The Effectiveness of CLIL-Based Instruction in Enhancing the MUST Engineering-Majoring students' EFL Functional Writing and Critical Thinking Skills

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Abstract

The present study examined the effectiveness of utilizing the CLIL-based instruction to enhance the engineering-majoring students' EFL functional writing and critical thinking skills. The 64 participants were third-year engineering majoring students in Misr University for Science and Technology (MUST). They were required to study the ESP course of Academic Writing during the first term of academic tear 2023-2024. They were equally divided into control and experimental groups with 32 students each. The present study employed two different versions of the functional writing and critical thinking pre-and-posttests. It also designed two assessment checklists of the functional writing and critical thinking skills. The current paper analyzed the elicited data quantitatively and qualitatively. The study employed descriptive and inferential statistics for the purpose of data analysis. As such, it employed the mean scores, standard deviations and frequency on one hand and paired samples t-test and independent samples t-test on the other. The findings showed better performance of the experimental students in the functional writing and critical thinking posttest compared to the control group students. They also had higher assessment rates in terms of functional writing and critical thinking skills compared to the control group. Recommendations were based on integrating the CLIL into curriculum planning and design of teaching ESP courses to engineering-majoring students in MUST.

Keywords: CLIL instruction, functional writing, critical thinking, engineering-majoring students, ESP courses.

فاعلية التدريس القائم على التعلم المتكامل للمحتوى و اللغة فى دعم مهارات الكتابة الوظيفية و التفكير الناقد للغة الإنجليزية كلغة أجنبية للطلاب الدارسين للهندسة بجامعة مصر للعلوم و التكنولوجيا

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الملخص

أختبرت الدراسة الحالية فاعلية إستخدام التدريس القائم على التعلم المتكامل للمحتوى و اللغة فى دعم مهارات الكتابة الوظيفية و التفكير الناقد للغة الإنجليزية كلغة أجنبية للطلاب الدارسين للهندسة حيث ضمت الدراسة ٦٤ مشاركا مقيدين بالفرقة الثالثة لدراسة الهندسة فى جامعة مصر للعلوم و التكنولوجيا (ماست) حيث أنهم مطالبين بدراسة مقرر اللغة الإنجليزية لأغراض خاصة خلال الفصل الدراسى الأول للعام الجامعى ٢٠٢٣-٢٠٢٤ ، و تم تقسيمهم بالتساوى إلى مجموعتين ضابطة و تجريبية ضمت كل منهما ٣٢ طالبا، و أعتمدت الدراسة على نسختين مختلفتين من الأختبار القبلى و البعدى لمهارات الكتابة الوظيفية و التفكير الناقد، و صممت الدراسة قائمتين تدقيق لتقييم مهارات الكتابة الوظيفية و التفكير الناقد، و حللت الدراسة البيانات البحثية كما و كيفا، حيث أعتمدت على الإحصاء الوصفى و الأستدلالى فى تحليل البيانات البحثية مثل المتوسطات الحسابية و الإنحراف المعيارى و معامل التكرار من جانب و أختبار "ت" للعينات المقترنة و أختبار "ت" للعينات المستقلة من جانب أخر، و أوضحت الدراسة تحسن أداء طلاب المجموعة التجريبية فى مهارات الكتابة الوظيفية و التفكير الناقد مقارنة بنظرائهم فى المجموعة الضابطة، كما حصلوا على معدلات تقييم أعلى بشأن مهارات الكتابة الوظيفية و التفكير التاقد مقارنة بالمجموعة الضابطة، و ركزت التوصيات على دمج التدريس القائم على التعلم المتكامل للمحتوى و اللغة فى تخطيط و تصميم مقررات اللغة الإنجليزية لأغراض محددة للطلاب الدارسين للهندسة فى جامعة مصر للعلوم والتكنولوجيا.

الكلمات المفتاحية: التدريس القائم على التعلم المتكامل للمحتوى و اللغة، الكتابة الوظيفية ، التفكير الناقد، الطلاب الدارسين للهندسة، مقررات اللغة الإنجليزية لأغراض محددة

Introduction

The enhancement of functional writing and critical thinking skills is essential to sustain the ESP learners' proficiency level. The ESP learners are often expected to prove ability of efficiently using English carry out tasks pertinent to their fields of study. They are required, for instance, to understand English-written technical texts, discuss, analyze, produce and critically think about those texts.

