

# PRODUCTIVE CONJUNCTIONS

## THE DESIGN OF EFFECTIVE LITERACY AND THINKING TOOLS

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*Abstract: The application of research outcomes aligned to a single paradigm can result in the design of polarized classroom pedagogies. In contrast, the application of multi-paradigmatic perspectives can result in the design of effective literacy and thinking tools.*

*The research outcomes from cognitive and neuro-psychologists adopting normative perspectives, and from linguists and sociologists adopting interpretative perspectives is applied to design two research-based literacy and thinking tools. The fiction meaning grid tool, linked to the reading and writing of narrative and recount texts, engages students in what neurologists describe as a theory of mind mechanism, and what sociologists adopting a cultural critique approach refer to as the social construction of identity through texts. The concept frame tool, linked to the reading and writing of report text, reflects the outcomes of normative research by cognitive psychologists who have described conceptual representation, and by sociologists who have described how knowledge is constructed. Both these tools illustrate the advantages of adopting multi-paradigmatic perspectives.*

*Productive Conjunctions*

Thomas Kuhn (1962) is commonly regarded as the progenitor of the concept 'paradigm', at least as it applies to the history and philosophy of science. The term comes from the Greek, *paradeigma*, meaning a pattern, model, or plan. Kuhn claimed that scientific theories, like theories of learning, are constructed around basic paradigms, for example the solar system model of an atom, or behavioural models of learning. Science and education are replete with paradigms that have been constructed as competitive, for example evolution and creationism, cognitive theory and behavioural theory. In education, these paradigms are reflected in different research methodologies and assumptions about human nature. Kuhn argued that shifts in theory require new paradigms or perhaps an amalgam of paradigms. Consistent with Kuhn's argument, this article proposes that research outcomes from multiple paradigms can result in the design of effective literacy and thinking tools.

Paradigms are theory-systems that shape experience. They determine what counts as evidence, what observations are relevant and even what is observed. Because the difference between sociological and cognitive-neuropsychological paradigms is logical and definitional rather than empirical, no observation can prove that one is right and the other is wrong. It is possible to understand them both in the context of designing effective literacy and thinking tools and to benefit from the rapprochement between them in practice.

When a researcher selects a paradigm, they are, by default, defining the types of experiences that they believe can legitimately lead to knowledge. Research paradigms can be more or less normative (objective/ logical positivist) or interpretive (subjective/ post-positivist/ constructivist/ post-modern/ relativist).

Educators who use pedagogy aligned exclusively to the research outcomes of a particular paradigm may, unwittingly, contribute to the creation of polarized educational practices. This polarization would occur, for example, if educators believed that the outcomes of research aligned to a normative paradigm, which includes understandings from cognitive psychology and neuroscience, were exclusive from outcomes aligned to an interpretive paradigm, encompassing sociology and socio-linguistics. These beliefs have the potential to create unproductive no-fly zones within literacy education and within approaches to the teaching of thinking. This article argues that paradigmatic polarization is incompatible with the design of effective literacy and thinking tools, and with the articulation of best practice. It takes the view that research outcomes stemming from the use of both normative and interpretive paradigms can inform the design of effective literacy and thinking tools.

Polarized positions in education seem an anathema in an age of interdisciplinary curriculum strands (Victorian Curriculum and Assessment Authority, 2005), interdisciplinary journals, interdisciplinary thinking programs (Marx, 1989) and inquiry learning approaches (Hill, Stremmel, & Fu, 2005). But paradigmatic polarization is clearly exemplified in the sometimes sustained and vehement debate between advocates of normative (Cuff & Payne, 1979) and interpretive (Hammersley & Atkinson, 1983) research paradigms. Polarization is also evident within paradigms, as witnessed by the debate among cognitive scientists between advocates of schema theory (Ruddell & Unrau, 2004) and dual coding theory (Sadoski & Paivio, 2001). Although both theories provide explanations of the reading process, their application results in quite different and singular pedagogies.

