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Content-Based Instruction: What Can We Learn from Content-Trained Teachers' and Language-Trained Teachers' Pedagogies?

Stella Kong

Abstract: This article reports on a study of the pedagogies of two content-trained teachers and two language-trained teachers in their content-based second language (L2) classrooms at the middle-school level in two Chinese contexts: Hong Kong and Xi'an. The study aims to identify pedagogies that support content and language learning, referred to here as 'content and language pedagogies.' The findings suggest that while the complex content at the middle-school level leads to correspondingly more complex language use, which therefore provides a strong foundation for advancing both content and language learning, the content must be explored in depth and from different perspectives to enable complex knowledge relationships to be co-constructed by the teacher and students through the use of correspondingly complex language to support this learning. This requires teachers to be aware of language form–function relationships.

Keywords: content-based instruction, content and language integration, content and language pedagogies, late immersion

Résumé : Le présent article porte sur une étude de la pédagogie de deux professeurs formés en contenu et de deux professeurs formés en langue dans leur classe de langue seconde basée sur le contenu (L2) au niveau de l'école intermédiaire dans deux milieux en Chine : Hong Kong et Xi'an. L'étude vise à déterminer les pédagogies qui soutiennent l'apprentissage d'une langue et le contenu, intitulées dans le présent contexte « pédagogies du langage et du contenu ». Les résultats suggèrent que, bien que le contenu complexe de l'école intermédiaire mène à une utilisation correspondante encore plus complexe du langage, ce qui offre donc une bonne base qui permet de faire progresser l'apprentissage tant du langage que du contenu, le contenu doit être étudié en profondeur et de différents points de vue afin de permettre au professeur et aux étudiants de construire ensemble les relations complexes du savoir grâce à l'emploi d'un langage complexe correspondant qui viendra soutenir cet apprentissage. Les

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professeurs doivent donc être au courant des relations forme-fonction du langage.

Mots clés : enseignement basé sur le contenu, intégration du contenu et du langage, pédagogies du contenu et du langage, immersion tardive

Brinton, Snow, and Wesche (2003) characterize content-based instruction (CBI) as 'the concurrent study of language and subject matter, with the form and sequence of language presentation dictated by content material' (p. ix). This characterization relates to an integrated view of the language–learning relationship which asserts that human learning is a meaning-making process and that humans use language to make meaning (Halliday, 1993; Wells, 1994). In Halliday's words, humans 'simultaneously engage in "learning language" and "learning through language"' (1993, p. 93). In a second language (L2) CBI context, learners learn an L2 by learning content presented in the L2. The focus on content learning provides favourable conditions for both content and language learning because of the depth of processing required within a purposeful and meaningful context (Grabe & Stoller, 1997; Lyster, 2007; Wolff, 1997).

CBI takes diverse forms in a wide variety of contexts across educational levels and has been increasingly shown as an effective curriculum approach to L2 learning (Grabe & Stoller, 1997; Lyster, 2007; Snow, 1998; Stoller, 2004). The balance that CBI models generate between content and language reflects curriculum factors such as program objectives and the practical possibilities in any particular context. Met (1998) describes the variety of approaches to integrating content and language in CBI as a continuum that ranges from the content-driven end (e.g., immersion programs in Canada) to the language-driven end (e.g., theme-based language classes in some ESL contexts). Whatever the balance is between content and language along the continuum, CBI models are characterized by a commitment, in different degrees, to the dual curriculum goals of content learning *and* language learning.

Despite this dual commitment, it is unusual for CBI teachers to have an equal level of academic and professional knowledge in both the content and the L2 because generally they are either content-trained or language-trained (Coyle, 2002; Fruhauf, Coyle, & Christ, 1996; Met, 1998; Short, 1997). Even in contexts where teachers have dual certification in a subject and an L2, such as Austria and Germany, teachers still need training in 'a content and language integrated approach to

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learning' (Wolff, 2002, p. 69). CBI teachers need these pedagogical skills so they can '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). In this paper, these skills are referred to as 'content and language pedagogies.'

Stoller (2004, p. 276), in discussing challenges facing further research and citing Wesche and Skehan (2002, p. 225), suggests that investigation into 'the interface of language and content' is 'the most important pedagogical issue for CBI at all program levels.' Recognizing that there is limited research into how CBI 'is actually appropriated, understood, and carried out' (Pessoa, Hendry, Donato, Tucker, & Lee, 2007, p. 103) to simultaneously support content and language learning, Pessoa et al. (2007) compared the classroom discourse of two Grade 6 CBI Spanish classes, each taught by a language-trained teacher in a suburban middle school in Pennsylvania. They found that the focus of the content could lead to a loss of an explicit focus on language, which adversely affected students' language learning. They also found that CBI teachers needed 'a more thorough grounding in academic subject-matter teaching' (Pessoa et al., p. 116) and that they needed to use language in ways that would help students explore and develop content understandings and meanings. Dalton-Puffer (2007) analyzed 40 audio-taped lessons from 14 classrooms of Grades 6–13 students in Austria who were taught subject content through English for discourse features that supported content and language learning. The 10 teachers in her study either had dual certification or were content-trained and possessed a high level of English proficiency. She found that the teachers were often so concerned about the depth and coverage of the content that language-learning goals became hidden. The study reported in this paper offers an attempt to further investigate how language and content interface through examining the pedagogies of content-trained teachers and language-trained teachers in two Chinese CBI contexts at the middle-school level.

The study: Context and aim

The two CBI contexts involved in the study were in Hong Kong, a former British colony and since 1997 a Special Administrative Region in China where English has long been recognized as a language of economic empowerment (Pennington, 1998), and in Xi'an, an ancient capital and a flourishing inland city in China where English is also increasingly recognized as a language of economic advancement

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(Hu, 2003). In Hong Kong, 112 (about 25%) secondary schools (Grades 7–13) adopt late-immersion education, with most school subjects taught in English by content-trained teachers. Primary education is mainly in L1.[1] The China–Canada–USA English Immersion (CCUEI) project was introduced in Xi'an on an experimental basis, where, since 1997, it has progressed from kindergarten to primary to middle schools (Chi, 2006; Hoare, 2007; Knell, Qiang, Pei, Chi, Siegel, Zhao, & Zhao, 2007). Only a small number of schools across these levels were involved (18 kindergartens, 13 primary schools, and 3 middle schools). Schools that participated in the project taught some subjects in English. Because the Language Law of China states that '[s]chools and other educational institutions must use *Putonghua* and standardised Chinese characters as the basic spoken and written language in education and teaching' (Kirkpatrick & Xu, 2001, p. 14), the three middle schools (Grades 7–9) can only offer one 'immersion' subject, science or social studies, which is not a subject within the government-stipulated curriculum. There are only two 'immersion' lessons per week, so the model at the middle-school level is more appropriately classified as CBI. The content subject is taught by language-trained teachers. This study focused only on the middle schools.

