussed with the research approvals officer before publication proceeds.

When your study is completed please email your report to: serap@det.nsw.edu.au.

You may also be asked to present on the findings of your research.

I wish you every success with your research.

Yours sincerely

[Signature]

Dr Susan Harriman
Leader, Quality Assurance Systems

§ April 2014

Policy, Planning and Reporting Directorate
NSW Department of Education and Communities
Level 1, 1 Oxford Street, Darlinghurst NSW 2010 – Locked Bag 53, Darlinghurst NSW 1300
Telephone: 02 9344 5000 – Email: serap@det.nsw.edu.au