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The Effects of Data-Driven Learning Approach in a Content and Language Integration Learning Classroom: A Study of Economics Subject in a Thai High School

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Abstract

There are several studies that teach specific content and the English language at the same time using the CLIL approach, but none of them reflect the students' linguistic ability in the given subject throughout the world, especially in Thailand. The Corpus-Based CLIL will be an efficient combination approach that can improve Thai high school students' comprehension of both English and specific content with an emphasis on Economics, as well as their linguistic ability. The purpose of this study is to (1) compare the effects of the Corpus-based CLIL method on the Economics subject and English language learning, and (2) examine how Thai high school students use CLIL and DDL learning processes while dealing with the Corpus-based CLIL method. This study included 40 high school students from the demonstration school. A mixed-methods study was conducted. The students' reflections, and the teacher's field notes observation were utilized to gather the qualitative data, while the pre-test and post-test were designed to determine the quantitative findings. The study revealed that students using the Corpus-based CLIL method could greatly enhance their understanding of both English and Economics, as well as linguistic features like syntax and collocation in the Economics. Additionally, students could improve their English, Economics, and DDL learning processes. These findings suggest that the Corpus-based CLIL method can effectively improve students' Economics and language abilities simultaneously.

Keywords: Content and Language Integrated Learning (CLIL), Corpus-based Approach, Data-driven learning (DDL), Economics studying, English Language studying, Teaching and Studying Language Corpora

1. Introduction

The most challenging elements of English learning and teaching in Thailand currently involve obsolete teaching methods because teachers have merely directed students to memorize English vocabulary, collocations, expressions, and structures, which are all taken from the commercial textbook and represented in each unit (Kirkpatrick, 2010; Marsh & Wolff, 2012). According to Richards and Rogers (2001), Thai teachers rarely provide students with opportunities to use the language naturally in order to understand the real messages that are embedded in the learning texts provided, along with the significance of those messages. However, the Ministry of Education in Thailand has started motivating teachers to teach English through academic subjects such as mathematics, science, technology, physical education, and social studies in Thai schools since 2004 (Tungthongtongkul, 2007). As a result, the role of teaching English in Thailand has been concentrated on both enhancing topic understanding in the subject being taught as well as all of the language's significant qualities in the classroom. Apart from teaching English in Thailand, teaching and studying Economics at the high school level is certainly challenging for both teachers and students, especially when using an English textbook (Khumjan, Juithong, Nilnopkoon, & Klangphahol, 2019). According to Thongda (2015), Thai students are likely to misunderstand the Economics contents if the teachers are unable to adequately clarify the technical words' meanings and word use. Furthermore, using English textbooks to teach students Economics will be unsuccessful if teachers always translate the information from L2 to L1 for students in the classroom.

Therefore, content and language integrated learning, or CLIL, is an efficient method for enhancing the acquisition of a second language through the academic subjects taught in the classroom (Charunsri, 2020; Cimermanova, 2020; Vazquez, 2007). In addition, CLIL can represent an effective teaching strategy that will

assist students in improving their cognitive processes in order to acquire knowledge and skills, allowing them to study language and content in the classroom as active rather than passive students (Graddol, 2006; Juangsih, 2021; Mephisto, Frigols, & Marsh, 2008).

Nevertheless, the CLIL method cannot fully improve students' English language abilities, particularly in linguistic elements, because it is only capable of enhancing their fundamental skills. Data-driven learning, also known as DDL, is an outstanding practical strategy that should be used in collaboration with the CLIL method because it allows students to more easily examine the technical words used in academic fields. In addition, the students can look into additional word patterns that appear in the concordance lines, which can help them apply the right terminology in the right situation (Guan, 2013; Sripicharn, 2010; Yaemtui, 2018). As a result, combining two teaching strategies can improve students' capacity to acquire both subject and linguistic information simultaneously (Piotrowska & Alekseeva, 2020). It is possible that the students' specific language and subject competency will be higher if the CLIL approach is combined with DDL strategies than if it is used separately.

However, there are fewer studies that used the combination methods between CLIL and DDL in developing Economics knowledge and language ability at the high school level. To address this problem, this study aims to investigate the effects of the Corpus-based CLIL method and materials on Economics and English language learning and examine how Thai high school students follow CLIL and DDL learning processes while dealing with the Corpus-Based CLIL method and materials during learning the Economics subject along with the English language.

This study emphasizes two major research questions:

1. To what extent does the Corpus-Based CLIL method contribute to the significant improvement of vocabulary proficiency in Economics terminology, collocation and grammatical features in the Economics' language, together with Economics content comprehension of Thai high school students?

2. How do Thai high school students follow CLIL and DDL learning processes during learning the Economics subject along with the English language through the Corpus-Based CLIL method?