Helaluddin, Purwati, Guntur, Hasmawatiy and Wijaya (2023) indicated that the functional writing skills are important to all EFL learners including the ESP students. Functional writing skills include the ESP students' adherence to: syntactic rules (word order and sentence structure), usage of appropriate terminologies, discussion of the subject matter, text analysis and text perfection (i.e. editing of spelling and grammar textual aspects).

Pedagogically, critical thinking which is also termed as reflective thinking encompasses various skills. Essien, Bukoye, O'Dea, and Kremantzis (2024) pointed out that the term refers to the EFL learners' ability to conceptualize, analyze, synthesize, apply and evaluate textual information contained in a reading text. These two skills are important to the engineering-majoring students who are mostly required to produce English-written reports, reflect on and understand engineering texts written in English. These two skills are interrelated because the former can be utilized to enhance the latter. In addition, those students are also required to study the engineering core course in English. Thus, the enhancement of English proficiency levels including functional writing and critical thinking of engineering-majoring students is a must.

According to Perez Canado (2020), one of the most influential educational approaches to elevate the proficiency level of EFL learners is the content and language integrated learning (CLIL) approach. The CLIL

approach can effectively cater for the learning needs of different proficiency levels of EFL learners. In Europe, the CLIL approach emerged as an educational tool that help enhance the teaching and learning of English language against the traditional approaches of foreign language teaching. The CLIL approach is a double-function pedagogical approach which focuses on language content and outcomes of language learning. Hidalgo and Ortega-Sanchez (2023) clarified that it is not an easy pedagogical approach for EFL teachers to carry out. That is, both components of language content and learning outcomes are entwined in the CLIL approach.

In other words, Deswila, Kustati, Besral and Sukandi (2020) clarified that the complexity of CLIL approach stems from the fact that it requires EFL teachers to focus not only on the language content being taught or the language related to that content, but also how to ensure that their students have comprehended the language content and improved their language learning outcomes. Zemach (2021) explained that the implementation of CLIL approach has been expanded all over the globe for the purpose of developing EFL learners' FL proficiency. It was designed as a doubled-function pedagogical approach concerned with teaching and learning foreign languages. It facilitates the spontaneous learning of FL content knowledge.

Like other pedagogical approaches, there are pros and cons for the CLIL implementation which may vary between success and failure. Some studies affirmed the better learning outcomes of students received CLIL-based instruction such as Shepherd and Ainsworth (2017), and Bulte, Surmont and Martens (2022). Other studies questioned the consistent effectiveness of CLIL instruction in sustaining the EFL learners' proficiency levels such as Fung and Lo (2023) and Fernández-Sanjurjo, Fernández-Costales, Arias Blanco (2019). Therefore, the current study

attempted to fill in the literature gap of the consistency of CLIL effectiveness.

Furthermore, the review of literature revealed that there are several theoretical studies focused on describing the benefits and perception of using CLIL approach or systematically reviewing the CLIL-pertinent studies. As such, the present study was intended to compensate for the lack of experimental studies on CLIL implementation, particularly at the Egyptian higher education level.

Statement of the Problem

Based on the conducted pilot study, the performance of third-year engineering majoring students in FL functional writing and critical thinking was far from being satisfactory (Table 1). Therefore, the current study examined the effectiveness of utilizing the CLIL-based instruction to enhance the engineering-majoring students' FL functional writing and critical thinking skills. The examination of these two skills includes the sub-skills clarified in the definition of terms.

Table 1: Descriptive Statistics of the Pilot Study

N	Mean	Standard Deviation	Minimum	Maximum
25	1.58307	2.36486	18	30

Questions

Below are the investigated questions within the current study's parameters:

1. What is the difference between the pretest performance in functional writing and critical thinking skills of the two groups?
2. How do the functional writing and critical thinking skills vary between both groups in the posttest?

3. What is the statistically significant difference between the posttest performance in functional writing and critical thinking between both groups?
4. What the effectiveness of CLIL approach and regular method in teaching FL functional writing and critical thinking skills?

Hypotheses

The present study conducted a verification of the following null hypotheses:

1. The pretest performance in functional writing and critical thinking skills does not differ between the two groups.
2. The two groups similarly perform in the functional writing and critical thinking posttest.
3. There is no statistically significant difference between both groups' posttest performance in relation to the two investigated skills.
4. The CLIL approach and regular method are equally effective in enhancing the participants' functional writing and critical thinking skills.

