Translanguaging and Trans-semiotizing Approaches to Content and Language Integrated Learning (CLIL): Innovating With the Multimodalities-Entextualization Cycle (MEC)

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Abstract
This research explores how translanguaging (Garci & Li, 2014) and trans-semiotizing, approaches can facilitate students’ expansion of their communicative repertoires to gradually make new ways of speaking, writing, and unfamiliar registers their own (Lin, 2012, 2017, 2019; He, Lai & Lin, 2017). Drawing on the sociocultural and social-semiotic perspectives, the study investigates meaning making in a multilingual CLIL classroom through fine-grained analysis of a series of lesson observation videos, teaching materials and sample student works collected during a school-university collaborative project on building up the CLIL capacity of teachers and South Asian minoritized students in Hong Kong. The results of this study shed light on how teachers design spaces for translanguaging and trans-semiotizing (Lin, 2019; Lin, Wu & Lemke, 2020) and spaces for target language and register use in the different stages of a curriculum genre (Rothery, 1996). The Multimodalities-Entextualization Cycle (MEC) is proposed and discussed as a heuristic curriculum genre for CLIL education (Lin 2015b, 2016). The study concludes by discussing theoretical and pedagogical implications and providing implementation suggestions for CLIL curriculum and teacher professional development (He & Lin, 2018; Lo, 2020).

Keywords: translanguaging, trans-semiotizing, multimodal approaches, Content and Language
Introduction

Content and Language Integrated Learning (CLIL) is a rapidly growing area of both research and practice in many parts of the world, especially in Europe and Asia where an increasing number of schools and universities are using CLIL as an educational approach to integrate the learning of content with the learning of a second, foreign, or additional language (Coyle, Hood, & Marsh, 2010). However, due to the special characteristics of CLIL and various contextual complexities, it remains a challenge for teachers to achieve the integration of content and language teaching in CLIL classrooms (Dalton-Puffer, 2018; Lin, 2016; Lo, 2020; Ruiz de Zarobe, 2016). One of the recurring themes for connecting content and academic language for English learners is to develop academic language across all curriculum areas through developing opportunities for a curriculum of talk (Swinney & Velasco, 2011). But how do we help students to make ‘alien’ words and foreign ways of speaking/writing/thinking in foreign/additional languages/academic registers their own? Lemke (1990) proposed that teachers should help students to grasp semantic and conceptual relationships in colloquial language first and then guide them to substitute scientific and technical terms for colloquial words. Recent research on co-development of science literacy and academic language literacy indicated that both designed scaffolding and spontaneous scaffolding (Gibbons, 2009; Lin, 2016) are indispensable for the development of content knowledge and academic language knowledge (He & Lin, 2019). Empirical studies on CLIL also pointed out that translanguaging (Garcí & Li, 2014) and trans-semiotizing (Lin, 2015a) can be useful scaffolding for meaning making and the development of content and academic language (Karlsson, Nygård Larsson & Jakobsson, 2019; Lin, 2019; Lin & He, 2017; Lin & Wu, 2015).

In this study, we shall focus on the CLIL education of multilingual and multicultural students.
in an English-Medium-Instruction (EMI) science classroom of a Hong Kong secondary school. We shall draw on recent theorization of translanguaging (Lin, Wu & Lemke, 2019) and multimodal approaches (Danielsson, 2016) to examine how translanguaging and multimodal activities can facilitate ethnic minority students’ expansion of their communicative repertoires (Lin, 2012) to gradually make foreign ways of speaking/writing and unfamiliar registers their own. We shall also adopt the Multimodalities-Extextualization Cycle (MEC) (Lin 2015b, 2016) as a heuristic tool to analyse how the CLIL teacher can design spaces for translanguaging and trans-semiotizing and spaces for target language/register use in the different stages of a curriculum genre (Rothery, 1996) to achieve the objectives of both content and language development in the CLIL classroom.

**Literature Review**

**Meaning Making Through Bridging Between Colloquial and Academic Registers**

From social semiotic perspectives, human learning is a meaning making process—a semiotic process during which language is the primary semiotic resource to construe (i.e. to construct and understand) content (Halliday, 1993). Language is essential for knowledge construction and interpretation in learning content subjects, and is viewed as the principal means through which the conceptual meaning of academic subjects is co-constructed in the classroom (Lemke, 1988). Academic subjects are characterized by their technical language features that are alien to learners. Content knowledge will be incomprehensible if the “foreign” language is not “translated” into students’ own language; namely, the colloquial language which they use for daily communication. However, as academic literacy is a stipulated syllabus outcome and the only legitimate discourse in school assessments, students need to develop academic literacy for entry to higher education institutions. Therefore, to facilitate academic subject learning, teachers need to help students to bridge the gap between colloquial language and academic language and guide them to “translate back
and forth” between the two different registers, as emphasized by Lemke (1990) in science education, “Students understand best what is explained to them in the language they use themselves, ordinary colloquial English... Students will begin to grasp semantic and conceptual relations in colloquial language first. Then they will substitute scientific, technical terms for colloquial words” (p. 172-173).