2. Literature Review

2.1 An Introduction and Key Concepts of CLIL

David Marsh was the first theorist to create and develop CLIL, which is referred to as the "Content and Language Integrated Learning" approach to apply in both learning and teaching based on communicative purposes since 1994 (Milla & García-Mayo, 2014). According to Marsh (2008), CLIL is an approach based on the bilingual education programs in Britain and Canada, and it has been used around Europe and other countries nowadays (Turner, 2013). CLIL is an approach to teaching and studying at school or university where the content subjects are taught and studied in a second language (Prasansaph, 2020). Dalton-Puffer (2011, p. 186) defines CLIL as the teaching approach in which the content is taught by the foreign language in transmission and is emphasized on meaning in language issues. Therefore, CLIL becomes a well-known method to apply in the authentic classroom because CLIL lessons can let students engage in the four major language skills of reading, writing, listening, and speaking in the real-life classroom when the students learn language through contents. Many studies, however, show that CLIL is used more in universities than in elementary or secondary schools.

Based on the 4Cs framework (Coyle, Hood, & Marsh, 2010), they can provide both a theoretical and methodological foundation for preparing well-organized lesson plans and materials through the CLIL approach because CLIL is integrated into the nature of teaching. The 4Cs in the CLIL framework are "Content", "Cognition", "Communication" and "Culture". The "Content" function in CLIL refers to the content from which students can get not only knowledge but also the skills' varieties. "Cognition" refers to the content that is related to the students' process of learning or thinking (cognition). "Communication" is focused on the language needs that are concerned with the contexts of learning, the reconstructions of the content, and the procedures of cognition. The last term, "Culture" refers to the relationship between culture and language use in the provided contexts. Therefore, CLIL can effectively create intercultural awareness through the process of learning for students (Coyle, 2006). Apart from applying the 4Cs framework, the Language Triptych, which is a representative of conception, should be used to link the objectives of content and language because it will support the perception that CLIL lessons are obviously effective. According to Coyle, Hood, and Marsh (2010, p. 36), they explained that the language triptych is composed of language of learning, language for learning, and language through learning. The term "language of learning" refers to the language needed that can connect to the provided concepts and skills in the area of knowledge, such as main keywords, expressions, and terminology.

Meanwhile, "language for learning" refers to the language that can facilitate the learner's practice in the environment of using a foreign language. The last is "the language through learning," which refers to the language that can be performed in the process of learning. In summary, the good lesson plans and materials that are used in the CLIL classroom should be authentic and focused on content and language competency, but the CLIL teachers should check carefully before adapting to the classroom. If the CLIL teachers would like to succeed in using CILL materials and lesson plans, they should rely on the 4C framework and the Language Triptych because these frameworks can control the processes of creating the content, activities, and material to support and relate to the CLIL approach.

According to Rizzo and Palmero (2014), the CLIL approach is challenging to use in the classroom for not only teachers but also students, especially those who are less proficient in using English. Yang (2015) supported the idea that teachers should figure out how to use CLIL in the classroom with not only students who are good at English but also students who are not quite good at using English. However, the CLIL approach will be unsuccessful if the teachers do not effectively use it to teach language and content in the classroom. (Charunsri, 2020; Ito, 2019; Juangsih, 2021; Lee, 2020; Urantsetseg, 2016; Vithanapathirana, & Nettikumara, 2020; Zheng, Lu, & Li, 2023).

Although the CLIL approach has the advantage of gaining content knowledge and English language skills at the same time, the students might lack linguistic knowledge such as lexis, syntax, and collocation because the CLIL is suitable to improve students' basic English knowledge. Therefore, the CLIL approach might not provide enormous information for students to study authentic language in the classroom, especially when investigating the linguistic information based on the subject provided.

2.2 An Introduction and Key Concepts of Data-Driven Learning, or DDL

DDL, or data-driven learning, has been known in language teaching since Johns (1994) first created it, and DDL is the tool that can attract students to use it nowadays (Mizumoto, Chujo, & Yokota, 2016). DDL is a successful learning approach that can transform the computer-retrieval collection of texts into the process of teaching and studying language in the classroom (Hadley, 2002). The students can have some opportunities to investigate the unknown information through DDL because it can provide information related to grammatical patterns, word usages, or collocations. Therefore, the concept of using DDL in language teaching and studying can be perceived as an inductive approach because the students must interpret the investigated data by themselves (Yaemtui, 2018). The DDL is totally advantageous to use in the classroom because it can increase students' awareness and noticing through the use of a concordance to identify similarities and differences in patterns and forms (Huang, 2001). In summary, the DDL is the life-long learning process, together with the autonomy of learning (Lin & Lee, 2015).

The DDL methods can activate the students to investigate the structure and form by themselves through the provided concordance lines, and there are three significant aspects, which are autonomous learning and self-discovery, authentic language input, and the process of inductive learning, that affect the DDL potential in the language classroom (Guan, 2013; Yaemtui, 2018). Furthermore, there are four concepts of theoretical issues that underpin the DDL approach, which are computer-assisted language learning (CALL), the use of corpus data in the language classroom, attention to language form, and grammatical consciousness-raising (CR) (Sripicharn, 2002).