Aim of the Study

The current study mainly aimed to determine the effectiveness of using the CLIL-based instruction to enhance the engineering-majoring students' EFL functional writing and critical thinking skills.

The present study intended to realize the following aims as well:

1. Describing the pretest performance in functional writing and critical thinking skills does not differ between the two groups.
2. Determining the two groups' similar performance in the functional writing and critical thinking posttest.
3. Verifying the statistically significant difference between both groups' posttest performance.

4. Stating the effectiveness of CLIL approach and regular method in teaching FL functional writing and critical thinking skills.

Significance of the Study

Significance of the present study can be summarized as follows:

1. Meeting the ESP students' needs to enhance their functional writing and critical thinking skills.
2. Sustaining the goals of developing TEFL process in MUST.
3. Providing insights to planning and designing ESP curricula in MUST.
4. Supporting the efforts of developing English proficiency levels of Egyptian ESP students.
5. Assessing the CLIL contribution to TEFL process in Egypt.
6. Providing lesson plans of CLIL implementation in the Egyptian ESP context.
7. Generally, enriching the TEFL literature.

Definition of Terms

The Content and Language Integrated Learning (CLIL)

Piacentini (2021) defined CLIL as an innovation-based approach which incorporates the learning of certain syllabus content by using a foreign language. The CLIL approach encompasses various methodological elements such as exposing students to authentic situations of communication, discursive teaching of the foreign language, comprehending, analyzing and producing oral and written language, and considering the FL social and cultural contexts.

The present study defined CLIL as an educational approach employed to sustain the ESP experimental participants' functional writing and critical thinking skills.

Functional Writing

Skar, Aasen and Jolle (2020) defined functional writing as a purposive action of writing which is based on activities practice, communication and memorization. It involves the use of language in accordance with its communicative and pragmatic rules. Functional writing entails that learners can interact in writing to realize different goals through producing a meaningful interactive written text. The development of function writing depends on the ability of producing text, observing coherence in producing phrases and sentences, and realizing certain meaning in a specific context.

The present study employed the term functional writing to indicate the participants' ability of producing accurate engineering-written texts in terms of syntax, usage of engineering terminologies, written discussion of engineering topics, analysis of engineering texts, and engineering text perfection.

Critical Thinking

Heard, Scoular, Duckworth, Ramalingam and Teo (2020) defined critical thinking as a set of cognitive skills directed to realize certain goals and purposes such as problems solving, experiment conduct, establishing arguments, topics comprehension, details analysis, information inferences, providing critiques, etc.

Critical thinking skills refer, in the present study, to the participants' ability of processing reading text information through conceptualization, analysis, application, synthesis, and evaluation.

Literature Review and Related Studies

As Lopez-Medina (2021) evaluated the FL textbooks used for implementing the CLIL approach. It is important to identify elements of strength and weakness of CLIL taught textbooks to ensure the realization

of CLIL objectives of enhancing language content and knowledge. Data were collected by using a 54-item evaluation checklist administered to five CLIL teachers and semi-structured interview. The checklist covered textbook evaluation criteria and the main components of CLIL approach. The results indicated that the EFL teachers believed that CLIL textbooks should support the engagement of parents to help students with the FL assignments. The participants also recommended that the teacher's guide needs to be modified to reinforce the use of CLIL approach for FL teaching. Appropriate CLIL activities are also required to be added to the student's book to facilitate the EFL teachers' role in implementing the CLIL approach. The participants also indicated that the CLIL approach sustains the FL use as a medium of instruction in FL classrooms as opposed to the mother tongue. The CLIL approach also facilitates learning of language content because it includes visual aids such as pictures, figures, etc. the variety of CLIL visual aids can elevate the EFL learners' low proficiency levels in order to comprehend the taught language content. The CLIL-based activities helps increase the mutual interaction between teachers and learning in a manner which improves the learning outcomes. The participants also suggested that the CLIL textbooks should include high and low thinking activities to sustain the students' cognitive skills.

