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A Basic Study of English Immersion Lexicon for Math and Science

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Abstract

The lack of English class hours and decontextualized English education in a curriculum creates a barrier for students to attain the functional proficiency of English for practical communication purposes. The concept of English immersion behind the study of science and math, which has been implemented in Asian countries such as: Malaysia, Singapore and Philippines, can be a possible solution to the lack of English and decontextualized English education. This paper will explore an English immersion dictionary of science and math based on the Korean national curriculum which will help teachers and students cope with immersion classes. To this end, a list of words and constructions will be extracted from the science and math textbooks corpus for the immersion dictionary. The dictionary item will consist of a word list based on the frequency and importance, and head words will include the definition and example sentences that are extracted from the corpus. In addition, collocations are listed if they are of any significance to the learning of the subject.

Keywords: *Immersion education, English education, Immersion dictionary, Math immersion dictionary, Science immersion dictionary*

1. Introduction

In order to meet the need of globalized and information-oriented society, practical English education was introduced in Korea after the 6th national curriculum. Its main aims were to instill interest and confidence in English into students' mind as to improve their communicative competence in English. The problem of practical English education is that there is not enough time in the course of the curriculum to develop basic communicative proficiency. Due to the lack of instruction time and the focus on promoting only basic L2 skills, English classes are merely a time to perform simple activities such as playing games for fun, singing English songs, watching video clips, and so on. The amount of language used in those activities may be extremely limited. Although English classes are more focused on listening and speaking than reading and writing, there are still not enough opportunities to speak naturally among over-crowded classrooms consisting of more than 30 students. According to Foreign Service Institute in the United States of America, the English language speaker should have an exposure time of 4,375 hours to foreign languages like Korean, Japanese and Chinese to attain fluency level enough to perform one's duties [1]. Considering that university students majoring in English in Korea are experiencing an average of 1,584 hours of exposure to English for 10 years, the insufficiency of English class hours is a major obstacle to successful English learning.

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One of the basic elements in real-life communication is vocabulary. Correct vocabulary use can make up for inaccurate grammatical knowledge, so the students' lexical knowledge plays a more important role than grammar in many situations [2]. Americans usually use 4,000~5,000 words per hour for casual communication, and the number of words that they use for everyday conversation is about 10,000 [3]. However, the average student learns approximately 2,500 words during their elementary and secondary school careers, so it can be said that students were receiving insufficient language input.

Students can access English language through various mediums such as: Internet or international broadcasting in EFL (English as a Foreign Language) within Korea. However, they indeed have fewer opportunities to utilize English in meaningful situational contexts. It means that enormous cost in English education is not spent effectively.

In order to enhance communicative competence, students need to receive abundant language input continuously. In addition, those inputs should be comprehensible to the students. Therefore, we need to think of a teaching method that students can learn English with the content of other subject matters, for example, science and math [4].

The advantage of integrating English with other subject matters is that students can understand the knowledge and skills learned not only in other subjects but also in English classes as well [5]. Also, learning English is the vehicle for learning the content of other subjects or disciplines to students.

In this regard, science and math are taught through English in some Asian countries including Malaysia, Singapore, and the Philippines. Through this, students increase their exposure to English, strengthening their motivation for studying English, and use English in a more meaningful and effective way. Many researchers recommend integrating English curriculum, for example, the Immersion program, CBI (Content-Based Instruction), or CLIL (Content-Language Integrated Learning) as an efficient teaching method in an EFL centered environment [6][7][8]. Therefore, we need to consider how to apply it within the Korean English educational system.

Immersion classes in English class are centered on promoting students' English proficiency with interdisciplinary subjects or themes.Many previous studies prove that the integration of English teaching has had very positive effects on students' English ability because it provides the opportunities for preparing and reviewing for the course and learning various contents in English [9][10][11]. For this reason, research on integrated teaching with English and other subject matters, have been actively underway in primary schools. Recently, teaching math and science in English is increasingly expanding to keep up with the need of integrated interdisciplinary education.

Nevertheless, there are no glossaries or dictionaries for teachers to refer to the numerous vocabulary and example sentences for a particular subject when implementing integrated English instruction. Thus, there is a need to select and sort out necessary vocabularies for teaching English in a comprehensive and integrative way. Moreover, it can help teachers to deliver useful subject-related vocabularies, and eventually contribute to effective English learning. Therefore, this study analyzed and developed the vocabulary and syntax list in the areas of math and science, because they serve as relatively easy subjects in which to integrate with English as an instructional language. Two kinds of vocabulary, (1) high frequency words in math and science and (2) core terms of each subject, were extracted with corpus analysis.

For it to be implemented appropriately, a specialized corpus was constructed with the 1st~6th grade math textbooks with that of the 3rd~6th grade science course books. All the text within the textbooks were compiled into a corpus. Essential vocabulary and the syntax for each subject was sorted out according to their frequency with concordance program.

2. Selection of essential vocabulary

In this study, a morpheme analysis was required in order to analyze the vocabulary in the math and science corpus. For this purpose, the frequency of the prototype vocabulary in the corpus was calculated using the software for analyzing the Korean language: The Korean Advanced Institute of Science and Technology morpheme analyzer or 'KAIST' morpheme analyzer for short, is the primary medium in which to analyze this paper's findings. The high frequency words in science corpus are shown below in Table 1.