Tim Johns (1994) was the first person to create the procedures of Data-Driven learning in the language classroom, and many teachers will adapt his principles to their teaching from now on. Johns (1994) categorized the procedures for using DDL in the language classroom into the three outstanding stages of Identification, Classification and Generalization. At the identification stage, the students are introduced to the target language, which is referred to as a problem for them to identify. The students must identify the information required from the concordance data, which can be retrieved from both paper-based and computer-based concordances (Petcharinphan, 2020). The second stage of using DDL is Classification. Regarding this second stage, the students must categorize the possible patterns of the language targets given from the concordance lines, which can be obtained from not only paper-based concordance but also computer-based concordance lines. The last stage of using the DDL approach is generalization. In this stage, the concordance data is used by the students to inductively generate language patterns or word usage (Gilquin & Granger, 2010). The generalization stage is very important for the students in the DDL approach because the students should apply the investigated information that they observed and hypothesized to create their language patterns and rules inductively (Petcharinphan, 2020).

Using the DDL approach in the language classroom or content classroom is beneficial not only for teachers but also for students nowadays. Moreover, the teachers who are the main factor in using DDL in the classroom should have knowledge not only of linguistic information but also teaching abilities to provide several effective activities that are designed on DDL (Flowerdew, 2012; Nugraha, Miftakh, & Wachyudi, 2017).

Although the DDL approach is useful for students to investigate linguistic information such as lexis, syntax, and collocation through the concordance lines given, students might lack content comprehension while studying in the classroom because the DDL is beneficial for students to study the specialized language from the texts more than providing the content concept in the content provided.

2.3 Previous Studies Using Data-Driven Learning in the Content and Language Integrated Learning Classroom

There have been a few studies on the theme of combining the CLIL and DDL approaches to improve students' content and language knowledge, but the five most well-known ones were those by Eldridge, Neufeld, & Hanciolu (2010), Jawhar (2012), Muszynska, Urp, & Gazk (2017), Piotrowska & Alekseeva (2020), and Santos (2015). They applied the combination approach between the CLIL and DDL to the students who studied at higher education institutions in Brazil, Poland, Russia, Saudi Arabia, and Turkey. Moreover, they only used content teachers to teach students content and language in the classroom.

In terms of research design, they used the quantitative method to investigate the effectiveness of students' learning language and content comprehension through the pretest and posttest, while they used the qualitative method to investigate the students' attitude through observation and interview.

In terms of the teaching and learning of grammar and vocabulary, the teachers encourage the students to use the DDL approach to investigate the lexical, syntactic, and collocational information from the provided concordance lines, which were related to particular subjects like art, computer, mathematics, science, and social studies. Additionally, some research studies utilized computer-based concordance lines, so the students had to examine the information on the COCA corpora website in order to obtain authentic data, such as grammatical patterns (Eldridge, Neufeld, & Hanciolu, 2010; Jawhar, 2012; Muszynska, Urp, & Gazk, 2017; Santos, 2015), while Sketch Engine, AntConc, Skell, and LexTutor were utilized by Piotrowska & Alekseeva (2020) as the primary tools for students to examine several specialized languages that were used in specific subjects.

After the students studied the patterns and meanings of the technical terms provided in each unit or each lesson plan, they were assigned to study specific contents such as art, computer, mathematics, science, and social studies through the CLIL approach (Eldridge, Neufeld, & Hanciolu, 2010; Jawhar, 2012; Muszynska, Urp, & Gazk, 2017; Piotrowska, & Alekseeva, 2020; Santos, 2015). The students were taught and studied by using English from the beginning to the end of each unit. Moreover, they were assigned to do the activities based on the contents of the class with their friends. However, the teachers did not focus on providing four English language skills: reading, writing, speaking, and listening, in each unit.

The results of using the combination approach revealed that the students could improve their English language and content comprehension. Moreover, the students had a high attitude toward studying language and content at the same time by using the combination approach between the CLIL and the DDL (Eldridge, Neufeld, & Hanciolu, 2010; Jawhar, 2012; Muszynska, Urp, & Gazk, 2017; Piotrowska & Alekseeva, 2020; Santos, 2015). However, all the research studies did not provide information about the students' learning process or their solving of problems during studying based on the combination approach.

In summary, the studies of using the DDL in CLIL are always focused on investigating the students' content and language outcomes, which are based on the students who study in higher education, through investigating the information in both quantitative and qualitative methods. Furthermore, the DDL approach is used to investigate the linguistic information, which emphasizes lexical or syntactical information from the computer-based concordance lines.

Based on this present study, the Corpus-Based CLIL method is used to figure out the Thai high school students' knowledge of language and content through studying Economics. It is applied to evaluate the students' language abilities in Economics vocabulary and grammar through both paper-based and computer-based concordances, and it is used to assess the students' content comprehension and English language skills in studying Economics content through the activities provided in the class. Moreover, this study will analyze the students' processes and problems solving after using the combination approach from the first stage to the ending stage in each lesson plan given in the authentic classroom. Regarding the procedures for teaching and studying Economics, content and language are equally designed and taught in each lesson plan. Finally, there are two teachers—a language teacher and a content teacher—who are responsible for teaching in this study. Therefore, the Corpus-Based CLIL

method in this study can effectively reduce the gap and problem of using the combination approach between CLIL and DDL.