The aim of the study was to explore content and language pedagogies used by content-trained and language-trained CBI teachers in L2 contexts to determine how content and language learning at the middle-school level can be better supported. The study rests on the underlying principle that language learning requires content and content learning takes place through language so that content learning will be constrained if relevant language learning does not succeed, and vice versa (Halliday, 1993; Lyster, 2007; Mohan, 1986). It is therefore important that both content *and* language learning make good progress with each CBI lesson. This parallel progression becomes more significant as students advance in their levels of study, because the L2 only develops to its higher levels if students are learning more challenging content through correspondingly more challenging use of language (Kong, 2008; Met, 1998; Wolff, 2002). Previous research into the teaching and learning processes in late immersion classrooms in Hong Kong has shown that content-trained teachers often give greater focus to content learning to the neglect of language (Hoare, 2003, 2004; Kong, 2004), a phenomenon also identified by Dalton-Puffer (2007). Pessoa et al. (2007) also found a lack of balance between content and language in CBI lessons taught by language-trained teachers. A study of content-trained teachers' and language-trained teachers' pedagogies may provide insights into how the balance

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between content and language can be better managed so that both are more effectively learned.

The data source and the lesson analysis framework

The data source from which this study draws consists of video recordings and transcripts of 30 lessons from more than 20 late-immersion schools in Hong Kong, including a range of subjects in sciences, social sciences, and cultural subjects (such as art and music), and video recordings and transcripts of nine lessons from the three middle schools in Xi'an. The video recordings from Hong Kong were collected during 2004–2005 as part of a project which tracked teachers' development following a full-time, eight-week in-service course on late-immersion education pedagogies. Those from Xi'an were collected during 2004–2006 as part of an initial study of the CCUEI initiative. Some of these teachers have attended workshops on CBI pedagogies. Video recordings and transcripts of four lessons, two from Hong Kong (Lessons 1 and 2) and two from Xi'an (Lessons 3 and 4), were selected from the 39 lessons collected for the purpose of this study.

The four lessons were chosen for the differences they display in the balance of content and language focus. Lesson 1 exhibits a strong focus on content with long teacher monologues explaining content concepts and short student responses (generally of only 1–2 words). Lesson 2 is also content-focused in that all activities focus on generating more and deeper content understanding but there are more frequent and lengthier interactions (whether teacher–student or student–student), mainly through the teacher's repeated use of a one-minute discussion activity. The teacher also verbally draws students' attention to language forms. Lesson 3 is similar to Lesson 2 in terms of content focus, but the lesson is more interactive with more or less equal contributions of lines from the teacher and the students. The teacher draws students' attention to language forms both in verbal and written forms. Lesson 4's content focus is less clear but includes more activities and more frequent teacher–student interactions. The teachers in both Lessons 1 and 4 give very little focus to language forms explicitly. Appendix 1 contains information about teacher–student interactions in the four lessons and gives some idea about these differences. Table 1 provides the background information for the four lessons.[2]

The four lessons were analyzed for evidence of content and language pedagogies (i.e., pedagogies that support students' content and language learning). A lesson analysis framework was derived by

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TABLE 1
Description of the four lessons

Lesson	Grade level	School subject	Topic	Length	Teacher's professional background	Educational context
1	8 (class size = 40)	Science	Structure and functions of the eye	60 minutes (including 12 minutes of laboratory work by students in groups)	Professionally trained graduate science teacher (i.e., content-trained), with more than five years of teaching experience	In a late immersion school in Hong Kong
2	8 (class size = 40)	Geography	Effects of scientific farming methods	42 minutes	Professionally trained graduate geography teacher (i.e. content-trained), with more than five years of teaching experience	In a late immersion school in Hong Kong
3	8 (class size = 56)	Science	Fire triangle and how it can be applied to put out a fire	45 minutes	Graduate in English literature but without professional training, attended some CBI workshops (i.e., can be considered language-trained), with less than 2 years of teaching experience	In a middle school in Xi'an
4	8 (class size = 50)	Science	Functions of the eye	40 minutes	Professionally trained graduate ESL teacher (i.e., language-trained), with less than 2 years of teaching experience[3]	In a middle school in Xi'an

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reference to both the literature and the data (i.e., the four lessons). Studies on classroom discourse that support content and language learning in CBI lessons, especially at the middle-/high-school levels (e.g., Dalton-Puffer, 2007; Pessoa et al., 2007), were first consulted. The data were then read to find out if the classroom discourse features used in these studies were applicable to analyzing the four lessons and to identify other possible features. Relevant literature on learning through language and on content and language learning (e.g., Edwards & Mercer, 1987; Good & Brophy, 2003; Halliday, 2004; Halliday & Martin, 1993; Kong, 2008; Lyster, 2007; Marton & Tsui, 2004; Mohan & Beckett, 2001; Mohan & Huang, 2002; Snow, Met, & Genesee, 1989; Swain, 1996, 2001; Wells & Chang-Wells, 1992) was also consulted. The framework was finalized when it was felt that the features identified could adequately reflect what was in the data. The study, therefore, takes a grounded approach within qualitative research that seeks to 'analyse what actually happens in naturally occurring settings' (Silverman, 2001, p. 259). The data contributed to the development of the analysis framework used.

The four features that were identified in the analysis of the lessons do not focus solely on classroom discourse:

1. Lesson structure
   Lesson structure refers to the stages of a lesson and how the stages together form a lesson. A different stage is often signalled by a change in class activity. Good and Brophy (2003) maintain that 'knowledge networks structured around powerful ideas' (p. 409) can 'move students towards important educational goals' (p. 410). They propose that good teaching should have 'content presentations structured around key ideas, [and] learning activities that carry students through to the intended outcomes rather than just providing them with disconnected facts and skills' (p. 406). In a cyclical lesson structure, the major stages and activities of the lesson revolve around a limited number of key ideas, often just one or two. This gives the lesson a clear focus and easily identifiable learning objectives. A linear lesson structure, however, is characterized by stages and activities that result in coverage of a list of 'disconnected facts and skills.' See Appendix 2 for a summary of the lesson structures of the four lessons.
2. Content-focused talk: Complexity of content and knowledge relationships
   Content-focused talk refers to classroom talk where the teacher and students are focusing on the subject content, as opposed to

language-focused talk, where the students' and teacher's focus is on language forms or the form–function relationships. Knowledge relationships refer to ways in which key ideas are related or connected, such as cause and effect, comparison, classification, evaluation, hypothesis, and definition. Mohan (1986) calls similar relationships knowledge structures. Dalton-Puffer (2007) calls them academic language functions because they identify the purposes and functions that academic language is used to achieve. Knowledge relationships refer to networks of knowledge and not to discrete facts. The more complex the subject content is, the more likely a knowledge relationship is involved. Mohan and Beckett (2001) and Mohan and Huang (2002) illustrate how knowledge relationships can form bridges between content and language as they each have related language forms identifiable through the language form–function relationships. Thus, there is the language of cause and effect, the language of comparison, and so on. See Kong (2008) for a detailed explanation of how knowledge relationships serve as a link between content and language.

