Cognitive content engagement in content-based language teaching

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Abstract

This paper reports a study of aspects of pedagogy that can bring about students' cognitive engagement with academic content and, thus, use of the academic language in content-based language lessons in three middle schools in Xi'an, China. Two criteria—academic content level and depth of processing—were used to determine cognitive content engagement by students. A detailed analysis of three lessons taught by the same teacher is presented in this paper. These are selected to highlight the differences between teaching that facilitated engagement and the use of the academic language and teaching that failed to do so. The analysis shows that engagement seemed to occur when the teacher focused the content on challenging technical academic knowledge and helped students explore this content in depth. She focused on relationships between meanings rather than facts in isolation and demanded the processing of knowledge in different ways, which created the space for the use of academic language. She structured her lessons in a cyclical manner and exploited the feedback moves in the predominantly initiation-response-feedback (IRF) classroom interaction pattern to facilitate deep processing. She also had clear content and language learning objectives.

Key words: cognitive content engagement, content-based language teaching, content-language pedagogy

I Introduction

The pedagogy of content-based language teaching (CBLT) has become an issue of concern in CBLT research with the understanding that teaching content through a second language is insufficient on its own to bring about language learning (Lyster, 2007; Mohan & Huang, 2002). Stoller (2004) suggests that investigation into 'the interface of language and content' is 'the most important pedagogical issue' (p.276) in CBLT. The content-language integrated relationship is the foundation on which CBLT programmes are built. Indeed, Halliday (2007) considers that the learning of the disciplinary content *is* the learning of the language of the discipline. The use of curriculum content necessitates the use of academic language and provides opportunities for students to 'broaden and deepen' their language proficiency and to acquire 'the more formal, decontextualized, cognitively complex academic language' (Crandall & Tucker, 1990, p.83). CBLT teachers therefore need the skills 'to integrate the teaching of language and content in the classroom in ways that can bring about the learning of both' (Hoare & Kong, 2008, p.254). This is particularly challenging when the content becomes more complex and abstract, and the language through which it is expressed and that, therefore, students are expected to learn, becomes correspondingly more complex and context-reduced.

This paper reports a study of how one middle school CBLT teacher brings about cognitive engagement with content and, in doing so, provides the potential for the learning of academic language. The study draws on data from a study of CBLT in three middle schools in Xi'an, China, the early stage of which is reported in Hoare (2010).

II Context and aim of the study

The study reported in this paper is set within the context of a CBLT programme in Xi'an in North Western China. The Xi'an CBLT programme began in 1997 at kindergarten, extending progressively to primary school and middle school. In 2004, there were 18 kindergartens, 13 primary schools and 3 middle schools offering the programme (Hoare, 2007).

In middle schools, with which this study was concerned, one subject is taught through English for two lessons each week. Each of the three middle schools selects and teaches a different subject: *Science and Life*, *Social Studies*, or *Nature and Society*. The subject cannot be part of the formal school curriculum as the language law requires this to be taught through Chinese (Kirkpatrick & Xu, 2001).

The data from which this study draws come from a project which investigated the contextual influences on the implementation of the CBLT programme in the middle schools in Xi'an (see Hoare, 2010, for an analysis of the initial stage of the project). In the course of investigation of this project, it was found that some lessons seemed to induce cognitive content engagement (CCE) by students to a greater extent than others. It was, therefore, decided to review the data from the perspective of CCE to explore aspects of pedagogy which may bring this about and may, in turn, facilitate learning of the relevant academic language. This review forms the study reported in this paper. The aim of the study was, therefore, to identify aspects of the pedagogy of CBLT lessons which may bring about CCE and the use of academic language. To provide a sufficiently in-depth analysis of data to illustrate CBLT pedagogies that may bring about CCE, this paper presents an analysis of three lessons taught by the same teacher but data from other lessons are used to exemplify each component in the CCE framework (see Section III

below).

III Cognitive content engagement

CCE as a construct is difficult to define but there is consensus within the literature that it is an important factor in learning. McLaughlin, McGrath, Burian-Fitzgerald, Lawrence, Scotchmer, Enyeart and Salganik (2005) suggest that '[A]t the most general level, learning occurs through the cognitive engagement of the learner with the appropriate subject matter knowledge' (p.3). Solis (2008) identifies engagement as 'a prerequisite of student learning'. For the purposes of this paper, CCE is defined as *'the cognitive interaction of the student with an appropriately challenging academic content level through activities that require sufficient depth of processing'.* This definition is based on a review of the literature and our CBLT lesson data (i.e. a grounded approach was taken, see Section IV below), which suggest two components of CCE, each with two indicators. The two components are academic content level and depth of processing. Table 1 summarizes the components and their related indicators. These are explained in the rest of this section with illustrations from our lesson data.

