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DEVELOPING STUDENTS' ACADEMIC WRITING FOR CONTENT LANGUAGE LEARNING

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ABSTRACT

This paper discusses how a knowledge structure – text structure approach can be used within an education context where English is used as the medium of instruction in school subjects. In such contexts, the requirement for teachers is to support students' learning of both English as a second language and the subject content. The knowledge structure – text structure approach provides pedagogical support to teachers in developing students' English, particularly in academic writing, for content-language learning. The paper exemplifies the approach with a detailed description of how it can be implemented with a unit of science learning and how students' English can thereby be developed for successful content-language learning. The major role of the ESL teachers within the approach is also explored.

Introduction

Using a second language to teach curriculum subjects in schools as a way to develop students' second language proficiency is a form of content-based language teaching (CBLT). CBLT has been increasingly shown to be an effective curriculum approach to second language learning (Snow, 1998; Stoller, 2004). It is not always easy to implement effectively, however, and the "interface of language and content", that is, how language and content act together to form meanings and how both can best be taught and learnt at the same time is acknowledged to be "the most important pedagogical issue" in CBLT (Stoller, 2004, p.276). An important means of addressing this interface in a school context is through collaboration between ESL and content teachers (Davison, 2006). Collaboration can be particularly important in CBLT programmes at secondary school level because of the high demands of the content and the increasingly complex language students are expected to master. For example, only a fully content-trained teacher can be expected to teach secondary school science. At the same time, the academic writing skills required in a second language for higher level science learning demands the skills of a trained language teacher.

This paper discusses how a knowledge structure – text structure approach (Kong, 2008) can be used to support students' content-language learning and, in particular, how ESL teachers can use the approach to develop students' English, and especially academic writing, for content learning. The approach is exemplified with learning materials from a unit of science on the topic of respiration. The paper then discusses in detail the role ESL teachers can play within the approach though the essential role of content teachers is also acknowledged.

The Knowledge Structure – Text Structure Approach to CBLT

Kong (2008) proposes a pedagogical framework for integrating content-language teaching and learning within the English medium of instruction context of Hong Kong. In Hong Kong, English is taught as a compulsory subject starting from the first year of primary school to the end of secondary school. English is also used as the medium of instruction for all content subjects, except Chinese-related subjects, in most of the academically top 25% of the secondary schools[1]. As with many other Asian contexts where English is the medium of instruction for content subject teaching, however, the dual curriculum goals of content and second language learning have not always been successfully achieved (Johnson, 1997; Kong, 2004; Marsh, Hau & Kong, 2000; Tsang, 2008; Yip, Tsang & Cheung, 2003).

The pedagogical framework proposed by Kong (2008) is an attempt to guide English medium teachers' planning and teaching for content-language learning. It is derived from course materials used in an in-service professional development course for English medium teachers in Hong Kong. The framework draws on the concepts of knowledge structures (Mohan, 1986), text structures (termed genres in systemic functional linguistics) (Derewianka, 1996; Hyland, 2004; Martin, 1989; Macken-Horarik, 2002), and language objectives that relate to content objectives (Snow, Met & Genesee, 1989).

The framework begins with content learning objectives, which are taken from the relevant content syllabus (e.g. a science syllabus). The knowledge structure which is represented in the content is then identified. Knowledge structures, such as classification or cause-effect, are said to be universals and represent concept relationships common in subject content; they can be represented by graphics and are, therefore, non-language-based. The language required to articulate the knowledge structure (and, therefore, the content objectives) can then be identified. Students must understand and be able to use this language in order to learn and talk or write about the content. It usually takes the form of a text structure, which is an organised way of using language to make meanings represented in knowledge structures, that is, they are the linguistic manifestations of knowledge structures. If the language is new to students or has not been used before in the subject context, it

may become a language learning objective (referred to here as a language objective). The language objectives are thus the new language (or new ways of using known language), often represented as text structures, that students need in order to learn new subject content. The text structures are particularly helpful for students who need to learn to express their content understanding in extended written language, which is the case in most subjects for at least some parts of a syllabus.

Table 1 shows an example of part of a plan for a science topic, respiration, using the pedagogical framework from Kong (2008, p.125).