Montoya (2022) conducted a systematic review study to discuss the contribution of CLIL approach to developing the EFL learners' writing skills. Montoya adopted the theoretical concept of bilingual education to describe findings of up-to-date CLIL relevant studies. Montoya found that the CLIL approach enabled students to comprehend language content and capture English linguistic knowledge. In other words, the CLIL sustains the EFL students' necessary cognitive skills for analyzing different structures of English sentences and learning linguistic knowledge needed for development of writing skills. The implementation of CLIL approach also

facilitated EFL teachers' exploration of their teaching strategies, identification and reflection on factors lead to the improvement of teaching FL writing skills. Montoya concluded that the CLIL approach can compensate for the inability of regular instruction to full meet the EFL learners' communication needs in various learning contexts. The CLIL approach helped develop the EFL students' learning of FL content and knowledge. It also encouraged EFL teachers to develop interactive strategies with students in a way that sustains the success of FL teaching.

Villabona and Cenoz (2022) discussed teachers' beliefs and understanding of achieving balance between content and language knowledge when implementing the CLIL approach. Villabona and Cenoz conducted in-depth examination of the beliefs and thoughts of two EFL teachers. The participants worked at two high schools in Spain, where the CLIL approach was implemented to reinforce multilingualism among the Spanish high school students. The two participants had different professional backgrounds and working experiences. The study sought to uncover their ways of conceptualizing the incorporation of content and language knowledge when implementing the CLIL approach. Data were collected through semi-structured interviews and classrooms onservation. Villabona and Cenoz found that balancing content and language knowledge is an arduous task to realize the two objectives behind CLIL implementation. The difficulty arose from the two participants' different views, concepts and thoughts of implementing the CLIL approach. One participant had more tendencies to use more content materials at the expense of language knowledge in implementing the CLIL approach. In contrast, the other participant was more language knowledge-oriented in implementing the CLIL approach. Villabona and Cenoz emphasized that language teachers shaped their CLIL implementation ways based on their beliefs, views and conceptualization of the CLIL approach. The researchers

concluded that the roles of language teachers vitally affected the CLIL implementation as some classrooms receive more intensive content-based instruction while other classrooms received intensive language knowledge-based instruction.

Alfred (2024) examined the views of EFL learners on the impact of using CLIL on their self-regulation perspective on the one hand. Alfred also discussed the interrelation between CLIL utilization and levels of self-regulation, challenges of content knowledge and language achievement on the other. One hundred sixty seven students enrolled in a junior secondary school in Hong Kong took part in the current study. Data were collected through two surveys. The first survey represented a motivation questionnaire to determine the participants' learn English by receiving CLIL-based instruction. The second survey covered a self-regulation questionnaire which verified the participants' self-monitoring, preparation, and reflection. The findings indicated that the participants are mostly of moderate self-regulation level, they have various challenges in learning the FL content knowledge, and they found great difficulty in mastering the English listening skill. Alfred affirmed that the participants' moderate levels of self-regulation are significantly correlated with the challenges of learning the FL content knowledge. Alfred emphasized that components of self- regulation significantly differed in predicting the participants' FL achievements. Out of all self-regulation components, motivation was the most statistically significant component affecting the participants' FL achievements. Meanwhile, the other self-regulation components including self-monitoring, preparation and reflection did not significantly contribute to the prediction of participants FL achievements.

Hu (2023) compared the employment of English-medium instruction (EMI) and CLIL approach in a bilingual educational environment. Hu systematically reviewed different studies on both approaches. The

researcher found that EMI should be *CLIL-ised* in what she termed as *CLIL-ised EMI*. The derived term pays attention to students' needs particularly it satisfies their need to master English linguistic knowledge. The *CLIL-ised EMI* is effective in the bilingual education environment since it helped to withstand language learning barriers encountered students in learning language content. Hu clarified that the *CLIL-ised EMI* implementation requires attention on the part of teachers to meet the students' needs of mastering linguistic knowledge. Thus, teachers should collaborate with curriculum designers in selecting content activities that sustain their students' linguistic knowledge.

Nguyen, Nguyen, Gao, Hoang and Starfield (2024) discussed the design of collaborative project to handle the needs for the development of EFL Vietnamese teachers' professional ability to implement the CLIL approach. Data collected through online interviews of EFL Vietnamese teachers' involved in implementing the CLIL approach. The interview questions centered on how the interviewees developed their professional ability to employ CLIL approach in comparison to other traditional teaching strategies employed in the teaching and learning process. The interviewees were also asked to identify obstacles that impede the CLIL implementation. These obstacles mainly centered on the EFL teachers' preparation to efficiently apply the CLIL approach. Thus, employment of CLIL approach entails the necessity of equipping EFL teachers with the professional training to successfully carry out CLIL-based instruction. Thus, Nguyen et al. asserted that development of professional ability of EFL teachers in Vietnam is a persisting issue necessary for the correct CLIL implementation.