Insert Table 1

McLaughlin et al. (2005) offer a comprehensive study of the relationship between cognitive engagement and learning. They review two types of student engagement: procedural and substantive. Procedural engagement refers to students' commitment to classroom rules and regulations and their willingness to work on assigned tasks.

Substantive engagement refers to students' 'sustained mental concentration' (p.32) with the content of academic work. It is through substantive engagement that students interact with the content of a lesson to learn (McLaughlin et al., 2005; Solis, 2008; Voke, 2002) and it is this form of engagement that this paper is concerned with.

McLaughlin et al. (2005) include four components in substantive student content engagement and define it as

> 'the cognitive interaction of the student with appropriately challenging subject matter knowledge (Subject Matter Content Knowledge) through an activity that should produce the mental processing necessary for learning (Occasion for Processing) and that the student is able (Physiological Readiness) and willing (Motivation) to perform' (p.34).

The components of physiological readiness and motivation are included as they are concerned with conditions under which students can be engaged. For the purpose of our study, only subject matter content knowledge and occasion for processing are relevant as the focus of our study is on pedagogy, that is, what a teacher can do directly to facilitate CCE. The components of physiological readiness and motivation can be affected by many factors other than pedagogy. Our data also give little indication that physiological readiness and motivation are significant factors in bringing about CCE in the lessons.

The first component, which we term *academic content level*, is the target level of academic content knowledge students are expected to acquire in any learning activity. Appropriate academic content level with high but achievable expectations where there are links with students' prior knowledge and real world meaning is most conducive to cognitive engagement and thus learning (McLaughlin et al., 2005; Voke, 2002). This

resonates with Vygotsky's (1978) proposition of the zone of proximal development within which, given appropriate expert support, learning will occur.

The literature and our lesson data suggested that the following two features tend to indicate the academic content level expected by the teacher:

1. The extent to which students are expected to focus on technical academic knowledge rather than common sense knowledge; and
2. The extent to which students are expected to focus on knowledge relationships in content rather than unrelated facts.

The learning demands on students resulting from the high levels of technicality and abstractness of specialized knowledge of academic disciplines, contrasted with common sense knowledge, are widely recognized (Christie & Derewianka, 2008; Mercer & Hodgkinson, 2008). A focus on knowledge relationships (such as classification, cause-effect, process), contrasted with unrelated facts, is also recognized as conducive to higher-order learning (Dalton-Puffer, 2007; Kong, 2008). A focus on technical academic knowledge and the knowledge relationships within it can therefore indicate a challenging academic content level.

The following excerpt from a Grade 7 lesson exemplifies this component. The teacher has just explained the water cycle; she is reviewing the process of cloud formation and reconstructing the knowledge together with the students.

T: OK, very good. So we have two steps to form clouds. OK, all right? The first step, <u>when the sun heats the water,</u> the water will change into what?

Ss: Vapour.

T: The vapour will?

Ss: Goes up into the sky.

T: Goes up into the sky. OK, and <u>when the hot vapour</u>…?

Ss: Meets some cold particles.

T: Cold particles in the sky. Yes, it will?

Ss: Condense and form clouds.

While the topic is closely related to the students' common sense knowledge, the actual process of cloud formation is technical academic knowledge in the domain of geography or science. This knowledge requires a focus on the relationships between heat (sunshine), evaporation, condensation and cloud formation and how they are part of one process. The process relationship is signaled by the teacher's use of the when-clause (underlined in the excerpt). The concept of condensation is abstract. The level of content knowledge targeted in this excerpt is therefore higher than the common sense knowledge that, on a hot day, we have clouds and rain.

The *depth of processing* of academic content also affects learning: deeper processing results in deeper cognitive engagement and, therefore, higher order learning (McLaughlin et al., 2005; Stoney & Oliver, 1999). Solis (2008) maintains that engaged students interact with the content of learning in a deep and thoughtful manner, which makes learning truly meaningful to them. While content level concerns the teacher's expectations of the complexity with which students will engage, depth of processing concerns what the students do to engage (the *'how'* of the depth of processing in contrast to the *'what'* of the level of content).

The literature and our lesson data suggested the following two features which tend

to indicate the depth of processing:

1. The extent to which students have to process knowledge and (re-)produce it in different ways; and
2. The extent to which students have to relate new knowledge to prior knowledge.

The revisiting of knowledge from different perspectives, each of which may target a higher level of understanding, facilitates a cyclical approach to, and thus deeper, processing (Kong, 2009). The need for students to construct their own understanding of new knowledge by relating it to their existing schemas is recognized as essential in processing for learning (Marshall, 1995; Mercer & Hodgkinson, 2008).