3. Methodology

3.1 Research Designs and Context

The study applied the quantitative method to answer research question number one, while the qualitative method was used to answer research question number two. 40 high school students who studied at the demonstration school in Nakhon Pathom, Thailand, were selected using a purposive sampling technique. There were four reasonable criteria for using the purposive sampling technique. Firstly, the participants had to study English for at least ten years and speak Thai as their mother tongue. Secondly, they had never previously used the Corpus-Based CLIL method to study Economics. Additionally, they had to study in 11th grade. Finally, their study schedules had to match those of both the language teacher and the content teacher.

3.2 Research Instruments

The instruments were composed of pre-test and post-test, teacher's field notes observation, and students' reflections. The pre-test and post-test were utilized to evaluate students' English language knowledge, their Economics content comprehension, and their linguistic competency. The pre-test and post-test contained 61 items, which were divided into three categories: 30 multiple-choice items in the vocabulary part, 30 multiple-choice items in the content part, and 1 writing item in the descriptive paragraph writing part. According to the vocabulary part, there were three subparts: selecting the most appropriate word from the given question, matching the definition, and selecting the appropriate words to complete the given paragraph to check students' Economics vocabulary and expression comprehension. In terms of the content part, the test was created to focus on Economics topics such as explaining the 10 principles of Economics, distinguishing "supply" and "demand", and summarizing the graph and figure to evaluate students' understanding of the subject. Based on the descriptive paragraph writing part, there was one topic and graph provided, titled "the production of consumer goods and the consumption of television sets in Bangkok, Thailand," so the students had to write a paragraph of at least 150 words with a suitable Economics concept. This test aimed at evaluating students' linguistic comprehension, including lexis, syntax, and collocation, focusing on Economics.

Based on the teacher's field notes observation, there were six main topics: students' participation, students' dealing with a concordancer in both paper-based and computer-based, students' dealing with corpus information, students' applying CLIL concept to study both content and language, students' dealing with Corpus-Based CLIL method and materials, and students' feelings and problems, which the researcher observed, analyzed, and categorized the data given while students were studying Economics and language from the new approach provided.

For students' reflection, there were two guided questions that covered both learning knowledge and learning processes for students to share their comprehension information in studying Economics and English.

3.3 Research Procedure

The six experts, who could be divided into two main groups, validated the data after implementing the pre-test and post-test, the teacher's field notes observation, and the students' reflections. Of the six experts, three were experts in English language teaching or linguistics, while the other three were experts in Economics. The IOC (Item Objective Congruence Index) from the six experts revealed that the pre-test and post-test, the teacher's field notes observation, and the students' reflections were each 0.90, 0.97, and 0.94, respectively. This was acceptable because the averages of the means all the instruments were not less than 0.5. However, some were modified or revised in accordance with recommendations from the experts. Additionally, 40 students who did not take part as a sample in the main research attended the pilot testing to evaluate the instruments' reliability. The modified version of the instruments was used in the main research after the pre-test and post-test, the teacher's field notes observation, and the students' reflections were revised based on expert validity and pilot testing.

3.4 Data Collection and Analysis

The pre-test was given to the participants before the contents were taught to them by the content and language teachers ten times using the new approach after the validity and reliability processes. On the other hand, the researcher observed how students behaved during the learning processes through taking note in the teacher's field notes observation. The participants completed the post-test after they had finished studying the contents by using the new method in class. The participants were required to describe the straightforward and reasonable information in the students' reflections given. The descriptive statistics and correlations approach was used to examine the pre-test and post-test data using the SPSS program. In terms of the students' descriptive paragraph

writing pre-test and post-test, the students' corpora and the Specialized corpora in Economics and business were used to investigate the similar linguistic characteristics information. The results of the teacher's field note observation and the students' reflections were examined by analyzing and categorizing themes.

4. Findings

The findings were following into two main research questions: the effects of Corpus-Based CLIL method on the Economics and English Knowledge development and the learning and problem-solving processes during learning Economics and English through the Corpus-Based CLIL method.

4.1 The Effects of Corpus-Based CLIL Method on the Economics and English Knowledge Development

In order to investigate how much the Corpus-Based CLIL method of studying both Economics and English could obviously help the eleventh-grade students improve their performance, the pre-test' and post-test' scores in each part were compared together. Furthermore, the provided scores of the pre-test and the post-test were analyzed in terms of statistical differences between the pre-test and the post-test; a paired samples t-test's results are shown from Table 1 to Table 5 below.

