

SEEING THROUGH TEXTS: DEVELOPING DISCOURSE-BASED MATERIALS IN TEACHER EDUCATION

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ABSTRACT

Research in ELT materials has not emphasised the use of visuals for cognitive development. In most cases, visuals serve for illustrative purposes. Recent cross-disciplinary findings by Mohan, 1986; White and Gunstone, 1992; Burgess, 1994; Cortazzi and Jin, 1996, concerning the use of visuals indicate that they have a much wider role.

In this paper we develop a strand of visualisation within a comprehensive Framework of materials design for English for Academic Purposes (EAP). We argue that visual elements are critical in the discourse exploitation of materials. Through our case studies in Britain, Malaysia and China, we demonstrate how EFL/ESL teachers have used a variety of visuals to develop text understanding and critical thinking.

Different visuals help teachers to see texts in different ways and to see through the process of making discourse-based tasks and activities. We report the use of: Key Visuals, which we define in Mohan's (1986) terms of symbolising text content; Text Frames (McCarthy and Carter, 1994) which give visual overview of a text's discourse structure and text type (Davies and Green, 1984; Jordan, 1984; Hoey, 1985; Davies, 1995) in teacher education research projects and illustrate these uses with classroom examples.

"Seeing through texts" has a further dimension of developing the critical thinking of both teachers and students regarding text content and structure, once this is visualised.

Research in ELT materials has not emphasised the use of Visuals for cognitive development. In most cases, Visuals serve for illustrative purposes. Recent cross-disciplinary developments by Mohan, 1986; White and Gunstone, 1992; Burgess, 1994; Cortazzi and Jin, 1996; Rafik Khan, 1997, concerning the use of visuals indicate that they have a much wider role.

In using English for academic/study purposes, students have to make the transition from learning to read to reading to learn. This means that they need to see through the text and comprehend global ideas and text organisation. This can be effectively achieved through the construction and use of various types of visuals to develop understanding of content through the discourse meanings of a text. This will also consolidate reading at more advanced language levels.

This means that teacher education courses (which involve training to teach reading skills and materials development/adaptation) will need to train teachers to develop learning, thinking and language skills through visuals. This is particularly useful/valuable with expository texts where different types of visuals help teachers to see texts in different ways and to see through the process of making discourse-based tasks and activities.

Although many teachers may use a variety of visual aids in teaching, these visuals may not be systematically related to students' learning and thinking. Students may not be taught how to use visuals, make or interpret them to enhance text understanding. In order to help students to achieve such skills teachers have to be trained to develop their own skills in this respect. Our studies have revealed that teachers can be trained to develop visuals for reading to learn using cross disciplinary texts. At the same time they discover their own weaknesses and strengths in understanding text organisation. They can be trained to view reading as an interactive process related to discourse knowledge, content knowledge, language skills and to the global meaning of texts, through visualization as shown Figure 1.

We can call this reading visualisation. This is the process of framing the text through a variety of visual means in order to successively emphasise language, global meaning, content knowledge and discourse meanings while simultaneously developing skills of visualisation. Visualisation would also develop quality of seeing text patterns and potential visuals in one's mind and using creativity and imagination in understanding text meanings. This model of reading visualisation progressively develops

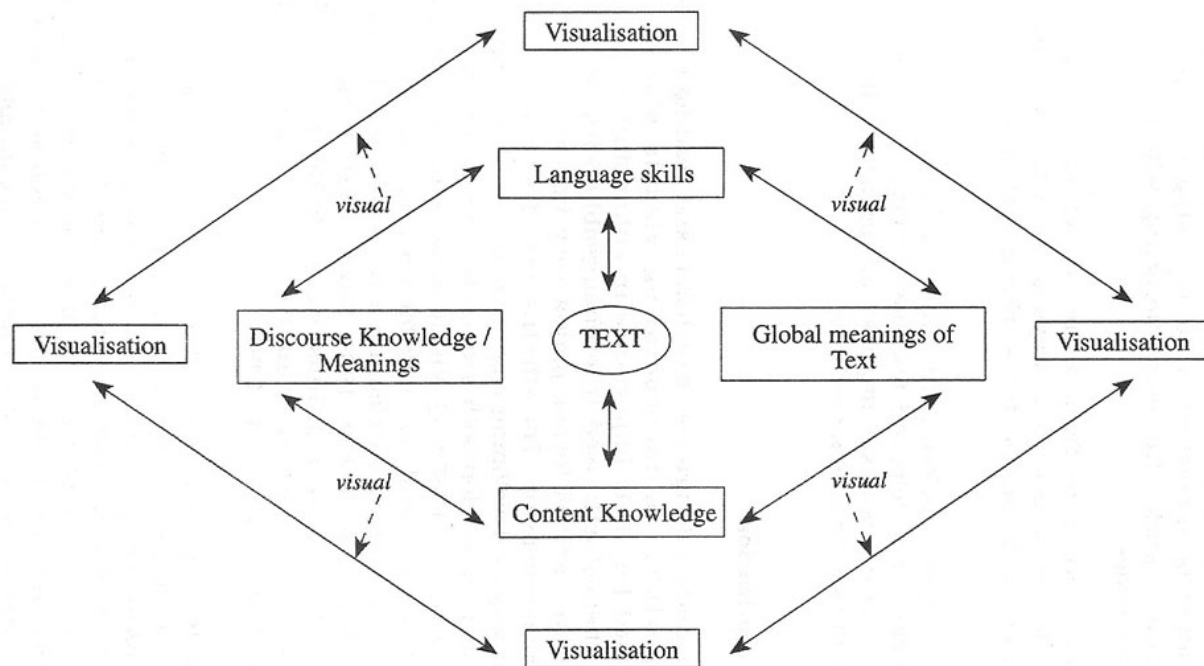


Figure 1: Interactive Processes of Reading Visualisation

trade off between visualisation (of the different elements in texts) and verbalisation (of different kinds of visuals). In this way, reading is interactive in iterative stages, as students systematically work with texts interacting with both visual and verbal modes.