Table 1: Kong's (2008) pedagogical framework for integrating content-language learning (exemplified with the process of ventilation of the lungs)

Topic	**Content objective**	**Knowledge structure**	**Text structure**	**Language objective**
Ventilation of the lungs	Students should be able to describe the process of ventilation of the lungs	Sequence	Process description	Students should be able to write a process description text to describe the process of ventilation of the lungs e.g. *Ventilation of the lungs is the process by which air is inhaled and exhaled. This process is the first stage in respiration.* *When we inhale, air containing 21% oxygen enters the respiratory system through the mouth and the nose. The air passes through the larynx and the trachea into the two bronchi, which divide into many bronchioles. The air passes into these bronchioles, which connect to tiny sacs called alveoli. Gaseous exchange takes place in these alveoli. When we exhale, air containing less oxygen but much more carbon dioxide goes back from the alveoli to the bronchioles and then to the bronchi. From the bronchi, air goes back to the trachea and the larynx and then goes out of the respiratory system through the mouth and the nose.*

The relationships between the components of the framework can be seen as moving from the left-hand side, column by column, to the right-hand side. However, in operation, the planning work usually needs to be recursive. For example, as there is often more than one knowledge structure in complex content, and consequently more than one text structure, the choices the teacher makes in these columns may be influenced by the need to focus on a language objective which is appropriate to students' language proficiency level. While the content teacher and the ESL teacher each needs to be aware of the concerns of the other, each has to contribute his or her own expertise to this planning process. The main process involves identifying a content objective from a topic identifying a knowledge structure related to the content objective identifying a text structure related to the knowledge structure identifying a language objective related to the content objective and the text structure by specifying the actual language used.

The plan shows how the language which students are expected to learn to use (i.e. the language objective) is guided by a text structure approach, thus requiring students to learn to use language at the extended text level and not just at the word or sentence level. Knowledge structures represent relationships of knowledge such as cause-effect, comparison-contrast, classification, sequence and evaluation. Because text structures are derived from knowledge structures, the language exponents in text structures have to represent relationships of knowledge and therefore need to be extended, connected and structured. Individual words and sentences cannot adequately represent these relationships. Also, because knowledge structures are derived from content objectives, the plan targets content-language learning. Students are helped to learn the language the content requires. In the example presented in Table 1 the language to describe the process of ventilation of the lungs is presented in the text structure of a process description. It is this interaction between language and content that demands the cooperation of ESL and content teachers to support students' content-language learning.

Text structures (genres) are "the *schematic structure* of … text" (Macken-Horarik, 2002, p.20, original emphasis). A text has a communicative purpose and is structured in a series of stages; each one achieves a purpose and together they fulfill the communicative purpose of the text as a whole. The order in which the stages follow one another is meaningful for the achievement of the purpose of the text. For example, a process description text, as required in the plan above, describes a process of events. In order to achieve this purpose, it is normally structured in two stages: first, identification of the process to describe (to identify the process the text is describing); second, description sequence (to describe the process step by step to show how it works). There are many ways of categorising academic text structures and different names are sometimes used to refer to the same text structure.

Table 2 shows some examples of academic text structures, the stages in each and the knowledge structures to which each may be related. Derewianka (1996) and Martin (1989) provide detailed analyses of some of these text structures using sample school and student texts.

Table 2: Examples of academic text structures and related knowledge structures

Text structures	**Stages** (^ = followed by; ( ) = optional)	**Related knowledge structures**
Process description / explanation	Identification of the process to describe / explain^ Description / Explanation sequence	Sequence (+ cause-effect)
Comparison-contrast	Statement of comparison^ Points of comparison^ (Summary of comparison)	Comparison-contrast
Recount	Orientation / Setting^ Events in time order^ (Reorientation / Evaluation)	Sequence
Descriptive report	General classification^ Description of class	Classification
Procedure	Goal^ Method / Steps^ (Results / Evaluation)	Sequence
Persuasion	Thesis^ Arguments^ Reiteration	Choice
Discussion	Statement of the issue^ Arguments for and against^ (Recommendation / Restatement of the issue)	Evaluation