Table 1. The Results of Participants' Economics Vocabulary Knowledge between Pre-test and Post-test (N=40)

			Paired Differences							
Test	**Mean**	**SD**	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	**t**	**df**	**P(Sig) (2-tailed)**
Pretest	11.98	6.69	14.20	6.81	1.08	16.38	12.02	13.20	39	.000
Posttest	26.18	2.29								

* p<0.001

Table 1 shows that the post-test mean score was higher than that of the pre-test, with the mean difference of 14.20, a t-value (39) of 13.20, and a significance level of .000 (p<0.001). Furthermore, the mean score of the pre-test was 11.98 and the SD was 6.69, while the post-test scores were 26.18 and 2.29, respectively. It shows that the mean score of the posttest was 14.20 higher than that of the pre-test after using the new approach provided.

Table 2. The Results of Participants' Economics Content Comprehension between Pre-test and Post-test (N=40)

			Paired Differences							
Test	**Mean**	**SD**	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	**t**	**df**	**P(Sig) (2-tailed)**
Pretest	9.55	2.50	16.25	3.86	0.61	17.49	15.02	26.62	39	.000
Posttest	25.8	2.79								

* p<0.001

Table 2 reveals that the post-test mean score was much higher than the pre-test mean score, with a mean difference of 16.25, a t-value (39) of 26.62, and a significance level of .000 (p<0.001). Additionally, the pre-test mean score was 9.55, with a standard deviation of 2.50, whereas the posttest outcomes were 25.8 and 2.79, respectively. It demonstrates that after applying the Corpus-Based CLIL method in the classroom, the mean score of the post-test was 16.25 higher than the average of the pre-test.

Table 3. The Results of Participants' Descriptive Paragraph Writing Ability between Pre-test and Post-test (N=40)

Test	Mean	SD	Paired Differences					t	df	P(Sig) (2-tailed)
			Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pretest	9.78	2.11	4.67	1.46	0.23	5.14	4.21	20.30	39	.000
Posttest	14.45	2.65								

* p<0.001

Table 3 displays that the post-test mean score was higher than that of the pre-test, with the mean difference of 4.67, a t-value (39) of 20.30, and a significance level of .000 (p<0.001). Furthermore, the mean score of the pre-test was 9.78 and the SD was 2.11, while the post-test scores were 14.45 and 2.65, respectively. It shows that the mean score of the post-test was 4.67 higher than that of the pre-test after using the Corpus-Based CLIL method in the classroom.

Table 4. The Results of Participants' Overall Score Part between Pre-test and Post-test (N=40)

Test	Mean ($\bar{x}$)	SD	Paired Differences					t	df	P(Sig) (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pretest	31.30	8.71	35.13	9.0	1.42	38.0	32.26	24.80	39	.000
Posttest	66.43	5.76								

* p<0.001

Table 4 shows the post-test mean score was doubly higher than that of the pre-test, with the mean difference of 35.13, a t-value (39) of 24.80, and a significance level of .000 (p<0.001). Furthermore, the mean score of the pre-test is 31.30 and the SD was 8.71, while the post-test scores were 66.43 and 5.76, respectively. It shows that the mean score of the post-test was 35.13 higher than that of the pretest after using the Corpus-Based CLIL method in the classroom.

As a result, the first research study question "To what extent does the Corpus-Based CLIL method contribute to the significant improvement of vocabulary proficiency in Economics terminology, collocation, and grammatical features in the Economics' language, together with Economics content comprehension of Thai high school students?" indicated that 40 students who studied in the eleventh grade could significantly improve their knowledge of both the English language and the Economics content because they could highly increase their English language, Economics content, and descriptive paragraph writing scores after they were taught by the new approach in the classroom.

Table 5: The Comparison of Frequent Content Words in the Descriptive Paragraph Writing Task between Pre-test and Post-test

Items	Content words	Pre-test Frequency	Post-test Frequency
1	production	155	192
2	consumer	121	148
3	goods	104	123
4	graph	103	115
5	import	56	75

According to Table 5, the information from the pre-test and post-test in descriptive paragraph writing was collected as students' corpora, and then the information was analyzed to investigate the word frequency of 40

participants. The result shows that the participants had improved their word choice in writing tasks because they could frequently generate words that related to the topic provided in the post-test more than in the pre-test after they were taught content and language by the new approach.

Table 6. Examples of Sentences Produced by the Participants in the Descriptive Paragraph Writing Tasks between Pre-test and Post-test

Items	Content words	Pre-test	Post-test
1	production	The line started in 1985 shows production is 100	The line graph stated the television production expense in 1985
2	consumer	The graph of consumer explains that in 1985 is around 100	The graph of consumer demands increased to 100 in 1985.
3	goods	the production of consumer goods decreased from 1985-1986	The television production in national goods significantly decreased from 1985 to 1986.
4	graph	In the second, graph television had first-line production	The second graph showed that television production was the first thing to compare.
5	import	the consumption and import of television set during 1991 and 1995	Between 1991 and 1995, the consumption and import demand for television sets significantly increased.