Visualisation thus frames the extraction of meanings from the text in at least four ways as we will show, visuals can also be "text frames" for working with discourse and content.

The key to working out such notions for visual frameworks for developing text based materials is teacher education since this model implies that teachers will need to be trained to see texts in a new way.

Visual Application

In any materials design course/syllabus and reading courses the importance of incorporating visuals should be emphasised for their importance in enhancing learning. Visuals (henceforth used interchangeably with the term graphics) in various forms, play a very important role in aiding comprehension. The effective use of visuals is also a powerful way of developing cognitive and thinking abilities. Visuals help to develop both sequential and lateral thinking (Barlex and Carre, 1985:8-7). Visual presentation or graphics of any style are useful not only for learning languages but also learning in other curriculum areas (Zimmer & Zimmer, 1978; McAlister & Robson, 1984; Block, 1991; Early, 1991; Hewings, 1991; White and Gunstone, 1992; Rowntree, 1993; Burgess, 1994; Cortazzi and Jin, 1996; Kress & Van Leeuwen, 1996; Rafik Khan, 1997).

In content area learning and in the reading of expository texts, the function of illustrations, graphics and other nonverbal aids are vital in complementing texts to assist learners to understand practical experience and to aid abstract thinking. A good graphic has the power to enhance reading, shows meaning and helps in drawing conclusions. It also enhances and develops the understanding of concepts.

For example, demonstration of results, explanation of processes, functions, procedures, can easily be presented in tabular form by teachers or learners themselves. In this way students show understanding of not only content but also of their perception of the coherence of a text. This will also enable students to show their reconstruction of knowledge and understanding. Practice and guidance in using visuals ultimately enables the learners to extract meaning and show understanding when they have found significant relationships in the text. The graphics used in language and content teaching provide support in communicating the structure of knowledge and allows teachers or students to develop probing questions alongside graphics (Mohan, 1986:87). Mohan maintains that various types of graphics develop not only learners' knowledge but also specific thinking processes related to particular knowledge structures (see Figure 2). Thus different types of graphics can develop different types of thinking skills.

Types of visuals/graphics and their importance

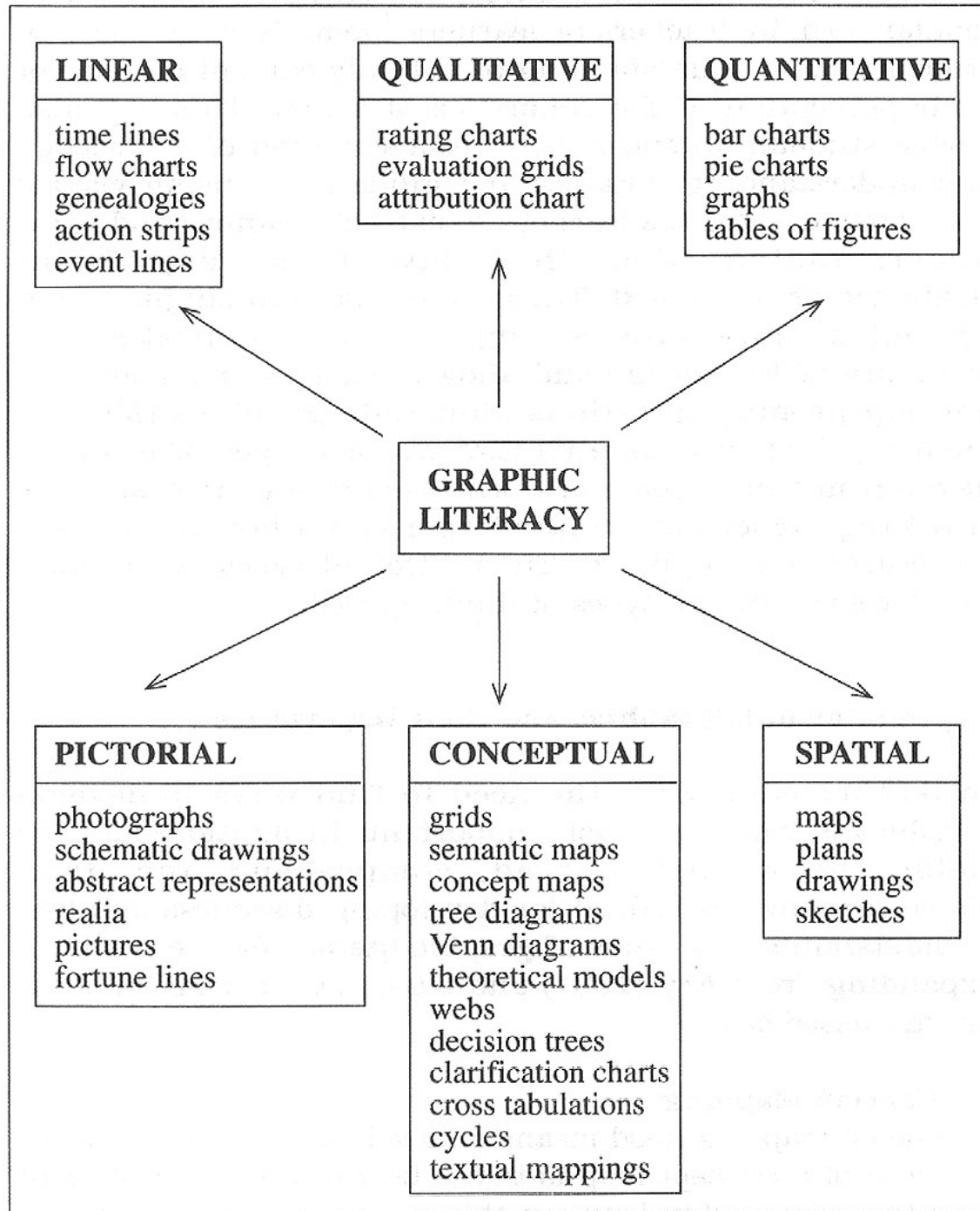
In teacher education, the need to find ways to develop graphics is considered very important. In multidisciplinary fields the ability to read, comprehend and draw visuals/graphics is crucial for developing discourse and text understanding. Six kinds of graphic literacy can be outlined, expanding from Fry (1981) and examples of some of these are discussed below.