It is worth noting that, in the teaching of abstract and technical subjects such as science, the bridging of languages may go beyond lexico-grammatical features and extend to the hybridizing of different registers. As proposed by Lemke (1990), “Teachers should use all the stylistic and rhetorical means available to communicate science to students, including narrative and dramatic presentations; humor, irony, and metaphor; fiction and fantasy; reference to actual scientific activities, disputes, and persons; personal anecdotes and historical examples” (p.174). Such trans-registering practices help to broaden the range of designed scaffolding and spontaneous scaffolding strategies (Gibbons, 2009; Lin, 2016) which allow teachers to deploy flexibly semiotic resources from an expanded communicative repertoire (Lin, 2012) to help students to bridge the gap between colloquial and academic language in content-based instruction.

**Translanguaging and Multimodal Amplification of Meaning**

Although language is the primary semiotic resource in human learning, meaning making is never the result of language alone, but the interplay between language (i.e. verbal) and other meaning making resources such as visual and gestural semiotics during communication. According to Danielsson, (2016), each mode of presentation has its specific “affordance” for meaning making defined as “meaning potential” (van Leeuwen, 2005). Through strategic deployment of multimodal resources, the different semiotic modes interact simultaneously, backgrounderg and foregrounding each other so that the meaning of concepts is not just repeated but also amplified (Kress, Jewitt, Ogborn &Tsatsarelis, 2001). As Lemke (1998) elucidated, “The ‘concepts’ of science are not verbal
concepts...They are semiotic hybrids, simultaneously and essentially verbal-typological and mathematical-graphical-operational-topological. The actional, conversational, and written textual genres of science are historically and presently, fundamentally and irreducibly multimedia genres” (p.87, emphasis in original). The multimodal approaches to meaning making have proved to be fundamental and fruitful in recent studies in science education (Cheng & Gilbert, 2015; Danielsson, 2016).

The multimodal social semiotic views of teaching and learning is essential for CLIL classroom where non-language content subjects are taught in a foreign/second/additional language. In bi/multilingual education, translanguaging has been widely researched since its emergence as a pedagogy that allows bilingual learners to comprehend the subject matter in one language and express their ideas about the subject in another (Baker, 2011). Translanguaging as “multiple discursive practices in which bilinguals engage in order to make sense of their bilingual worlds” (Garcí, 2009, p.45, emphasis in original) has been found to be beneficial for the content and language development of emergent bilinguals (Garcí, 2009) through promoting their understanding of the subject matter and learning of the less familiar language (i.e., the foreign/additional language) (Baker, 2011; Lin & He, 2017; Lin & Wu, 2015). It should be noted that, the translanguaging approach questions the concept of language separation and rejects the view that assumes bilingualism as the addition of two separate languages or the practice of parallel monolingualisms (Garcí & Lin, 2017; Lin & Lo, 2018); rather, it advocates a holistic view of semiotic (i.e. meaning-making) repertoire which “signals a trans-semiotic system with many meaning-making signs, primarily linguistic ones that combine to make up a person's semiotic repertoire” (Garcí & Li, 2014, p.42). Building on Halliday’s (2013) “trans-semiotic” view, Lin (2015b) developed the concept of “trans-semiotizing” and emphasised the seamless flow of entanglement of multiple meaning making resources. Languages (as a central semiotic) not only interact with each other but also intertwine with other
semiotics (e.g., visual images and gestures) in human communication practices during which the common semiotic repertoire expands with the ongoing contributions of the communicators (Lin, 2012; Lin, 2019). This has been evidenced in a study investigating the effective communication between a professor and a multilingual audience through translanguaging and trans-semiotizing during a multimodal seminar presentation, despite the fact that the speaker and the audience shared little common language background (He, Lai, & Lin, 2017).

Recent literature illustrates the multilingual, multimodal, experiential and transformative nature of translanguaging. In a study of how transnational self-directed learners of Chinese mobilized their multilingual, multimodal, and multisemiotic repertoires, as well as their learning and work experiences as resources in language learning, the researchers witnessed how this translanguaging and multimodal learning process transcended the limits of form, meaning and function in traditional language learning and created a “space” for the multilingual learners to bring together and orchestrate their personal beliefs, histories, experiences, physical and cognitive abilities, social ideology as well as the environment, hence transforming language learning into a multilingual, multimodal and multisensory experience (Li & Ho, 2018). Translanguaging is theorized as both a practice during which participants are engaged in “dynamic” and “functionally integrated” uses of languages or language varieties, and a process of knowledge construction that goes beyond language systems (Li, 2018). Translanguaging classroom discourses not only encourage fluid multilingual practices within the limits set up by the roles and objectives of tasks but also aim to push the limits and transcend the boundaries, hence transforming the classroom experiences (Li & Lin, 2019). This dynamic, fluid and transformative nature of translanguaging resonates with the dynamic and distributed view of translanguaging as *flows* (Lemke, 2016, 2018; Lin, Wu & Lemke, 2019). According to Lemke (2018), translanguaging has a material history, which consists of processes and *flows* across timescales and complex eco-social systems. Each individual body is a place where the *flows* of the...
community, past and present, have passed through it. Translanguaging is a community phenomenon within which individuals as mediums for the flows of matter, energy and information are interconnected with those of other members in the community, and the flows in different communities are further intertwined in the ecology, which makes translanguaging a dynamic, fluid and constantly intertwining ecosystem phenomenon.