Delimitations

The current study is delimited to:

1. The engineering-majoring ESP students in MUST (n=64).

2. The enhancement of functional writing and critical thinking skills.
3. The evaluation of CLIL effectiveness in teaching ESP courses.
4. The significance level is 0.05.

Method

As a mixed method based study, the current paper analyzed the elicited data quantitatively and qualitatively (Helaluddin et al., 2023, Fung and Lo, 2023and Essien et al., 2024). The quantitative approach relied on the descriptive statistics of minimum and maximum scores, mean scores, and standard deviations of the pre-and-posttests. The current study employed the inferential statistics of paired samples and independent samples t-tests as well. The qualitative approach handled the description of the participants' performance in the functional writing and critical thinking pre-and-posttests. The qualitative analysis also relied on the frequency score to analyze the assessment of both groups' functional writing and critical thinking checklists.

Participants

The 64 participants were third-year engineering majoring students in MUST. They were required to study the ESP course of Academic Writing during the first term of academic tear 2023-2024.

Procedures and CLIL-Based Instruction Model

The study was conducted during the first term of the academic year 2023-2024 where the participants sat for the pre-and-posttests of the functional writing and critical thinking skills at the end of the term successively. Two different versions of the functional writing and critical thinking pre-and-posttests were constructed and derived from Lloyd, James, and Frazier's (2012) textbook (Appendices A and B). Following the pretests, the participants were assigned to two groups, namely control and experimental groups. Each group comprised thirty-two students where a

CLIL-based instruction model of functional writing and critical thinking was designed for the experimental group (Appendix C). Meanwhile, the control group studied the syllabi of functional writing and critical thinking by using the traditional method of lecturing.

The design of CLIL-based instruction model was constructed based on the British Council CLIL lesson plan framework https://bridge.edu/tefl/blog/clil-lesson-plans. The main principles behind the CLIL-based instruction model were: (1) English was used as a medium of instruction for the realization of two purposes learning the content and reinforcing the experimental students' functional writing skills, and (2) combination of content knowledge and language knowledge. In other words, the model focused on the combination of critical thinking skills of handling the engineering content knowledge and functional writing skills. Ensuring the success of this model, it combined the elements of (1) content, (2) communication, (3) cognition, and (4) FL culture. Content refers to achieving progress in the experimental students' comprehension of engineering related contents and topics. Communication means sustaining the ability of the experimental students to employ English functional writing in engineering and technical related topics. Cognition refers to the experimental students' ability to process, analyze, evaluate and synthesize engineering-related information. Culture means the experimental students' exposure to FL cultural elements.

Therefore, each CLIL-based instruction lesson plan includes the four skills of language learning. For instance, listening and reading were employed to provide the experimental students with the engineering terminologies necessary for developing their functional writing skills. Through reading skill, the experimental participants were trained on how to process, analyze, evaluate and synthesize engineering related information.

The experimental students also learned types of proper structure of English sentence through writing skills. Speaking skill was employed as an oral application of developing the experimental students' critical thinking and functional writing skills. In order to compensate for the main CLIL drawbacks, the researcher used tools of advanced technology to enrich the sources of CLIL learning materials and facilitate the practice of CLIL-based activities (Appendix D). The training treatment for both groups spanned a 10-week period. The participants of both groups studied the training content derived from Lloyd et al.'s (2012) textbook as shown in Table 2.

Collaborating with other TEFL staff, the researcher assessed the functional writing and critical thinking skills of both groups by using two separate checklists (Appendices E and F). The pre-and-posttest versions and the two checklists were reviewed by a panel of three TEFL professors for the purposes of accuracy, consistency and validity. A pilot study was earlier conducted to check for the validity and reliability of the functional writing and critical thinking tests and the two checklists by using a sample of 25 students. In terms of validity, some questions were adjusted for the purpose of clarity and the number of questions was reduced to make the tests length consistent with the allowed times. Similarly, the two checklists items were also modified and rearranged based on the panel recommendations. The tests and checklists were valid as they observed the different sub-skills of functional writing and critical thinking. The Cronbach's Alpha reliability coefficients of .90, .92, and 0.88 for the functional writing and critical thinking test, the functional writing checklist and the critical thinking checklist respectively suggested high reliability of the three instruments.