3. Language-focused talk: Form–function relationships
   Language-focused talk refers to classroom talk that focuses explicitly on language forms or the form–function relationships. It has been well documented that simply teaching content through an L2 is not sufficient enough to lead to content and language learning and that a focus on language form is necessary (Lyster, 2007; Mohan & Huang, 2002; Snow et al., 1989; Swain, 1996). The form–function relationships may also serve as a link between content and language as the purposes and functions that language is used to achieve can be content-related.
4. Teacher–student interaction
   Classroom interaction in different modes has been recognized as important to content and language learning (Dalton-Puffer, 2007; Edwards & Mercer, 1987; Lyster, 2007; Marton & Tsui, 2004; Wells & Chang-Wells, 1992). Drawing on a wide range of empirical research, Lyster (2007) proposes that immersion and CBI programs need to 'adopt instructional practices that situate teachers in a more interactive relationship with students and knowledge than do transmission models of teaching' (p. 3). The data suggest that two interactional features can lead to better quality teacher–student interaction: (1) the way the teacher uses questions, and (2) the nature of student–student interaction activities set by the teacher. Appendix 1 gives an overview, in quantitative terms, of the teacher–student interaction patterns in the four lessons.

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The analysis of each of the four lessons with reference to the four features in the lesson analysis framework is presented below. Though these features are analyzed separately, they are interrelated and affect one another in the actual enactment of a lesson. The lesson stage and the turn and line numbers refer to those of the lessons analyzed (see Appendix 2 for the lesson stage numbers quoted in the 'Findings' section that follows). The grammatical errors from the original transcript extracts have been retained.[4]

Findings

Lesson 1 *(taught by a content-trained teacher from Hong Kong)*

Lesson structure

Lesson 1 exhibits a cyclical lesson structure. There is only one content learning objective, the structure and functions of different parts of the eye, which the teacher states at the very beginning of the lesson (Stage 1). The other stages and activities of the lesson almost all revolve around this objective and the teacher explicitly makes the connection clear to the students. For example, the teacher connects the activity of dissecting an ox eye (Stage 3) to the key learning objective – the structure of the eye, by saying:

> Now I would like you to pay attention on all these structures. And we are now going to cut over an ox eye and try to identify all these structures, OK? [Turn 32, Lines 195–197]

Content-focused talk: Complexity of content and knowledge relationships

A prominent feature of the content-focused talk in Lesson 1 is its complexity. The following extract illustrates this:

> Yes, the pupil is used to admit light into the eye. And in fact pupil is nothing but a hole. This is not an object. In fact, it is a hole. However, *(1) the size of a pupil can be changed by the iris*. In different situations, under different conditions, the size of a pupil can be adjusted by the iris. And in fact the iris will change the size of the pupil *(2) depending on the lighting condition*. Under very bright condition, *(3) when there is bright light around, the iris will move to make the pupil smaller*. And when we are looking things under dark

> condition, the iris will move *(4) to make the hole larger to make the pupil larger.* So more light can enter the eye, OK? Na, this kind of adjustment is part of the accommodation. OK? (Drawing the focusing muscles and lens on the partially drawn diagram of an eye) After passing through the pupil, the light ray will meet another structure. This is the focusing muscle and this is the lens. *Don't forget to put 's' at the end of this word. This is important. Don't say 'len.' Lens*. But the lens is used to focus object. When light enters the eye, the lens help to change, help to focus all the objects into *(5) a single point on the retina which is the back of the eye*. (Drawing light rays entering the eye on the diagram) Again the lens can be adjusted. In fact, *(6) the thickness of the lens* can be adjusted by *(6) the movement of the focusing muscles*. When we are looking objects from different distances, the lens, the thickness of the lens will be changed. If we are going to look at far objects, the lens will become thinner by the movement of the focusing muscle and when we are looking at a near object, the lens will become thicker, will become thicker to focus the object, to get a good image of it. It is another kind of adjustment in the eye. And again part of the accommodation of the eye. So that our eye can see under bright or dark condition. We can see things from far or near distances . . . [Turn 22, Lines 79–103]

This represents only about one quarter of the teacher's full explanation of how the eye sees. The complexity of the content is reflected in the intricate knowledge relationships involved. These include the *cause–effect* relationships between the environment (the light conditions and the distances of objects from the eye) and the reaction of the eye (changes in the size of the pupil and the thickness of the lens, and the movement of the iris and the focusing muscles), and the *comparison* relationships between different environmental conditions and different adjustments made by the eye. All these contribute to the *definition* of the concept of accommodation of the eye, which explains the mechanism involved in seeing.

These complex knowledge relationships demand the use of correspondingly complex language (Halliday, 2004; Halliday & Martin, 1993). The following examples from the extract above illustrate the complex language used by the teacher to explain the complex content. Each numbered item, except the last one, describes the form–function relationships of the parts in italics and correspondingly numbered in the extract:

1. *the size of a pupil can be changed by the iris*: the passive voice to put the topic in focus in the 'theme' position of a sentence (*the size of a pupil* becomes the topic in focus)

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2. *depending on the lighting condition*: a participle phrase to provide more information (the condition under which the iris will change the size of the pupil)
3. *when there is bright light around, the iris will move to make the pupil smaller*: a 'when' clause and a 'to' infinitive to explain cause–effect relationships
4. *to make the hole larger to make the pupil larger*: an infinitive phrase to describe purpose
5. *a single point on the retina which is the back of the eye*: a long noun phrase with post-modification of prepositional phrases and relative clauses to provide detailed information
6. *the thickness of the lens; the movement of the focusing muscles*: nominalized phrases to represent a concept and to allow the concept to be further explained and developed
7. subject-specific words (e.g., *accommodation*, *iris*, *pupil*, *lens*, *retina*, *optic nerve*, *light sensitive cells*).

Language-focused talk: Form–function relationships

There is no significant language-focused talk in Lesson 1. The teacher does not explicitly draw students' attention to language forms or to form–function relationships. The only time when the teacher talks about language is to draw students' attention to a language form – the spelling of 'lens':

> Don't forget to put 's' at the end of this word. This is important. Don't say 'len.' Lens. [Turn 22, Lines 90–91, double-underlined in the extract quoted in the previous section]

Teacher-student interaction

Appendix 1 shows that Lesson 1 is dominated by teacher talk (which accounts for 92.4% of the total number of lines in the lesson transcript), mostly in the form of sustained teacher monologues where the teacher explains the content concepts to students. These teacher monologues can be as long as 74 lines and there are four segments of teacher monologues more than 30 lines long, taking up about 60% of the lesson.