The Multimodalities-Extextualization Cycle (MEC) as a curriculum genre for CLIL

As discussed above, the translanguaging and multimodal approaches are innovative for CLIL classroom practices. In this study, we shall discuss how teachers can design spaces for translanguaging and trans-semiotizing and spaces for target language/register use in the different stages of a curriculum genre (Rothery, 1996). The MEC (Lin 2015b, 2016) has been proposed as a heuristic curriculum genre to achieve this aim. The MEC has three stages (Figure 1): first, create a rich experiential context; second, engage students in reading and note-making; and third, engage students in entextualizing the experience.
In the MEC, while Stages 1 and 2 allow for the uninterrupted flow of meaning-making and pedagogical support through translanguageing and trans-semiotizing, the third stage allows students to have a space to practise, orienting their meaning making towards the discourse and cultural patterns required by the school and academia for successful participation in future assessment tasks and for expanding their communicative repertoires (Lin, 2012). In this stage, scaffolding needs to be provided (e.g. useful vocabulary, sentence patterns, writing/speaking starters). The MEC in principle can be reiterated without an end-point to emphasize the equal importance of all the multiple linguistic and multimodal resources. Hence, the MEC is proposed as an innovative tool for CLIL educators to think about how to design systematic scaffolding in content-based language education and CLIL classrooms.
Method

This research was part of a school-university partnership QEF Project funded by the Education Bureau of the Hong Kong government. The research project aimed at building up the CLIL capacity of teachers and addressing learner diversity in multicultural and multilingual EMI science classrooms. The project lasted for 18 months and the researchers provided CLIL curriculum development support for the teachers who taught ethnic minority students of South Asian community backgrounds in the school. Ethical approval by school principal, teachers, students and parents had been obtained with informed consent forms signed before the project started. The current research report focuses on the data collected in the second half of the project and aims to address two research questions:

1. How did the teacher and students make meaning through translanguaging and multimodal activities in the CLIL science classroom?

2. How did the teacher create spaces of translanguaging and trans-semiotizing and spaces for academic language development through a MEC-based curriculum genre?

Research site and participants

Due to teacher and learner diversity, the collaborative school was characteristised by its multicultural and multilingual background. It enrolled both the local Cantonese-speaking students and students from ethnic minority families from South Asian countries; e.g., Pakistan, India and Nepal. The Cantonese-speaking students were streamed into Chinese-Medium-Instruction (CMI) classes while the South Asian students were streamed into EMI ones. The teaching staff consisted of local bilingual Cantonese-English speaking teachers, native English-speaking teachers and South Asian teachers who spoke English and Urdu, Hindi or Nepalese. Although both English and Cantonese were the working languages at the school, the languages of the South Asian communities
could also be heard especially in the multilingual EMI classes. As the Hong Kong government implements the “bilingual and tri-lingualism” language policy, a Putonghua course was also available in the schedule which not only provided an opportunity for students to learn a new spoken language, but also allowed the South Asian students to learn some traditional Chinese characters (繁體字) which constitute one of the official written languages in Hong Kong.

Ms Wan (pseudonym) was a Cantonese-speaking teacher with three years’ teaching experience. She taught biology, integrated science (IS) and integrated humanity subjects for both CMI and EMI classes in the school. The teacher was keen on improving her students’ English academic literacy. During the collaboration, she was studying in a CLIL MEd Programme in a local university. Ms Wan was fluent in both Cantonese and English, but she did not know the South Asian students’ first languages. She had developed a friendly relationship with the students and tried to learn some basic Urdu words from the students so that she could use them to attract the students’ attention during the lessons. The student participants were in a S3 (Secondary 3 / Year 9) EMI class consisting of 14 girls from Pakistani and Indian families. Although the students all spoke Urdu, few of them knew how to read or write the language. Their proficiency of English and Cantonese showed a huge diversity. Some students had relatively better English proficiency as they went to EMI primary schools. Others were born in Hong Kong and had acquired some Cantonese through daily exposure to the local Cantonese community; however, their English proficiency could be weak as not all of them studied in an EMI primary school and the English proficiency of their parents was generally low. There were still some students who had just immigrated to Hong Kong and knew little English, Chinese or Cantonese. The linguistic diversity had increased the teaching and learning challenges in the CLIL classes.

**Procedure and Materials**
During the project, the researcher (first author) was stationed at the collaborative school as a teaching consultant and co-developed CLIL materials with the participating teachers for the EMI science classes. The data for this article were based on the collaboration with Ms Wan in her S3 IS lessons. During the collaboration, the researcher provided Ms Wan with the lesson analysis and teaching resources of the unit to be taught. Ms Wan was able to understand the content and language objectives of the lesson design, and would provide feedback on the teaching materials. She would also share with the researcher her own plans about how to incorporate the materials into the lessons so that the CLIL lessons were implemented based on the materials and pedagogy co-developed by Ms Wan and the researcher.

