INTEGRATING CONTENT AND LANGUAGE LEARNING IN EMI EDUCATION
---EXPLORING "THEMATIC PATTERNS" AS PEDAGOGICAL STRATEGIES

The University of Hong Kong

Prof. Angel M. Y. LIN
angellin_2018@sfu.ca

Dr. Peichang HE
hepc1@hku.hk

Research and Development Project Dissemination Conference of SCOLAR
May 9th, 2019 Hong Kong Science Park, Sha Tin, Hong Kong
Overview

• Background
• Literature review
• Methodology
• Results
• Discussion
• Limitation
• Implication
Unfavourable conditions in English as the Medium of Instruction (EMI) schools in Hong Kong (Lin & Man, 2009)

- inadequate English skills of the students
- lack of language support
- lack of professional development opportunities for teachers
- lack of Language-Across-the-Curriculum (LAC) co-ordination
- unsuccessful Bridging Courses
Exam culture & Rote-learning

“The students are really well-motivated and self-disciplined”
(“自覺讀（背）書”).

“Once I get the (Science) notes, I'll recite all of them, the more words the better, I'll treat them as if I am learning Chinese History...”
“Foreign Language”: content subjects taught in English as an additional language (EAL)

“Foreign Language”: the challenges from academic subject literacy

• Learning science is virtually learning a “foreign language” (Wellington & Osborne, 2001)
• Foreign language “squared” (Lin, 2016)
Content and Language Integrated Learning (CLIL) in EMI education

To help students to learn the (science) subjects in a meaningful way by enhancing both their academic content awareness and academic language awareness.
CLIL

• Content and Language Integrated Learning (CLIL) is an educational approach where students learn non-language content subjects through a second/foreign/additional language (Coyle, Hood & Marsh, 2010).

• Previous CLIL studies have mainly focused on its various definitions, language and content learning outcomes as well as pedagogical issues (Cenoz, Genesee, & Gorter, 2013; Dalton-Puffer & Nikula, 2014; Lin, 2016; Llinares & Lyster, 2014).

• Recent studies start to investigate CLIL teacher education (Cammarata & Ó Ceallaigh, 2018)
  - CLIL teachers’ knowledge about language (Morton, 2018)
  - CLIL teacher professional identities (Dale, Oostdam & Verspoor, 2018)
  - CLIL teacher language awareness (He & Lin, 2018)
Research Gap

While there is no denying that CLIL involves the teaching of both content and language, it remains a challenge to achieve pedagogical integration of content and language in CLIL classrooms (Dalton-Puffer, 2018; Lin, 2016; Ruiz de Zarobe, 2016).
Concept instruction and language

Concepts are fundamental in all content subjects, but they are difficult to learn because of their abstractness and complexity.

Traditional (science) pedagogy privileges the notion of “concepts” but neglects the role played by language.
Concept mapping

• Concepts are “perceived regularities or patterns in events or objects, or records of events or objects, designated by a label” (Novak, et al., 1983, p. 625).

• Novak developed the idea of “cognitive maps” or “concept maps” (Novak et al., 1983). Although concept mapping is believed to facilitate meaningful learning by constructing a spatial and visual representation of interconnected concepts and the hierarchical structure of conceptual knowledge in the human mind, concept maps which “strip away all text except for concept labels” may lead to the “lack of clarity for most people” (Novak, 2010, p. 32).
The *mentalistic representations* of concepts “lack the necessary vocabulary” (Lemke, 1998) to inform teachers how they should guide their students to learn and apply the concepts correctly.

*Concepts* are mediated by *thematic patterns*. What science teachers typically do in the classroom is in fact exposing students repeatedly to the ‘*thematic patterns*’ (Lemke, 1990).

