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Linguistic Challenges in CLIL Assessments: A Perspective from Systemic Functional Linguistics

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Introduction

Content and language integrated learning (CLIL) programmes, an instructional approach developed based on content-based instruction, have been gaining popularity around the world in recent decades. CLIL programmes aim to promote second language (L2) learning and content learning of non-language subjects (e.g. history and science) at the same time (Stoller, 2008). In Hong Kong, CLIL programmes have been adopted in English-medium schools since the 1960s (Lightbown & Spada, 2013; Lo & Lin, 2015). However, various studies have suggested that some learners do not attain the L2 proficiency level that allows them to benefit from CLIL programmes (Johnson, 1997; Lin, 2013).

Similar to many other places of Confucian-heritage cultural background, Hong Kong has developed a strong exam-oriented culture (Carless, 2010; Carless & Lam, 2014). Under the current education system, local students have to sit for the Hong Kong Diploma of Secondary Education Examination (HKDSE), a high-stakes public examination, at the end of Secondary 6 (Grade 12). The HKDSE result is a measure of learners' attainment throughout their six-year secondary education and has significant influence on learners' future pathways, including further education and employment. In light of this, this paper aims to explore the complexity of the written language in the prompts in a Biology assessment under CLIL by drawing upon understandings from systemic functional linguistics (SFL). Findings in this study may shed light on learners' language needs in science education and provide teachers with insights about ways to better prepare students with the assessment in addition to content knowledge.

Literature Review

Language in Science Education

Language plays an important role in science education. When learning science, language is a challenge to first language students and hence it is potentially more challenging to L2 learners, whose language proficiency is low, in particular, to understand scientific concepts (Richardson Bruna, Vann, & Escudero, 2007; Wellington & Osborne, 2001). One difficulty that many learners face is the understanding of scientific terms that are not common in everyday language (Halliday & Martin, 2003; Wellington & Osborne, 2001). For example, biology students have to learn words like '*unicellular*', '*elongation*' and

'*zygote*'. In some other situations, learners have to use scientific language to talk about everyday phenomena (Mortimer & Scott, 2003). For instance, when discussing the phenomenon of melting ice, learners have to describe the process as '*an energy absorbing process in which water changes state from solid to liquid*'.

However, simply knowing the technical vocabulary is insufficient for students to master the scientific concepts or knowledge as the grammar of science writing is considered to be a greater challenge to learners (Halliday & Martin, 2003; Mohan & Slater, 2006). According to Halliday and Martin (2003), the difficulties of grammar in scientific texts come from a range of features such as interlocking definition, syntactic ambiguity and lexical density. Science texts are usually nominalized as abstract scientific processes and are often packed into nominal groups (Chan, 2014; Halliday & Martin, 2003). Hence, the lexical density of scientific texts is usually high as information is usually condensed from clauses into nominal groups when constructing scientific knowledge (Maxwell-Reid & Lau, 2016). In short, learners have to decode both the technical vocabulary and language constructions of abstraction and compression of information in science texts.

Complexity and Clausal Embedding

Long and dense nominal groups are common in technical registers (Flowerdew, 2013). In terms of text complexity, spoken language is considered to be grammatically intricate while written language is lexically dense (Halliday, 1989; Halliday & Matthiessen, 2004). Lexical density is a measure of the ratio between the number of lexical words to the number of ranking (non-embedded) clauses and it is usually higher in written texts (Flowerdew, 2013; Halliday, 1989). The higher the lexical density of a text, the more challenging the text is for students to read. In the following examples, the lexical words are in bold and the lexical density is in brackets.