However, the view taken by this paper is that, although the academic debate around ways of knowing is valid, the research outcomes stemming from the use of both paradigms can inform the design of literacy and thinking tools.

The empirical nature and typical set of replicable procedures that characterize cognitive psychology, and that align with normative paradigm, seem most valued in literacy education. For example, the National Institute of Child Health and Human Development (2000) in the United States that reviewed how best to teach reading, did not accept indirect evidence such as descriptive or correlational studies as arbiters of best practice, instead relying exclusively on empirical research.

Research aligned to normative paradigms varies in terms of its objectivity and level of control. However, it still aims to arrive at causality, rather than association, and to establish and use a body of theory in the resolution of problems. For example, linear explanations of the reading process (Gough 2004), and reductionist lists of thinking skills (Beyer, 2001) seem to signal a determination on the part of these researchers to discover general laws governing reading and thinking processes. Their explanations and lists have evoked criticism from those advocating research methods aligned with interpretive paradigms.

For example, advocates of the Frankfurt School of critical theory, including Habermas (1972), claim that when all knowledge becomes equated with scientific knowledge, aesthetic, critical, moral, creative and other forms of knowledge are neglected. Similarly, Krashan (2002), like other researchers adopting interpretive paradigms (Luke, 2003), argues that literacy and thinking education can only be understood from the standpoint of the individual literate thinker, and from an appreciation of the context in which language and thought are constructed and observed. For researchers aligned to an interpretive paradigm, literacy and thinking are 'situated activities' subject to multiple interpretations.

It is unsurprising then, that literacy education and the teaching of thinking are fraught with polarized and somewhat unproductive debate. These debates emanate, for instance, from advocates of phonics (Gough, 1981) who argue their position using empirical data, and from advocates of whole language approaches (Goodman, 1993) who tend to construct practice based on qualitative data. Similar polarized debates are contested between researchers adopting genre approaches to the teaching of writing (Martin, 1985), based on the functional socio-linguistic analysis of text, and process approaches (Graves, 1994) based on research methods more aligned to interpretive paradigms. Likewise, entrenched debates have emerged between advocates of the systemic teaching of thinking skills (Beyer, 1987; 2001; de Bono, 1991; Feuerstein, Rand, Hoffman, & Miller, 1980) and those supporting a holistic, infused approach that employ thinking strategies (Creativity Techniques (n.d.); Root-Bernstein, 1999).

According to Beyer, de Bono and Feuerstein, success at school depends upon the acquisition and use of innate, discrete cognitive functions, or skills, such as recalling, comparing, classifying, inferring, generalizing, evaluating, experimenting and analysing which should be taught through systematic direct instruction. Together, these debates reflect a tension between advocates of normative and interpretive paradigms.

But is this polarization productive? And are pedagogies that stem from the application of research outcomes aligned to normative paradigms of no use because one favours an interpretative perspective? When teachers of literacy and thinking adopt polarized paradigms they largely forgo opportunities to explore the potentially productive conjunctions of research outcomes from across paradigms. This article demonstrates the value of designing effective literacy and thinking tools using research outcomes from both paradigms.

Objective understanding of the collective behaviours of literate thinkers together with an understanding of the intentional, subjective world of individuals can inform the design of effective literacy and thinking tools. The potential for these synergies is explored by addressing two questions. The first question asks whether outcomes generated from a normative paradigm (cognitive psychology, evolutionary psychology and neuro-linguistics) and an interpretive paradigm (sociology and applied linguistics) can inform the way we teach literacy and thinking. The second question asks whether understandings from both normative and interpretive paradigms can assist teachers design literacy and thinking tools. This second question is addressed by describing two literacy and thinking tools.