Table 5 shows the sentences created by participants in the post-test were more grammatical and meaningful than the sentences produced in the pre-test. The participants could, for example, use their Economic knowledge to generate accurate and meaningful sentence patterns. Furthermore, as illustrated on items 1, 2, 3, and 5, they could utilize a word that could appropriately collocate with the indicated the frequent content words. Additionally, most participants could show their progress in studying Economics and English grammatical structures by wisely clarifying the sentence expression e.g.,4 that represent their syntactic and collocational comprehension of the concepts of Economics that they learnt in class. As a result, it suggested that, at least, the participants had a better understanding of the functions, structures and meanings of the learned Economics content and Economics vocabulary, which were frequently happened from the descriptive paragraph writing post-test after they had been taught using the Corpus-Based CLIL method.

To summarize the study's findings, the Corpus-Based CLIL method enhanced participants' abilities not only in terms of Economic content comprehension but also in terms of English language awareness, as indicated by their descriptive paragraph writing post-test. When compared to the pre-test findings, the number of word types and word tokens in the descriptive paragraph writing post-test increased from 505 and 4553 to 589 and 5980, respectively. Furthermore, the frequency of word choice in the post-test was higher than those of the pre-test. The frequency of content terms extracted from the participants' descriptive paragraph writing post-test rose considerably, as did syntactic and collocational pattern similarities. Additionally, the results demonstrated that the similar syntactic patterns of content words, including "production", "consumer", "goods", "graph", and "import" in the participants' descriptive paragraph writing post-test were significantly higher than those of the pre-test when compared to the Specialized Corpora in Economics and Business data. In addition to the results of the similar syntactic patterns between the Specialized Corpora in Economics and Business and the participants' corpora in descriptive paragraph writing, it showed that the number of similar collocational patterns of the content words such as "production", "consumer", "goods", "graph", and "import" was significantly higher than those in the pre-test as well.

4.2 The Learning and Problem-Solving Processes During Learning Economics and English through Corpus-Based CLIL Method

The teacher's field notes observation was used to gather the qualitative data through the activities from lesson plans 1 to 10 in order to provide a more comprehensive awareness of how Thai high school students follow the CLIL and DDL learning processes as well as their problem-solving processes during learning Economics and English through the Corpus-Based CLIL method. Furthermore, the data from the teacher’s field notes observation were also utilized to supplement the information obtained from the students' reflections. The data from teacher's field notes observation were analyzed using the interpretive technique, and the results are reported in the next section. According to the qualitative data collected from the teacher’s field notes observation, they revealed that all participants had high performance in studying Economics and English at the same time.

Additionally, they were able to follow the Corpus-Based CLIL procedures, which were composed of the presentation stage, the content stage, the communication stage, the cognition stage, and the culture stage.

Regarding the presentation stage, most of the participants reported that this stage was certainly challenging for them because they had to study the Economics key wordlists by using the paper-based and computer-based concordance lines to investigate the meanings, forms, structures, and collocation patterns of the words given in each lesson plan. Although they had to spend several times finding the information through the concordance lines, they could understand and see the authentic information instead of memorizing it from the text books. Furthermore, they could study some specialized Economics vocabulary and grammar patterns through the COCA corpora website and AntConc program, so they could investigate the accurate information and some examples to ensure their prediction before they answered the questions that were provided at this stage.

In terms of the content stage, all participants reported that this step would not be difficult if they understood the accurate meanings and functions of the Economics words because they would be confident to share their ideas and provide answers about Economics contents such as supply and demand when the teachers asked. The participants were motivated to learn the contents and language at the same time through several activities, such as group, pair, individual, and whole class. Therefore, they could understand the Economics concepts and develop their English knowledge, such as if-clause patterns, article patterns, and sentence patterns, because the passages that were provided would let participants study at the same time. If the participants had some problems studying, the teachers and their friends would always help them explain or clarify because the atmosphere in the Corpus-Based CLIL classroom was not competitive. Therefore, the participants were highly satisfied to study Economics and English, and their Economics and English knowledge gradually improved from the first to the last time.

Besides the presentation and content stages, all participants reported that they highly enjoyed the communication stage because they could improve their English skills, especially in speaking and listening, through the Economics contents and activities provided. The participants significantly improved their English-speaking skills because all participants could communicate with the teachers and their friends since lesson plan 6, although they had problems expressing their ideas or their answers in English based on a few lesson plans at the beginning of this experiment. Moreover, they could perform their performance, which related to the Economics concepts in their role-play activities. When they received the questions from the teachers, they always brainstormed, outlined, discussed, and summarized the information into bullet points before they created their dialogue in the role-play activity. Therefore, the participants would get the most benefit from the activity at this stage because they could dare to speak and present their ideas in English in front of the class.

Based on the culture and cognition stages, the participants reported that it was the most difficult stage in studying Economics contents because they had to apply the contents that they had learned in each lesson plan to the situation in Thailand. For example, they had to use the demand and supply contents to support their opinions and suggestions on the topic that the teachers provided, but they also had to show some examples that were related to Thai contexts. Therefore, some participants would not perform this stage well at the beginning of this experiment, but they gradually improved themselves with the teachers' assistance. However, the participants could show their content comprehension, language skills abilities, and knowledge of linguistic characteristics through the activities provided in group or in whole class.