In a Grade 8 lesson on the fire triangle, for example, the teacher starts the lesson by showing students pictures of forest fires and then explores with students how a fire occurs. She demonstrates in an experiment that a fire requires oxygen, fuel and heat. Students answer three times whether a fire will occur in the absence of one of the three conditions, supported by relevant diagrams of the fire triangle with one missing condition in each diagram. The students then apply this knowledge to suggest, in the teacher-class question-answer activity, through oral interaction in groups and in individual written homework, how and why a fire occurring in different situations can be extinguished. Finally, they apply their new learning of the fire triangle to discuss how forest fires, the situation raised at the beginning of the lesson, can be extinguished.

The lesson thus requires the students to process the new knowledge of the fire triangle and (re-)produce it in multiple ways. They are exposed to the concept of the fire triangle from different perspectives and are required to use this concept to explain different fire incidents: in an experiment, in various daily life situations when a fire has to

be put out (e.g. a finished barbecue, a wok on fire) and an environmental problem (a forest fire). This supports multiple and deeper processing of the new knowledge in various contexts.

The following excerpt illustrates how the students draw on what they have learnt about the fire triangle to suggest ways to put out a forest fire, indicating some depth of processing involved:

T: How to put out the forest fire? OK...?

S: I think first we can cut off the tree around the fire because…er…it is without have fuels in the forest and second we can use water to put out the fire because there is no oxygen it will stop burning.

T: There is no oxygen…you…?

S: We use water.

T: Yes?

S: To put out the fire. Yes. No, I mean also can…er…make the temperature come lower. And I think shouldn't use the carbon dioxide for the forest fire is too high…is too big. We…we don't don't need…er…er…water with carbon dioxide.

T: You mean…the carbon dioxide extinguisher usually is very small right?

S: Yes.

T: Different ideas…?

S: Again we can use carbon dioxide because we can use the plane fly through the sky throw the carbon dioxide into the forest and this can be…the oxygen…replace the oxygen. There won't be oxygen and then the fire will be put out.

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S: I have another reason to…to cut down the trees because I mean in the forest fire the trees is also…is also another is a kind of fuel for the forest fire so we cut down the trees that means we…we...remove the fuels for the fire…forest fire so we need to cut down the trees.

IV Data and methodology of the study

Although this paper focuses on data drawn from three lessons taught by one teacher, the data used in our larger study on CCE consist of 29 Grade 7 and Grade 8 lesson transcripts taught by 12 teachers, transcripts of post-lesson interviews with these teachers, samples of homework writing by two classes, and post-lesson written tests for 12 classes of students. Five of the 29 lessons come from the first stage of the project reported in Hoare (2010). The other 24 come from the second stage where two consecutive lessons each from two teachers from each of the three middle schools were observed, video recorded and transcribed.

Post-lesson interviews with the teachers were conducted in English using a semi-structured interview protocol that allowed the interviewer to explore topics in greater depth when appropriate (Wiersma & Jurs, 2009). The interviews were 50-60 minutes long and the questions focused on the teachers' understanding of the rationale for using CBLT and their explanation of the pedagogical decisions taken for the lessons observed. The samples of homework writing submitted were from the first stage of the project and were chosen by the teachers with five each of high, middle and low levels of performance. Homework writing assignments were set by the teacher, and students were allowed to use any resources available, mainly their textbook and the Internet. The post-lesson written tests were from the second stage of the project. They were administered within five days of the second lesson. The tests were designed by the researchers after reviewing the lesson videos. Students completed the writing in class with no access to resources.

The lessons that were observed and video recorded were regular lessons and not specially taught for the purposes of the study. The only intervention was the professional

development provided for the teachers through training workshops at the end of the academic years during the project. The training workshops were conducted by the researchers as part of an ongoing professional development relationship with the CBLT teachers in Xi'an. They focused on general CBLT pedagogy and did not directly address the issue of engagement. The workshops were not part of the research.

The framework of CCE shown in Table 1, with two components and their related indicators, was used to analyse the lesson transcripts for evidence of student engagement and the pedagogical strategies to facilitate it. The framework was derived partly from the literature and partly from the lesson data, as described in the section on CCE above, that is to say a grounded approach was taken (Wiersma & Jurs, 2009). Two researchers analysed the data independently, made notes and discussed their analysis to reach an agreed view.

The student writing provided some preliminary evidence of learning. The writing was scored and analysed for both content and language, using a set of assessment criteria at five levels. The assessment criteria focused on the articulation of an accurate understanding of the content through the use of appropriate academic language. Two researchers each scored the writing independently. For each score where there was disagreement, which was never by more than one level, a third marker scored the writing using the same criteria. The third marker always agreed with one or the other of first markers and the agreed score was accepted.