(a) Concept Mapping

A concept map is a good means of developing thinking skills. The aim of a concept map is to see how a teacher or student sees the relationship between things, ideas or people (White and Gunstone, 1992: 15).

Using concept maps in EAP enables the teacher/student to see how ideas are linked and how topics are structured. Mapping is a means of eliciting the relations each teacher/student perceives between the concepts. Types of concept maps vary according to the content of a text/topic and individual interpretation. They can range from simple to

Figure 2 : Key Kinds of Graphic Literacy



complex with a range of variations and are excellent for developing discourse knowledge and the teaching of reading and writing (Novak & Gowin, 1984; White & Gunstone, 1992; Buzan, 1993; Cortazzi & Jin, 1996; Rafik Khan 1997).

A variant of content mapping is textual mapping. Textual mapping allows a teacher or learner to break down the text into smaller units to ease understanding. Information load can be systematically reduced via textual mapping and through the use of text - cohering links. Such techniques help increase understanding/comprehension of text content add discourse. Using textual mapping techniques enables a teacher or learner to practise ways of simplifying complex information but also to clarify the rhetorical and logical relationship between various sections of a text (Bhatia, 1987).

(b) Drawings

Other methods of probing understanding is through the use of drawings. Drawings reveal to teachers and students the ideas held by the student. They can also indicate shifts in views, problems with interpretation and understanding (Lunzer & Gardner, 1984; Davies & Green, 1984; White & Gunstone, 1992; 99).

(c) Fortune lines, Event lines, Time lines

Fortune lines probe learners' understanding of a story, sequence of scenes or events in history by requiring learners to estimate and graph one or more quantities for each scene (White and Gunstone, 1992: 107-122). Using such techniques allows students to generate ideas, events, progress and stages/steps which can be plotted in graph or tabular form. This seems particularly useful if the learners are presented with texts that contain schedules of experiments, sequences of events and other similar work. Such techniques would sharpen their analytical ability.

(d) Tables and Action Strips

i. Tables

Lists and tables are another widely used form of graphics. According to Mohan (1986:85), there are two forms of tables; one is for making judgements on objects, items and individuals and the other is for making judgement on cases, actions and outcome.

ii. Action strips

Action strips are also useful techniques to develop a sense of structure of a text but they are limited in visionary power. However, if used together with other forms of graphics they can increase comprehension and understanding.

(e) Flow Charts, Grids and Tree Diagrams

Mohan (1986:58) defines a flow chart as a 'device which shows choices and their reasons and which outlines more complex processes in action situations'. It is thus considered to be a very useful method of drawing attention to the structure of a situation.

Burgess (1994:309) maintains that flow charts, grids and tree diagrams are the best models available of how the mind organises ideas in information sets. Flow charts embody temporal or casual sequences and encourage critical and flow thinking. Grids, on the other hand, represent "the attribution characteristics to phenomena, thus developing attribution thinking" (Burgess, 1987, 1994) and further defined as "managing clusters of ideas that interrelate across two axes (i) the axes of phenomena and (ii) the axes of criteria" (Burgess, 1987).

Tree diagrams, which seem to be popular among teachers represent highly abstract classification of ideas in hierarchies. According to Burgess (1987, 1994) tree diagrams develop what he calls "hierarchy thinking" and are techniques of relating ideas to each other in order of generality.

Graphics can be used effectively to highlight the linguistic devices of knowledge structure. This is useful in the EAP context (Tang, 1992). Research findings into the use of visual aids can be discerned from research investigating methods to facilitate science and maths learning (Rewey et al, 1989; 1992; Gunstone & White, 1986). Other research into use of various types of graphics to aid learning and comprehension has been carried out (Carrell et al, 1989; Ruddel and Boyle, 1989; McGagg & Danasareau; 1991; Amer, 1994; Cortazzi and Jin, 1996). Findings from such research studies indicate that different types of graphics such as knowledge maps, semantic maps, and concept maps are effective tools in both language and subject matter teaching.

Burgess (1994: 310) explains that certain schemata can be "usefully expressed as ideational frameworks" through grids, flow charts and tree diagrams. These graphics can be used to "contain and organise the ideational content that language learners are dealing with; in other words, they can function as the medium through which the language is processed, the link between the receptive skills of reading or listening and the productive skills of speaking and writing" (ibid). Graney (1992), Gun - Rozenblit (1989), and Holliday (1975) strongly maintain that such graphics, whether they be "text graphics or maps," should be used in aiding reading comprehension. Celce - Murcia and Hilles (1988) advocate their use in the teaching of grammar.

A number of recent theoretical developments in concept mapping, complex diagramming of content learning, visual semiotics and in the grammar of visual design will allow increasingly powerful applications of visuals in learning and in learning to teach (Novak & Gowin, 1984; White & Gunstone, 1992; Kress & van Leeuwen, 1996).