**Thematic-pattern-based Concept + Language Mapping**
The theory of “thematic patterns”

“The pattern of connections among the meanings of words in a particular field of science I will call their thematic pattern. It is a pattern of semantic relationships that describes the thematic content, the science content, of a particular topic area. It is like a network of relationships among the scientific concepts in a field, but described semantically, in terms of how language is used in that field” (Lemke, 1990, p.12).

“Talking science is not the totality of doing science. But very little science gets done, or could get done, without the semantic resources of language, and particularly the thematic patterns and genre structures specific to science”…

...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).
Thematic patterns, semantic relations and thematic items (Lemke, 1990)

Thematic pattern is a pattern of semantic relationships that describes the thematic content of a particular content area.

Semantic relationships refer to the relations between the thematic items are key terms or concept words when they are used together in talking about a particular topic.

Describe how the meanings of two thematic items are related include:

- **Nominal relations** e.g. attributive, classifier, quantifier, etc.
- **Taxonomic relations** e.g. token, hyponym, meronym, synonym, antonym, etc.
- **Transitivity relations** e.g. agent, target, medium, beneficiary, range, identification, possession, etc.
- **Circumstantial relations** e.g. location, time, material, manner, reason, etc.
- **Logical relations** e.g. elaboration, addition variation, connection, etc.

and other relations, etc.
<table>
<thead>
<tr>
<th>Global thematic strategies (Lemke, 1990, p.227)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Repetition with variation</strong></td>
</tr>
<tr>
<td>“One or more repeats of the same partial thematic pattern, each with some items and relations similarly expressed and other differently expressed. Enables abstraction of pattern and flexible expression.”</td>
</tr>
<tr>
<td><strong>Condensation</strong></td>
</tr>
<tr>
<td>“Assigning a pattern of thematic items and their semantic relationships to a single new thematic item, that is, naming or designating the pattern. Condensations are then more easily connected to other themes.”</td>
</tr>
<tr>
<td><strong>Thematic nexus</strong></td>
</tr>
<tr>
<td>“The bringing together of themes expressed in different parts of the lesson or text into a single structural unit; a synthesis.”</td>
</tr>
<tr>
<td><strong>Theme-weaving (cohesive harmony)</strong></td>
</tr>
<tr>
<td>“Establishing patterns of thematic interconnection by introducing thematic items and relations and bring them together in different combinations across the lesson or text; usually leads to one culminative or through more than one intermediate thematic nexus.”</td>
</tr>
<tr>
<td><strong>Intertextual allusion</strong></td>
</tr>
<tr>
<td>“Establishing thematic relationships by implicitly or explicitly invoking a thematic pattern which is not explicitly expressed in the lesson or text, but which is known to the participants or can be located in some other text or occasion of discourse.”</td>
</tr>
</tbody>
</table>

This PPT handout is designed by Prof Angel Lin and Dr Peichang He. Please do not circulate without the authors' consent.
A. Photosynthesis

Through eating, we obtain energy for carrying out various body activities. However, plants do not eat like us. How do green plants get their energy for growth?

Green plants can make their own food. They take in carbon dioxide and water from the surroundings and build them into food using light energy. The light energy is absorbed by a green pigment called chlorophyll inside the chloroplasts in green plant cells. The food produced is usually starch. Oxygen is also produced as a by-product during the process (Fig. 7.8).

This process of making food in green plants is called photosynthesis. It can be summarized by the word equation below:

\[ \text{light energy} \rightarrow \text{carbon dioxide} + \text{water} \rightarrow \text{chlorophyll} \rightarrow \text{food} (\text{starch}) + \text{oxygen} \]

A. The process of photosynthesis

Green plants make their own food by photosynthesis. It is a complicated process. Below are four main aspects of photosynthesis:

1. Raw materials: The raw materials are carbon dioxide and water. Carbon dioxide is obtained from the air. Water is obtained from the soil.
2. Energy source: Light energy is required in the process. It is absorbed by chlorophyll in the green leaves and other green parts of the plants.
3. Product: The food produced is usually stored in starch. The chemical energy stored in the food is converted from the light energy absorbed by chlorophyll.
4. By-product: Oxygen is also produced and is released into the air.