The data collection was carried out when Ms Wan was teaching the circulatory system unit. The teaching of the whole unit lasted for six weeks during which the researcher observed and took videos of the classes including four lessons in the classroom and two experiments in the lab. As the teacher and the researcher had tried out their collaboration in the previous unit, both Ms Wan and the students had got used to the co-developed curriculum and lesson observation by the researcher, and they did not pay much attention to the camera during the lessons. The data collected in this study included three sources: first, six lesson observation videos, each recording a 70-minute double-period lesson; second, the teaching and learning materials as well as samples of student work; and third, a 92-minute semi-structured interview with Ms Wan and a 53-minute focus group interview with the students at the end of the project. The data collected were analysed in two rounds: First, initial data analysis was made following an inductive coding method (Miles & Huberman, 1994); the unclear scenarios were identified and then clarified by the teacher and students during the follow-up interviews; for example, the Urdu phrases mentioned by Ms Wan were explained by the teacher and translated by the students. Second, the researchers conducted fine-grained multimodal analysis of the data collected based on both the translanguaging and multimodal approaches to meaning making.
(Danielsson, 2016; Lemke, 2016; Lin, Wu & Lemke, 2019) and the MEC (Lin, 2015b; 2016), with foci on the processes of translanguaging (Garcí & Li, 2014), trans-semiotizing (Lin, 2015a) and trans-registering (Lin, Wu & Lemke, 2019) during teacher-student interactions at different stages of the MEC.

Results

In this section, we shall introduce the results of the research by first presenting a detailed analysis of the beginning sections of the first lesson of the collaborative unit to illustrate the translanguaging and multimodal meaning making through interactions between Ms Wan and the students. We shall then analyse the revision lesson to illustrate how spaces for academic literacy development were created in the CLIL classroom based on the MEC (Lin, 2015b; 2016).

In the first lesson on the circulatory system, Ms Wan intended to make an overall introduction about the key components of the unit, and then went on to teach the first component “blood”. As shown in Figure 2, the teacher prepared a worksheet which consisted of the relevant concepts and interrelationships to be taught in the early stages of the first lesson.
**Introduction to the circulatory system**

The circulatory system unit was composed of three main sections: “blood”, “blood vessels” and “heart”. As the technical term “circulatory system” may sound unfamiliar to the students, Ms Wan provided a diagram on the worksheet (Figure 3) with which she intended to help the students to build up the schemata of the unit through guiding them to identify the components in the diagram and label them accordingly.
Ms Wan started the lesson by writing the title “Circulatory System” on the blackboard. At the beginning of the lesson, as the students were very excited talking in Urdu and English, Ms Wan tried to calm them down by uttering a few sounds like “Choop” and “Shuno” which she learned from the students, meaning “Silence” and “Listen to me” respectively in their Urdu language. Since the key word “circulatory” is a technical term which is unfamiliar to the students, Ms Wan reminded them of its location in the textbook and also tried to paraphrase the root word “circulate” by an everyday expression “going round and round”, with an accompanying gesture by her index finger drawing circles in the air, which a student further interpreted as “in a circle”. Although students might have heard about “blood”, “blood vessel” and “heart”, they might not understand the scientific meanings of the terms. Ms Wan thus used city transportation as a metaphor to explain the features and functions of the circulatory system.

Excerpt 1: “Yes, you can imagine it, like in a city.”

T: Today we’ll start a new system.

Ss: Circulatory system.

[The teacher wrote the topic “Circulatory System” on the blackboard and then started booting the computer. The students were chatting excitedly in both English and Urdu, their first language (L1).]

T: All right. Choo::p. [A word sounds like the Urdu word meaning “Silence”] So, for circulatory system, this word
itself means circulation. Circulation means, all right, page 57. So “circulate” means, things go...[
*talking with her right index finger drawing circles in the air*]

[Students kept on chatting in both English and their L1 which made the classroom noisy.]

T: Shu::no. [The teacher changed to an Urdu word (meaning “Listen”) to attract students’ attention.] Well, you talk and I talk. We can’t listen to each other. All right, it means, things are going round and round.

S1: In a circle.

T: Yeah. [Teacher distributed the worksheets to students]

T: There are three parts in our circulatory system. So we need to bring things round and round

S1: Round and round?

T: Yes. So the first thing is *like*, if you got a city, you want people to go round the city, so at least you need some roads.

S2: Circulatory road.

T: [Turning to the blackboard and started to write] Yeah. For us, in our body we don’t have those kinds of circulatory roads. We don’t call it roads.

S3: We have the vessels.

T: Yeah we call it “vessels” [writing “blood vessels” on the blackboard while speaking]

S4: Vessels.

T: All right. Which looks like the roads [Adding “(roads)” on the blackboard after “blood vessels”] Okay. Even though you got roads, people may not be able to go round. They still need cars, buses...

S2: Blood.

