A Communicative CLIL Science Course for Engineers

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Goal

Deliver a communicative CLIL (content and language integrated learning) science course to 2nd year materials science and applied chemistry students.

Background

English Medium Instruction has been growing in Japan over the last decade, largely as MEXT has pushed for Japanese universities to become "more global": delivering graduates who can function in an English-speaking environment, and additionally making those universities more attractive to international students. A lot of focus has been on large universities, but many smaller universities have begun adopting EMI to some extent to satisfy MEXT requirements. EMI classes in such universities will naturally be of a different character to those in top-flight institutions. Students will not have as good an ability in English, may have less self-confidence, and will find learning about and communicating about the studied subject very challenging. To account for these issues, a EMI course with a communicative focus was designed, as communication in lower-level institutions is still neglected, despite its key role in active, engaged learning (Dornyei, 1998). The course is also aligned with the core points of communicative activities (Brandl 2009).

Implementation

Instructor-produced articles were the main materials of the course. Due to Covid, the class was conducted by Zoom, which impacted the communicative aspects somewhat. Comprehension checks and written work were moved to Google Forms.

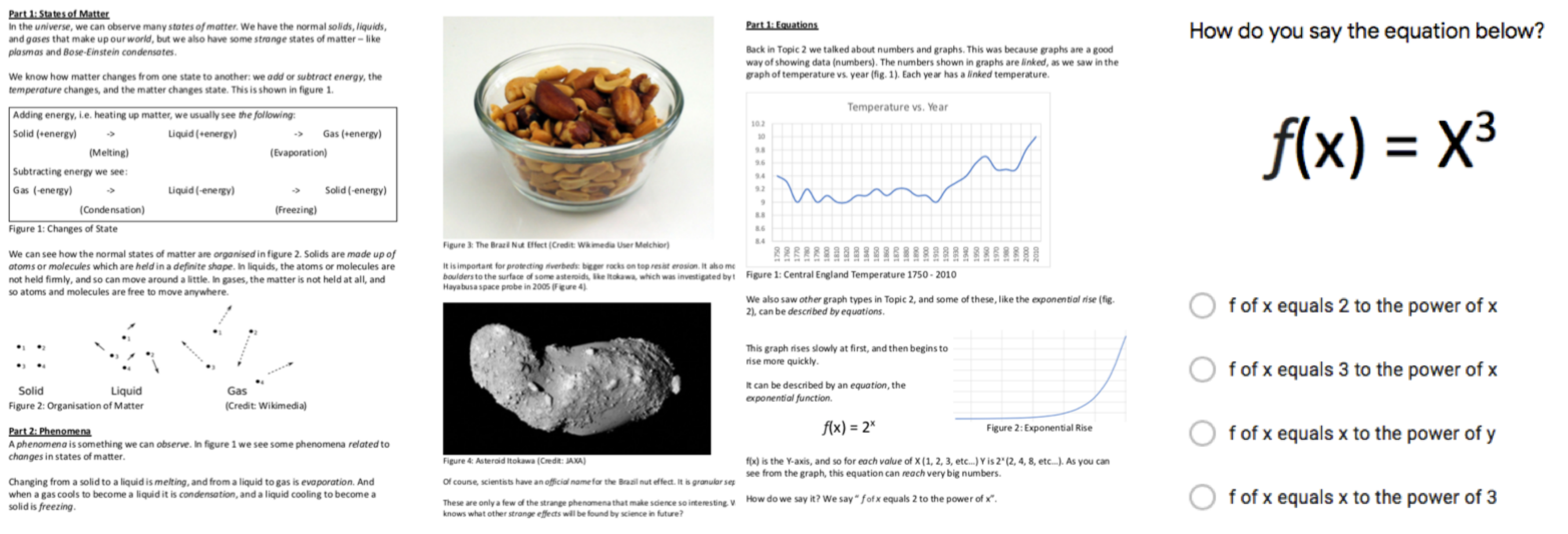
Course Overview

Topics introduced concepts slowly at first, so as to not overwhelm the students. Topics covered two lessons

Topic 1 Experiments. Scientific instruments, how we "see science", are introduced. "Natural experiments", those we do in our everyday lives, introduce the Scientific Method.

Topic 2 Numbers, Symbols, and Graphs. Students learn to read numbers, compare data, say and use mathematical and scientific symbols, and talk about common graphs.

Activity 1 Three Scientific Challenges. Students prepare three paragraphs on scientific challenges of the next 50 years, shared them in class, and reported on one challenge from a partner.