### **QUESTION 1: CAN RESEARCH OUTCOMES GENERATED FROM NORMATIVE AND INTERPRETIVE PARADIGMS INFORM THE WAY WE TEACH LITERACY AND THINKING?**

The literature on the teaching of literacy and thinking is replete with examples of academics using single paradigms to construct exclusive sites of disciplined contestation. For example, Pinker (1995; 1997; 2002), Boyd (1998; 2004), and Cosmides and Tooby (1989; 1992) among others, describe literacy and thinking from the normative perspective of evolutionary and cognitive psychology and neuroscience. Their perspectives have produced understandings that can inform the design of effective literacy and thinking tools. For example, at a general level

their understandings help us appreciate that literacy and thinking are products of the mind; that literacy and thinking have something to do with the brain's ability to perceive, think and register emotion. More specifically, evolutionary psychology allows us to consider human nature within the largest historical context of all and so appreciate authors, through their characters, as evolved problem-solvers.

The research methodologies used by cognitive psychologists tend to align with a normative paradigm and provides understandings about learning and memory. The outcome of this research can also inform the design of effective literacy and thinking tools. Specifically, understandings about the way information is structured and stored in long term memory (Farah, & McClelland, 1991) have informed the design of graphic organisers, and the way teachers might scaffold students to understanding through talk. Further understanding about our ability to reason and solve problems (Holyoak & Thagard, 1997; Newell & Simon, 1972) has also informed how we might help students learn to think through literacy.

Additionally, the identification of functionally specific neural systems implicated in processing language, and in thought, have provided a neurological substantiation of literacy and thinking behaviours described by cognitive psychologists. In particular, the identification of language pathways that implicate the angular gyrus area (Brodmann area 39), Wernicke's area (posterior third of the superior temporal gyrus incorporating Brodmann areas 22, 41 and 42) and Broca's area (Brodmann area 44 extending into area 46) have allowed teachers of literacy to understand how readers use grapho-phonetic, semantic and syntactic information while reading and writing. Further, understandings about the frontal and pre-frontal lobes have clarified our understanding of how the mind plans, regulates, monitors and evaluates its own cognitive function, and how it reasons and how it infers the behaviours of others.

Academics researching from an interpretative paradigm (Barthes 1972; Derrida 1992; Foucault, 1998; Lacan (see Muller et al., 1982); Luke, 2003; Martin, 1985) describe literacy and thinking through the use of cultural critique approaches. This type of approach provides a historically sensitive way of interpreting the product of our thoughts, and their perspective assists us to understand how our views are socially constructed and not always based on evidence.

For example, Alan Luke's research has revealed how texts are never neutral. He

shows how texts construct identity and power relationships among people and characters, and how these are mirrored in society; how authors selectively construct knowledge by stating what they value and omitting other knowledge. Luke and others show how texts reflect what authors believe and value, and by default what we should believe and value, and how dissenting voices are silenced. Similarly, Jim Martin uses functional and sociolinguistic approaches to reveal how genre, as social constructs, serve as agents of ideological closure and how power in society is linked to one's use of high status text forms.

But, can research from these contested normative and interpretative paradigms ever work synergistically in support of the design of effective literacy and thinking tools? Can an understanding of human evolution and our innate abilities offered by evolutionary psychologists, together with an analysis of class, gender, identity, power relationships, values and beliefs, in an historical context, offered by those adopting interpretative paradigm, help us to design effective literacy and thinking tools? Might an understanding of human nature, as advocated by Pinker *et al.* 'free' those adopting interpretative perspectives, and who conceive literature as social text or discourse, from their sterile post-modern and social determinist positions (Boyd, 1998)?

Normative and interpretative paradigms seem to provide two legitimate and supportive ways of knowing. Indeed, the recent confirmation by the neuro-psychologists Gallagher and Frith (2003) of Bruner's (1995) cognitive 'theory of mind mechanism' would seem to support this legitimacy. If we acknowledge that as a species we can be legitimately described as both 100% scientific (normative) and 100% cultural (interpretative) (Freedman, 1993) depending on the paradigm employed, then there is some support for the design and use of literacy and thinking tools that are based on the outcomes of multi-paradigmatic research. These beliefs are articulated in the answer to Question 2.