Because of the complex relationships of knowledge involved in subject content learning at the secondary school level, the language use has to be correspondingly complex. For instance, the example of ventilation of the lungs above involves a sequence of events in a particular order: Event 1 (inhaling air containing more oxygen than carbon dioxide) Event 2 (air goes into the mouth and the nose) Event 3 (air moves on through the larynx and the trachea) Event 4 (air moves through the bronchi) Event 5 (air moves on to the bronchioles) Event 6 (air moves on to the alveoli) Event 7 (gaseous exchange takes place at the alveoli) Event 8 and so on (air containing more carbon dioxide than oxygen goes out of the lungs in the opposite direction). The order must be accurate and has to be represented in

appropriate language. This is a relatively straightforward process. The process of how air is forced into and out of the lungs (see Part 2 in Appendix 1) involves more complex relationships with a sequence of cause-effect relationships: Cause 1 (the intercostal muscles contract) Effect 1 (the ribs move upwards and outwards and the diaphragm becomes flattened, becoming Cause 2) Effect 2 (the volume of the chest increases and the pressure inside the chest decreases, becoming Cause 3) Effect 3 (air is forced into the lungs). Again, students have to learn to use language to represent these relationships. This is one of the challenges of academic learning at the secondary school level.

Some characteristics of academic English provide another challenge of learning English through curriculum content and these are also related to the demands of curriculum studies. Actions, represented by verbs (e.g. *the intercostal muscles contract*) often have to be turned into objects or events, represented by nouns (e.g. *the contraction of the intercostals muscles*) so that they can be further explained and elaborated (e.g. *the contraction of the intercostal muscles causes the ribs to move upwards and outwards*). This is an attempt to turn human actions, which can only be observed, into concepts, which can be recorded, learnt (i.e. passed on from generation to generation) and further developed (Halliday & Martin, 1993, Halliday, 2004). As learning involves more concepts, the language becomes more academic and complex. Such academic language typically consists of (long) noun phrases (e.g. *the microscopic size and the large number of alveoli in the lungs*) and nominalisations (e.g. *contraction, respiration*). Academic language therefore has to be systematically taught and learnt. The knowledge structure – text structure framework provides a guide for this teaching and learning.

Applying the framework to a unit of science learning

The learning materials on respiration in Appendix 1 exemplify how the framework can be applied to develop students' academic writing to support their learning of the language required by the science content. The materials presented here are intended for use by an ESL teacher in collaboration with a science teacher as they focus on aspects of language required by the content. The materials would be planned by the ESL and science teachers together and they would then be used in parallel with the science teaching (See Table 3). Collaboration between the teachers is essential because the materials are intended to help students learn both the science and the language needed to express the science meaning.

The learning materials include the students' worksheets on the left hand side and the teacher's planning on the right hand side. The exemplar worksheets are in six parts and focus on writing development. The worksheets start with an overview of the three stages in respiration and take students through each of the three stages, focusing on the key knowledge relationships, represented as knowledge structures,

and the related language, represented mostly as text structures. The science focus in each of the six parts is:

PART 1: The three stages in respiration
PART 2: Ventilation of the lungs
PART 3: Gaseous exchange
PART 4: Tissue respiration
PART 5: Comparing aerobic and anaerobic respiration in humans
PART 6: Respiration and photosynthesis in plants

The planning reflects the components in Kong's framework: content objectives, knowledge structures, text structures (where appropriate), and language objectives. Other aspects of teaching and learning, particularly the science teacher's spoken explanations and the ESL teacher's focused language work on text structures (see the next section) are not included here but would need to considered for the materials to be pedagogically complete. The worksheets also require students to read a science text (not included here for lack of space) to obtain the information needed to complete the work.

The worksheets are designed on the following pedagogical principles:

1. *Principle 1: Simple to complex progression.* For example, in Part 1, students label the three stages in respiration with the appropriate terms. This information is easily found in the reading text. As the labelling requires vocabulary only, the language is not very demanding. As students label the three stages in respiration, they learn both the content (i.e. the idea that there are three stages and what each is) and the language (i.e. the vocabulary to name the three stages). In Part 2, the students label a diagram showing the ventilation of the lungs, the first stage in respiration. As they label, they learn the individual parts of the lungs and thorax (i.e. the content) and the words to name them (i.e. the language). Using the diagram as support, the students then complete a text to describe the process of ventilation (there are two possible text versions, which are explained in the next section). This is more demanding of both the content and the language as the sequence must be understood and expressed in connected English. If the students cannot write using the appropriate English for the text structure, then the science (i.e. the sequence) will be incorrect. Then they write part of another text to explain how air is forced into and out of the lungs, based on a diagram in the reading text. At the stage of gaseous exchange (Part 3), they label a diagram and learn to use noun phrases as the subject of a sentence. At the stage of tissue respiration (Part 4), they transfer word equations into writing and vice versa and then write definitions. Finally they learn to write two texts almost

on their own with the support of a table, first with the first and last paragraph frames given (Part 5) and second with only a reminder of the text structure required (Part 6). Each of these tasks builds from the simple (e.g. labelling) to the more complex (e.g. writing a supported text) and the language and the content develop at the same time.