It is clear from the above discussion that visuals play a key role in learning as a whole. If teachers are trained to see through texts to make different types of graphics in their teaching - learning materials it is likely that students will see how information is presented in a much clearer manner. Through practice, teachers will see the relationship within the text (both cohesion and coherence) and will design relevant materials incorporating appropriate graphics. If teachers are able to identify text structures and the manner in which the information is presented through discourse analysis they may be better equipped to utilise and optimise the use of graphics/visuals in their teaching - learning materials. The idea is to get teachers to view their materials in a more comprehensive manner and continually bear in mind that visuals are essential in helping to conceptualise and concretise abstract information.

Some graphics discussed above are often found alongside texts, in which case teachers can be encouraged to help students to derive maximum information from the graphics. If a text has no visual accompanying it, teachers can help students to develop comprehension of texts by teaching them how to draw such graphics to represent text content or text structure.

Some Visual Approaches to Reading Texts

Since the early eighties several specific approaches to reading which use visual and graphic devices to promote understanding (and are excellent in helping teachers to see through texts) have been developed. Examples of some of these are: the ERICA model, the DARTS approach, the Knowledge Framework, Text Frames and the Clause-Relations model. Such models provide the teachers and students with specific techniques for whole text understanding, visual development and guidelines for writing. Initially teachers will need guidance and practise in using these approaches themselves before using them in the classroom to help students develop effective study skills.

1. The ERICA model

ERICA stands for Effective Reading in the Content Areas and was developed with teachers in Australia (Morris & StewartDore, 1984). The model is designed to show students how to extract information from texts and teachers can be similarly trained to do the same. This model consists of four stages:

- i. **Preparation:** previewing texts, surveying materials, preparing ideas, identifying new vocabulary, by using structured overviews in the form of tree diagrams and charts to help both teachers and students understand the organising ideas;
- ii. **Thinking through:** developing three levels of comprehension: literal comprehension, reading 'on the lines'; interpretative comprehension, reading "between the lines"; and applied comprehension, going 'beyond the lines';
- iii. **Extracting and organising information:** using charts, diagrams and other visuals to select and transfer information;
- iv. **Translating:** readers use group discussion or write reports based on the notes, outlines, diagrams, charts they made earlier.

2. DARTS

This approach was developed in Britain and is known as Directed Activities Related to Text (Lunzer & Gardner, 1984). Like the Australian ERICA model, this approach was developed together with teachers. This approach provides a series of practical ways to help teachers to help students with reading texts across the curriculum. It consists of two aspects: a list of 12 classroom activities and a structural classification of text types ('topic types').

The list of classroom activities covers two aspects: reconstruction of a modified text and analysing a straight text. See Figure 3 and 4.

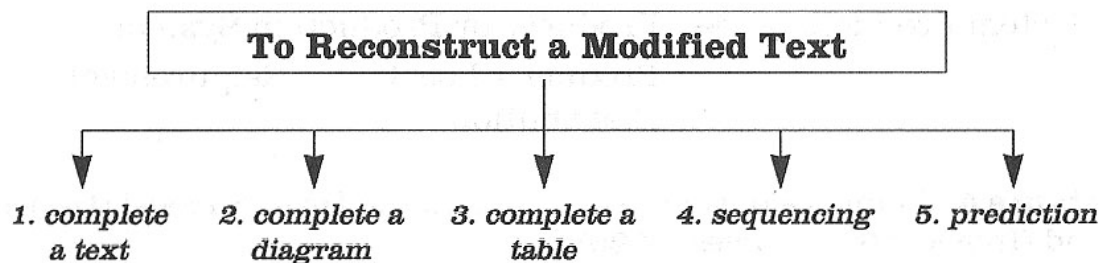


Figure 3. Reconstruction of a Modified Text

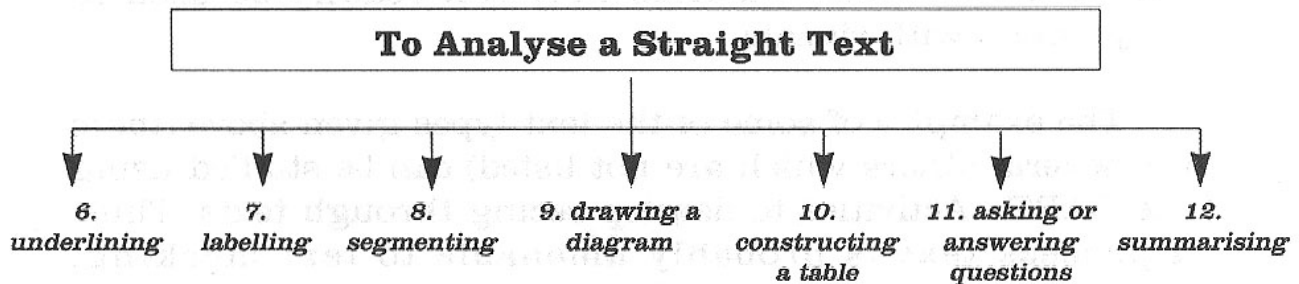


Figure 4. DARTS activities (after Lunzer & Gardner, 1984; Davies and Greene, 1984)

Visuals are involved in numbers 2, 3, 9 and 10. However, we use these activities in teacher education not simply as a list but rather as a number of activities which can be combined in sequenced stages to develop discourse-based materials.

Example of a structural classification of text types

| Test Type | Information Structure Constituents |
|----------------------|--|
| Physical structure → | Part → Location + Property + Function |
| Process → | State or form of object/material → Location Time or Stage + Instrument or Agent + property or structure + Action |
| Instruction → | Step or procedure → Materials + Apparatus or Measure + Caution or Condition + Result + Interpretation |
| System/Production → | Producer or Production System → Product + Location + Requirement + Distribution |

Figure 5. Examples of some Text types in the DARTS model (Davies and Greene, 1984; Davies, 1995)

Not all the DARTS techniques use a visual approach. However, since many of them can be used in a number of combinations and sequences they can readily be used in conjunction with visuals.