Table 2: Content of Training Treatment

- hat is engineering? - Shapes - Materials - Tools - Energy - Simple Machines - Working with numbers -	- Types of measurement - The scientific method - Safety precautions - Civil engineering - Chemical engineering - Mechanical engineering - Electrical engineering - Aerospace engineering

Data collection instruments

The present study employed two different versions of the functional writing and critical thing pre-and-posttests. Both tests consist of five questions were marked out of 100 marks as twenty five marks were assigned for each question. The pre-and-posttests contain reading comprehension about engineering as a career and engineering tools successively. The participants were required to answer five questions related to the reading passage. The true and false questions tested the participants' ability of correctly process and comprehend engineering related information. The section of supply the missing words includes five sentences to demonstrate the participants' knowledge of engineering lexis and vocabulary. In question three, the participants' functional writing ability was tested as they were required to write reports on engineering as a career and types of engineering tools. Question four examined the participants' ability to analyze engineering related information by describing the engineer's tasks and functions of different engineering tools alternatively. In question four, the participants were also expected to process, analyze, and synthesize engineering related information. Question five focused on the evaluation component of the critical thing skills where the participants were required to evaluate the studying of engineering and the mechanisms of different engineering tools.

In addition, two separate checklists were designed in line with other related studies (Lopez-Medina, 2021; Helaluddin et al. 2023; and Essien, 2024) to assess the functional writing and critical skills of both examined groups. Each checklist consists of 10 items and is designed on the basis of four-Likert scale, namely Frequently=1, Sometimes=2, Seldom=3, and Never=4.

Data Analysis

The quantitative analysis, in terms of paired samples t-test, aimed to identify the potential differences between the control and experimental groups' performance in the pre-and-posttests. The independent samples t-test verified the improvement of both groups' performance in using the functional writing and critical thinking skills. The quantitative analysis verified the statistical significant differences between both groups' performance in the posttest by computing the gained mean scores. As for the descriptive statistics, Table 3 showed that all participants poorly performed in the functional writing and critical thinking pretest. This is evident in the mean scores (29.38 for the control group), (29.16 for the experimental group) and standard deviations of (4.79) for the control group and (4.62) for the experimental group. The two groups had similar minimum-maximum scores (22-49) for the control group and (23-50) for the experimental students. The participants poorly processed and understood engineering related information. They showed poor knowledge of engineering lexis and vocabulary. They failed to correctly write reports on engineering as a career. Terrible trouble spots were found in their answer to question four as they could hardly process, analyze, and synthesize engineering related information. Similarly, all participants had problems in answering question five as they poorly demonstrated ability to evaluate the studying of engineering compared to other fields. Thus, the current study accepts the hypothesized assumption that there is no difference between the

performances of both groups in the pretest. The finding is compatible with those reported by Fung and Lo (2023) and Fernández-Sanjurjo et al. (2019).

Table 3: Descriptive statistics of the paired

	Mean Score	SD	Min.	Max.	N
Control pretest	29.3824	4.79301	22	49	32
Control posttest	40.7803	16.96640	52	70	32
Experimental pretest	29.1620	4.62611	23	50	32
Experimental posttest	65.2957	27.48513	59	88	32
Valid Number					

Table 4 showed that the experimental students outperformed their control group counterpart in the functional writing and critical thinking posttest. The former had higher mean score (65.29), standard deviation (27.48), minimum-maximum scores (59-88) compared to those of the control group students (40.78), (16.96), and (52-70) respectively. In other words, the experimental group's errors in functional writing and critical thing were fewer than those of the control group participants. On the contrary to the experimental group, there was statistical significant difference between the control group's performances in the pre-and-posttests. The finding rejects the second null hypothesis concerning similarity between both groups' performances in the posttest. The finding comes in agreement with those reported by Shepherd and Ainsworth (2017), and Bulte, Surmont and Martens (2022), Montoya (2022), and Hu (2023).