2. *Principle 2: Gradual release of scaffolding.* While this principle is a technique to enable students gradually to take on more challenging content and is, therefore, a means of achieving Principle 1, it is so fundamental to the management of the language and content interface that it is appropriate to consider it separately. Both content and language scaffolding (e.g. diagrams and supported texts) provided for students are gradually removed so that they learn to write increasingly complete texts. For example in Part 2 the students are given the frame of the full text and they only have to fill in the blanks. They next write a full paragraph based on an example given (a process explanation on how air is forced into and out of the lungs). Then, in Part 4, they write full definitions based on examples given (on tissue respiration). Finally, in Parts 5 and 6, they write almost the full text based on information in a table and some hints on the text structure required. The inclusion in these worksheets with different types and levels of scaffolding is for exemplification. In reality, school students cannot write without scaffolding so suddenly; the pace will depend on the teacher's judgement and students may need a lot of practice with one text type before the scaffolding can be omitted.. The release of scaffolding would probably, therefore, take place over time as students become more familiar with specific text structures. Content and task complexity changes over time as well. The release of scaffolding is usually not a smooth uninterrupted progression from a high to a low level.

3. *Principle 3: Recycling of learning.* The two text structures of process description and process explanation, which are similar in structure, are recycled in Part 2. The text structure of comparison-contrast in Part 5 is also recycled in Part 6. Some sentence structures, for example, … *is the process by which* … (as the language of definition, used in Parts 2 and 4) and the when-clause to explain cause-effect relationships, are also recycled (used in Parts 2, 5 and 6). The recycling provides students with multiple exposure to and use of the target language to maximise learning.

4. *Principle 4: Use of graphic organisers as links between content and language.* For the knowledge structures of sequence and cause-effect on ventilation of the lungs in Part 2, diagrams are used to show the processes and act as links between the knowledge structures, which focus more on the content, and the

> text structures of process description and process explanation, which focus more on the language. For the knowledge structure of comparison-contrast in Parts 5 and 6, tables, in which the content is in focus, are used to show the comparisons and link to the comparison-contrast text structure, in which the language is in focus. Non-linguistic representations of knowledge (generally graphics though models, for example, might serve the same purpose) provide invaluable bridges between knowledge and language. Both content and language teachers, and even more so, students, find it difficult to relate content ideas directly to text structures and their specific language exponents. One reason for this is the complexity of subject content. Graphic organisers, such as a timeline or a flow chart, provide a simplified and visual representation of the structure of the content (i.e. knowledge structure) to which language can more easily be matched.

Using Kong's pedagogical framework, the design of the worksheets is based on the identification of knowledge structures from the content objectives. The worksheets focus on the knowledge structures of sequence, sequence + cause-effect, definition, and comparison-contrast, as required by the content objectives. The knowledge structures of sequence and sequence + cause effect are required for the content objectives of the three stages in respiration, the process of the ventilation of the lungs, and the process of gaseous exchange. The knowledge structure of definition is required for the content objective of defining aerobic respiration, anaerobic respiration and respiration itself. The knowledge structure of comparison-contrast is required for the content objectives of the differences between aerobic and anaerobic respiration, and between functions of gaseous exchange in plants. Being able to tell the differences between two entities can support deeper learning of both.

These knowledge structures are represented linguistically as text structures. The knowledge structure of sequence and sequence + cause effect can be linguistically represented in the text structures of process description and process explanation. The knowledge structure of comparison-contrast can be represented in a comparison-contrast text structure. Instead of repeating the process description / explanation in the topic of gaseous exchange, the language use focuses on the use of noun phrases to name the factors that facilitate gaseous exchange in our lungs while the topic of tissue respiration focuses on the revision of the passive voice and the use of the language to define. These are characteristic of academic language. The language objectives thus focus on learning how to write two main text structures, namely process description / explanation, and comparison-contrast, how to write definitions of concepts, and how to use noun phrases in the subject position of a sentence. The language objectives, therefore, support the learning of the content objectives. The language is not separate from or incidental to the content, it is part of the content

(Halliday, 2004). Students learn to use the language of the content and thus learn both content and language in parallel. The language objectives also more generally support the learning of academic language, helping students with other curriculum subjects.