V Findings

As cognitive engagement requires sustained mental effort (McLaughlin et al., 2005), it

can be more coherently tracked and demonstrated within a full lesson. The presentation of the findings below focuses on three full lessons chosen because of the contrast they present in the level of CCE the teacher is able to induce among the students. Lesson 1 appears not to bring about much CCE while Lessons 2A&B seem to achieve this to a much greater extent. A key factor that brings about the difference in CCE in the lessons seems to be the pedagogy, rather than factors such as time on task. It is not claimed, however, that Lesson 1 'fails' as a language lesson. It allows, for example, many opportunities for students to express a wide range of personal opinions through English, which they probably rarely do outside class (see Hoare, 2010).

All three lessons were taught by the same teacher in the same school. They were within the subject *Nature and Society*. The topic in Lesson 1, *'Water'*, was taught in full in the single 50-minute lesson. The topic in Lessons 2A&B, *'Classification of living things'*, was taught over several lessons of which these two consecutive ones form just one part; the students had not studied this topic before. The students in Lesson 1 were at Grade 8, aged 13-14; the students in Lessons 2A&B were at Grade 7, aged 12-13. There were about 50 students in each class. Lessons 2A&B were recorded about a year after Lesson 1. The teacher was a graduate in English and education and, at the time of the first data collection, she had seven years' teaching experience. The students had previously studied English both as a subject and through CBLT in primary school, usually for at least three years and sometimes more. In addition to the CBLT lessons in middle school, the students also studied English as a subject for eight lessons per week with the same teacher. The English lessons were grammar-focused by the teachers' own report, following the requirements of the school. The two classes were, therefore, similar in

background as they came from the same school and had similar experience of learning English.

The analysis of Lessons 1 and 2A&B using the framework shown in Table 1 is presented below. The teacher's pedagogy is also described. Language errors in the extracts are original. Interview data are quoted to support the findings. Two samples of student writing, one from each topic, are presented to illustrate preliminary evidence of student learning.

1 Lesson 1 (Water)

a Academic content level: Technical academic knowledge: The topic is treated more as common sense knowledge about water, which students already know from daily life experience, than as technical academic knowledge. It provides opportunities for the students to talk about what they know but there is little academic content.

The teacher introduces the topic in a non-technical way:

Excerpt 1

T: OK, so we are going to learn something about water. [ll.8-9]

She proceeds to the next stage of the lesson by saying:

Excerpt 2

T: I asked you to find some interesting facts about water. Now let's share, let's share your interesting facts with our classmates. So everyone can have your chance to share your ideas with others. [ll.27-29]

Later, she comments to the students on how easy the factual content is:

Excerpt 3

T: This one is easy for you. Can we drink the water from tap directly? Why or why not? Can we?… Even a little child won't do it because he or she knows it well. Can we? Yes or no? [ll.191-193]

Some more technical academic knowledge, such as the three states of water, is only stated as fact and not explored from a scientific perspective. Throughout the lesson, the classroom interaction, of which Excerpt 4 is representative, never requires the students to go beyond their common sense knowledge. In Excerpt 4, the fact that living things and humans need water to survive is stated without further exploration of why or how.

Excerpt 4

T: Living things need the water to live. So can they survive without water? Can they?

S5: No.

T: What about human? Human beings?

S5: The same.

T: The same. All living things need water to survive, to live. [ll.114-119]

In her interview after Lesson 1, the teacher gave the following account of the lesson aims, explaining, "I want them to learn, for example, how much water there is on the earth, why water is important to us and how we can save water." Her focus was, therefore, firmly on the content and not on new aspects of English to learn. Despite that, she stated, "I just go on the surface, I didn't go deep," suggesting that she was aware that

the topic was not explored in depth. When asked how she helped students learn the content, she replied, “I give them some previews, actually that is before the class, I asked them to find out their answers by themselves, if they don’t have any knowledge in advance, they won’t understand it,” which implied that she had no detailed and defined content in mind which students were expected to master.

b Academic content level: Knowledge relationships: The common sense knowledge is treated as a list of ‘interesting facts’ [ll.27]. The teacher does not revisit them in the course of the lesson, that is to say, she structures the lesson in a linear, rather than cyclical, manner (Kong, 2009). The pedagogy does not require the students to work at the level of concepts or knowledge relationships. Even when the teacher mentions relationships, the focus is still on facts, as in the following extract:

Excerpt 5

T: These questions are all about the relationship between human beings and water. -- How many bottles of water do you drink every day? [ll.129-132]

She tends to refocus questions away from relationships such as cause-effect (‘Why or why not?’), to facts again (‘Yes or no?’), as in Extract 3.

c Depth of processing: Processing and reproduction of knowledge: The linear lesson structure together with the multiplicity of unrelated facts leaves very little space for the content to be further explored or revisited from different perspectives for deeper learning. Excerpts 4 and 6 show how the IRF (Initiation-Response-Feedback) pattern of classroom

interaction proceeds from one fact to another with no more than superficial processing by the students. Typically, the teacher initiates an interaction by nominating a student, the student shares her/his information, the teacher restates the information and/or provides a comment and then moves straight on with another nomination. There is no attempt to elaborate and extend the learning.