(a) *He is very **good** at **science***. (2)
(b) *An **ionic bond** is a **chemical bond*** [[*that **involves** the **transfer** of **electrons***]]. (7)

Such density is often achieved by rankshifting - embedding processes realized by clauses into nominal groups. An embedded clause can act as the head or postmodifier in a nominal group and the embedded clauses are represented with double square brackets [[*embedded clause*]] (Halliday & Matthiessen, 2004). As exemplified in Sentence (b), the process of chemical bond formation is packed into the sentence as an embedded finite clause functioning as the postmodifier in the nominal group. The various types of clausal embedding in nominal groups are summarized in Table 1. Clausal embedding in nominal groups is considered to be an essential linguistic resource in contributing the density in written language as potentially it is recursive to have embedded clauses (Halliday, 1989). However, the dense information makes it difficult for students to understand the language.

TABLE 1
Types of Clausal Embedding in Nominal Groups

Function	Class	In Nominal Group
Postmodifier	clause: finite	the house [[that Jack built]]
	clause: non-finite	the house [[being built by Jack]]
Head	clause: finite	[[what Jack built]]
	clause: non-finite	[[for Jack to build a house]]

Note. Adapted from Halliday & Matthiessen (2004: 427)

Empirical Studies on CLIL

Existing studies on language use in CLIL tend to place more attention on classroom discourse (e.g. Lo, 2015; Richardson Bruna et al., 2007) and stakeholders' perceptions (e.g. Chan, 2014; Lo, 2014). Based on the analysis of classroom discourse, it is shown that content subject teachers can foster learners' metalinguistic awareness in English with the aid of learners' first language (Lo, 2015). However, some subject teachers have raised various concerns about CLIL programmes. One key issue is that these programmes mainly benefit the more capable students and lower the learning motivation and achievement in the content subjects among students with low language proficiency level (Chan, 2014; Fung & Yip, 2014).

Recent studies have attempted to investigate the language in textbooks and question types in CLIL assessments (e.g. Chan, 2016; Maxwell-Reid & Lau, 2016). Chan (2016) explored the question types in school-based examination papers and found that there was a reduction of higher-order thinking questions as a means to reduce language challenge when the school adopts English as the medium of instruction. This suggests that language in assessment can be challenging for students. However, the linguistic challenges in CLIL assessments seem to be an under-explored issue.

The Study

The Context

This exploratory study was conducted in Hong Kong where most students have Cantonese as their L1. The CLIL assessment involved is taken from the Hong Kong Diploma of Secondary Education (HKDSE) examination, which is a public examination taken by secondary school learners after the completion of six years of secondary education. In the past, only a small number of schools in Hong Kong were allowed to use English as a medium of instruction in content subjects (Evans, 2000). According to the latest language policy, more flexibility is provided for the schools and more schools are adopting English to teach content subjects as this may better prepare students for tertiary education (Chan, 2014). Drawing upon SFL theories, this study is guided by the following questions:

(1) How complex are the assessment prompts in terms of lexical density?
(2) What is the distribution of various types of clausal embedding in the assessment?

Data Collection and Analysis

Textual data were collected from the HKDSE Biology paper from 2012 to 2019. According to the figures released by the examination authorities, Biology is the subject with the greatest number of candidates among the science subjects (HKEAA, 2018). In this study, the essay questions were selected for investigation as they carry the highest marks on the assessment every year. This implies that this question type has a significant role in learners' overall performance in the examination. A total of eight examination prompts were collected and analyzed. Data analysis was divided into two stages. First of all, the texts were loaded to O'Donnell's (2013) *UAM CorpusTool* to assist the calculation of the number of words and clauses and the lexical density. Then, the embedded clauses in the nominal groups were examined and categorized according to their types. The categorization offers a clear understanding of the key linguistic resources that students need to possess to comprehend the questions.

Findings

Lexical Density

The descriptive statistics on the number of words, the number of clauses and lexical density of the texts are summarized in Table 2. It was observed that the number of ranking clauses in each question was quite steady, with an average of three to four ranking clauses, while the length of the assessment prompts increased throughout the years and the use of language seemed to be lexically denser, with the lexical density increases from 4.33 in 2012 to 9.5 in 2019. It is noteworthy that the lexical density in the essay prompt in 2018 is 12.3, which is the most lexically dense text in the data. This suggests that much information was packed in the three ranking clauses in that question.