**QUESTION 2: CAN UNDERSTANDINGS FROM BOTH NORMATIVE AND INTERPRETIVE PARADIGMS INFORM THE DESIGN OF LITERACY AND THINKING TOOLS?**

The answer to this question is illustrated through the description of two literacy and thinking tools. This description articulates the possibilities of designing tools based on research outcomes aligned to both interpretative and normative paradigms. The tools incorporate research outcomes

that underpin the critical literacy approach (McLaughlin & DeVoogd, 2004), that provide a means of discourse analysis. They incorporate research outcomes from evolutionary, cognitive and neuro-psychology that provides a means of knowing what makes narrative worth attending to, how narrative reflects the evolved problem-solving functions of the brain, why some behaviours have evolved in gendered ways, and why humans have the altruistic urge to support the weak.

The first literacy and thinking tool, the *meaning grid* is underpinned by what neuroscientists describe as the 'theory of mind mechanism' of the anterior paracingulate cortex, and by what sociologists describe as the ability to deconstruct identities and power relations based on an appreciation of contextual values and beliefs.

The second literacy and thinking tool, the *concept frame* is underpinned by what cognitive scientists describe as the schematic representation of concepts in long term memory, and by what sociologists interpret as the social construction of knowledge.

**THE FICTION MEANING GRID**

One aspect of social cognition that sets us apart from the primates is our ability to anticipate other people's behaviour, almost as if we had read their minds. It underlies our ability to explain and predict their behaviour by attributing to them independent mental states, such as beliefs, desires, emotions and intentions. This ability is realised when we infer the desires and feelings of others and predict their intentions. This ability is known as having a 'theory of mind'. From a neurological perspective this ability seems to be a pre-wired, automatic function of the anterior paracingulate prefrontal cortex, bilaterally and corresponds to Brodmann areas 9/32 (Rizzolatti, Fogassi, & Gallese, 2001; Siegal & Varley, 2002; Gallagher & Frith, 2003; Geary, 2005). This is a recently evolved area of functionally specialized projection fibres called spindle cells that begin to appear about four months after birth. These cells operate as mirror neurons that allow the meaning of an observed action to be matched with that of a self-action. It is also likely that this 'theory of mind' ability is distributed rather than confined to this single module of spindle cells; emotional and face recognition areas of the brain are also involved in the development of this ability.

From an interpretative perspective, this ability seems to be a link to the influence of culture and society. Indeed, in recent years, theorists have noted that attention to social and cultural influences is often missing from discussions of how children develop an understanding of mind (Lillard, 1998; Bruner, 1995). Their thesis is that children do not acquire concepts in a vacuum and that our understandings of theory of mind mechanisms have underemphasized social influences and culture. Indeed, Nelson (1973) has argued that it is 'wrongheaded' to see children's understanding of minds as arising all from within the child's own mind.

What makes *Coronation Street* and other soap operas popular is that their plot gives us an opportunity to exercise our theory of mind, to infer the mind states of our favourite soap characters as we view. Likewise when we read, we are engaged in inferring the emotional and intentional states of characters.

The design of the *fiction meaning grid* (Whitehead, 2001) is consistent with neurological research describing this innate theory of mind mechanism. The tool enables students to develop their theory of mind mechanism because it challenges them to infer the minds of others (characters and people) and then reflect on what they infer.

The tool is also consistent with the outcomes of research by socio-linguists because the tool assists writers' to process information into forms that, in particular, align with the social and semantic purposes of writing descriptive characterisations and historical recounts. It also engages readers in types of critical thinking described by advocates of cultural critique that assists students to problematize texts.

Figure 1 illustrates a *fiction meaning grid* based on a reading of *Jane and the Dragon* (Baynton, 1998). A selection of the main characters is listed across the top of the grid, and descriptors related to the emotions and desires of these characters are recorded down the left side of the grid. While some of these descriptors may come from the text, most need to be suggested by readers. The comprehension of descriptors in a text and the production of other inferred descriptors for inclusion on the grid engage a student's theory of mind mechanism.