Excerpt 6

T: XXX, what have you found?

S6: There are many rivers are pollution.

T: There are many rivers…?

S6: Are pollution.

T: Are pollu…?

S6: -tion.

T: Are pollution, are polluted. There are many rivers are polluted. So they are not as clean as they used to be. XXX.

S7: I know China is, don't have enough water for people. And the water is the most important way to make electricity.

T: There isn't enough water for Chinese people, isn't enough water for Chinese people. So China is one of the water shortage countries. And water is, OK, the last sentence?

S7: Water is the most important way to make electricity. [ll.76-90]

Similarly, the reading exercise in the middle of the lesson requires filling in blanks on factual content, and the role play at the end requires students to show how they tell, not even persuade, someone who wastes water not to do so. No technical academic knowledge is required. The emphasis is on English practice rather than developing a deeper understanding of the topic. Neither activity is organized to provide opportunities

for further or deeper processing of knowledge.

d Depth of processing: Relating new to prior knowledge: The teacher's pedagogy gives students few opportunities to accommodate new knowledge, if any, into their existing frames of reference. She moves quickly from fact to fact and students are expected to report (new) information they have found in their preview but rarely to explore the ideas further or to explicitly relate them to their own experience, as shown in Excerpts 4 and 6.

e Student writing: The students' writing, done as a homework assignment, includes some subject-specific vocabulary and, to a limited extent, the language of persuasion. Both are required for the purpose of the writing, which is to persuade the public to protect water resources. However, even the high performance samples use informal and non-academic language, which tends to undermine the purpose. No scripts score a Level 5, on a scale of 1-5 with 5 being highest, for this reason. Table 2 shows the score of the 15 samples collected.

Insert Table 2

The extract from a sample of student writing quoted below is from the high performance end scoring a Level 4. The writer uses some subject-specific vocabulary (double-underlined below) and modals to persuade (e.g. 'must', 'should') but the language use is personal and social (single-underlined below), more in the nature of BICS (Basic Interpersonal Communication Skills) than CALP (Cognitive Academic Language

Proficiency) (Cummins, 1994); it includes influences from oral language (Zwiers, 2008). First person address ‘we’ is used throughout (e.g. ‘we are very fortunate’). Personal pleas and imperatives, such as ‘Come on! Everyone!’, evoke emotions, which is uncharacteristic of academic language. Colloquial and non-technical language, such as ‘have a drink of water’, is used. Subject-specific vocabulary accounts for only 6% of the words. The personal and non-academic nature of language use makes the writing a personal plea rather than a public formal persuasion using informed and scientific evidence as support.

What can we do to protect water resources?

We are very fortunate. When we need to have a drink of water or need to wash up, we simply turn on the tap, clean and safe water comes out. But… millions of people living in other parts of the world are not as lucky as we are. So, we must know that water is very important in our daily life. Water resources is very limited and what can we do to protect the water?

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Wasteing is also very serious. We should get over it, too. Please remember that it is always possible to use less water. So, in the future, we should use the water used by watering the vegetables to watering the flowers. We also should turn off the running tap everywhere. Alough the advice is very easy to think about, it’s very difficult to do, and we can try our best to do it.

Protect the water is our duty, we should do it and we must do it. Come on! Everyone! Let’s protect the water and make our earth more beautiful!

2 Lessons 2A&B (Classification of living things)

a Academic content level: Technical academic knowledge: The focus of these two lessons, which form part of the topic on classification of living things, is on the

classification of vertebrates into mammals, fish, amphibians, reptiles or birds using four physical features. The physical features are the method of breathing (e.g. gills or lungs), the method of reproduction (e.g. live birth or laying eggs), the body covering (e.g. feathers or scales) and whether they are cold-blooded or warm-blooded. Though some of this is common sense knowledge, the classification system is technical academic knowledge, as are the characteristics of vertebrates when presented as defining features for classification purposes.