Teacher–student interaction takes the form of the teacher asking questions and a student nominated to answer. Students talk very little and when they do, they mostly give just one-word answers to

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the teacher's questions. This is partly due to the way the teacher asks questions, as illustrated in the extract below:

T: What do you think the change will be if we are looking at a far object under a dark condition? (Putting down 'far object under dark condition') So what will the diagram look like? What will be the change in the pupil? And what will be the change in the lens? Catherine. Catherine. What will the pupil become now? Will it be small or large if we are looking at . . .? It will be wide. It will become larger. This pupil, the hole, will become larger. Why? What are you looking at? What is the condition now? What is the condition?

S: Dark.

T: Yes it is a dark condition. Right. So under the dim light condition . . . [Turns 22–24, Lines 107–116]

The teacher asks a rather complicated question: What are the changes to the eye when we look at a far object under dark conditions? Instead of providing support for the student nominated to answer the question by, for example, breaking it up into a series of questions that will help her arrive at the answer step by step, as the teacher in Lesson 3 does, he asks a few questions all at the same time and answers some of those himself, leaving the student no time to think and answer. The student eventually says one word, which only answers a small part of the original question, and the teacher goes on with his explanation.

Lesson 2 *(taught by a content-trained teacher from Hong Kong)*

Lesson structure

Lesson 2 also exhibits a cyclical lesson structure, with the stages and activities of the lesson revolving around the two content learning objectives: the problems created by scientific farming methods and possible solutions. Most of the lesson (Stages 2–9) focuses on these two objectives, taking up 95% of the lesson time. The teacher also makes an explicit link, in terms of a problem–solution relationship, between the two objectives (Stage 7):

I'd like you to do another activity now, that we have already discussed five problems from the scientific farming methods. I'd like you to . . . discuss the possible solutions. Think about, use your imagination, think about how

you can solve these five problems that come from the scientific farming methods. [Turn 82, Lines 203–207]

Content-focused talk: Complexity of content and knowledge relationships

Related to the two content learning objectives are two knowledge relationships: *cause–effect* (the adverse effects of scientific farming methods), and *problem–solution* (possible solutions to the problems generated by scientific farming). The teacher guides the students through the content by focusing on these two knowledge relationships and insisting that students relate content knowledge in these ways. See the 'Language-focused talk' section below for how she uses the language of cause–effect and helps the students use the language for this purpose.

Language-focused talk: Form-function relationships

Lesson 2 exhibits the teacher's systematic use of the language of cause–effect, in relation to one of the two knowledge relationships in the lesson: cause–effect. The teacher starts by revisiting with students the three problems of scientific farming covered in the previous lesson and uses the language of cause–effect (in italics in the extracts below) in her elicitation:

How would a scientific farming method *lead to* environmental pollution? [Turn 5, Lines 18–19]

How can we describe, how can the methods *leads to* environmental pollution? [Turn 5, Lines 20–21]

Later, she explicitly reminds the students to use these or similar language forms to represent the cause–effect relationship:

But please remember when you try to write these in the ... in your answers, you need to use '*therefore*,' and use complete sentence, or you can say '*result in*' or '*lead to*' in order to link the several phrases together. [Turn 19, Lines 38–40]

She consistently uses the language of cause–effect throughout the lesson, whether for revisiting previous knowledge or exploring new knowledge:

> We learned 'harmful to ecology,' can you still remember how the use of scientific farming methods create or *lead to* a harmful ecology? [Turn 19, Lines 41–42]

> How did scientific farming methods *lead to* soil erosion? [Turn 36, Line 65]

> . . . now we go to point number four, unemployment. Open your book to 90. (Students open their books) A scientific farming method may *lead to* unemployment. [Turn 40, Lines 72–73]

Following a very brief explanation of the new point, the teacher asks the students to read out loud the relevant parts from the textbook:

> Mechanization in farming needs less labour, *therefore* this may *lead to* unemployment of farm workers, especially in South China (Students read the sentence together). [Turn 43, Lines 78–79]

After elaborating on the idea, she asks students to work in pairs and to explain the effect to each other, with the textbook closed. She then asks a student to retell the idea to the whole class; one student says:

> The mechanization needs less labour and finally *leads to* unemployment. [Turn 54, Line 102]

The teacher then praises the student, again highlighting the language:

> Very good. Very good of you to use '*lead to*,' mechanization, you can say a higher level of mechanization *leads to* fewer or . . . *leads to* less need of labour, less need of labour, and *therefore result in* unemployment. [Turn 55, Lines 103–105]

As she moves on to the next stages of the lesson, she continues to use the language of cause–effect that she has explicitly reminded her students to use.

Teacher-student interaction

There is more student talk in this lesson than is indicated in Appendix 1 as the number of turns and lines involved in student–student interaction activities were not recorded. One key interactional feature is the teacher's frequent use of one-minute student–student exchanges to

provide students with the opportunities to rehearse their answers to her questions before they give them to the class. This helps students produce longer and better answers. For example,

> Long periods of cropping and overuse of fertilizer decrease the soil fertility and the soil . . . can easily wash away by the wind and rain. [Turn 39, Lines 69–70]

Lesson 3 *(taught by a language-trained teacher from Xi'an)*

Lesson structure

Lesson 3 also shows a cyclical lesson structure. There are two content learning objectives: the fire triangle (i.e., the three conditions necessary for a fire to occur) and how it can be applied to putting out a fire. Most of the classroom activities revolve around these two objectives. The teacher relates the discussion activity on how to put out a forest fire (Stage 7) back to the fire triangle (Stage 6) by explicitly asking the students to use this new knowledge in their discussion:

> Just now we learned some knowledge about fire triangle, right? And here . . . here think about how to put out a forest fire. Now please use this fire triangle. (Showing the diagram of a fire triangle on PowerPoint). [Turn 176, Lines 253–256]

Content-focused talk: Complexity of content and knowledge relationships

The teacher focuses on the knowledge relationships of *cause–effect* and *hypothesis* to support students' learning of the two content objectives of the fire triangle and its application to putting out a fire. See the 'Language-focused talk' section below for her language use in supporting students' learning of *hypothesis* with the if-conditional.

Language-focused talk: Form–function relationships

Lesson 3 demonstrates the teacher's use of an explicit form–function relationship: the if-conditional for hypothesizing. The language form used, which she asks students to read out loud, is clearly shown on her PowerPoint slides. She does not insist on students using it when

answering her questions, but she uses it consistently throughout the lesson. The following extracts illustrate how she uses the form (italicized in the extracts).