The examples of some of the text types given above (there are several others which are not listed) can be studied using the DARTS Activities to develop seeing through texts. Thus, a process text is probably amenable to text marking, segmenting, making a flow diagram, labelling or completing a table.

3. The Knowledge Framework

This Canadian model was developed by (Mohan, 1986) with teachers. The emphasis is on ESL across the curriculum. The model links language skills with knowledge and thinking through the use of key visuals for curriculum planning but can be used for task construction. It develops a knowledge framework for classifying learning activities. In using this model for developing tasks the teachers are trained to link language skills, thinking skills and key visuals interactively.

The tasks can be designed to develop the learners' cognitive and language ability. In an EFL/ESL situation, when teachers simplify language they often also simplify the cognitive demands of tasks. This can sometimes seem patronising to some learners. It might be more productive and challenging to keep the cognitive demands at an appropriately high level while keeping the language demands low. In such a context, visuals may help to motivate ESL/EFL students whose language competence does not allow them to express what they have understood in content. A variety of activities/tasks can be devised which demands their intellectual and cognitive involvement in completing a visual task through their reading comprehension.

This model proposes that there are six major knowledge structures (see Figure 6).

THE KNOWLEDGE FRAMEWORK

| | | |
|-----------------------|-------------------|-------------------|
| THEORETICAL | | |
| Classification | Principles | Evaluation |
| PRACTICAL | | |
| Description | Sequence | Choice |

Figure 6. The Knowledge Framework Categories (Mohan, 1986)

Each of these knowledge structures is associated with particular thinking skills. The framework is used in Canada to help teachers plan the curriculum, so that students will work on activities which systematically relates to all six knowledge structures covering any particular topic. Such an approach helps to overcome the unconscious tendency of some teachers to avoid tackling principles, choice or evaluation in classroom activities.

Each of the knowledge structures is associated with key visuals. These can be consciously used by teachers as symbols of knowledge rather than simply as illustrations. This would enable the students to see the structure of knowledge embodied in the visual which is extremely useful for transfer of knowledge and skills across the curriculum. Each knowledge structure is further linked to typical uses of language. The links are often predictable but complex. Only some examples are provided here (see Mohan, 1988 and Cortazzi & Jin, 1996). Figures 7 and 8 show the relationship between thinking skills, visuals and examples of language (after Mohan, 1986).

| DESCRIPTION | | |
|---|----------|-----------------------|
| Thinking Skills | Visuals | Language examples |
| observing | tables | stative verbs |
| labelling | diagrams | adjective |
| describing | pictures | relative clauses |
| comparing | plans | quantifiers |
| contrasting | drawings | articles |
| | maps | preposition of place |
| | | adverbs of comparison |
| Key question words: compare, contrast, differentiate, describe, state, identify | | |

Figure 7. Three elements in description

| DESCRIPTION | | |
|---|---------------|-------------------|
| Thinking Skills | Visuals | Language examples |
| classifying | webs | generic nouns |
| categorising | tree diagrams | stative verbs |
| defining | tables | possessives |
| | graphs | species nouns |
| | databases | relative clauses |
| Key question words: define, enumerate, list, outline, interpret | | |

Figure 8. Three elements in classification

One weakness of Mohan's model is that it has not been used with texts, but mostly with curriculum planning. The emphasis has been on teachers' planning and not on the development of students' ability and skills to make visuals. Mohan's model can however be used in relation to Figure 9 where the teachers learn to make visuals by linking them with skills and language with particular learning tasks and texts. As learners become familiar with model examples,

they are encouraged to verbalise the visuals by expressing in their own words their understanding of the knowledge or thinking embodied in a key visual. Teachers can develop tasks by referring to DARTS or ERICA approaches. In this way the various models discussed here provide a more powerful approach to developing discourse-based materials when the models are used in combination. Figure 9 presents our extension of the use of the knowledge framework for working with texts.

4. Clause Relations

This model was developed in Britain by linguists looking for logical relations in texts. There are broadly similar models elsewhere, for example, the rhetorical structure theory of Mann, Mathieson and Thompson (1989), although the linguistic techniques may be somewhat different. The clause relations model (Hoey, 1983; Jordan, 1984) seeks for such text relations as comparison - contrast, problem-solution, cause-effect, or condition-sequence. These are minimally realised by a clause but may be expressed in sentences or larger chunks of discourse. They are frequently identifiable by lexical signals which can be regarded as key words or interpreted as markers of the logical relations, a kind of metalanguage. Thus 'condition' may be signalled by *if*, *provided that* or *whenever*, while 'contrast' might be marked by *whereas*, *in contrast*, *on the other hand*, and 'solution' can be seen by *solve*, *tackle*, *overcome*, *answer* or *remedy*. The importance of the signals is that although they may not be obligatory, once seen they are immensely helpful in appreciating how discourse relations structure the text content. The original model is used in linguistics and has been used in EAP.