To summarize, green plants absorb light energy by chlorophyll to produce food from carbon dioxide and water. Oxygen is formed as a by-product. The process of photosynthesis can be represented by the word equation below:

\[ \text{carbon dioxide} + \text{water} \rightarrow \text{light energy} \rightarrow \text{chlorophyll} \rightarrow \text{food} (\text{starch}) + \text{oxygen} \]

Q&A

Q: How does a plant use the food produced during photosynthesis?
A: The food is used to provide energy for growth and is changed into starch and oil for storage. It can also be changed into proteins and chlorophyll.

Teaching notes
- During photosynthesis, glucose is produced first, and then it is changed to starch for storage.
- Besides carbon dioxide and water, minerals are also required for plant growth.

The following is a simplified equation representing the process of photosynthesis:

\[ \text{carbon dioxide} + \text{water} \rightarrow \text{light energy} \rightarrow \text{chlorophyll} \rightarrow \text{starch} + \text{oxygen} \]
Thematic pattern, condensation, thematic nexus and theme-weaving

**Photosynthesis** (光合作用) is the process by which green plants make food from carbon dioxide and water using light energy.

The semantic relations in the definition “photosynthesis”

1. PHOTOSYNTHESIS is a PROCESS [Token / Type]

2. GREEN PLANTS make FOOD [Agent / Process / Target]
   - by PHOTOSYNTHESIS [Circumstance: manner]
   - from CARBON DIOXIDE and WATER [Circumstance: material]
   - using LIGHT ENERGY [Circumstance: condition]

An example of a thematic pattern

**Photosynthesis** is important [Carrier / Attribute]

**because**

[logical relation: Cause / Consequence]

it produces food (starch) and releases oxygen for all living things.

[Agent / Process / target] [logical relation: Item / Addition] [Process / target] [Circumstance: beneficiary]
Meaning making in the classroom: synergistic integration of semiotic resources

• “The ‘concepts’ of science are not verbal concepts...They are semiotic hybrids, simultaneously and essentially verbal-typological and mathematical-graphical-operational-topological” (Lemke, 1993).

• “The natural language of science is a synergistic integration of words, diagrams, pictures, graphs, maps, equations, tables, charts, and other forms of visual and mathematical expression” (Lemke, 1998).

• Learning from animated concept maps with concurrent audio narrations (Nesbit & Adesope, 2011)

• The importance of a consistent diagrammatic and verbal representation in communicating scientific ideas (Cheng & Gilbert 2015)
“…..the fundamental sense of literacy in science is the ability of an individual to construct meaning through interaction with the multiple forms of semiotic communication that are used within the discipline of science. Indeed, the five major communicative activities of science can be seen as writing science, talking sciences, reading science, “doing” science, and representing scientific ideas” (Osborne, 2014, p.591).

Four kinds of communicative approaches
(Mortimer & Scott, 2003, p.35-39)

<table>
<thead>
<tr>
<th></th>
<th>INTERACTIVE</th>
<th>NON-INTERACTIVE</th>
</tr>
</thead>
</table>
| DIALOGIC               | A  
Interactive/dialogic            | B  
Non-interactive/dialogic          |
| AUTHORITATIVE          | C  
Interactive/authoritative       | D  
Non-interactive/authoritative     |
Designed/Planned scaffolding vs Interactional/Spontaneous scaffolding (Gibbons, 2009; Lin, 2016)

**Designed/planned scaffolding:** the support teachers consciously plan in advance.

**Spontaneous/Interactional scaffolding:** the support teachers provide contingently through dialogue during instruction or other interaction.
Research Questions

1. Does the CLM approach facilitate development of both content knowledge and language knowledge in EMI classrooms?

2. How does the CLM approach affect the process of content and language knowledge development in EMI classrooms?
Research design