T: [Went on writing on the blackboard “blood (cars)”] Yes. In our circulatory system, it means the blood, which is like the cars.

S5: Public cars or private.

T: Yes. It can be public, it can be private.
S2: How do we know these are public cars?

T: Hmm, in our body, we got different types of blood cells. Just like we got different kinds of cars in a road.

S3: Red blood cells and white blood cells.

S4: Mercedes, Ferrari.

S6: BMW.

T: Well I mean bus and mini bus.

S7: Lamborghini.

T: All right. We’re talking about the blood. And the last one... [Turning to the blackboard and writing “heart’] is the heart. So this kind of cars in your body are very...

S4: Wheels.

T: Lazy. They don’t go by themselves.

S3: They just...

T: They need a pump [went on writing “(pump) ” behind “heart”] to push them round.

S4: Petrol, petrol.

T: Kind of. Yeah.

S2: Traffic light.

T: A pump that gives it energy to go. Okay? So today we’ll start with the blood first. We’ll start with the blood first, and then blood vessels.

S8: [Pointing at the blackboard writing] So the cars are like the blood in the circulatory system?

T: [Pointing to the words on the blackboard ] Yes, you can imagine it, like in a city.

The metaphoric example seemed to have effectively engaged the students who started to join in the teacher’s narrative about the components of the circulatory system by curiously guessing and raising questions following the teacher’s talk. The students were able to label the concepts in the
diagram correctly. Some of them (Figure 3) even copied the metaphors “car”, “road” and “pump” beside the corresponding concepts to remind themselves of the characteristics of the key components in the circulatory system.

**Blood**

The second part of the lesson was about “blood”. The knowledge points included the composition of blood, the characteristics of different types of blood cells, and the identification of blood cells according to their features. Ms Wan designed multimodal exercises with a graphic organizer, a table and a microphotograph to represent the concepts and their inter-connections. To visualize the abstract concepts, she played a video about “the components of blood”. As the presenter in the video demonstrated the four components of blood -- red blood cells, white blood cells, platelets and plasma, by using red play-doh, white play-doh, irregularly shaped cardboard pieces and a glass of yellowish water respectively, the vivid representations helped students to complete the graphic organizer easily. Many students not only fill in the blanks with words but also use color pens to note and draw beside the concepts the corresponding features they captured from the video description (Figure 4).

![Graphic organizer](image)

*Figure 4.* Graphic organizer sorting out components of blood on a student’s worksheet.
However, although the video provided some relevant information about the lesson, during the worksheet exercises, Ms Wan needed to help students to clarify their understanding of some concepts, guided them to think about the causes of some phenomena, and answered students’ questions that are relevant to the theme--components of blood. For example, Ms Wan reminded students that using white play-doh as an example to illustrate white blood cells in the video could be misleading as white blood cells are not “white” but “colourless”. Similarly, when the students quoted the metaphor “donut” from the video to describe the shape of a red blood cell, Ms Wen suggested a more scientific technical term “biconcave” and she elaborated on the shape by drawing a cross-sectional view of biconcave on a worksheet projected on the screen. To help the students understand the technical word, she reminded students of the prefix, “bi- means two, like bicycle”. She then used both her hands to make a quick “going down” action, and with the gesture she translated the term into a colloquial Cantonese word “凹咗”; then pointing to her drawing on the worksheet she added a description, “That means, in the middle part, it’s thinner.” To guide the students to explore the function of this special characteristic of the shape, Ms Wan raised a question, “Why does it need to be thinner?”

![Figure 5. Blackboard sketches about the biconcave shape of a red blood cell.](image)

The teacher then drew sketches of a flat oval-shape and a biconcave on the blackboard (Figure 5).
5. By guiding students to compare the surface areas of the two shapes, Ms Wan explained to them that more oxygen can be carried along if red blood cells have a larger surface area—a biconcave shape. These blackboard sketches of the biconcave shape were once again referred to after several minutes when the teacher and the students discussed the identification of different types of blood cells in a microphotograph. Ms Wan drew an “eye” above the “biconcave (red blood cell)” and some arrows below the shape to show the direction of light in an electron microscope. She told students that due to the thinner of the middle, more lights can go through this part so the observer may find the red blood cell lighter in the centre while darker in the parts around. In a student’s worksheet (Figure 6), the teacher’s explanation about the special features and functions of the biconcave shape of red blood cell was noted down at the margin of the worksheet with arrows linking the notes with the corresponding concepts in the table or the photo. The student also copied the Chinese translation of the “biconcave disc” (雙凹圓盆) and “blood clot” (血凝塊) from the textbook to amplify the meaning of the concepts to facilitate comprehension and memorization.
During the lesson, students were intrigued by the different scientific phenomena being discussed and they tried to raise different questions even though some of them could not even complete the sentence of a question due to the lack of corresponding vocabulary in either English or Cantonese. For example, one student seemed to be curious about those people who have problem in blood clotting. She tried to ask the question but could not finish her sentence after several attempts. This confused Ms Wan as she did not understand what the student wanted to know. At this moment, the student and her peers resorted to their first language and gradually co-constructed the question. One of the students whose English proficiency was higher helped her to rephrase the question in English so that Ms Wan was able to understand what they wanted to know and explained the phenomenon. Another student was interested in how blood can be separated into different types of blood cells. To explain the phenomenon, Ms Wan elaborated on the separation of blood cells from the plasma by centrifugation. She used a pen to represent a test-tube with blood and then swirled the “test-tube with blood” in the air quickly to illustrate the rapid spinning of the “test-tube” in a centrifuge. Then she pointed to the upper and lower parts of the “test-tube” to show the separated plasma and blood cells respectively. After the demonstration, Ms Wen showed the students the pictures in the textbook about centrifugation so that they may have clearer images of the centrifuge and centrifuged blood sample (Figure 7).
The discussion on blood and blood cells further reminded the students of other relevant topics such as blood transfusion at the Red Cross, the previous blood donation of one student in the class, Ms Wan’s practicum in a lab, and an interesting question “whether DNA will be affected if one receives a blood transfusion?”--the same question which Ms Wan had asked her teacher when she was in secondary school. The lesson thus went on with interweaving of discussion about the worksheet exercises and the teacher’s answers to the questions raised by students spontaneously.