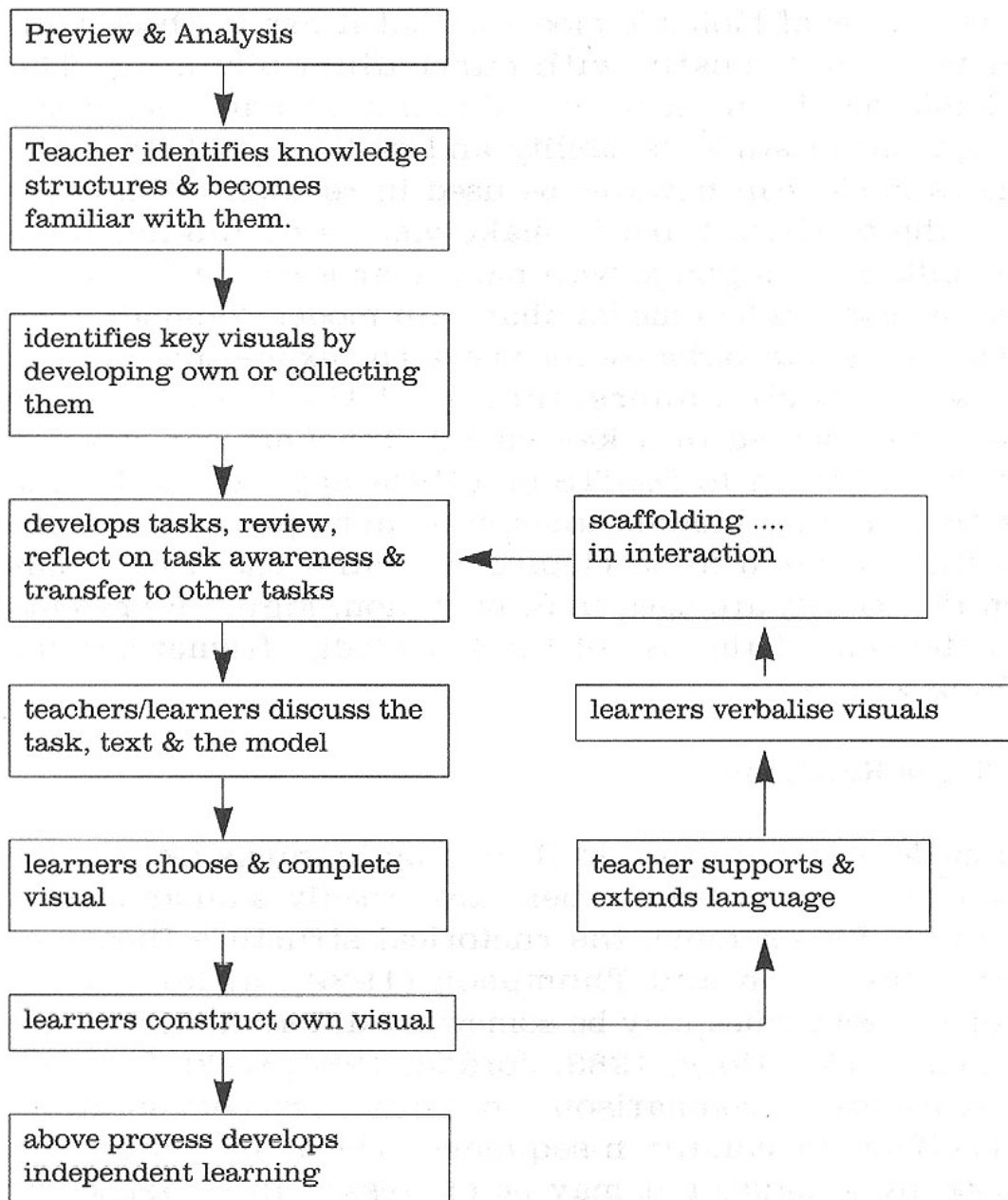


Figure 9. Developing the knowledge framework

In teacher education courses this model can be related to the teaching of reading and writing by relating clause relations to a visual showing the overall framework of a text. Such a display is a 'text frame' (McCarthy & Carter, 1994) which can be used for teaching reading comprehension and to help students plan writing.

A clause relation pattern such as 'comparison' may frame a whole text but within this pattern embeddings and combinations of other patterns are likely. Many teachers have found the model useful for planning to teach a text.

5. Graphic Organisers

A further visual approach which has been used for some time is the use of graphic organisers (Moore & Readance, 1984; Griffin et al. 1995). These are graphic representations to portray the relationships among key items of information in texts to give a structured overview of the content. While they are commonly used by teachers to introduce texts as pre-text activities, they can be extended to in-text or post-text reading and, like other approaches discussed here, can be transferred to learners, i.e. students can be taught to produce graphic organisers for themselves as study skills. This approach lacks linguistic element such as the identification of lexical signals to help teachers or students see what kind of visual is appropriate for a particular text type. This linguistic element is the focus of the Clause Relations approach.

Figure 10 shows how each of the five approaches/models can be usefully extended or integrated by taking account of the strong points of the others. Combining or integrating these models also has the effect of emphasising the value of visual approaches in teacher development for the teaching of reading skills. The application of visuals in these five approaches can be further developed by using the pre / in / post-text sequence as a guideline.

The suggested method as elaborated in Figure 10 provides three different stages which can be used independently to develop reading visualisation processes (which involve cognitive thinking skills and the use of lower and higher order skills).