Before conducting the experiment to demonstrate the burning power of oxygen, she encourages students to make a hypothesis:

T: And now (Clicking the PowerPoint that shows the language form) . . . now (Picking up some wooden splint) *if* I light . . . light this splint and put this into this so-called empty tube right, *what will happen* to this splint? *What will happen*? Just make a guess.

Ss: (Whispering)

T: Yes . . . Do you have any idea? XXX (Calling a student's name), please.

S1: . . . the test tube *will still burn*.

T: Still burning and . . .

S1: And . . .

T: What happen, *what will happen* later?

S1: Later maybe . . . The fire *will be put out*.

T: The fire *will be put out*. OK, maybe . . . a guess, right? Any other guesses? . . . No. OK. Now let's do the experiment. [Turns 57–65, Lines 80–93]

Following the experiment, she concludes:

T: Please look at the screen. Now, *if* we put the burning splint into the tube filled with normal air, just now we have done the experiment, *it will* . . . go out (Saying it at the same time as the students), right?

Ss: . . . go out. [Turn 79–80, Lines 118–121]

Similarly, when she has finished with the glowing splint and the students have talked about what they saw, she concludes:

T: (Clicking to show the PowerPoint slide) Look at this. *If* we put the glowing splint into a tube filled with oxygen, right?

Ss: Yes.

T: *It will* burn again. [Turns 97–99, Lines 146–149]

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She then relates the experiment to the idea of the fire triangle she mentioned earlier, establishing that oxygen is one of the conditions necessary for a fire to burn, again using the if-conditional:

T: (Showing the question on the PowerPoint) *Will* a fire happen if there is only oxygen?

Ss: No. [Turn 107–108, Lines 159–161]

She then gets the students to use the language form:

T: I'd like one student to tell us the answer. XXX (Calling a name)?

S2: There . . . if . . . if . . . if . . . there will . . . er . . . there will no fire if there is no heat.

T: No heat, right?

S2: *There will be no fire if there is no heat*. [Turns 166–169, Lines 229–232]

Teacher–student interaction

Among the four teachers, the teacher in Lesson 3 is the most successful in eliciting more and better student talk. There are more student turns (50.3%) than teacher turns and the student talk accounts for almost half of the total number of lines (43.1%). The longest teacher turn is the same in length as the longest student turn (5 lines), and there is frequent student talk which is of a sentence or more, not counting the student discussion that was not recorded.

The teacher also succeeds in using questions to promote interaction that supports students' learning of a key content objective – that burning needs oxygen. The following extract illustrates this:

T: Now, what happened just now? What happened with the splint?

Ss: (Noises)

T: The . . . splint . . . stopped burning, right?

Ss: Stopped burning.

T: OK. Why? Why it stopped burning? Why? OK (Inviting a student to answer).

S3: Because there is not enough oxygen in this test tube.

T: In this test tube . . . there is not enough oxygen, right? OK. There is not enough oxygen there also means . . . oxygen is . . .

- - -

T: Oxygen in this test tube is very limited, right? Now think about the relationship between this (Holding the test tube and the wooden splint) burning . . . burning splint and the oxygen . . . . There is . . . not enough oxygen, right? Why? Why there is not enough oxygen, the fire stops burning? The fire stopped. (Inviting a student) OK.

S5: Burning need oxygen.

T: Burning needs oxygen. Good. [Turns 67–79, Lines, 98–117]

Instead of asking just one question (e.g., What does the experiment show?), the teacher asks a series of questions to help students arrive at the key idea step by step. First, she asks a 'what happened' question so that students can describe what they saw when the burning splint was put into a test tube filled with normal air. She then asks the students a 'why' question to require them to explain the reason for what they saw, followed by another 'why' question to explain the relationship between what they saw and oxygen. Her use of questions not only helps students learn a key idea but also helps them use the language of the content (i.e., *burning needs oxygen*). She also repeats the language at the end for reinforcement.

The student–student interaction activities set by the teacher, which require content exploration and a definite product, also facilitate teacher–student interaction that supports content and language learning. The following extract shows such an interaction that followed a student discussion activity on how to put out a fire under different conditions using the knowledge of the fire triangle they have just learned:

T: Why does the person cover the wok with a lid when the wok is on fire?

S6: Because when the person cover the wok with a lid it will remove the oxygen because *if there is no* oxygen, *there will be no* fire.

T: There is no oxygen, there will be no fire. Right?

- - -

T: The waste paper in the rubbish bin is burning. How would you put out the fire?

S7: I think we can put the rubbish basket upside down . . . *there will not be* enough oxygen for the fire running and then *the fire will be* put out.

T: OK. Put the bin upside down, right? There is not enough oxygen, right? So there will be no fire. OK, you (Inviting a student).

S8: I don't agree because *if we put the rubbish bin upside down the fire will destroy the rubbish bin*. [Turns 267–297, Lines 388–427]

When students suggest how to put out a fire under different conditions, they revisit both the content knowledge that oxygen is needed for a fire to burn and the language form the teacher targets for learning (i.e., the if-conditional, italicized in the extract above when used by students). The teacher also asks students to express their views about other students' ideas and a student applies the if-conditional to a slightly different context from that taught by the teacher (in italics above).

Lesson 4 *(taught by a language-trained teacher from Xi'an)*

Lesson structure

Lesson 4, which is on the same topic as Lesson 1 (i.e., the eye, albeit with different lesson objectives), exhibits a linear lesson structure. The teacher moves from one sub-topic of the eye to another. She generally links the information by making a concluding statement about the previous sub-topic then stating the next. The sub-topics are, however, not linked to an overall focus beyond the topic itself (i.e., the eye). For example, when she moves from the causes of short-sightedness to the interviewing activity on how to protect our eyes from short-sightedness (Stages 8–9), she does not help students link the causes to possible preventive measures. She only says:

Many get short-sighted. So how do you take care of your eyes? [Turn 142, Line 212]

Content-focused talk: Complexity of content and knowledge relationships

The content-focused talk in Lesson 4 is in clear contrast to that in Lesson 1 in terms of the depth and complexity of content. While

Lesson 1 focuses only on the structure and function of the eye, Lesson 4 covers a few sub-topics in relation to the eye: how the eye sees, why two eyes are better than one, the functions of the tear glands and blinking, the causes of short-sightedness, and how to protect our eyes from short-sightedness. The following extract is the teacher's full explanation of how the eye sees:

T: So how do our eyes see? How do our eyes see things? Now let me tell you, OK? (Showing a PowerPoint slide with the diagram of the cross-section of an eye and a flower at a distance from the eye) This . . . (Pointing at the flower)

Ss: Flower.

T: The light, comes through your eyes. Light comes through your eyes, and get to come to the back of your eye. The flower comes through your eye and get to the back of your eye. OK?