The role of ESL teachers

This set of worksheets focuses on content and language learning in a context where the content subject is taught through English as a second language. The need for collaboration between the ESL and content teachers in such contexts has been widely documented (e.g. Davison, 2006). Collaboration between ESL and content teachers is also needed within this planning framework. Table 3, below, outlines briefly the possible focuses of science and English teaching in the unit on respiration described in the last section and in the worksheets in Appendix 1. This section then briefly describes the possible collaboration between ESL and content teachers more generally in terms of planning, teaching and assessment. It will then focus on the major role of the ESL teachers within the framework.

Table 3: Respective focuses of science teaching and English teaching in a unit on respiration with a language focus on academic writing for science

	The focus of science teaching	**The focus of English teaching**
PART 1: The three stages in respiration	Overview of respiration; identifying three main stages in respiration in sequence (probably spoken explanation, perhaps with diagrams, videos and/or models).	Helping students to extract key information from the reading text and reading for an overview of the content; mastering the three key terms (e.g. pronunciation, word formation).
PART 2: Ventilation of the lungs	Explanation of how air moves in and out of the body; the role of different parts of the body in bringing this about (probably spoken explanation, perhaps with diagrams, videos and/or models).	Text structure of a process description and a process explanation; Sentence grammar: relative clauses; 'when ...' clauses to show cause-effect; prepositional phrases of direction.
PART 3: Gaseous exchange	Explanation of how gaseous exchange occurs, involving different concentrations of gases on different sides of a boundary.	Complex noun phrases
PART 4: Tissue respiration	Explanation of different forms of respiration, with examples.	Revise passive voice and teach the language of definitions

PART 5: Comparing aerobic and anaerobic respiration in humans	Consolidation of students' understanding of respiration by explaining the differences between aerobic and anaerobic respiration.	Structure of a comparison-contrast text
PART 6: Respiration and photosynthesis in plants	Consolidation of students' understanding of respiration by explaining the differences between respiration and photosynthesis in plants.	Structure of a comparison-contrast text

Note 1: There are many different models of collaboration and this represents just one. The focus of each teacher depends on their own priorities and the needs of the class. The focus on writing in this paper could equally well be replaced by, for example, a focus on speaking or, more likely an integrated focus over time on several aspects of academic English.

Note 2: A detailed explanation of the science teaching involved is not appropriate here. It might, of course, include experiments or demonstrations, videos, models, etc.

Note 3: The exemplar materials for academic writing included here assume that students would work largely from a reading text. Of course their science learning would not be exclusively reading based.

Note 4: New science vocabulary to be learned and used at each stage is not listed here.

At the planning level, the content teachers have to start the plan, which is based on the content objectives and the knowledge relationships involved in the content. ESL teachers need to identify related text structures and language objectives. However, both need an understanding of the content-language relationships and an awareness of the language form-function relationships to enable the collaboration to work. At the teaching level, the content teachers have to be responsible for the teaching of the content concepts and the content-obligatory vocabulary (Snow et al., 1989). Matching this, the ESL teachers have to support students' learning of the text structures and related sentence structures, such as the when-clause to explain cause-effect relationships, the relative clause to define or to provide more information. At the assessment level, the content teachers have to ascertain that the student production is accurately expressed in terms of content while the ESL teachers have

to be sure that the language is accurate for the purpose of the content. Both have to acknowledge that the content and the language are interdependent and that one cannot be correct without the other. Both content and ESL teachers have to note from what students produce those areas in which they need more help.

Text structures represent a key point of learning for which the ESL teachers should be responsible in this approach. Students need to learn to use text structures appropriately for different knowledge structures and content objectives (see Table 2 above). A teaching-learning cycle as shown in Figure 1 below has been suggested as an effective approach to helping students learn to use text structures (Hyland, 2004; Macken-Horarik, 2002). The teaching-learning cycle starts with the building of the context. Within Kong's pedagogical framework, the context building should aim to help students understand the communicative purpose of the content objectives. For example, the content objective that students should be able to describe the process of the ventilation of the lungs (in Table 1 above) sets the context and purpose for language use. The ESL teachers have to help students learn how to use language for specific contexts and purposes.

