21st Century Language Teaching Conference 2024

Post Conference Proceedings

Editor in Chief

Anthony Brian Gallagher

Published March 2025

Independently Published through

Kindle Direct Publishing (KDP).

All Rights Reserved

Table of Contents

21st Century Language Teaching Conference 2023

CLIL for Physics in an EFL Junior High School Setting

Pei-Jung Kuo
National Chiayi University, Taiwan.

Abstract

It has been reported that the Content Language Integrated Learning approach (CLIL), increasingly used to teach bilingual courses, is not suitable for teaching physics. In this paper, we discuss our CLIL bilingual physics course at an EFL junior high school in Taiwan. We had students engage in making toys that illustrated physics concepts. Physics principles were explained in Mandarin, the students' primary language, but English was used during toy-making demonstrations and students' hands-on practice. Despite encountering some challenges and mixed outcomes, we found the CLIL approach to be effective in teaching basic physics and simple English to EFL beginning-level learners. Moreover, toy-making and the permission to use the native language reduced stress, which was beneficial to the CLIL practice.

Keywords: CLIL, physics, toy making, EFL, Taiwan

Introduction

Taiwan has a trade-based economy, occupies a key position in the global supply chain, and has increasingly attracted the interest of multinational companies. As a result, there is a growing need for the population to have English proficiency in order to enhance global competitiveness, expand professional opportunities, and continue to attract international investment. To this end, the government has established a 2030 Mandarin-English bilingual policy, and many schools in Taiwan are now implementing bilingual courses. To comply with the bilingual policy, our team used the Content Language Integrated Learning (CLIL) approach to teach physics in a middle school in Chiayi County, Taiwan. CLIL is an approach that integrates learning a subject (Content) and learning a foreign language (Language). In our project, we used English to teach students science through practical demonstrations and some simple conversations. Our team is called the STEAM+E team. The acronym STEAM stands for science, technology, engineering, arts, and mathematics. The addition of

"+E" signifies that we put English learning into the science project so it became a bilingual education project. Also, "+E" is homophonic with Chiayi, the location of the middle school where we carried out the project. Our team consists of one professor and five senior students from the National Chiayi University Department of Foreign Languages and one professor from the Department of Electro-physics. Hence, this project is a cross-domain cooperation between two different fields.

In the following, we present how we implemented the CLIL approach via physics toy-making. First, we discuss some advantages and disadvantages of the CLIL approach mentioned in the literature and review course subjects currently taught with CLIL. Second, we present our CLIL course methodology and results. Third, we discuss the effectiveness of CLIL teaching, problems we encountered, and possible solutions. We conclude the paper in the last section.

CLIL in Taiwan

In this section, we first provide a brief overview of some advantages and disadvantages of CLIL teaching discussed in the literature and then discuss subjects currently taught in Taiwan with this approach.

Advantages and Disadvantages

As mentioned in the Introduction, bilingual education has become a trend in Taiwan in recent years, and CLIL is one of the common approaches in bilingual teaching. Since CLIL is becoming popular in elementary school through high school, it has triggered discussion among different scholars. Some think that CLIL is a useful way to create an environment conducive to learning English, but others think it may make it harder for students to learn subject content. Shao (2020) mentions that most teachers show positive attitudes toward CLIL implementation at the elementary education level and agree that CLIL is an effective pedagogy for students, especially in their English listening comprehension and speaking performance. Some scholars also agree that integrating CLIL pedagogy into advanced academic subjects is beneficial to students. The benefits of using CLIL in English teaching of professional courses include developing intercultural communication skills, preparing for internationalization, increasing depth and breadth of learning, and developing critical thinking (Chen & Yang, 2021).