Ss: Yes.

T: *And then*, what's that? (Pointing at the brain in the diagram)

Ss: Brain.

T: Brain, right, *so* your brain, your brain . . . gets the message, your brain knows you see something, so the brain tells you 'oh a flower, it's a red flower.' *So* this one is the pupil. (Pointing at the pupil in the diagram)

Ss: Pupil.

T: *So* what colour is your pupil?

Ss: Black.

T: Yes, the black part of our eyes. *And then* this is the lens. (Pointing at the lens in the diagram)

Ss: Lens.

T: Like a mirror right? It's like a mirror. *And then* the back of your eye is called retina.

Ss: Retina.

T: And this is your brain.

Ss: Brain.

T: Now you know how you see things.

Ss: Yes. [Turns 25–42, Lines 37–60]

In contrast to the complex knowledge relationships of *cause–effect, comparison*, and *definition* involved in the explanation of how the eye sees in Lesson 1, the teacher in Lesson 4 presents the process of how the eye sees as a description of a *sequence* of events, which is reflected in her use of the connectives of *and then* and *so* (underlined in the extract above, with *so* used as a sequence, not causal, connective). Also, she relies on the students' understanding of the diagram but does not explain the complex process involved. Because the content is so much simpler, the language use is correspondingly less complex. Coordinate clauses are used but not subordinate clauses. A few subject-specific words (*pupil, lens, retina*) are used but the meanings are taught simply by reference to the diagram.

Language-focused talk: Form–function relationships

Despite being taught by a language-trained teacher, there is no language-focused talk in Lesson 4. At no point in the lesson does the teacher draw the students' attention to language use or language forms, except when drilling the pronunciation of a few new words such as *tear gland, blink, protect, short-sighted*. Interestingly, she does not drill students' pronunciation of the subject-specific words such as *retina* or *lens*.

Teacher–student interaction

There is frequent teacher–student interaction but the student turns tend to be short, mostly ranging from a word to a line. The quality of the interaction may have been affected by the simplicity of the content and the nature of the student–student interaction activities. These activities tend to rely on students using their own ideas but not working with or further exploring the content of the lesson. They tend to result in a language practice activity where students use the language they already know to talk about content they already know, instead of a learning activity where students explore the content of the lesson, drawing on what they have learned to construct further knowledge by using content-related language. The following extract, where the teacher asks the students to share what they have discussed and written about how to protect their eyes, illustrates a lack of exploration of the content and the content-related language that develops learning:

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S1: (Student reading what he/she has written) *We can have* a good rest *and often see plants*. Don't play computer for a long time, ah do eyes exercise, eat many vegetables, don't read in the sun, the last one is don't watch TV for a long time.

T: Thanks a lot, another group? . . .

S2: . . . ah *eye exercise*, don't read in the sun, don't read on the bus, ah watch more flowers and trees.

T: Thank you. OK, next.

S3: Don't watch TV for a very long time and don't read under the sun. We . . . we should do exercise, eye exercises every day, *and often have* a rest is very important. And don't play computer for too long.

T: OK. Thank you. [Turns 157–162, Lines 250–259]

The ideas the students shared are all accepted without clarification or elaboration by both the teacher and the students. They are a list of ideas without much connection to the other ideas presented (contrasted with, for example, *In order to protect our eyes, we should. . .*) or to other parts of the lesson. Some of the language forms are inappropriate for the function (i.e., giving advice) (italicized in the extract above).

Discussion

The findings from the analysis of the four CBI lessons in the two Chinese contexts provide some insights into what may be more effective content and language pedagogies that better support content *and* language learning in these contexts. The findings suggest that a focus on content provides a strong foundation for CBI. This supports Brinton et al.'s (2003) contention that in CBI, 'the form and sequence of language presentation [should be] dictated by content material' (p. ix). This does not mean, however, that any pedagogical model that has the content as its basis will be effective. The findings of this study suggest that *the new content has to be explored in depth and from different perspectives to enable complex knowledge relationships to be co-constructed by the teacher and students through the use of correspondingly complex language*. This provides input and, with the use of appropriate pedagogies, elicits output that supports progressively more advanced content and language learning. This is particularly important in the

middle- and high-school contexts where the learning becomes cognitively more and more demanding (Met, 1998; Wolff, 2002). Met (1998) sees the need to 'allow . . . students to develop and/or apply concepts and understandings that are in keeping with general curriculum expectations. To do less is to short change students' intellectual development' (p. 42).

The analysis has shown how the complexity of the content in Lesson 1 demands the teacher's use of complex language to explain the content. In contrast, the simplicity of the content, also on how the eye sees, in Lesson 4 is reflected in much simpler language. The difference in the input, content, and language for the students is clear. While the students in Lesson 1 might find the input challenging and therefore need some support to learn it, the students in Lesson 4 may not receive much new input, except perhaps some vocabulary. The input in Lesson 1 provides the basis, together with appropriate pedagogies, for progression and advancement of content and language learning while that in Lesson 4 does not.

A predominant focus on content, however, can lead to sustained teacher monologues, as in Lesson 1. This can result in little participation by the students and thus little co-construction of knowledge between the teacher and the students (Marton & Tsui, 2004; Wells & Chang-Wells, 1992). It also puts the students at risk of learning the language incidentally (Lyster, 2007), if at all, as they produce very little language and there is no explicit and targeted language use in the lesson to guide their language learning. Dalton-Puffer (2007) suggests that teacher monologue can be effective in supporting content and language learning at middle- and high-school levels because 'longer and syntactically complex teacher utterances' are needed to make explicit 'complex cognitive relations between facts and concepts' (p. 91). She recommends 'reconsidering the value of teacher monologue (in well-considered dosage), both in the interest of presenting coherent conceptual networks of topic content and in the interest of providing sustained, syntactically complex oral input' (p. 296). However, she recognizes that teacher monologues need to be used in moderation for them to be effective. Consideration also has to be given to how students can be supported when they are learning the complex language of the complex content used by the teacher.

One of the content and language pedagogical strategies the teachers in Lessons 1, 2, and 3 use to explore with students the content in depth and from different perspectives is to organize the lesson in a cyclical structure. They focus on a limited number of content learning objectives around which most of the stages and activities in the lesson revolve. This

provides students with multiple opportunities to explore and revisit the learning and to use content-related language in the process. For example, the group discussion on possible solutions to the five problems of scientific farming methods in Lesson 2 and the group discussion on how to put out a forest fire using knowledge of a fire triangle in Lesson 3 provide such opportunities. Language production within the context of meaningful content is conducive to language learning (Lyster, 2007; Swain, 2001). A cyclical lesson structure provides the teacher and the students with a coherent frame within which they can co-construct knowledge relationships between different aspects of a topic. The teachers also establish relevant knowledge relationships by making explicit connections between different stages of the lesson to help students connect their learning, as shown in the Findings section above. This is more effective than a linear lesson structure that tends to turn the lesson into coverage of a list of facts, as in Lesson 4.