Table 1. Example of high frequency words in science textbooks

Word	Frequency	%	Word	Frequency	%
가루(powder)	8	0.08356	모래(sand)	7	0.073115
감각기관(sense organ)	5	0.052225	물질(material)	12	0.12534
강낭콩(kidney bean)	8	0.08356	물체(object)	16	0.16712
강물(river)	3	0.31335	발견(discovery)	7	0.073115
개구리(frog)	3	0.31335	방법(method)	8	0.08356
개미(ant)	3	0.31335	방향(direction)	7	0.073115
거름종이(filter paper)	3	0.31335	별자리(constellation)	8	0.08356
렌즈(lens)	6	0.06267	볍씨(rice seed)	6	0.06267
막대(stick)	5	0.05225	보름달(full moon)	3	0.31335
머리(head)	6	0.06267	봉숭아(peach)	5	0.5225
먹이(food)	10	0.0445	북두칠성(the Big Dipper)	4	0.04178
먹이연쇄(food chain)	5	0.05225	분류(classification)	9	0.094005
빛(light)	8	0.08356	산성비(acid rain)	6	0.06267
빨대(straw)	4	0.04178	산소(oxygen)	7	0.073115
뼈(bone)	6	0.06267	이산화탄소(carbon dioxide)	7	0.073115
뿌리(root)	12	0.12534	잎맥(vein of a leaf)	4	0.04178
전기회로(electric circuit)	9	0.094005	전자석(electromagnet)	8	0.08356

3. Selection of essential syntax

The KAIST morpheme analyzer extracted the frequently used words in math and science textbooks, in order to help identify the overall outline. However, it is difficult to accurately grasp the usage and meaning of individual vocabulary, thus the NLPTools were used to understand the actual usage and meaning of a particular word from example sentences, or, concordance lines. NLPTools provide a KWIC (key word in context), as the most common format for concordance lines like Table 2.

Table 2. Example of concordance lines in science corpus

Word	KWIC	Usage in context
공기(air)	공기(air)	[공기] 중에서 물체의 무게를
	공기의(of air)	[공기의] 20% 정도는 산소입니다.
관찰(observation)	관찰(observation)	테이프에 붙은 씨를 [관찰]
	관찰하고(observe and ~)	4-5 번 정도 보름달을 [관찰하고] 그 위치를 그림으로
	관찰한(noun to observe)	종이깃발과 팔랑개비를 두고 [관찰한] 경험이 있습니다.
	관찰합니다(observe)	전등불을 비추고 변화를 [관찰합니다.]

[Table 2] shows the KWIC results using '공기(air)' and '관찰(observation)' as keywords. '공기(air)' appears alone, or in case alternation form, '공기의(of air)'. '관찰(observation)', on the other hand, was used in more varied forms, e.g., '관찰(observation)', '관찰하고(observe and)', '관찰한(*noun* to observe)', '관찰합니다(observe)'.

4. Composition of vocabulary items

The composition of the vocabulary items for the English immersion program was arranged in the order of Korean and English vocabularies, respectively. This is because students can find the headword more easily. Each vocabulary item has the definition in English and example sentences/collocations extracted from math and science corpus.

Table 3. Composition of vocabulary item for English immersion program

Vocabulary	Contents
공기 air	●Definition: the mixture of gases we breathe; the atmosphere ●Example sentences - Air consists of about 78 percent nitrogen and 21 percent oxygen. - The dust hangs heavy in the air. - Local residents could band together and pay a local firm to reduce air or water pollution. - The factory may pollute the air.
가열, 가열하다 heat	●Definition: the transfer of energy from one body to another as a result of a difference in temperature or a change in phase ●Example sentences - Heat the water to 40 degrees. - Heat margarine in a skillet until melted. - Heat the oven to (a temperature of) 200 degrees Celsius. ●Collocation - The heat exchangers are connected to the pressure. - The inner jug is made of heat-resistant borosilicate glass.
갈비뼈 rib	●Definition: any one of the bones which curve round and forward from the backbone, enclosing the heart and lungs ●Example sentences - Bodies are made in planks you see and there's a rib in it. - My ribs are broken. - I have some broken ribs. ●Collocation - Rib muscle injury ruled out the fast bowler. He nudged me in the ribs with his elbow.
감각기관 sense organ	●Definition: a part of the body that receives stimuli and transmits them as sensations to the brain ●Example sentences - Fish is not a breathing passage, but an opening to a chemical sense organ. - Now Baker reports that man also has a potential 'magnetic sense organ', a concentration of magnetic in the bones in the base of the skull.

Each headword, such as '공기(air)', '가열/가열하다(heat)', and '갈비뼈(rib)', appears in Korean first, and then in the English equivalent, followed by example sentences in English. Teachers can use them when teaching math or science in English and explain the meaning and concept of the word. Furthermore, the students become familiar to these definitions as examples presented and extracted from their actual textbooks. In addition, the information about collocation, which appears in vocabulary such as '가열' and '갈비뼈', allows the students to learn the specific words that occur regularly whenever the certain headword is used.

5. Conclusion

English immersion education with science and math can supplement the lack of the hours for English classes, and provide more opportunities to use English meaningfully. In order to do so, we need to find a way to teach English while simultaneously using the textbooks of the national curriculum, because every public school should use them to follow the educational policy enacted by the Korean government. In this context, dictionaries for English immersion education can be a basic and valuable tool for both students and teachers.

Although some cities have yet to implement an English immersion program, it should be a program that more cities should highly consider as viable options in improving the standards for their populations' comprehension of English. However, some provincial offices, such as Busan Metropolitan City Office of Education and Jeju Special Self-Governing Provincial Office of Education, have partially implemented the immersion program. In order to reduce the gap in education, it is critical to find a viable model for English immersion education in the national curriculum through various studies, and dictionaries for English immersion can be one of the most valuable of tools. To do this, we selected the necessary words for immersion dictionaries, and extracted the sample sentences to show their usages in math and science textbooks. Also, collocational information was presented with each headword. If the preliminary efforts in this study are realized in various ways, English immersion education will be able to develop one step further in a better direction.

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