“Development Research” Framework
(Reeves, 2000)

- pre-intervention interviews with teachers probing teaching and learning challenges
- thematic-pattern-based CLM materials designed by the researchers and reviewed by teachers
- CLM materials tried out by participating teachers who decided on which materials to use and when to use them
- teachers and researchers co-reflected on the CLM pedagogy and improved it in an ongoing process

Concurrent triangulation mixed methods
(Creswell, 2003)

- naturalistic observation
- semi-structured interviews
- documents
- quasi-experimental design
## Summary of research sites and participants

<table>
<thead>
<tr>
<th>Schools</th>
<th>MOI</th>
<th>Banding</th>
<th>Grade</th>
<th>Subjects</th>
<th>No. of students</th>
<th>Included (Y/N)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>School 1</td>
<td>EMI</td>
<td>Band I</td>
<td>S1</td>
<td>Junior Geography</td>
<td>31</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EMI</td>
<td>Band I</td>
<td>S2</td>
<td>Integrated Science</td>
<td>29</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EMI</td>
<td>Band I</td>
<td>S2</td>
<td>Junior Geography</td>
<td>30</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EMI</td>
<td>Band I</td>
<td>S3</td>
<td>Biology</td>
<td>30</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EMI</td>
<td>Band I</td>
<td>S4</td>
<td>Senior Geography</td>
<td>20</td>
<td>N</td>
<td>There was only one class in S4 Geography. Control class was not available.</td>
</tr>
<tr>
<td></td>
<td>EMI</td>
<td>Band I</td>
<td>S4/5</td>
<td>Biology</td>
<td>28</td>
<td>Y</td>
<td>There was only one class in S4 Biology. The S4 (intervention class) and S5 (control class) Biology teachers taught the same topic during the intervention period.</td>
</tr>
<tr>
<td>School 2</td>
<td>EMI</td>
<td>Band III</td>
<td>S5</td>
<td>Biology</td>
<td>16</td>
<td>N</td>
<td>There was only one class in S4 Biology. Control class was not available.</td>
</tr>
<tr>
<td>School 3</td>
<td>CMI</td>
<td>Band III</td>
<td>S3</td>
<td>Integrated Science</td>
<td>19</td>
<td>N</td>
<td>This project focused on EMI classrooms.</td>
</tr>
<tr>
<td></td>
<td>CMI</td>
<td>Band III</td>
<td>S1</td>
<td>Integrated Science</td>
<td>19</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>School 4</td>
<td>CMI</td>
<td>Band III</td>
<td>S2</td>
<td>Integrated Humanity</td>
<td>31</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CMI</td>
<td>Band III</td>
<td>S1</td>
<td>Integrated Science</td>
<td>24</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>
### Details of participants

<table>
<thead>
<tr>
<th>MOI; grade; subject; number of students; subject teacher; number of lessons during intervention</th>
<th>Intervention Class</th>
<th>Control Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMI S1 (Grade 7) Junior Geography</td>
<td>N=31 Ms C 7 lessons</td>
<td>EMI S1 (Grade 7) Junior Geography</td>
</tr>
<tr>
<td>EMI S2 (Grade 8) Integrated Science</td>
<td>N=30 Mr H 7 lessons</td>
<td>EMI S2 (Grade 8) Integrated Science</td>
</tr>
<tr>
<td>EMI S2 (Grade 8) Junior Geography</td>
<td>N=29 Ms L 3 lessons</td>
<td>EMI S2 (Grade 8) Junior Geography</td>
</tr>
<tr>
<td>EMI S3 (Grade 9) Biology</td>
<td>N=30 Ms S 8 lessons</td>
<td>EMI S3 (Grade 9) Biology</td>
</tr>
<tr>
<td>EMI S4 (Grade 10) Biology</td>
<td>N=28 Ms T 8 lessons</td>
<td>EMI S5 (Grade 11) Biology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>L1 of students</th>
<th>Cantonese</th>
<th>Cantonese</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>English language proficiency</th>
<th>• above-average among same-grade students in the city</th>
<th>• above-average among same-grade students in the city</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Learning attitudes</th>
<th>• well motivated with good learning attitude</th>
<th>• well motivated with good learning attitude</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Teacher background</th>
<th>• The L1 of the participating teachers is Cantonese, but they are all qualified EMI teachers and are experienced in teaching the content subjects. • Mr H teaches both Integrated Science and English language subjects. • All teachers participated in the project for first time.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Pre-/post tests</th>
<th>taken on the same day</th>
</tr>
</thead>
</table>