The prominent focus on technical academic knowledge is maintained throughout the lessons. The students have prepared to present the description of each vertebrate type. The following extract, representative of the classroom interaction of the two lessons, illustrates how the teacher ensures that they focus on the physical features of amphibians as one type of vertebrate (the students' use of the language *for* classification is double-underlined). The same strategy is used with the other four types of vertebrates. She ensures a focus on the more specific content that amphibians breathe with gills when they are young and lungs when they are adult, they live on land when they are adult, and they are cold-blooded.

Excerpt 7

S21: <u>Amphibians are covered with skin.</u>

T: Amphibians are covered with skin. Yes, what else?

S21: … and <u>they can live on, live on the land or in the water.</u>

T: They can live on land or in the water. And how do they breathe?

S21: <u>They breathe with lungs.</u>

T: They breathe with lungs. They breathe with lungs. <u>When amphibians are young, how do they breathe?</u>

S21: They breathe with gills.

T: So can you give us a better answer?

S21: Amphibians breathe with gills *when they are young*.

T: *when they are young* and when they grow into adults, how do they breathe?

S21: They breathe with, er lungs.

T: They breathe with lungs and where do they live when they are adults?... Do they live in water?

S21: No, they live on lands.

T: They live on land when they are adults. Anything else? XXX.

S22: And, er, the body temperature of amphibians, er, amphibians changes with surrounding environment.

T: Yes, so there are body temperature changes, it means they don't have the constant body temperature. In another words, they are?

S22: They are cold, they are cold-blooded animals. [Lesson 2A, ll.208-229]

When interviewed, the teacher said that she wanted the students to "…learn how to classify things by their physical features. That is the content objective -- to use their brain to think. I want them to learn more about science." There is a corresponding focus on the academic language *of* and *for* classification. She said, "…for English objective, they have to learn "can be classified", "breathe with lung or gills", "lay eggs to reproduce" or "give birth to babies to reproduce." These aims are reflected in the lessons through both the teacher's and students' language use.

b Academic content level: Knowledge relationships: The knowledge relationship of classification and the use of keys in classification are the major concepts in the topic. In Lesson 2A, the teacher reminds students of the concept of keys by eliciting the keys for classifying the students into two groups (i.e. sex), living things into animals and plants

(e.g. movement, method of feeding), and living things into vertebrates and invertebrates (i.e. presence or absence of a backbone). Students then describe examples of each vertebrate type with respect to their defining features. They then classify five 'things with wings' (plane, penguin, pigeon, bat, butterfly). Lesson 2B starts with more classification activities, followed by a short study of sharks as fish and how they are exceptions. Her selection of activities, therefore, ensures that the students focus on the knowledge relationship of classification rather than simply descriptions of the animals. Excerpt 8 below illustrates this focus on classification (students' use of the language *of* classification is double-underlined).

Excerpt 8

S44: <u>They can be classified into two groups.</u>

T: Two groups. What are the two groups?

S44: <u>One is living things.</u>

T: One is living thing. The other is?

S44: Er, <u>non-living things.</u>

T: Non-living things. OK, so I have the same classification with you. Living things and non-living things. OK.

S44: <u>Living things can be, living things can be classified into two groups.</u>

T: Two groups.

S44: <u>One is birds. One is mammals.</u>

T: One is birds, the other is mammals. And what else? Non-living things, so what's in this group?

Ss: Plane.

T: Plane. Yes, plane. And birds and mammals. Birds…birds and mammals. That's your classification. What about butterfly? Which group does it belong to? [Lesson 2A, ll.426-440]

The use of the language *for* classification, i.e. describing the physical features of the five types of vertebrates to justify the classification, exemplified in Extract 7, and the use of the language *of* classification, exemplified in Extract 8, dominate the lessons. The language *of* and *for* classification is characteristic of academic language and classification is an important academic study skill (Dalton-Puffer, 2007; Zwiers, 2008).

c Depth of processing: Processing and reproduction of knowledge: The teacher organizes the class activities within a cyclical lesson structure around the knowledge relationship of classification, moving the students through the lesson stages at progressively higher and wider levels and building onto their learnt knowledge, as follows:

1. presentation of previewed knowledge of each vertebrate type followed by reading aloud the defining features in the textbook (teacher-led work),
2. comparing the vertebrates feature by feature using a table (teacher-led work),
3. deciding on classification keys for five 'things with wings' (group work),
4. comparing vertebrates by features at random (teacher-led work),
5. explaining two different approaches to classifying the five 'things with wings' (individual student responses),
6. classifying more different living things and non-living things including exceptions such as whales (individual student responses),
7. elaborating and exploring more specific areas: cold-bloodedness (one feature), fish (one vertebrate type), and sharks (one type of fish) leading to some new concepts and words such as 'hibernate', 'skeleton', 'swim bladder'.