Students complete the grid by rating each character against each descriptor – a descriptor is suggested for one character but then applied to all other characters. A rating of 1 indicates the students' inference that a character is weak in that trait, and a rating of 5 that they are strong. As the key at the top of the *fiction meaning grid* indicates, the simple version, indicated by single ratings on the grid (see 'sensitive' and 'egotistic' under Jane), provides a general rating for each character based on an entire text. The standard version (see grid boxes with diagonal lines) allows students to generate temporal-comparative ratings by assessing characters against each descriptor at the beginning and end of a text (see 'unloved' under Jane). The complex version (see grid boxes divided into four sectors) allows students, in addition, to select and rate one specific event (bottom, left-hand box) then substantiate their rating by quoting a page number, or if the grid is made big enough, by substantiating verbatim from the text (bottom right-hand box). For example, in Figure 1 Jane has been rated as very 'determined' at the beginning and end of the story, and this inferred characteristic was substantiated on page 13 (when she fought the Dragon).

The design of the standard and complex versions of the *fiction meaning grid*

additionally engage students in types of reflective thinking that align with the interpretive research outcomes of socio-linguists. To facilitate this thinking, the design of the tool incorporates four generic questions that are written in the 'Reflecting on what we know' section below the grid. Consistent with a cultural critique approach these questions serve to focus students' thinking on how authors constructed: (i) characters'/people's identity, (ii) power relationships among characters/people, (iii) knowledge, and (iv) beliefs and values.

The design of the *fiction meaning grid* therefore, reflects the productive conjunction of research outcomes that stem from the use of both normative and interpretative paradigms.

Figure 1:

A *fiction meaning grid* based on *Jane and the Dragon*

Rating for Simple Meaning Grid		Rating for Standard Meaning Grid		Rating for Complex Meaning Grid	
<b>Characters</b>	Jane	Dragon	Jester	King	<b>Processing what we know</b> All / some / few / most / reasoned statements
<b>Descriptors</b>					
Determined	5 5 p13	2 3 3 p6	2 4	4 4	Most of the characters were determined but in different ways. The heroine was the most determined.
Unloved	5 2	1 5	1 3	2 2	Most of the characters changed from being unloved to being loved.
Sensitive	4	4 4	5 5	1 1	Only one character was insensitive in the beginning and end of the story
Egotistic	3	2 4	1 1	5 5	Two of the characters remained egotistic throughout the story.

**Processing what we know** (Listing or comparative statements)

- Jane and the King were **similar** because they remained determined throughout the story. (Comparative structure)
- In contrast** to the other characters the King was egotistic throughout the story. (Comparative structure)
- The Jester was sensitive, loved and not at all an egotistic character that became determined to have Jane as his friend. (Listing structure)

**Reflecting on what we know** (Asking critical questions)

**Questions about how authors construct the identity of characters.**

- Why did the author construct the King as egotistic? Are all rulers egotistic?
- Do all heroines need to be determined?

**Questions about how authors construct power relationships.**

- Why did Jane disobey her mother? Should daughters disobey their mothers?
- What gave Jane the right to fight the Dragon?

**Questions about how authors construct knowledge.**

- What did we learn about the Jester? How did we learn this?
- How did we learn that Jane and the Jester were determined?

**Questions about what authors believe or value.**

- Does the author believe that young girls should disobey their parents?
- Why did the author construct the Jester as a sensitive character?

### THE CONCEPT FRAME

A second literacy and thinking tool that reflects the productive conjunctions of multi-paradigmatic ways of knowing is the *concept frame* (Whitehead, 2001). From a socio-linguistic perspective this tool enables students to gather and process information into forms that align with some of the conventional classification and topical paragraph components of report genre. It also allows them to reflect on what they know using questions that reflect the research outcomes of those adopting cultural critique approaches.

These questions assist readers to ask whether an author included enough information, whether the most appropriate information was selected, and whether the author ordered information in the most logical and cohesive fashion.