| Teaching resources | tried out during intervention | not available |
Thematic-pattern-based "C+L Mapping" pedagogy

- "Concept + Language" teaching/learning materials
  - C+ L Cards
  - C + L Maps
  - C + L supporting materials:
    - *e.g.* sentence-making tables, experiment report template, essay writing guides, etc.

- "Concept + Language" teaching/learning activities
  - collaborative learning:
    - *e.g.* discussions, experiments, debates, games
  - self-directed learning:
    - *e.g.* completing worksheet, experiment report, home assignments, etc.
photosynthesis (光合作用): the process by which green plants make food from carbon dioxide and water using light energy

Language knowledge:
- photo-synthesis
- photo: "light"
- Synthesis (綜合體): “the combining of constituent elements (構成成分) of separate materials into a unified entity (統一的實體)”

Biology + Language knowledge:
- Photosynthesis is important because it produces food (starch) and releases oxygen for all living things.
- Green plants make their own food by photosynthesis.
- Chlorophyll, light, carbon dioxide and water are needed for photosynthesis during which Carbon dioxide and water are consumed while food (starch) and oxygen are produced.
- During photosynthesis, green plants convert light energy to chemical energy stored in the food produced.
- Photosynthesis is important in maintaining the balance of oxygen and carbon dioxide in the atmosphere.
CLM Scaffolding:
C+L Map

“Concept + Language” Mapping: The process of photosynthesis

1. Green plants take in carbon dioxide and water from the soil.
2. Chlorophyll inside the chloroplasts of the cells of green plants absorbs light energy from the Sun.
3. Carbon dioxide and water react in the cells of green plants to produce food (starch) and oxygen.
The action verbs and the nouns in the C+L sentence-making table indicate the thematic items and semantic relations of each thematic unit. They are classified as: **Process** (Verb), **Agent** (Subject) and **Target** (Object) (i.e. **Transitivity Relations**) and are highlighted with underlining and in bold.

<table>
<thead>
<tr>
<th>Action Verb</th>
<th>Noun</th>
<th>Process Description</th>
<th>Target Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Put</td>
<td></td>
<td>into a beaker of boiling water; and</td>
<td></td>
</tr>
<tr>
<td>boil</td>
<td></td>
<td>for 2 mins; then, turn off the Bunsen burner.</td>
<td></td>
</tr>
<tr>
<td>soak</td>
<td>the leaf</td>
<td>in a boiling tube half-filled with alcohol with a pair of forceps, and then put the boiling tube into a beaker of hot water for 10 mins.</td>
<td></td>
</tr>
<tr>
<td>Take</td>
<td></td>
<td>out of the alcohol with a pair of forceps.</td>
<td></td>
</tr>
<tr>
<td>spread</td>
<td></td>
<td>on a white tile; and</td>
<td></td>
</tr>
<tr>
<td>add</td>
<td></td>
<td>a few drops of iodine solution to</td>
<td></td>
</tr>
</tbody>
</table>

**Circumstances:** location/time/material/manner/reason
CLM Scaffolding: C+L writing guide
**C+L essay writing guide**

The **C+L essay writing scaffolding** guides students to develop the bullet-point notes into the answer to an essay writing question (A DSE question type demanding for even Band I EMI students).