Revision

After four lessons of knowledge construction through translanguaging and trans-semiotizing as well as observations and hands-on practices in experiments, Ms Wan decided to draw students’ attention to the development of academic language use. However, since the science textbook only consisted of truncated passages that are fragmented with diagrams, tables, activities, and lab reports scattered here and there, teachers seldom referred to the texts and students did not want to read them. After discussing with the researcher, Ms Wan decided to adapt the passages in the textbook and developed a set of genre-based (Rose & Martin, 2012) reading handouts. Figure 8 shows a section of the handouts about the introduction of the circulatory system and the components of “blood”.
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Figure 8. A section of the reading handouts for revision of the circulatory system unit.

In the reading handouts adapted from the textbook, there were texts which were more coherent with clear genre structure, academic sentence patterns and academic vocabulary such as subject-specific words, general academic words and logical connectors which were highlighted with bold, italics and underlines to illustrate the different language features. In the handout for teachers, there were guiding questions designed according to the sentence patterns of different academic functions in the paragraphs so that the teacher may guide students to focus on functions such as defining, describing, classifying, exemplifying, etc. These various sentence patterns of academic functions and their corresponding examples in the text were further presented in PowerPoint slides (Figure 9) which Ms Wan explained to the students to raise their academic language awareness.
During the revision lesson, Ms Wan drew students’ attention to the different academic functions and their examples in the adapted text handouts. She then used the first paragraph of the handout; that is, the introduction about the circulatory system, as an example to demonstrate how to ask questions according to the academic functions of the sentence patterns in the paragraph. After students were able to identify the different academic functions and their corresponding sentence patterns, Ms Wan grouped the students and encouraged group members to ask each other questions according to the academic functions they could identify in different paragraphs in the reading handouts. Grounded in the handout, students read carefully, using markers to highlight the different academic functions and the relevant sentence patterns, and then started to ask each other questions in groups (Figure 10). Since students’ English language proficiency and academic literacy varied largely among the class, those who were able to understand the text better helped their peers to unpack the meaning of the texts. They then repacked the information to answer the questions with the help of the sentence-making tables provided in the handouts. During the collaborative reading activity, Ms Wan allowed the more capable peers to explain the text to their less capable peers in
their first language, and then provided feedback and language prompts to help the students to express the sentences in English. According to the students in the interview, they found the reading handouts useful and used them for self-directed learning after class. In the last lesson, the students had a quiz about the unit which consisted of a puzzle word game about the key concepts and four short-answer questions about the circulatory system. The results of the papers indicated that students were able to write longer sentences and more logical answers to the open-ended questions compared with their previous quizzes.

**Discussion**

In this section, we shall discuss the results of the current study by focusing on meaning making by translanguaging and multimodal activities in the multilingual science classroom, the spaces of translanguaging and trans-semiotizing as well as the spaces for academic language development in the MEC-based curriculum genre.