Table 4: Results of paired samples t-test

Participants	Mean Score	SD	N	df	t-value	Sig.
Control pretest	29.3824	4.79301	32	31	7.836	0.006
Control posttest	40.7803	16.96640	32	31		
Experimental pretest	29.1620	4.62611	32	31	24.731	0.000
Experimental posttest	65.2957	27.48513	32	31		

Table 5 indicates the results of computing the gained mean score for each group. Obviously, the experimental participants obtained higher gained mean score (36.13) vis-à-vis their control group counterparts (11.39). The difference between both groups' gained mean scores was statistically significant at 0.05. This is a piece of evidence on the effectiveness of CLIL-based instruction in teaching the functional writing and critical thinking skills to the experimental participants compared to the regular method applied to the control group students. Therefore, these findings reject the third and fourth null hypotheses. The findings agreed with those reported by Villabona and Cenoz (2022), Alfred (2024), and Nguyen et al. (2024).

Table 5: Results of independent samples t-test

Participants	N	GM	SD	df	t-value	Sig.
Control	32	11.3961	12.17339	31	16.895	.000
Experimental	32	36.1337	22.85902	31		

Results of Functional Writing and Critical Thinking Checklists

Table 6 indicated that the assessment experimental students' functional writing was extremely higher than that of the control group. The experimental students were highly assessed in terms of frequent adherence to the functional writing skills as their total frequency (156) was highly greater than that of the control group (57). Furthermore, the least assessments of 'Seldom' and 'Never' adherence to functional writing skills (30) and (28) were in favour of the experimental group compared to (97) and (54) for the control group successively. The supremacy of experimental participants' assessment of functional writing skills compared to their control group counterparts is attributed to the use of CLIL educational approach in teaching and learning these skills in comparison to the use of traditional method as in the case of the control group.

Table 6: Functional Writing Checklist

Items	1		2		3		4	
1.Ability to communicate information explicitly	C	E	C	E	C	E	C	E
	5	14	10	8	9	6	8	4
2. Ability to express ideas clearly	7	18	11	10	8	2	6	2
3.Ability to support evidence of their views	4	16	12	9	13	4	3	3
4.Ability to organize writing according proper writing rules	8	15	10	8	9	5	5	4
5.Ability to observe cohesion and coherence	3	17	12	9	10	4	7	2
6.Ability to use engineering terminologies correctly	5	18	11	8	11	3	5	3
7.Ability edit their writing	7	15	12	10	9	4	4	3
8.Ability to use different types of sentence structures: simple, compound and complex	4	16	11	8	9	5	8	3
9.Ability to analyze engineering information in writing	6	17	10	9	12	4	4	2
10.Ability to discuss engineering topics in writing	8	19	13	8	7	3	4	2
Total frequency	57	156	112	87	97	30	54	28

Frequently=1, Sometimes=2, Seldom=3, and Never=4

C= Control E= Experimental

As for the practice and demonstration of critical thinking skills, Table 7 indicated that the experimental students based on the panel assessment outperformed their control group counterparts in practicing the critical thinking skills. The finding is evident as the total frequency of experimental group's frequently assessment (159) highly exceeded that of the control group (59). The experimental students also had the least assessment scores of 'Seldom' (33) and 'Never' (26) responses for practicing the critical thinking skills compared to those of the control group students (93) and (57) successively. In other words, the control group students are in need for further development of their critical thinking skills. This entails that, the use of innovative teaching methods such as CLIL can help them improve their critical thinking skills.

Table 7: Critical Thinking Checklist

Items	1		2		3		4	
1. Providing reasons for their opinions	C	E	C	E	C	E	C	E
	7	15	11	10	9	4	5	3
2. Ability of problem solving regardless of its complexity	4	13	12	11	10	5	6	3
3. Ability to discuss topic with instructors and colleagues	5	16	14	10	7	3	6	3
4. Ability to reflect on others' views	8	14	10	13	8	3	6	2
5. Ability to assess evidence	4	7	11	9	10	4	6	2
6. Ability to comprehend information	6	18	8	8	13	3	5	3

7. Ability to correctly interpret information	7	17	9	10	12	3	4	2
8. Ability to analyze, break down and synthesize information	8	15	10	13	8	2	6	2
9. Ability to using logical steps to realize persuasion	4	16	13	10	7	3	8	3
10. Ability to evaluate information	6	18	12	8	9	3	5	3
Total of frequency	59	159	110	102	93	33	57	26