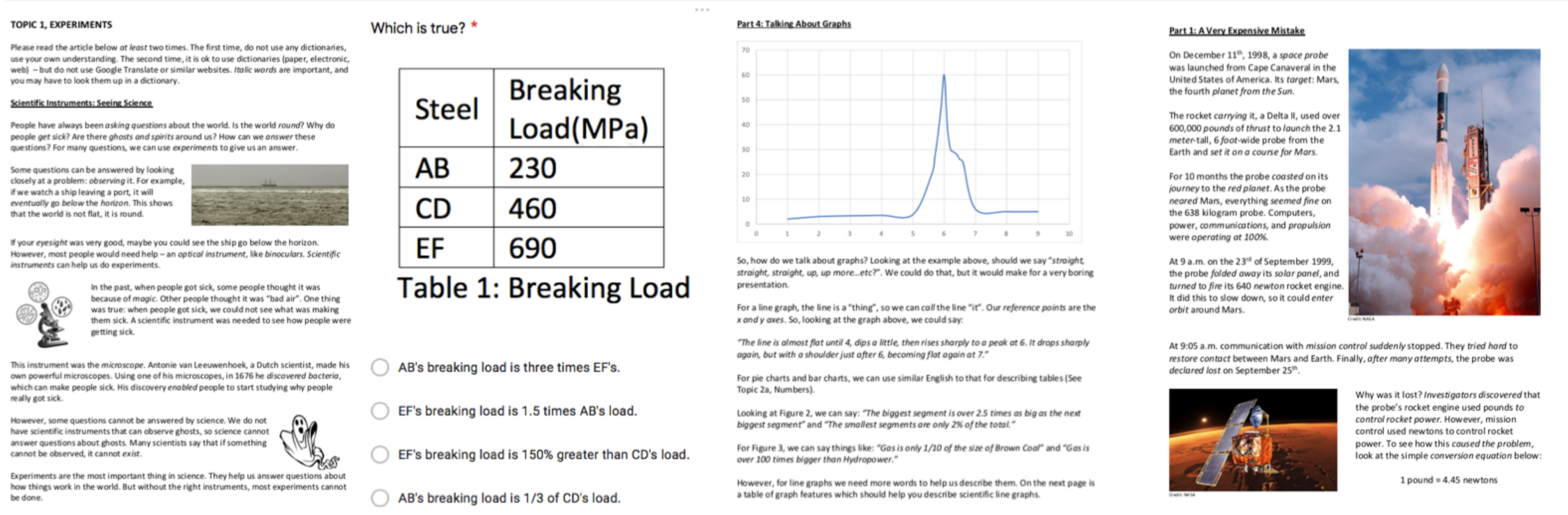
Topic 5 Equations and Life. Introducing equations with reference to Topic 2, how to say them, and what an equation for life in our galaxy could mean for alien contact. There was also a full discussion on alien life and the implications of its discovery.

Final Homework Students construct introductory and concluding paragraphs for their Activity 1 work, making one complete scientific essay.

Course Plan

Fundamental English for Materials Science (FEfMS) is a mandatory, formerly elective course. Students are 2nd year Materials Science and Applied Chemistry students. One hundred and nine students were enrolled in this class.

Classes are science focused, constructed to gradually introduce scientific concepts and also fit the solutions-oriented philosophy of science. Thus puzzles and critical thinking were a key part of the course. Almost all classes had opportunities for students to communicate, from short exchanges at the course start, to significant discussions towards the end.



Topic 3 Units and Errors. Topic was introduced by a story about the loss of a multi-million dollar space probe due to a maths error. A short discussion on space exploration and money followed.

Topic 4 Matter and Phenomena. The many states of matter, and the strange phenomena of matter were explored, from freezing hot ice cream, to bumpy asteroids.

Activity 2 Writing the introductory and concluding paragraphs for an teacher-provided essay on global warming.

Student Output The majority of comprehension questions were correctly answered, but for mathematical questions, some were challenging. Graph questions were well done, as were most of those on matter and phenomena. Questions on equations were mainly well-answered.

Student preparation for discussions and essays were easy to understand, reasonably well-formed, and scientifically valid.

Student Perceptions

Students were given a Google Forms questionnaire at the end of the course covering the areas of English Skill Improvement, Course Opinions, and Topic Opinions. Most questions were Likert-scale, with 1 signifying total disagreement, and 5 signifying total agreement. Other questions involved topic ranking. The results are given in the tables below. All numerical values are medians of the Likert results, n=78.

Course Qs: Course Progression	
As course progressed, new article understanding increased	3.7
As course progressed, English nervousness decreased	3.3
Discussion skills improved as course progressed	3.5

Topics: General	
Prefer science English topics to general English topics	3.5
Course topics professionally useful for me	3.8
Course topics professionally interesting for me	3.8

Course Qs: Impact of Stdnt Science Knowledge (SK)	
SK helped me guess meaning of difficult words	3.7
SK helped me guess article's meaning	3.8
SK helped me learn English words	3.7
SK helped me understand English sentences	3.8
SK helped me understand English articles	3.8

Course Qs: Student General	
I had interesting discussions with my classmates	3.4
I learned a lot from my classmates	3.4
I learned new scientific knowledge	3.9
I want to study English more after this course	3.7
Class discussion was professionally relevant	3.7
English is professionally relevant to me	4.0
I tried to use English a lot in this course	3.6
I used translation software a lot in this course	2.6

Topics: Most Interesting (n=58)	
1	T4: Matter & Phenomena
2	T5: Equations & Life
3	T1: Experiments & Scientific Method
4	T2: Numbers, Symbols, & Graphs
5	T3: Units & Errors

Topics: Most Useful (n=58)	
1	T2: Numbers, Symbols, & Graphs
2	T3: Units & Errors
3	T4: Matter & Phenomena
4	T1: Experiments & Scientific Method
5	T5: Equations & Life

Topics: Most Difficult (n=58)	
1	T5: Equations & Life
2	T4: Matter & Phenomena
3	T3: Units & Errors
4	T2: Numbers, Symbols, & Graphs
5	T1: Experiments & Scientific Method

English Skill Improvement	
Listening	3.5
Speaking	3.3
Reading	3.7
Writing	3.4
Communications Skill	3.5

Areas of note are in *impact of science knowledge; communications skill, reading, and listening improvement*; *new article understanding*; and the students' *professional opinions* on the course and English. It is also noteworthy that the two most difficult topics were also the two most interesting topics, and also that the two most useful were the two least interesting.

Final Points

The course was originally intended to be given face-to-face, with much more interaction possible between students, based on Tohoku University's Prepare, Discuss, React (PDR) Method. Aspects of the PDR method were, however, incorporated in the discussions. It is to be assumed that the communications skill would have increased under these circumstances, with related increases in listening and speaking. Some students groups also failed to participate in discussions, but these were less than 10% of the students enrolled.