**Meaning making through translanguaging and multimodal activities in CLIL classroom**

As Figure 2 shows, during the discussion of the worksheet exercises in the first lesson, meaning making was realised via multimodal activities (Danielsson, 2016; Lemke, 1998). For example, the introduction of the circulatory system, which was a labeling diagram exercise on the worksheet, was carried out through teacher-student interactions during which metaphoric language was used to describe similar structural characteristics between a city transportation system and a human circulatory system. The components of blood and their corresponding features, which were represented by a graphic organizer indicating classification of blood components and a table comparing the colour, shape and function of different blood cells, were demonstrated through a video accompanied by the teacher’s verbal elaboration and sketches on the blackboard. The identification
of different blood cells displayed on a microphotograph was clarified by the teacher’s drawing on the worksheet, gestures, together with verbal comparison of sketches on the blackboard. The different modes interplayed to facilitate meaning making during knowledge construction. As Danielsson (2016) pointed out, each mode (e.g., word, image and action) representing a concept has its special “meaning potential”; that is, the “affordance” that may convey a certain aspect of the conceptual meaning. For instance, visual images such as the diagram of the circulatory system provided information about the positions of the heart and vessels as well as their intertwining relations; while the arrows below the biconcave shape in the sketch on the blackboard also indicated the directions of light in a microscope. Gestures such as Ms Wan’s finger circling in the air to show “circulate” and “going round and round”, and her gesture of swirling the pen rapidly to illustrate the spinning of a centrifuge both added dynamic features to the meaning of the concepts. On the other hand, the verbal explanation and exemplification by the teacher’s spoken language and written notes in the worksheet helped to clarify the abstract meaning or even correct misleading concepts (e.g., ‘White blood cell is not white but colourless’) which are unobservable and cannot be shown by either the visual or gestural modes (Kress, et al. 2001). The shifting between multiple modes during knowledge building did not just repeat the same meaning of the concepts, but multiply and amplify their meaning (Lemke, 1998) by highlighting the different characteristics and complexities in the concepts. The orchestration of different modes to elaborate on the same concept also helped to make meaning more dynamic and impressive. For example, during the discussion of the shape of red blood cells, the teacher’s verbal description served as the background when she drew a biconcave shape on the worksheet projected on the screen, which became the foreground; that is, something attracting the audience’s attention. However, when she gestured the “going down” action with her hands and simultaneously uttered the Cantonese words “凹咗”, her drawing on the worksheet was backgrounded while the gesture and the verbal explanation became foregrounded (Kress, et al. 2001).
Such dynamic foregrounding and backgrounding interplayed to facilitate comprehension and consolidation of the meaning of the abstract concepts during the science lesson.

Observation of the lesson shows that, the presentation and discussion of concepts at different stages of the lesson was guided by designed scaffolding--the multimodal worksheet, and then implemented through spontaneous scaffolding (Gibbons, 2009; Lin, 2016). These include the interactions between the teacher and students in *flows* of translanguaging (Lemke, 2016; 2018; Lin, Wu & Lemke, 2019) and trans-semiotizing (Lin, 2015a; 2019), interweaving sounds (spoken English, Urdu and Cantonese), acts (speaking, drawing and writing on worksheets and blackboard), artefacts (worksheet, textbook and realia), meaning (mutual communication of concepts) and feeling (e.g., imagination of dizziness in the loss of blood) into *spaces* (Lin, Wu & Lemke, 2019) of information that connected events of now (blood and blood cells being discussed) and then (a student’s blood donation experience and the teacher’s experiment about blood in her previous practicum), here (discussion about blood cells in the classroom) and there (blood transfusion at Red Cross), concrete (city transportation system) and abstract (human circulatory system), colloquial (donut) and academic (biconcave) through verbal (i.e., spoken languages such as English, Urdu and Cantonese; and written texts such as the textbook and the student’s English and Chinese notes on the worksheets), visual (i.e., videos, diagrams, graphic organizers, tables, photos, drawings and sketches, etc.) and actional (hand gestures, body movements and facial expressions) modes which interplayed seamlessly to expand the socially shared communicative repertoire (Lin, 2012; He, Lai & Lin, 2017), hence effectively facilitating meaning co-making in ongoing inquiry of the science knowledge.

**Creation of spaces of translanguaging and trans-semiotizing and spaces for academic language/register use in MEC**

An overview of the six lessons in the circulatory system unit (Table 1) shows not only the
various spaces of translanguaging and trans-semiotizing but also spaces for academic language development. While there seemed to be no fixed patterns within each specific space with seamless shifting between different modes and dynamic *flows* of translanguaging and trans-semiotizing across timescales and socio-ecological systems, the different lessons seemed to follow the stages of the MEC (Lin, 2015b; 2016) as a curriculum genre; namely, using multimodality to engage students in comprehension and discussion of the concepts about the content subject so that they were able to build up the thematic patterns (Lemke, 1990) of the unit; that is, the interconnected structures of semantic relationships between different thematic items, or concepts in the subjects. Then the teacher guided students to deconstruct texts and take notes to raise their awareness of academic language features by guiding them to identify the language features such as text-type structure, sentence patterns and functions, and academic vocabulary. For example, the first four lessons in the unit mainly focused on the presentation and practice of the basic content knowledge; for each lesson, students had rich experiential opportunities (e.g., video, images, experiments and games, etc.) to discuss and explore the relevant knowledge on the topic; and then had hands-on workbook exercises which involved some reading (e.g., decoding questions and identifying question prompts) and writing (e.g., answering questions in complete and grammatical sentences) exercises which help students to develop their academic literacy. By doing so, the teacher followed the MEC in each of her lesson so that the cycle of three stages reiterated in different lessons. Then after the key conceptual knowledge of the whole unit had been taught, in the fifth lesson Ms Wan guided students to have a general revision. She provided the students with adapted texts to demonstrate the useful language features so that they had an opportunity to reflect on the integration of academic language and content learning through guided reading and collaborative learning with peers. In the last lesson, the teacher assigned a quiz for students which consisted of a few open ended short-answer questions. This is a stage-three practice according to MEC which guides the students to entextualize their leaning experiences into
formal academic texts. These reiterating cycles of the MEC reflected Lemke’s (1990) proposals for content-based instruction: “…Reasoning is combing the use of thematic pattern with the use of a rhetorical or genre structure pattern. One supplies the content, the other supplies the form of organization of the argument” (p. 122-123) and “Students will begin to grasp semantic and conceptual relations in colloquial language first. Then they will substitute scientific, technical terms for colloquial words” (p. 173). Namely, in multilingual classroom, teachers can allow students to make good use of their prior experiences, home culture and familiar languages to facilitate comprehension of the content subject (Cummins, 2015). Apart from content knowledge development, the teacher may also help students to foster the development of academic language awareness from first using colloquial everyday registers (e.g., “like a donut”) to gradually shifting to technical and professional academic discourse (e.g., “a biconcave shape”).