Frequently=1, Sometimes=2, Seldom=3, and Never=4

C= Control **E= Experimental**

Discussion of the results

The CLIL effectiveness was tangible in enhancing the experimental students' FL skills of functional writing and critical thinking. Such an enhancement is attributed to the CLIL ability to develop the experimental students' cognitive skills and FL academic knowledge. Through implementing the CLIL educational approach, the experimental students were given opportunities not only to learn the contents of functional writing and critical thinking, but also the target language in general. The CLIL helped to develop the experimental students' cognitive skills, so as they had better understanding of the linguistic content implied in the functional writing and critical thinking skills. The experimental students were also able to improve their communicative competence and awareness of FL culture due to the implementation of CLIL-based instruction. The implementation of CLIL-based instruction had subconsciously improved the experimental students' attitudes and motivations to learn English because it developed their English proficiency. Findings of analyzing the two checklists emphasized the positive role of using the CLIL educational approach in

sustaining and enhancing the functional writing and critical thinking skills of the experimental students in contrast to their control group counterparts who studied these two skills by using the traditional method. The finding comes in agreement with those reported by Shepherd and Ainsworth (2017), and Bulte, Surmont and Martens (2022), Montoya (2022), and Hu (2023).

Implications

The preparation and training programs of EFL teachers should pay attention to the development of Egyptian student-teachers' skills of using and implementing the CLIL pedagogical approach in EFL classrooms. The step is necessary for equipping Egyptian EFL instructors with efficient teaching strategies that can yield positive learning outcomes. In addition, it is necessary for language instructors at MUST to find ways of integrating the CLIL pedagogical approach into the ESP curriculum taught to ESP undergraduates. The CLIL integration at MUST should not only bet restricted to the ESP courses, it may also be extended to the teaching of other core courses at the Faculty of Foreign Languages. Thus, the academic teaching staff can be guided to employ the CLIL pedagogical approach in their English courses in order to maximize the benefits of using CLIL pedagogical approach at the faculty. The design of ESP courses at MUST should also give rooms for the inclusion and practice of CLIL-based activities that can elevate the MUST undergraduates' English proficiency levels. The benefits of using the CLIL pedagogical approach should also be exploited at earlier educational stages in the Egyptian EFL context. It is the role of Ministry of Education to utilize the CLIL pedagogical approach in the primary, preparatory and secondary schools through its incorporation into these various EFL curricula in the Egyptian EFL context. The findings agreed with those reported by Villabona and Cenoz (2022), Alfred (2024), and Nguyen et al. (2024).

The CLIL implementation is often associated with related drawbacks mainly the availability of adequate learning sources. To overcome such expected CLIL associated disadvantages, it is suggested to utilize tools of advanced technology such as artificial intelligence (*AI*) applications along with the CLIL-based instruction. Those *AI* applications can strengthen and accelerate the effectiveness of CLIL implementation.

Conclusion

The present study came to the conclusion that the CLIL had an effective impact on enhancing the experimental students' functional writing and critical thinking skills. Thus, CLIL is an effective pedagogical approach that should be integrated into teaching ESP courses at MUST. The experimental students were able, due to the implementation of CLIL-based instruction, to not only master the functional writing and critical thinking skills but rather the English language in general as well. The CLIL helped to save time allocated for teaching and learning ESP courses as the experimental students gained knowledge in the specifically two intended language skills and generally in the target language proficiency. The experimental students were exposed to natural ways of learning English compared to the control students because of implementing the CLIL pedagogical approach. Proficiently, the experimental students attained higher levels of English proficiency in terms of function writing and critical thinking skills in comparison with the control students. The CLIL shoed higher effectiveness in enhancing the experimental students' functional writing and critical thinking skills compared to the traditional method applied for teaching these skills to the control group.

Recommendations

The current study recommended the investigation of the following research topics.

1. The effectiveness of CLIL educational approach in developing other English learning skills of ESP students.
2. The impact of utilizing CLIL educational approach on developing the ESP students' attitudes and motivations towards learning English.
3. The effect of using CLIL on the ESP students' academic achievement in other academic courses.
4. The planning and designing ESP curricula in the light of implementing CLIL educational approach.
5. Technology can compensate for possibly CLIL related drawbacks.

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