When used prior to, during or after reading, a *concept frame* activates knowledge in a neurologically consistent and ordered fashion and helps students question the basis of the author's selection.

From a normative perspective the design of the *concept frame* reflects the innate ability of the mind to abstract the physical world and represent it conceptually. Humans conceptualise reality. According to some cognitive scientists (Blaut, Stea, Spencer, & Blades, 2003; Collins & Loftus, 1975; Farah & McClelland, 1991; McRae, de Sa, & Seidenberg, 1997) concepts are represented, or stored, in permanent memory in the form of connected meaning nodes as illustrated by Figure 2.

Figure 2:

A schematic representation of meaning nodes for the concept 'dog'

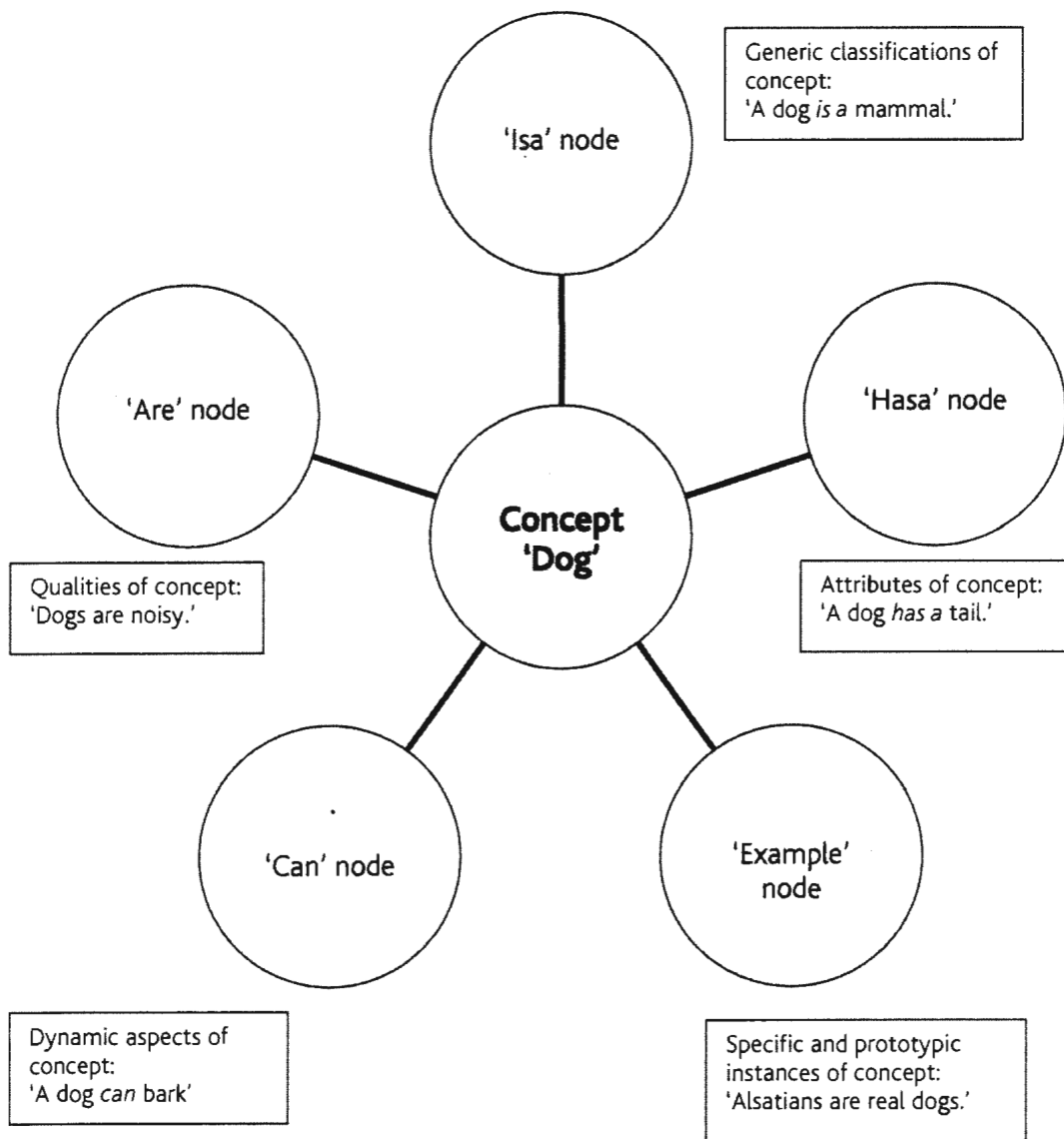


Figure 3 illustrates a *concept frame* that explores the 'dog' concept using the five memory meaning nodes illustrated in Figure 2 as headings. From the normative perspective of cognitive psychology, these headings have 'psychological validity' because they reflect the way cognitive psychologists think concepts are represented in memory.

Consistent with these understandings, the meaning nodes illustrated in Figure 3 include: (i) an 'isa' node that represents generic classifications of concepts like, 'A dog is a mammal'; (ii) a 'hasa' or 'have' node that represents concept attributes

like, 'A dog has a tail'; (iii) a 'can' node, that represents the dynamic aspects of concepts like, 'A dog can bark'; (iv) an 'are' node, that represents qualities of concepts like, 'Dogs are noisy'; and (v) an 'example' node, that represents specific and prototypic instances of concepts like, 'Alsations are real dogs.'

**Figure 3:**

*A concept frame based on the concept 'dogs'.*