---

**Add an introduction referring to the question**
- The structure of DNA is well suited to its function as a genetic material because of the following aspects:
  - **First**, DNA molecule consists of a large number of nucleotides. Therefore, it carries a large amount of genetic information.
  - **Second, since** DNA molecule has a long sequence of bases to form genetic code, it stores a large amount of genetic information.
  - **Third**, DNA is a stable molecule because it has strong sugar-phosphate backbones and double helix structure maintained by the hydrogen bonds between the two strands.
  - **Fourth**, DNA can replicate itself accurately through complementary base pairing. As a result, identical genetic information can be passed to the new cells from generation to generation.

---

**Provide supporting details to make your arguments solid.**

**Use sequential conjunctions to make your argument clear.**

**Use logical connectors (e.g., cause & effect) to make your arguments logical.**

**Use academic words (e.g., 'replicate' instead of 'copy') to make your arguments scientific.**

---

**Bullet-point notes in the science textbook.**

- DNA is well suited to its function as the genetic material because of the following aspects:
  - DNA is a **stable** molecule.
  - The base sequences form the **genetic code**.
  - A DNA molecule can carry a **large amount of genetic information**.
  - DNA can **replicate** accurately so that the same genetic information can be passed to new cells.
## Summary of quantitative and qualitative data

<table>
<thead>
<tr>
<th>Class</th>
<th>Quantitative data</th>
<th>Qualitative data</th>
</tr>
</thead>
</table>
| **S1 Junior Geography** | ● pre-test scores  
● post-test scores  
● control class N=33  
● intervention class N=31 | ● lesson observation (videotape appr 245 mins)  
● focus group interview with students (audiotape appr 40 mins)  
● semi-structured interview with Ms C (audiotape appr 30 mins)  
● student works of the try-out unit (intervention class N=31) |
| **S2 Integrated Science** | ● pre-test scores  
● post-test scores  
● control class N=30  
● intervention class N=30 | ● lesson observation (videotape appr 245 mins)  
● focus group interview with students (audiotape appr 30 mins)  
● semi-structured interview with Ms C (audiotape appr 30 mins)  
● student works of the try-out unit (intervention class N=30) |
| **S2 Junior Geography** | ● pre-test scores  
● post-test scores  
● control class N=29  
● intervention class N=29 | ● lesson observation (videotape appr 105 mins)  
● focus group interview with students (audiotape appr 35 mins)  
● semi-structured interview with Ms C (audiotape appr 40 mins)  
● student works of the try-out unit (intervention class N=29) |
| **S3 Biology**        | ● pre-test scores  
● post-test scores  
● control class N=27  
● intervention class N=30 | ● lesson observation (videotape appr 280 mins)  
● focus group interview with students (audiotape appr 30 mins)  
● semi-structured interview with Ms C (audiotape appr 45 mins)  
● student works of the try-out unit (intervention class N=30) |
| **S4/5 Biology**      | ● pre-test scores  
● post-test scores  
● control class N=30  
● intervention class N=28 | ● lesson observation (videotape appr 280 mins)  
● focus group interview with students (audiotape appr 50 mins)  
● semi-structured interview with Ms C (audiotape appr 50 mins)  
● student works of the try-out unit (intervention class N=28) |
Finding 1

Results of **quantitative data analysis** indicated:

- in the post tests, the intervention classes **outperformed** the control classes in both **content** and **language** knowledge development;

- the **differences** were statistically **significant** when...
  - both **designed scaffolding** and **interactional scaffolding** (Gibbons, 2009; Lin, 2016) were provided for the students during the EMI lessons, and
  - **content knowledge** and **language knowledge** were **integrated** during the EMI lessons.
Finding 2

The thematic-patterns-based CLM materials were welcomed by the students and teacher who considered the CLM pedagogy helpful for learning the subjects in English as their additional language.
Feedback on CLM teaching materials

The C+L cards offered **meaningful learning opportunities** and helped students to **clarify the meaning of the concepts**.