Table 1

*Translanguaging and Multimodal activities in Multimodalities-Entextualization Cycle (MEC)*

<table>
<thead>
<tr>
<th>Lessons</th>
<th>Multimodal Activities</th>
<th>Modes &amp; Multimedia</th>
<th>TL-TS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 1 Blood and Blood vessels</td>
<td>-T-Ss interaction -video watching -worksheet blank filling -workbook exercise</td>
<td>-textbook, worksheet, workbook, -video, diagram, table, photo, blackboard sketches, -gestures</td>
<td>TL: English; Urdu; Cantonese; Traditional written Chinese</td>
</tr>
<tr>
<td>Lesson 2 Revision &amp; Experiment</td>
<td>-Introduction of experiment apparatus and procedure -Experiment 1: observing blood vessels -worksheet exercise</td>
<td>-textbook, worksheet, workbook, -experiment materials and apparatus, -blackboard sketches, -gestures</td>
<td>TL: English and Urdu</td>
</tr>
<tr>
<td>Lesson 3 Heart</td>
<td>-T-Ss interaction -observing/feeling organ models -worksheet blank filling -using teaching realia to imitate the blood flow direction and movement -workbook exercise</td>
<td>-textbook, worksheet, workbook, -diagrams, pictures -teaching realia, model of organs in human body</td>
<td>TL: English and Urdu</td>
</tr>
</tbody>
</table>
Conclusion

In this study, we analysed Ms Wan’s CLIL lessons which provided practical examples of multilingual and multicultural CLIL classroom practices. From the students’ active engagement; for example, their meaningful questions and co-construction of knowledge with the teacher as well as their worksheet notes and improved assignments, it can be seen that the science lessons about the circulatory system were effective. This did not seem to have been affected by the linguistic, cognitive or cultural diversity, as the teacher and students were not fettered by the “English only” rule of many traditional EMI classrooms; rather, the students were allowed to flexibly translanguage between English as the target language, Urdu as their first language and Cantonese as the most widely used language in the city. The different semiotic resources also allowed them to make meaning through translanguageing and trans-semiotizing in flows which started from the teacher to some students who co-constructed their information both in their mind (interpreting conceptual meaning), languages (spoken and written English, spoken Urdu, Cantonese and traditional written Chinese), gestures (trying to express ideas by gestures when lacking the vocabulary to express themselves) and physical
artefacts (their worksheet notes showing traces of the teacher’s verbal explanations, sketches, drawing and words on the blackboard or the screen). And then through group work, these different sources of information were entrained further into the flow of meaning co-making among the peers in the learning community of the CLIL classroom (Lemke, 2016; Lin, Wu & Lemke, 2019). What was discussed in the science lesson may not only transcend the boundary of languages but also connect different time-scales (e.g., a student’s blood donation before), physical environment (e.g., blood transfusion in Red Cross), or textbook content (e.g., the relationship between blood and DNA which will not be taught until Secondary 5). In this sense, meaning making in Ms Wan’s multilingual CLIL classroom broke the limits and transcended the boundaries (Li & Lin, 2019) of traditional monolingual classrooms. The translanguaging and multimodal practices based on the MEC curriculum genre provided an example of lesson design to tackle the pedagogical challenges—planning and delivering content-and-language-integrated lessons, which confront CLIL teachers, especially pre-service teachers (He & Lin, 2018; Lo, 2020). Seeing that the diverse cultural and linguistic resources of Ms Wan’s CLIL classroom had actually enriched the communicative repertoire shared by both the teacher and the South Asian minoritized students, and the learner diversity in the school may turn out to be beneficial rather than hindering students’ content and language development, we propose that future CLIL programmes should change from a “Deficit-based Model” of teaching to an “Asset-Based Model” of teaching, mobilizing the multilingual and multimodal resources in the classroom with the MEC as a heuristic tool for planning CLIL lessons (Lin, 2020).

Notes

1. QEF Project. This paper is based on data from a Quality Education Fund (QEF) project funded by the Hong Kong Education Bureau (Project #EDB/QEF/2012/0483) awarded to Angel M. Y. Lin.
2. All names of teacher and students are pseudonyms in this article.

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