<p><b>Is... / is a...</b></p> <p><i>Order</i>    <i>Attributes</i></p> <p>3.        A friend</p> <p>1.        A mammal</p> <p>X        A furry animal</p> <p>2.        A domestic animal</p> <p>          <i>A companion</i></p>	<p><b>Dog (s)</b></p>	<p><b>Are...</b></p> <p><i>Order</i>    <i>Attributes</i></p> <p>2.        Pets</p> <p>1.        Expensive to keep</p> <p>X        Noisy</p> <p>3.        Meat eaters</p> <p>          <i>A health hazard</i></p>
<p><b>Can...</b></p> <p><i>Order</i>    <i>Actions</i>    <i>Groups</i></p> <p>4.    Catch ball    }    <span style="border: 1px solid black; padding: 2px;">Play</span></p> <p>3.    Swim            }    <span style="border: 1px solid black; padding: 2px;">Play</span></p> <p>2    Lead the blind    }    <span style="border: 1px solid black; padding: 2px;">Work</span></p> <p>1.    Save people     }    <span style="border: 1px solid black; padding: 2px;">Work</span></p> <p>5.    Bark</p> <p>      <i>Be put down</i></p> <p>      <i>Retrieve</i></p>	<p><b>Has... / has a... / have...</b></p> <p><i>Order</i>    <i>Attributes</i></p> <p>1.        Fur</p> <p>2.        Tail</p> <p>3.        Teeth</p> <p>6.        Collar</p> <p>4.        Fleas</p> <p>5.        Bad breath</p>	<p><b>Example</b></p> <p><i>Order</i>    <i>Examples</i>    <i>Groups</i></p> <p>1    Spaniels        }    <span style="border: 1px solid black; padding: 2px;">Pets</span></p> <p>2    Poodles         }    <span style="border: 1px solid black; padding: 2px;">Pets</span></p> <p>3    Dingoes         }    <span style="border: 1px solid black; padding: 2px;">Wild</span></p> <p>4    Coyotes         }    <span style="border: 1px solid black; padding: 2px;">Wild</span></p>

**Processing what we know**

1. If possible, combine words into labelled groups.
  2. Order the lists of words to reflect the order they might be used in a report.
  3. Use the Example words to construct questions beginning with 'Name of dog' plus 'can', 'are', 'is' new word?
- For example, 'A Spaniel can retrieve.' 'Retrieve' is then recorded in the 'can' sector of the *concept frame*.