The progression of activities and the alternative classifications and exceptions challenge and raise students' understanding of the concept of classification to a higher level.

The teacher also often exploits the F-move in IRF interaction to elicit further elaboration by the student. She achieves this by asking another question which accepts the student's response while demanding more or by accepting the response and prompting (e.g. 'OK?' in Extract 9, below). For example, in Excerpt 7, she uses four questions consecutively in the F-moves (single-underlined in the extract) to elicit more specific technical content from the student. In Excerpt 9 below, she guides and pushes the student, through her questioning and elicitation techniques in the F-moves (see underlined), to provide more detail of his idiosyncratic but acceptable classification of 'things with wings'. Though the student had worked out at least part of the classification before being asked to describe it to the class, the teacher ensures through her questioning and elicitation that it is articulated in full.

Excerpt 9

T: OK, so XXX, would you please repeat your classification?

S1: Living, er, things with wings can be classified into two groups. One is, the first group is can't fly.

T: Oh, the first group is the things that can't fly. <u>OK?</u>

S1: The second group is the things, er,

T: <u>That…</u>

S1: That can fly.

T: Can fly. <u>OK?</u>

S1: The, the penguin is, the penguin can't fly.

T: The penguin can't fly, so it belongs to this group. <u>And?</u>

S1: Er, the thing that can fly can be classified into two groups. One is living things and another group

is non-living things.

--

T: Non-living things. OK. So what is the non-living thing? --

S1: A plane.

T: A plane, yes. A plane is the non-living thing. And for living-things?

S1: Er, living-things can be classified into two groups. One is, the first group is invertebrates and the second group is vertebrates. Er, in, invertebrates can be classified… er, the butterfly is invertebrates.

T: Butterfly belongs to this group. OK?

S1: Vertebrate, er, vertebrates, birds is the vertebrates. The birds can, and penguin.

T: Penguin…

S1: Birds and mammals are vertebrates. Penguin is birds.

T: Penguin?

Ss: Pigeon.

S1: Pigeon is birds.

T: A pigeon belongs to this group and?

S1: Bat is mammals. [Lesson 2B, ll.100-130]

The use of the cyclical lesson structure and the variety of activities within it, together with the use of the F-moves for further elicitation and elaboration, require students to process and (re-)produce knowledge from multiple perspectives and at increasingly more challenging levels, thus promoting deeper processing.

d Depth of processing: Relating new to prior knowledge: The cyclical organization of lesson activities requires the revisiting of knowledge learnt throughout the lessons. The teacher also frequently refers to students' existing knowledge frames to support their new

understanding. For example, students are asked to describe the defining features of each vertebrate type by reference to an example they know, such as frog as amphibian. In discussing body temperature, she relates ‘changeable’ to the changeable weather in Xi’an that students are familiar with to help them understand the new concept. She draws on students’ common sense knowledge to help them correct misconceptions (e.g. using dogs and cats to correct the notion that mammals are covered with skin and to guide a student to the correct technical knowledge of mammals being covered with hair). The constant connection and building on to the known makes the abstract classification by defining features more accessible.

e Student writing: The students’ writing, though short and done as a test, exhibits appropriate use of the language *of* and *for* classification. The first question asks students to explain how birds and fish are similar and different, the second to explain which group a bat belongs to. Question 1 was better answered than Question 2 as it is more directly related to what was covered in class. Table 3 shows the distribution of scores:

Insert Table 3

The example below, scored at Level 5, involves the use of subject-specific vocabulary and the language *of* or *for* classification (underlined in the writing) in every sentence. The answer uses appropriate academic language to explain why a bat is classified as a mammal by referring to the four defining features. The answer provides a scientific explanation (Martin & Veel, 1998) as required by the question.

A bat belongs to mammals. A bat gives birth to live babies. A bat breathes with lungs. A bat feed milk on its young. A bat is warm-blooded animal. The temperature of bat is constant. A bat is covered with skin and has hair or fur. So I classify it into mammals.

VI Discussion

The findings presented in the previous section illustrate high levels of student cognitive engagement with the content in Lessons 2A&B. This occurs when there is a focus on *'an appropriately challenging academic content level through activities that require sufficient depth of processing'*. The engagement is highlighted by the contrast with Lesson 1 in which the content is not cognitively challenging and there is no requirement for deeper processing. The more complex content-related language used in Lessons 2A&B, contrasting with the extensive practising of known non-academic language in Lesson 1, is a direct result of the 'cognitive interaction of the student[s] with appropriately challenging subject matter knowledge'(McLaughlin et al., 2005, p.34). It is the pedagogy that brings about the difference in engagement.