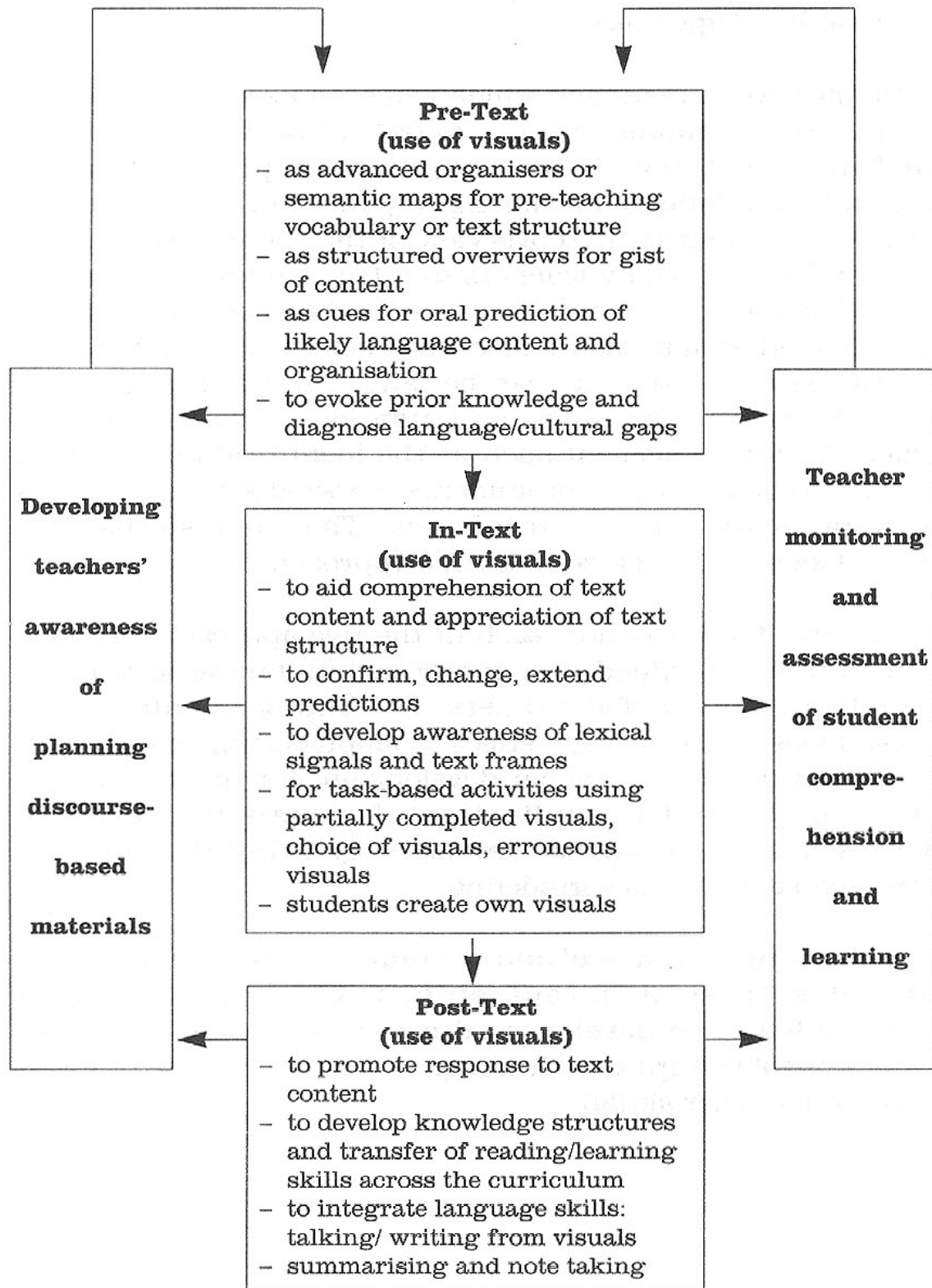


Figure 10. Use of visuals in reading to learn (after Cortazzi & Jin, 1996)

As part of pre-text reading activities, visuals can be used for various prediction tasks. Other tasks with visuals can be focused on while students are reading as in-text activities can help them realise the meanings involved. Finally, reflection on the text after reading can be encouraged by using visuals in post text activities. In teacher education this process can also help to develop teachers' skills in materials planning and assessment of student learning.

Teacher Training

In using the above approaches and models for text understanding, teachers are seeing through texts in a further sense. This is because through such techniques teachers can take a text, be helped to see the discourse relations in a text and its content meaning and translate these to an appropriate visual format in order to develop teaching materials. For example, event lines, attribution charts, maps or text frames can become the basis of reading comprehension materials guiding students to global understanding of a text.

The same visual materials can also be used to aid students to verbalise the essential meanings of the text (in the absence of a text or putting aside the text) both for oral language practice and as support to internalise text meanings by verbalising this meaning in their own words.

The verbalisation and visual representation of texts can therefore be seen as key complementary aspects of visual literacy (Petterson, 1994). The visual elements scaffold students understanding when they are used in teacher-student interaction focused on the text (Wertsch, 1985).

This student verbalisation and students' own construction of visuals to represent discourse meanings also allow teacher assessment of student understanding of a text. In this way the development of discourse-based materials allow teachers to see through the whole planning and preparation process as outlined in Figure 11.