**Reflecting on what we know**

*Questions about identity:* How would you describe what a dog is?

*Questions about our values:* Might there be things dogs 'are', and 'can do' that people value?

*Questions about who has power:* If humans have the power of life and death over dogs does this mean dogs 'are' threatened, and 'can' be mistreated?

From a socio-linguistic perspective, the structural features of a *concept frame* align with some of the conventional components and purposes of report genre (Martin, 1985). One of these components is the *classification* that classifies the topic of a report by associating it with a larger set. For example, a report about dogs might include 'mammals' in the classification, for instance, 'Dogs are mammals'. Some of the information needed to complete the classification component of a report can be obtained from the 'isa' and the 'are' sectors of a *concept frame*. In a written report based on the *concept frame* illustrated in Figure 3, the classification component might include sentences about 'friends' and 'mammals', 'pets', and 'things that are expensive to keep'.

The other three (shaded) sectors of the *concept frame* relate well to the topical nature of paragraphs found in the body of a report text. Students may use the key vocabulary from these sectors to compose topical paragraphs, and more specifically topic sentences.

Like the *fiction meaning grid* the *concept frame* tool involves processing information and reflecting on what is known. Processing information involves selecting, deleting, sequencing, grouping and analysing information represented in the frame. For example, Figure 3 illustrates that students have deleted words deemed inappropriate to the purpose of their report (see X beside some words), and sequenced words (see numbers beside words) to indicate the order these might be introduced as topics in a report. Students have also grouped ideas as indicated by the braces and labelled boxes. These boxes can serve as placeholders for sub-headings or can provide key words for topic sentences.

Students can also use *concept frames* to reason. This requires them to select one entry from the 'is / is a', 'have', 'are' or 'can' sectors of the frame and construct a question. For example, the entry 'a friend' from the 'is / is a' sector can be used to design the question 'If a dog is a friend it is also a .....? The word 'companion' might complete this statement and this word would be recorded in the 'is / is a' sector as shown in italics in Figure 3. Again, from the 'are' sector, but linking to the 'can' sector, 'If dogs are noisy they can be ...? might prompt the words 'put down' which are recorded in the 'can' sector. Finally, 'If dogs have fleas they are...? might prompt the words 'a health hazard', which is recorded in the 'are' sector.

Students can also process what they know by designing questions based on each example of dogs listed in the 'Example' sector. The structure of these questions is based on the other sectors of the *concept frame*. Thus a Spaniel 'can' retrieve, which

is added in italics in the 'can' sector. Likewise, Spaniels 'have' pups, and Spaniels are expensive to de-sex, and so on will generate additional ideas that can be recorded in the appropriate sectors of the *concept frame*.

The final step, *Reflecting on what we know*, when completing a *concept frame* is consistent with research outcomes that stem from the use of more interpretive paradigms. It is informed by principles that underpin critical literacy (Lewison, Flint, & Van Sluys, 2002) and involves asking questions about information recorded in the frame. For example, as illustrated in Figure 3, three generic reflective questions have been provided to help students think about dogs. Specifically, these questions are designed to assist students think about their construction of identity, values and power in respect to the concept 'dogs'. During this step students can be assisted to: (i) reflect on the resources they used to construct their *concept frames*; and (ii) think about the extent to which their concept of 'dog' is inclusive or filtered through a selective cultural lens.

Again, the design of the *concept frame* reflects the productive conjunctions of research outcomes that stem from the use of both normative and interpretive paradigms.

## CONCLUSION

The design of the two literacy and thinking tools described in this paper suggest that together, research outcomes generated from normative and interpretive paradigms can inform the way we design literacy and thinking tools. An understanding of these paradigms, and of research outcomes aligned to them, provides teachers who use these tools with a theoretical justification for their place in curriculum programmes. It also provides those wishing to design literacy and thinking tools with a theoretical framework on which to hang their ideas.

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