Besides analyzing and categorizing the participants' behavior from CLIL learning processes as well as their problem-solving processes through the Corpus-Based CLIL method, this present paper would present the DDL learning processes and problem-solving processes in both paper-based and computer-based concordance from the participants.

Based on DDL processes in the paper-based concordance, the data show that the Identification step was obviously simple for the participants to involve in investigating the information of keywords given because they studied the information that was provided for them, then carefully examined the concordance lines, parts of speech from the keywords given, and irrelevant keywords. After that, they tried to figure out the possible syntactic, lexical, and collocational information from the keywords given. Despite the fact that the concordance lines were not completed, all participants were notified that they had to guess what may be contained in each keyword under investigation. During the Analysis step, the participants agreed that they had to pay extremely close attention compared to the previous stage because they had to examine the information that was hidden in the concordance lines. Before categorizing the word patterns and collocations, they had to compare the provided information from the words with their possible information. When they were truly confident in their answers, they would select the appropriate keywords from the concordance lines or write the correct answer on the answer

sheet given. During Generalization step, the participants claimed that they had to take into account the context provided with the keyword and try to gather evidence to support their answers or check their theoretical models that support the linguistic functions in order to obtain a specific rule of lexical, syntactic, and collocation information. Furthermore, the participants said that the generalization step was not difficult for them if the information from the Analysis step was totally correct and meaningful.

In terms of using DDL processes in computer-based concordance, the participants said that the Identification step was simple, and after carefully thinking of the possible words that might be collocated with them, they were able to recognize the keywords given to put in the COCA's search box and the AntConc application's search box. Although there were several searching options and features on the COCA corpora website and the AntConc program to get meaningful concordance lines, the participants said that they had to determine the possible collocate of each keyword under investigation. Moreover, they had entered both the keyword and its possible collocate into the COCA and AntConc's search boxes to verify their hypotheses. In Analysis step, they reported that it was more challenging than the Identification step in the computer-based concordance because they had to spend a lot of time investigating the information that they obtained from the concordance lines. If their assumption was incorrect, they had to think of the possible words a second time to find out the accurate information. However, the participants applied the KWIC option, especially in COCA corpora, to help them analyze the possibly correct collocate word from the concordance lines. During Generalization step, the participants were suggested to check the concordance lines that had certain common and shared characteristics or not, so they could avoid overgeneralizing each keyword given. In this stage, the participants said that they had to take the context of the keyword into account and try to gather evidence to support their answers or check their theoretical models that support the linguistic functions in order to obtain a specific rule of lexical, syntactic, and collocation information. Furthermore, the participants said that the generalization step was not difficult for them if the information from the Analysis step was totally correct and meaningful. If they were unsure, they would check the detail and summarize again before they made their final decision to choose or to write the keywords, together with their collocates, based on two computer-based concordance lines.

Moreover, this present study used the information which obtained from the students' reflections to investigate the learning processes through Corpus-Based CLIL Method.

Table 7. The Processes of Learning Economics Vocabulary and Grammar through Using the Corpus-Based CLIL Method of the Forty Participants

Rank	Reflections and Comments	Frequency	Percentage
1	I can apply the DDL processes to investigate the information from concordance lines to study vocabulary patterns, vocabulary meanings, and grammatical structures appearing in Economics	34	85%
2	I can apply the DDL processes to investigate the information from concordance lines to study vocabulary patterns, vocabulary meanings, and grammatical structures appearing in Economics, but the Analysis step and the Generalization step are difficult for me	6	15%

According to table 7, the data reveal that the first ranking of written reflections was composed of 34 comments, or 85%, which indicated that the participants could apply the DDL processes to investigate the information by using paper-based concordance lines and computer-based concordance lines, while the second ranking was composed of 6 comments (15%), indicating that the participants applied the DDL processes to investigate the information from concordance lines to study vocabulary patterns, vocabulary meanings, and grammatical structures appearing in Economics, but they thought both Analysis step and Generalization step were difficult for them.

Table 8. The Processes of Learning Economics Content through Using the Corpus-Based CLIL Method of the Forty Participants

Rank	Reflections and Comments	Frequency	Percentage
1	I can apply the Corpus-Based CLIL method to study all Economics contents and English.	20	50%
2	I can apply the Corpus-Based CLIL method to study all Economics contents and English, but I must spend much time studying the contents to understand.	10	25%
3	I can understand the Economics contents through activities such as discussing, role-playing, and presenting the information based on the new approach.	6	15%
4	I can apply the Corpus-Based CLIL method to study Economics; although, I must study through English texts.	4	10%

According to table 8, the data present that there were 20 comments (50%) that ranked in the first position and expressed that the participants could apply the Corpus-Based CLIL method in studying Economics and English. The next position was composed of 10 comments, or 25%, indicating the Corpus-Based CLIL method can help participants study Economics and English, but they had to spend a lot of time understanding the contents. There were six comments (15%), which were ranked in the third position, which showed that the participants could understand the Economics contents through activities such as discussing, role-playing, and presenting the information based on the new approach. The lowest rank of the written reflections consisted of 4 comments, or 10%. The information in the lowest rank presented suggested that the provided new approach could help them understand the Economics content clearly, although they had to study in the English language.