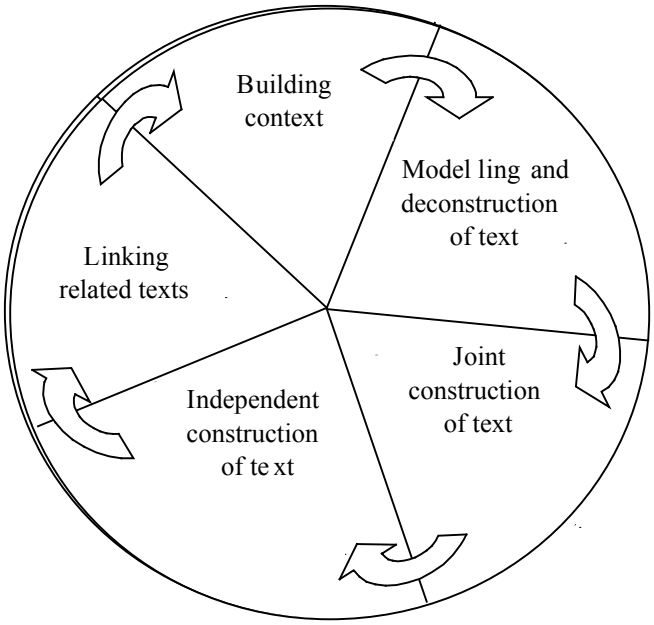

Figure 1: The teaching-learning cycle for text structures
(adapted from Hyland, 2004)

The modelling can take the form of the ESL teacher writing up a process description text with the class to 'model' to students how to write such a text structure, talking aloud all the way about her decision and choice of language use to suit the context and purpose. If the teacher feels less confident with writing a process description text about the ventilation of the lungs, she can choose another topic with which she feels more confident. The aim is to show students how to write a process description to prepare them for writing about new and more challenging content. Alternatively, the modelling can take the form of students deconstructing a process description text. The teacher identifies an appropriate process description text (it can be the one on the ventilation of the lungs or it can be on another topic) and designs a worksheet (see Appendix 2 for an example) to help students deconstruct the text to learn about its structure. This will include the purpose of the text as a whole, how many stages there are in the text, the purpose of each stage, and the language use at each stage to achieve its purpose. This helps students learn about the text structure, the purpose the text achieves and the language use to achieve the purpose.

The next stage in the cycle is to jointly construct the text structure with students, either by writing up a text together with students in class, with both the teacher and the students contributing ideas and language to the gradual building up of the text, or by providing students with scaffolds in a writing worksheet (such as in Appendix 1). The degree and type of scaffolding can be varied so that students gradually write more and more independently (see Principle 2 in the section above and how this applies in the worksheets in Appendix 1). This leads to the next stage of independent construction of texts at which students can write in a text structure without support.

A useful distinction between the approach to scaffolding for the same text by ESL and content teachers is that the former might provide the full frame of the text with key *grammar* words left as blanks for students to fill in. Content teachers, on the other hand, might leave out key *content* words from the same text to support students' learning of key content concepts (see the second part of the ventilation of the lungs (Part 2) in Appendix 1 for an example: the first text has blanks for content words while the second text has blanks for grammar words). Within a process description text, for example, the key grammar words are those that describe the process (see the second language objective in Part 2 on the ventilation of the lungs in Appendix 1). This approach can support students' learning of the language of the text structure, in this case the language to describe a process.

Students need to work with the same text structure a number of times with different content and also with other text structures so that their repertoire of text structures gradually expands. When teachers introduce new text structures, they must point out connections with other text structures. This is the stage of linking related texts. Text

structures are not discrete and Hyland (2004) suggests that there are more hybrid than stand-alone text structures. Within a comparison-contrast text, for example, there can be a process description or explanation. This is particularly so as the content becomes more complex.

Conclusion

This paper applies a knowledge structure – text structure approach to support students' academic language development in CBLT contexts where English is used as the medium of instruction in some curriculum subjects. It uses a unit of learning in science to exemplify the approach. As knowledge structures and text structures are applicable in most academic subjects, the approach can be applied to other content subjects as well though the language exponents within each content area will vary. The focus on academic language development can also support learning across the curriculum and will, therefore, help students' further studies through the medium of English. The exemplar unit shows how the main pedagogical principles can be applied within a unit, demonstrating development and progression of learning. In real classroom situations, development and progression will also occur over time and implementation will depend on factors such as students' ability and the number of subjects in the school curriculum adopting this approach.

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