Another content and language pedagogical strategy used by some of the teachers is to organize the complex cognitive relations of the content as knowledge relationships such as *cause–effect*, *problem–solution*, and *hypothesis*. As ways of organizing content knowledge, knowledge relationships are abstract thinking skills (Kong, 2008). They have to be actualized for students through language use. Mohan and Beckett (2001) and Mohan and Huang (2002) have demonstrated the potential function of knowledge relationships as 'bridges between language learning and content learning' (Mohan & Beckett, 2001, p. 133). The teachers in Lessons 2 and 3 actualize the knowledge relationships by identifying specific language forms for them, for example, the language forms for *cause–effect* in Lesson 2 and the if-conditional for *hypothesis* in Lesson 3. They then use these forms explicitly (e.g., by telling students the form–function relationship as in Lesson 2 or by drawing students' attention to the language forms on PowerPoint slides as in Lesson 3) and consistently throughout the lesson. Effectively, these two teachers have both identified language learning objectives for their lesson (Snow et al., 1989). The findings from the study suggest that identifying language objectives as target language forms related to knowledge relationships and using the forms explicitly and consistently with students can support their language production, as exemplified in Lessons 2 and 3. The approach makes explicit the form–function relationships and supports students' noticing and use of the language forms (Lyster, 2007; Swain, 2001). It is thus an effective content and language pedagogy, which requires teachers' awareness of the form–function relationships. The findings also suggest that knowledge relationships may serve as a link to the

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systematic integration of form-focused instruction and content instruction, which has been recognized as necessary in CBI contexts (Genesee, 2002; Lyster, 2007; Swain, 2001). A focus on complex knowledge relationships should also advance content learning as the complexity demands higher order thinking, aptly suiting the needs of middle- and high-school students.

The study also shows that teacher questioning and student–student interaction activities that focus on the exploration of the lesson content, as used in Lessons 2 and 3, provide more opportunities for students to develop and recycle the content and the language in focus, resulting in better quality teacher–student interaction and students' use of target-language forms for the content.

Conclusion

This study investigated four CBI lessons taught by two content-trained teachers and two language-trained teachers to identify effective content and language pedagogies at the middle- and high-school levels. The findings from the study suggest that while a lack of content focus provides an inadequate foundation for content and language learning, as in Lesson 4, a predominant focus on content to the neglect of language, as in Lesson 1, will not provide students with adequate support for learning. Within a content-focused context, the possible effective content and language pedagogies found are as follows:

1. Lessons structured in a cyclical rather than linear manner to provide multiple opportunities for students to explore and revisit content and content-related language.
2. Complex content organized as knowledge relationships and actualized in targeted language forms related to the knowledge relationships.
3. Explicit and consistent use of targeted language forms in exploring content with students.
4. Use of questions and student–student interaction activities to explore and revisit content.

Teachers need an awareness of the language form–function relationships to be able to adopt these pedagogies.

This study, however, offers only a preliminary investigation into these pedagogies. How the various pedagogies can be used in a 'well-considered dosage,' to use Dalton-Puffer's (2007) words again, and in

relation to each other for effective content and language learning, needs further investigation. The interface of language and content is a challenging issue, and there is 'much potential for refining pedagogical know-how and enhancing learning outcomes' (Lyster, 2007, p. 23).

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Notes

1 Immersion education in Hong Kong originated in the colonial days. Refer to Hoare and Kong (2008) for more details.
2 All four lessons were taught by L1 Chinese teachers in English to L1 Chinese students with English as a second language. The L1 in Hong Kong is Cantonese, and the L1 in Xi'an is Putonghua. Cantonese and Putonghua are two spoken forms of Chinese, which are phonologically different to the extent that speakers of either form find the other incomprehensible. The two forms share the same written language, though there can be minor differences in vocabulary and syntax.
3 Interviews with school principals indicate that more experienced teachers are generally reluctant to try out CBI because of the challenges involved. When they are not content-trained, they feel that they do not know enough about the subject matter and this is exacerbated when there are no readily available teaching resources.
4 Transcript conventions: . . . (pause); ---- (segments omitted).

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Appendix 1

Teacher–student interaction in the four lessons

	Lesson 1	Lesson 2	Lesson 3	Lesson 4
No. of teacher turns	35 (59.3%)	62 (55.4%)	166 (49.7%)	80 (49.4%)
No. of student turns	24 (40.6%)	50 (44.6%)	168 (50.3%)	82 (50.6%)
No. of teacher lines	292 (92.4%)	218 (79.3%)	272 (56.9%)	170 (64.4%)
No. of student lines	24 (7.6%)	57 (20.7%)	206 (43.1%)	94 (35.6%)
Longest teacher turn	74 lines (when explaining how the eye adjusts to bright light + instruction of how to dissect an ox eye)	24 lines (when explaining how scientific farming methods lead to financial problems for farmers)	5 lines (when stating the 3 conditions for fire to occur)	9 lines (when instructing students to draw on flower petals about ways to protect our eyes)
Longest student turn	1 line (of a sentence of 8 words; other turns are usually one word or a phrase)	2 lines (4–5 turns of this length; others are shorter)	5 lines (more than 50 responses of a sentence or more, more than 15 of which are 2 lines or more)	3 lines (other turns are generally short)
Activities with students' use of language	Answering teacher's questions, with teacher nomination of student	Answering teacher's questions, with teacher nomination of student	Answering teacher's questions, voluntarily	Answering teacher's questions, voluntarily

(*continued*)

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(*continued*)

	Lesson 1	Lesson 2	Lesson 3	Lesson 4
	Writing in textbook exercise	Participating in 1-minute discussions throughout the lesson to revisit ideas, retell ideas from the textbook in their own words, etc.	Participating in group discussion to apply knowledge of the fire triangle learnt to suggest ways to put out a fire in different conditions	Participating in group discussion to brainstorm their own ideas
		Participating in group discussion to generate ideas about possible solutions	Writing sentences as homework	Role play of news reporter interviewing classmates
		Writing ideas on the board		Writing on petals of flowers about how to protect the eye
		Writing in textbook exercise		

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Appendix 2

Lesson structure of the four lessons

Notes:

The stages in each lesson are described chronologically.

The greeting and ending of the lessons are not included because they are usually very short (less than a minute) and mainly formulaic with the teacher saying 'Good morning' and 'Good bye' and students responding in the same way (except in Lesson 4, see Lesson 4 Stage 1 below).

In square brackets are the approximate time (in minutes), the number of turns and the number of lines for each stage of activity. The turns between two consecutive stages sometimes overlap, thus the total may not be equal to the sum of all the turns. This is the same with the number of lines. The number of turns and lines for student discussion or group work is not recorded.