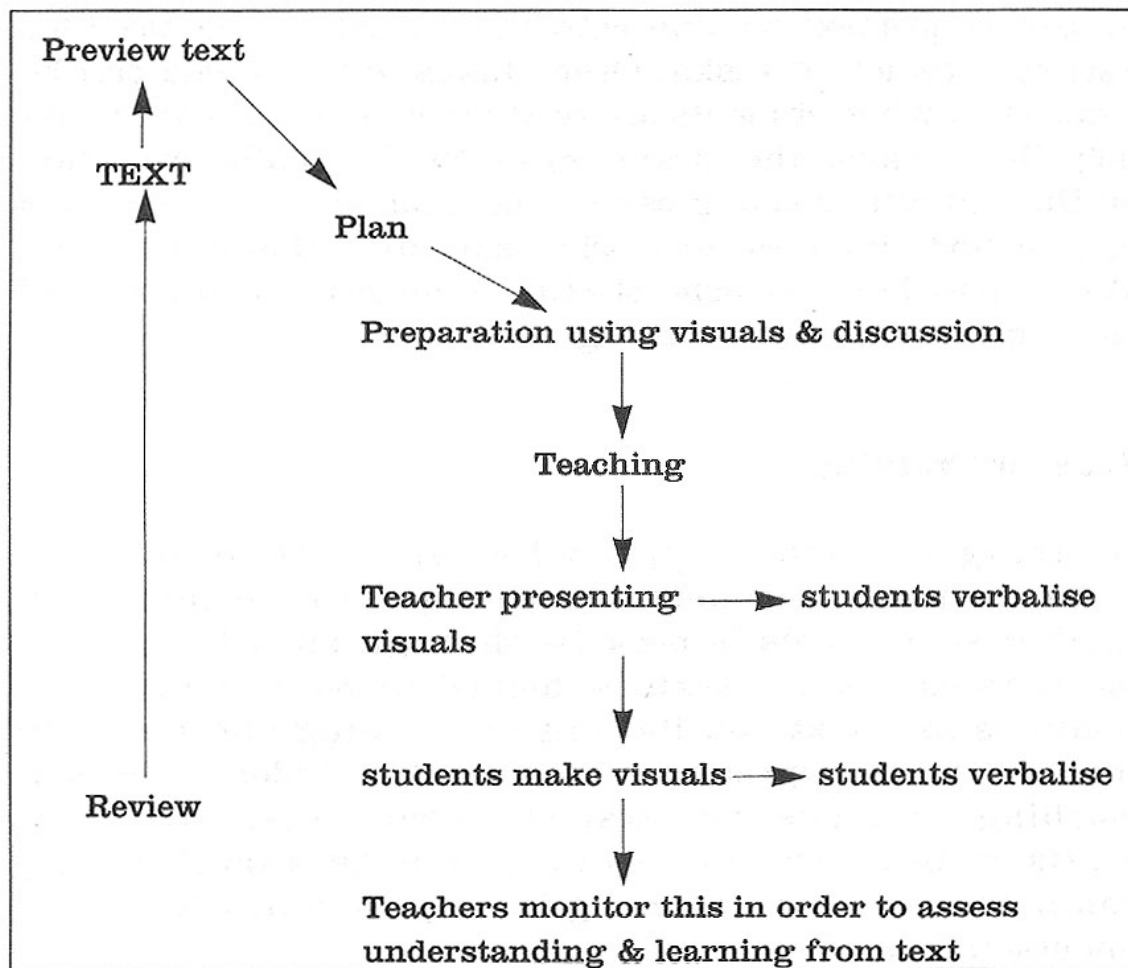


Figure 11. Planning stages of visual construction.

Sample texts and visual examples developed with teachers in Britain, Malaysia and China

The following examples show sample texts and visuals which illustrate some of the possible reading visualisation processes.

Example 1 was used with teachers in China. The structure of the text is ~, problem solution text and the cause-effect elements is within the problem solution frame.

Example 2 was used with Malaysian teacher trainees both in the UK and Malaysia. This text can be considered a descriptive text. In the DARTS model this would be considered a typical physical structure text. It also has elements of definition, function and cause-effect. Teachers had commented that they had not realised that a text which looks simple is actually a text with a number of embedded structures or elements.

Example 3 is a primary school text. It is a classification text but with examples, a wide variety of visuals are possible.

Example 1: Mice in Mongolia

Nicholas Middleton, a British environmental expert, spotted a mouse when he arrived in Mongolia and took a drive in the steppes east of the capital Wan Bator.

He saw a second mouse, then a third and a fourth. Then another. And another. He looked carefully and found the grass alive with mice-or Microtus Brandti, to give the Mongolian species its correct name.

The number of mice in the Mongolian steppes has shot up at least 40 billion. The country is gripped by an unusual environment disaster. The mice occupy 154,000 square miles in the steppes.

"Anywhere you drive in the steppes you see the mice, you really do" said Dr. Middleton, back in Britain last week after a four week fact-finding conversation trip undertaken at the Mongolians' request.

The mice are devouring the grass and grass seeds in the steppes and thereby threatening the existence of the livestock: 4.3 million goats, 13 million sheep, 2.5 million cattle, 2 million horses and 0.5 million camels. 70 per cent of Mongolia's 2.1 million population depend on these animals for their existence. The quantity of milk products produced has also sharply declined.

The Mongolians have tried spraying pesticides on the land to kill the mice. But this has intensified the problem. The toxic chemicals are entering the food chain, since the dead mice are eaten by foxes, wolves and marmots, which are killed by Mongolians for their meat. "Vegetables are contaminated." said Dr. Middleton, an Oxford University geography lecturer, "and of course, the Mongolians eat these too."

Because of Mongolia's remoteness, news of the disaster has so far remained undisclosed. Dr. Middleton is the first Westerner to be invited by the Mongolian association for the conservation of nature and the environment. He will begin a campaign this week to get international help for the poverty-stricken country.

The Mongolian species is about three inches long, with a stocky body and short ears. It resembles the British field mouse. One theory is that the number of mice has risen because foxes and wolves, which feed on the rodents, have been killed by herdsman, either for meat or for furs, or to reduce the threat to cattle.

Dr. Middleton has consulted Oxford colleagues about the disaster: one proposed the release of hundreds of sterilized male mice on the Mongolian plains. This would have the effect of reducing the mouse population, but it could take a long time. Another suggested exporting British owls, known to regard field mice as delicacies. A problem with this solution is that the Mongolian steppes have few trees and so the owls would have no nesting sites on the grasslands. A third put forward the idea of sending in hordes of British cats, but they were thought to be too tame and would probably become homesick.

Mr Richard Strand, executive director of the British Pest Control Association, advises Mongolia to employ outside rodents experts. Dr Roger Johnson, technical manager of Sorex, a company that produces pesticides, was asked if he had an answer. "I have," he said and suggested "a solution of the last resort - a major poisoning campaign with zinc phosphate, an acute poison." He admits that this will also kill "non-target" animals and birds. It may also affect the herds of sheep.

However, the problem may already be too serious and Mongolia may have to wait for nature to resolve the crisis in its own way. Ju