TABLE 2
Descriptive Statistics of the Texts

	2012	2013	2014	2015	2016	2017	2018	2019
Words per text	23	39	58	34	61	61	75	100
Ranking clauses	3	4	4	3	4	4	3	6
Lexical density	4.33	5.75	7	6	7.75	8	12.3	9.5

Clausal Embedding in Nominal Groups

A total of 32 embedded clauses were identified in the eight assessment prompts. All four types of embedded clauses were used. As shown in Table 3, non-finite clause functioning as the postmodifier was found to be the most dominant type of embedded clause in the data, with 14 occurrences. Finite clause functioning as the head of the nominal group was also found to be common, with 13 occurrences. These two types of embedded clauses occurred at least three times more than the other two types of embedded clauses.

TABLE 3
Distribution of Embedded Clauses in Nominal Groups

Types of embedding		Frequency
Postmodifier	clause: finite	2
	clause: non-finite	14
Head	clause: finite	13
	clause: non-finite	4
Total		33

In the following, extracts from the assessment prompts were provided to illustrate each type of embedded clause and some of their functions were described. As shown in Example 1, a non-finite clause was used to enhance the Head '*ways*' by expressing the manner of '*maintaining blood flow*'.

Example 1 (Postmodifier, non-finite clause)

… their structural differences are related to the different ways [[*of maintaining blood flow inside the blood vessels*]]

Instead of enhancing the Head, the non-finite clause in Example 2 was used to elaborate on the act of '*carrying out*' various functions. Similarly, the reduced relative clause '*(which is) buried underground*' in Example 3 was an elaboration that defines the Head '*dinosaur*'.

Example 2 (Postmodifier, non-finite clause)

…the different conformations enable them [[*to carry out different functions*]]

Example 3 (Postmodifier, non-finite clause)

… derived from a dinosaur [[*buried underground*]]

In Example 4, the whole embedded clause '*whether it is scientifically valid*' functions as the Head of the nominal group. This was the most typical usage of this type of embedded clause in the examination prompts as it was used in six out of the eight examination prompts and accounted for 11 instances. In addition, a nominal group with an embedded clause as Head was used as a projected statement or claim as exemplified by Example 5.

Example 4 (Head, finite clause)

For each of the claims above, discuss [[*whether it is scientifically valid*]].

Example 5 (Head, finite clause)

Sharon was told [[that she might be breathing out carbon dioxide…]]

The following examples show the two less common types of embedding in the essay prompts. It was observed that non-finite clauses functioning as the heads of nominal groups were usually realized by imperfective aspect in clauses consisting of at least one *-ing* verb, or gerund in traditional terms, as illustrated in Example 6, while finite clauses functioning as the postmodifiers were mainly realized by defining relative clauses as represented in Example 7.

Example 6 (Head, non-finite clause)

[[*Keeping pets (such as dogs and cats)*]] is becoming popular in Hong Kong.

Example 7 (Postmodifier, finite clause)

Mitosis and meiosis are important processes [[*that ensure the continuity of life*]].

Discussion

Linguistic Challenges to CLIL learners

This study set out to explore the linguistic challenges learners may face in CLIL assessments drawing upon understandings from SFL. Findings suggest that the language used in assessment prompts is a potential challenge to L2 learners of English. As revealed in Table 2, there is a trend that the language used in the questions has been getting lexically denser in recent years. The average lexical density for written English should be between 3 to 6 (Halliday, 1989). However, only three essay prompts over the past eight years fall into this range. In most of the years, the lexical density is higher than 6 and the language in the assessment could be so condensed that the lexical density reached over 10 in 2018. This implies that it is unavoidable for learners in CLIL programmes to deal with the complex clause structures in the examinations.