The teacher brings about engagement by, first of all, planning for both content and language learning objectives that focus on the knowledge relationship of classification. This ensures that the content is at the technical academic knowledge level inherent in the more abstract concept of classification, rather than at the common sense knowledge level. To help students achieve the level of learning expected, the teacher structures the lessons in a cyclical manner. This consistently engages students with the content by requiring them to process the new knowledge from different perspectives and at increasingly more challenging levels and to relate new to existing knowledge. This engagement demands the use of academic language related to the content by both the teacher, who models it,

and the students, who have to use it to process and (re-)produce the content knowledge. For example, the content focus on classifying vertebrates into five types requires the use of the language *for* classification five times. In each of these instances the content is different (because the defining features of each vertebrate type are different) and, therefore, the language use, though following a pattern, has to be different. This demands cognitive engagement and understanding, and provides the potential for learning. Excerpts 7 and 8 exemplify how the focus on classification provides multiple opportunities for students to use the language *of* and *for* classification. The repeated use of language within the context of a content that gives the language use meaning and purpose is conducive to language learning (Wolff, 1997). The teacher maximizes these opportunities for students also through her use of questions and elicitation in the F-move in the predominantly IRF pattern of classroom interaction, as seen in Excerpts 7 and 9.

The range and complexity of subject-specific vocabulary that students use, including types of animal (e.g. vertebrate, amphibian, reptile), parts of their body (e.g. gills, lungs, scales) and bodily functions (e.g. breathe, reproduce, give birth), is demanding for Grade 7 students in an EFL environment. The vocabulary is used as part of the language *of* and *for* classification. Further preliminary evidence that this pedagogy leads to learning can be seen in the results of the student written test. Students generally performed well, with 51% and 36% in Questions 1 and 2 respectively scoring Levels 4-5. There is also evidence of academic language use in the writing, as shown in the sample student writing quoted.

In contrast, the content knowledge expected in Lesson 1 is only at the common sense level and is presented as isolated facts, apparently owing to the lack of clear content

and language learning objectives. The low content level results in the lack of depth of processing of knowledge; in other words, there is little engagement. The pedagogy tends to encourage participation and extended English use but to discourage engagement by moving quickly from one fact to another. The linear lesson structure and the single IRF interaction pattern without further exploitation of the F-move deny both the teacher and the students the opportunities or need to use academic language except for some subject-specific vocabulary, such as ‘water resources’, ‘ground water’ and ‘electricity’. The language use focuses mostly on spoken language practice of known English with some new vocabulary. Though this complements the form-focused English lessons (Hoare, 2010), it does not advance students’ learning of new or more academic language; this is reflected in the student writing.

VII Conclusion

The contrasts between the lessons discussed in this preliminary study indicate how CBLT pedagogy can bring about CCE and provide the potential for students’ language development. The study has implications for teacher development for CBLT teachers and, arguably, for all second language teachers. It suggests that teachers might be guided through a planning procedure which would start with the identification of appropriately challenging content; they then need to develop content objectives which entail the understanding of concepts and relationships between concepts, and related language objectives to support students’ language development. This planning is then implemented with a pedagogy that requires students to process this content in sufficient depth using the appropriate academic language, explicitly taught as necessary. Research into such

professional development programmes is needed to determine the most effective strategies for supporting teachers.

Further research in other CBLT contexts is also needed to investigate the pedagogies that can bring about CCE. This preliminary study of CBLT pedagogy was of a limited scale and set within the context of only one CBLT programme. Further studies might, for example, explore the notions of content level and depth of processing within different subject–matter disciplines.

Notes

[1] The transcript conventions used are:

* *	teacher and students speak at the same time;
--	segment omitted;
…	pause;
XXX	naming a student;
S1	the first student etc.

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Components	Indicators
Academic content level	The extent to which students are expected to focus on: 1. technical academic knowledge rather than common sense knowledge; and 2. knowledge relationships in content rather than unrelated facts.
Depth of processing	The extent to which students have to: 1. process knowledge and (re-)produce it in different ways; and 2. relate new knowledge to prior knowledge.

Table 1: Components and indicators of cognitive content engagement

Score	No. & percentage of scripts
5	0
4	3 (20%)
3	8 (53.3%)
2	3 (20%)
1	1 (6.7%)

Table 2: Scores and percentages of student writing in the Water lesson

Question 1	Question 2

Score	No. & % of scripts	Score	No. & % of scripts
5	8 (17%)	5	6 (13%)
4	16 (34%)	4	11 (23%)
3	9 (19%)	3	14 (30%)
2	10 (21%)	2	8 (17%)
1	4 (9%)	1	8 (17%)

Table 3: Scores and percentages of student writing in the Classification lessons