In conclusion, the Corpus-Based CLIL method was certainly helpful to participants in studying Economic content and the English language. The participants could apply the learning processes to study both content and language well. Additionally, they were able to solve the unexpected problems while studying the content and language parts. Therefore, the results of research question number 2 could address the suitable way of learning by using the Corpus-Based CLIL method for people who would like to improve not only their English but also Economics.

5. Discussion

5.1 The Effects of Corpus-Based CLIL Method on the Economics and English Knowledge Development

According to Coyle, Hood, & Marsh (2010), they stated that the content in CLIL is the most significant factor because the content can be the progression in developing students' knowledge, skills, and perceptions from the contents given, which are relevant to the subjects' areas. As a result, the students will have the opportunity to learn the contents in English while they are being taught by teachers in the classroom. Furthermore, their conclusions correspond with statements in Charunsri (2020), MacGregor (2016), and Mehisto (2012) that this useful method given in this study consistently focuses on students' abilities in both knowledge and language, and the content in the subjects given can effectively motivate students to involve themselves in studying language as well.

Focusing on the linguistic features of students' descriptive paragraph writing, the findings showed that the students could significantly improve their linguistic features, such as syntactic information and collocation information, after they studied the Economics subject through the corpus-based CLIL method and materials. As Marsh (2005) explained, the sufficiency of good-quality input can make language acquisition successful for students. In order to ensure the students' success in language acquisition, the teachers should develop their language skills together with studying the real cultures of several people before teaching their students. Furthermore, Phoocharoensil (2012) and Sripicharn (2002) explained that the DDL strategies could effectively enhance students' language knowledge, especially in specific language targets such as collocational information, because the students could learn from authentic information both online and offline, so they could perceive much more English sentence structures than they received from the text books. Based on vocabulary teaching in the classroom, the DDL approach was very useful for the teacher to teach students because the students could understand and enjoy finding the language information, especially in specific language targets, by themselves in class instead of studying through commercial books (Guan, 2013; Petcharinphan, 2020). Therefore, the effects of

the Corpus-Based CLIL method on the first research question could summarize that the students' progression in Economics content comprehension and English language abilities was influenced by the new method given.

5.2 The Learning and Problem-Solving Processes During Learning Economics and English through Corpus-Based CLIL Method

The students were energetic and participated in every task that the teachers assigned in the CLIL classroom (Eurydice, 2006). Harrop (2012) supported the study findings that the CLIL process could stimulate the students' motivation to use the real-life texts to improve their language use, so it could enhance an opportunity for the students to properly use L2 language and help the students relieve their anxiety and suffocation in studying a foreign language as well. According to Prasansaph (2019), the CLIL strategies were highly effective in increasing the students' knowledge because they could learn and apply them to every kind of activity. According to Harrop (2012), the students could understand and absorb the various languages used through the language given in the tasks designed. Although they always made a lot of mistakes at the beginning of the experiment, they could prove that they had made progress in the use of Economics. Therefore, the results could be summarized as showing that the students could improve their knowledge of specialized linguistic features through the corpus-based CLIL methods and materials.

Moreover, the students seemed to be accomplished at interpreting the information obtained from the paper-based concordance and computer-based concordance applications by using DDL strategies because they could improve the number of technical terms in Economics based on the expansion of linguistic features such as lexical, syntactic, and collocation knowledge. The expansion of linguistic features could increase students' abilities to handle the concordance lines in the given texts or assignments (Blake, 2021; Vincent & Nesi, 2018). The development of linguistic qualities could improve students' capacity to manage concordance lines in texts or assignments. The students claimed that the teachers should advise them on how to use the computer-based concordance lines to become more proficient before allowing them to use the program independently. However, the students claimed that the strategies provided allowed them to simultaneously improve their language skills and content comprehension, which were similar to the paper-based concordance lines. To sum up, the DDL strategies (Identification, Analysis and Generalization) in paper-based and computer-based concordance lines were to both improve students' language and content abilities, along with supporting them to learn by themselves outside the classroom as well.

6. Conclusion

It was evidently found that the results of using the Corpus-based CLIL method were effective based on the average scores in the English language part, the Economics content part, and the descriptive paragraph writing part of the post-test. As is revealed, the average scores of the students' post-test were significantly higher than those in the pre-test on their English knowledge, Economics knowledge, and descriptive paragraph writing abilities. Focusing on the descriptive paragraph writing, the participants could improve the number of content words, the accurate grammatical patterns, and the suitable collocation patterns on their post-test. Additionally, it was generally accepted that the Corpus-Based CLIL method, especially in CLIL and DDL processes, promoted the participants understanding of Economics content and English language simultaneously because they were motivated to study by several outstanding processes in the lesson plans and concordances, which were both paper-based and computer-based.

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