Figure 1 clearly displays how information is packed in the essay prompt through clausal embedding. There were three ranking clauses only in this question but nine embedded clauses in the nominal groups. This question demonstrates the recursive nature of clausal embedding as there can be other embedded clauses within an embedded clause (Halliday, 1989). Take the first sentence in Figure 1 as an example, the sentence structure is rather simple: '*Sharon was told (**something**)*'. The retained complement '***something***' was realized by a that-clause. Within the clause, there was one clause postmodifying the Head '*carbon dioxide*', one embedded clause postmodifying the Head '*carbon*' and one more clause postmodifying '*dinosaur*'. These kinds of dense writing are believed to be difficult for students, in particular low proficiency learners, to process (Fang & Schleppegrell, 2008; Maxwell-Reid, 2015). The extensive use of embedded clauses can be daunting and hence hinder some students to provide accurate responses during the examination.

Sharon was told [[*that she might be breathing out carbon dioxide* [[*containing carbon* [[*which was once a part of the body of a dinosaur* [[*buried underground for millions of years*]]]]]]]]. Use your biological knowledge [[*to describe the journey of the carbon*]]. The journey should include [[*how it is possible for the carbon* [[*derived from a dinosaur* [[*buried underground*]] [[*to go through millions of years and appear in the form of carbon dioxide in Sharon's breath*]]]]]].

Figure 1. Essay prompt in 2018 HKDSE.

Regarding the types of embedded clauses, attention should be given to the pervasive use of the finite clause as the head and the limited use of finite clauses as a postmodifier. As described in the previous section, Example 4 shows the most common type of finite clause functioning as the head. This is probably related to the context where these texts appear. These texts were taken from the public examination paper and thus they can be regarded as examination questions. Embedded clauses are used to shift the questions into declarative sentences (Halliday & Matthiessen, 2004). In other words, questions are commonly asked in the form of indirect questions, using the structure of '*Verb (i.e. discuss, describe, explain) + whether/ WH-word + indirect question*'.

Interestingly, the use of relative clauses in nominal groups is very limited in the assessment prompts. In many ESL/EFL contexts, relative clauses have been included in the syllabi and grammar books (Celce-Murcia & Larsen-Freeman, 1999; Yule, 1998). Relative clauses have also been included as one of the teaching focuses in the English curriculum in Hong Kong. However, there were only two instances of relative clauses in the Biology assessment prompts. It seems that there exists a gap between the language taught in General English lessons and the language students' face in assessments in content subjects like Biology.

Implications and Conclusion

This study has identified some possible linguistic challenges relevant to clausal embedding in nominal groups in CLIL assessments. English teachers play a vital role in providing scaffolding for learners to acquire these complex structures in written language (Vygotsky, 1978). To better equip learners with the necessary grammatical resources, English teachers should reconsider the texts and materials they use in class. On the one hand, English teachers may try to ensure that they provide comprehensible input to learners by simplifying the materials used in English lessons. On the other hand, they should also think of ways to bring students through the complexity of language they may encounter in other subjects or authentic materials through a gradual process.

Apart from the role of English teachers, CLIL teachers should also explore the possibility of collaboration with English teachers. Cross-curricular collaboration is encouraged as this is an effective way of addressing both students' academic and linguistic needs (Coyle, Hood, & Marsh, 2010; Lo, 2014). While content subject teachers are responsible for teaching students the content knowledge, English teachers can pick on the academic language so that students can cope with the language in assessments. By doing so, the chance of language being a barrier for students to demonstrate their subject knowledge in assessments can be reduced.

Using tools in SFL, this study looked into the complexity of language used in CLIL assessment of one subject and identified some features of clausal embedding that might be challenging to L2 learners. Few investigations have focused on the linguistic challenges in CLIL assessments and this initial study has offered some insights into this area. More research should be done on the role of clausal embedding in other CLIL materials such as textbooks and assessments of other subjects. Also, this study only focused on textual data. Eliciting learners' views on the linguistic difficulties in learning content subjects and written responses to the assessment prompts will possibly enhance our understandings of learners' needs. With more work being done, it is believed that both language teachers and content teachers can collaborate well to help students learn both language and subject knowledge in a more effective way.

The Author

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