Lesson 1 (content-trained teacher): Science lesson on structure and functions of the eye	Lesson 2 (content-trained teacher): Geography lesson on scientific farming methods
Setting: Students sitting in groups round a bench in the science laboratory, with teacher using overhead transparencies and the board.	Setting: Students sitting in rows facing the teacher in a classroom, with teacher using PowerPoint and the board.
Teacher stating the topic of the lesson: the structure and functions of different parts of the eye + revision of the structure of the eye through showing a diagram and checking with students names of different parts. [5'; 16 turns; 36 lines]	Teacher starting by setting homework and encouraging students to do well. [2'; 5 turns; 11 lines]

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Lesson 1 (content-trained teacher): Science lesson on structure and functions of the eye	Lesson 2 (content-trained teacher): Geography lesson on scientific farming methods
Teacher explanation of how the structure of the eye functions to help us see in different light conditions (including asking students to underline some key words in the textbook, drawing a diagram, asking students to come out to draw similar diagrams to show how the eye makes adjustments in different conditions, and some questioning to check understanding). [25.5'; 13 turns; 154 lines]	Revision of three problems of scientific farming methods through eliciting from students, interspersed with one-minute student–student talks for 'rehearsal of answer' purposes. [8'; 36 turns; 60 lines]
Teacher instruction on how to dissect an ox eye using drawings and demonstrating how to use some apparatus. [9.5'; 1 turn; 55 lines]	Teacher explanation of two more problems through eliciting ideas from students, interspersed with one-minute student-student talks, reading aloud ideas from the textbook and students retelling the ideas in the textbook. [14'; 35 turns; 106 lines]
Students dissecting an ox eye in groups with the teacher going around to each group to help them identify different parts of the ox eye; students screaming some of the times while cutting open the ox eye and responding to teacher's questions and support; newspaper is used to line the table to keep it clean but also to allow students to see how words in the newspaper are enlarged using the lens from the dissected ox eye. [11.5'; 27 turns; 47 lines]	Teacher instruction on a group task to summarize the problems of scientific farming methods, followed by group work. [1.5'; 2 turns; 9 lines]
Teacher rounding off the practical work and instructing students to finish an exercise on what they observe in the dissected eye in the textbook. [3.5'; 1 turn; 16 lines]	Teacher eliciting task answers from students. [1.5'; 7 turns; 10 lines]
Students working on the exercise, teacher ending the lesson by asking students to finish the exercise before the next lesson for answer checking [5'; 3 turns; 8 lines]	Teacher summarizing the problems of scientific farming methods [1'; 1 turn; 8 lines]
Total: 60'; 59 turns; 316 lines	Teacher instruction on a group discussion task of solutions to problems of scientific farming methods, followed by the discussion. [2'; 1 turn; 5 lines]
	Some students writing on the board ideas discussed in the group, some students carrying on discussion, teacher encouraging students to think of more points. [6'; 2 turns; 10 lines]
	Teacher following up on solutions written on the board, checking with students about their ideas and elaborating / explaining each point given. [6'; 28 turns; 63 lines]
	Total: 42'; 112 turns; 279 lines

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Lesson 3 (language-trained teacher): Science lesson on fire triangle	Lesson 4 (language-trained teacher): Science lesson on the eye
Setting: Students sitting in rows facing the teacher in a classroom, with teacher using PowerPoint.	Setting: Students sitting in rows facing the teacher in a classroom, with teacher using PowerPoint.
Teacher elicitation from class on what we can do to put out a forest fire. [1.5'; 19 turns; 23 lines]	Teacher greeting the class by saying she is happy to see them and asking what they can see in the room to introduce the topic: eyes. [2'; 11 turns; 14 lines]
Teacher introducing the topic for the lesson: fire triangle. [0.5'; 6 turns; 11 lines]	Teacher creating a gap for learning by asking students to imagine what they cannot see without eyes, leading to the question, 'How do we see with our eyes?' [2.5'; 15 turns; 24 lines]
Revision of gases in the air and what oxygen can do through questioning. [1.5'; 22 turns; 27 lines]	Teacher explanation of how our eyes see. [1.5'; 18 turns; 23 lines]
Teacher demonstration of experiment on oxygen supporting burning: introducing apparatus – asking students to guess results of experiment – doing experiment (talking while carrying out steps) – asking students to explain results – concluding that oxygen is needed for burning. [7.5'; 60 turns; 97 lines]	Teacher instruction on a discussion task about why two eyes are better than one, followed by group discussion. [1'; 3 turns; 6 lines]
Teacher explaining the three conditions (oxygen, fuel, heat) needed for burning with reference to the experiment using questions. [3'; 37 turns; 45 lines]	Teacher-led sharing of ideas discussed. [1'; 3 turns; 4 lines]
Teacher revisiting the fire triangle using the three conditions needed for a fire. [5'; 33 turns; 47 lines]	Teacher demonstrating how two eyes are better than one using a bottle of water. [3'; 15 turns; 29 lines]
Instruction on group discussion: how to put out a forest fire using knowledge of a fire triangle; followed by group discussion. [4.5'; 5 turns; 11 lines]	Teacher explanation of the functions of the tear glands and blinking and the causes of short-sightedness, ending with instruction on group discussion on the causes of short-sightedness; followed by student discussion. [11'; 78 turns; 107 lines]
Teacher-led sharing of ideas from discussion. [6.5'; 44 turns; 77 lines]	Student discussion on causes of short-sightedness, followed by teacher-led sharing of ideas discussed. [3'; 3 turns; 5 lines]

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Lesson 3 (language-trained teacher): Science lesson on fire triangle	Lesson 4 (language-trained teacher): Science lesson on the eye
Instruction on group discussion: questions in the textbook about how to put out a fire in different conditions, followed by group discussion. [7.5'; 9 turns; 15 lines] Teacher-led sharing of ideas from discussion. [6.5'; 89 turns; 115 lines] Instruction on homework about examples of fire triangle in daily life. [1'; 6 turns; 10 lines] Total: 45'; 334 turns; 478 lines	Instruction on how to carry out the activity of a news reporter interviewing other students on how they protect their eyes from short-sightedness, followed by one student interviewing two other students in front of the class. [3'; 14 turns; 25 lines] Instruction on group work to discuss how to protect our eyes (students have to draw the petals of a flower and write on the petals their ideas), followed by group work. [7.5'; 1 turn, 8 lines] Students showing their drawing to the class and sharing ideas on how we can protect our eyes. [3.5'; 7 turns; 13 lines Setting homework: each student draws a poster about how to protect our eyes. [1'; 1 turn; 6 lines] Total: 40'; 162 turns; 264 lines

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