The C+L cards built up **networks of interrelated meaning** about the concepts and provided more focused structures of their critical attributes that are scattered at different locations in the textbook.

The **multimodal** information helped students to better understand the concepts.

The **language support** was beneficial for students to better express the content knowledge.
Finding 3
The importance of designed scaffolding and spontaneous scaffolding

The thematic-pattern-based CLM approach enabled the teacher to guide the students to better understand and inquire into the content knowledge through both designed and spontaneous scaffoldings (Gibbons, 2009; Lin, 2016) in shifting communicative approaches (Mortimer & Scott, 2003).

The thematic-pattern-based CLM materials and activities enhanced students’ motivation to learn both the content and language knowledge actively through self-directed and collaborative learning.
"Concept + Language" Mapping: The process of photosynthesis

Green plants take in carbon dioxide in the air and water from the soil. The chlorophyll inside the chloroplasts of the cells of green plants absorbs light energy from the Sun to produce food (starch) and oxygen from carbon dioxide and water.
S4: The C+L maps on the PPT we saw during the lessons made it easier for us the remember what we've learned. I mean, we don't need to recite everything in the book all the time.
R: What's the difference between a big map and the cards in different pieces?
S4: Well the maps are bigger when you read them you don't just focus on a certain part.
R: What is there between the different small parts?
S5: There're connections.
R: Are there just arrow-connections or are there also some words in the connections?
S5: There're words, which is good. If there were only cards without connection, it would be time-consuming for us to search which concepts are linked with which and which one is being introduced. It would be easier to remember what we’ve learned if we read the whole maps.

Complicated concepts are constructed by simple concepts which are connected logically according to the interrelationship between each other. The ‘Concept + Language Mapping’ Approach visualises the interrelatedness between the concepts (thematic patterns).

R: Now can you make your own C+L maps?
S1: I will put all the key points on paper slips, and then stick them on my notebook. And the maps will connect all the key points together.

The ‘Concept + Language Mapping’ Approach motivated students to do self-directed learning.
Teaching and learning activities with CLM scaffolding---
‘C + L’ Cards and ‘C + L’ Maps: **Self-directed Learning**

Highlighting notes on ‘C+L’ cards while listening to the lesson

Completing ‘C+L’ Map by referring to ‘C+L’ cards

Finishing worksheet exercises by referring to ‘C+L’ cards

Discussing and learning with ‘C+L’ cards: Preparing for a debate activity

Teaching and learning activities with CLM scaffolding---
‘C + L’ Cards and ‘C + L’ Maps: **Collaborative Learning**
Group experiment design
(Joint construction)

Experimental Reports
(individual construction)
Bingo Game with “C+L Cards”

**Dictation in a Bingo Game**

**Directions:**
- Select 9 words or phrases from the vocabulary about Basic Genetics.
- Fill the vocabulary items into the grids on your Bingo Card at random order.
- Listen carefully to the teacher when she announces the definitions of different vocabulary items one by one.
- Circle the word or phrase in the grid if it matches the definition the teacher announces.
- Say “BINGO!” when you have three circled vocabulary items in a straight line horizontally, vertically or diagonally.

**Rules of the game:**
- The words circled should match the definitions announced.
- All vocabulary items must be spelled correctly.
- The one who gets three circled vocabulary items in a straight line is the winner.

---

A Level 1 Bingo game: There are only 9 grids.

The happy winner gets the award.

---

A Level 2 Bingo game: There are 25 grids.

The teacher explains the concept: During gamete formation, separation of each pair of heredity factors occurs so that each gamete receives only one factor from each pair.
Finding 4
The importance of content and language integration

The thematic-pattern-based CLM approach helped the teacher to raise students’ awareness of both academic content literacy and academic language literacy.

The thematic-pattern-based CLM approach takes effect only when the teacher integrates flexibly and appropriately the teaching and learning of both content and language during the CLIL practices.
Mr X: Okay. ‘Soak’ means you dip something completely under water. Is it okay? Or under a liquid. So that is ‘soak’. Highlight that. That is a new word that you, you may want to learn. Is that okay? Instead of always saying ‘put, put, put’, you can say ‘soak’.

S1: Mr X. [raising hand] Can we soak the… soak the leaves to the soda… soda…lime?

Mr X: Under water or liquid. [smiling] Good question. What do you think? Soda lime, soda lime. Is soda lime liquid or solid?

S2: Solid.

Mr X: Soda lime is solid, right? So can we use the verb ‘soak’?

Ss: No.

Mr X: No. But good try.

**Soak** means “to immerse something into liquid to clean it or make it softer

Since in the previous experiment we “soak the leaves in the boiling tube half-filled with alcohol” (sample sentence in the sentence-making table), now can we say “soak the leaves in the boiling tube with soda lime?”

**Soda lime** is a solid mixture of sodium and calcium hydroxides used to absorb carbon dioxide
Integrating the learning of academic content knowledge and academic language knowledge

The thematic pattern ("Soak", "the leaf", "into a boiling tube half-filled with alcohol") PROCESS/TARGET/CIRCUMSTANCE is highlighted in the sentence-making table. The special feature of the CIRCUMSTANCE of the thematic pattern requires a "liquid" not a "solid".
Learning by rote-memorization or C+L mapping?

I tend to **rote-memorize** everything because **I cannot understand the meaning of the lessons**, therefore I cannot **re-associate** (重整) **the different concepts and knowledge points**.

The CLM materials offered us a **meaningful learning strategy** and **scaffolding** which enabled us to learn the science concepts in **meaningful and logical and interrelated** way, hence it enhances our **awareness** in both academic language and academic content knowledge.
Summarize critical attributes of the concepts and clarify key concepts.

Serve not only as a writing guide (genre structure, sentence pattern, grammar, vocabulary) but also a road map for exploring science via experiments (i.e., a storyline that guides the narration of the science story).

Build up patterns of rhetorical/academic functions; highlight logical relations.

Link concepts; highlight interrelations.
Integrating Content and Language in EMI Education

Under the CLM Approach, content cannot be separated from language

• The talking, reading, writing, representing and doing in content subjects cannot be implemented without the use of language in networks of thematic patterns and semantic relationships.

• The teaching of language becomes meaningless if it is not based on the content knowledge which it conveys.
Teacher education about “thematic-pattern-based” CLM pedagogy

- CLIL teachers need to go beyond the mechanical and dichotomous belief that CLIL means simple addition of “Content” and “Language”.

- An indepth reflection on the “thematic-pattern-based” CLM approach and its pedagogy may give teachers an implication of the true meaning of “integration” in CLIL.
Limitations

• A quasi-experimental design
  - only one intervention class and one control class for each subject and grade
  - approximately 30 students in each cohort
• The limit of class number and class size may affect the quantitative result
• Short intervention (only tried out 3 - 8 lessons)
• The same teacher teaching both the control class and intervention class (e.g. in S1, S2 Junior Geography, S2 Integrated Science and S3 Biology)
• Delayed post-test in S2 Integrated Science
Implications for future research

• Future research on the thematic-patterns-based CLM approach may adopt a **longitudinal** research design.

• Intervention may be tried out in **other subjects with MOIs other than English**.

• Data collection may also include **students’ design and elaboration** on their own CLM materials, e.g. how students express their understanding of the thematic patterns through their own C+L cards and maps.

• Data analysis may focus on **the effects of teacher’s questioning and interactive/dialogic communications** (Mortimer & Scott, 2003) on students’ content and language development.
References


Acknowledgement

This research study was funded by a grant awarded to Angel M.Y. Lin (Project #2015-0025) by the Standing Committee on Language Education and Research (SCOLAR), Hong Kong Government.