On the other hand, there are concerns about implementing CLIL in the classroom. For example, Chen (2019) mentions five difficulties associated with implementing CLIL, including increased time requirements, laborious course preparation, the challenge of transforming teaching methods, the difficulty for students, and the insufficiency of school and family supports. Furthermore, for CLIL courses, teachers must prepare materials that both encourage students to listen and speak in the foreign language and also develop students' subject domain knowledge and cognitive abilities (see

Tsou, 2018). To reduce teaching burdens, it has been suggested that schools make CLIL teaching examples readily available, provide teachers with references when designing teaching courses, and give teachers more flexibility and space for innovation. Schools should also allow teachers to have more professional autonomy, build on-campus teaching resources, and make good use of peer learning so that different domain teachers can reduce their fears and the burdens of bilingual teaching (see Cheng, 2021).

CLIL and Subjects

Currently, in Taiwan, CLIL is not often used in teaching science, especially when students are learning English. This may be because science has complicated theories and principles that are hard for teachers to explain in English. Students' learning motivation may also decline due to the challenges of using English to learn science (Huang, 2022). Subjects generally chosen are therefore from the humanities, the arts, or other less academically-related courses like physical education.

Though CLIL science courses are less common, there have been some successful cases presented in the literature. For example, Curran and Chern (2017) report that teachers successfully implemented integrated science-English classes after a planning process that included a lab visit, exposure to possible resources, and various rounds of discussing and fine-tuning lesson plans. The teachers created a bilingual experimental classroom for students, including experimental props and bilingual experimental steps, marked both in Chinese and English, and they taught students vocabulary and sentences in English that related to the experiment so that they could learn English while doing the science experiment. Yang and Hsu (2021) also discuss their successful CLIL science course design. In the first and second class sessions, they taught students basic scientific phenomena and principles, such as "knowing bubbles" and "know the three properties of bubbles."

While teaching the principles, they also taught the English that might be used in the class and provided scaffolding for students during both English and science learning. In the third and fourth class sessions, using simple English sentences, the teachers began to lead the students to practice the bubble activities. Indeed, most CLIL bilingual science courses we researched include two general parts in the course design: the theoretical explanation in the primary language, followed by the bilingual demonstration. This dual design is structured to facilitate English learning without impeding the learning of necessary subject theories or principles.

CLIL and Physics Toy-making

In this section, we present how we combined English and physics using the CLIL approach via toy making. We understood that teaching physics theories in English would be difficult for both students and teachers. Therefore, inspired by the literature reviewed above, we attempted to implement integrated English-physics teaching in a simple way that stimulated student interest.

Curriculum Implementation

The aim of our team was to integrate English and physics learning in a junior high school in Chiayi County, Taiwan. We designed four science courses, each with a different topic. Each course included four one-hour classes scheduled for Saturday mornings. There were a total of 20 middle school students, who were the top students in their grade, but whose English abilities differed. Based on the students' backgrounds, we designed bilingual material and an English demonstration to teach them how to make toys that illustrated physics principles. We first taught them some English vocabulary related to the course topic to prepare them for the bilingual demonstration. Then, the teacher demonstrated how to make the physics toys using simple English with another assistant who repeated the sentences with gestural support. Principles and theories were explained in Mandarin so that students would not get confused by difficult concepts. In this way, students could both learn English and physics and enjoy their science toy-making classes.

Course Topics and Process in Detail

As mentioned above, we had four science topics to cover in one semester. For the first topic, we taught students how to fold a "fly-back paper airplane." First, we taught related words such as "fly"; and "airplane"; that would be used during the subsequent toy-making demonstration and hands-on practice. Then, we started the bilingual practice session using English to guide them to fold their own paper airplane and give them the experimental steps.

For the second topic, we taught them how to make a firing cannon, an experiment about smoke and pressure. In contrast to the first topic, in this course we gave simultaneous explanations in Chinese and English for the experimental steps, because the content of this experiment was much more difficult than the previous one, including a lot of new words and complex grammar and sentence structures.

The third course topic was about the movement of bouncy balls. We connected two bouncy balls in a series to simulate two planets with the same mass for binary motion. The most difficult part of this topic was the production of bilingual material. The mechanics-based scientific principles were more advanced than previous topics, so we tended to rely more on Mandarin, rather than English translations, to describe
experimental steps. As with the previous courses, scientific principles were explained in Mandarin.

The fourth topic was "float-up feather." For this course, students learned how Bernoulli's principle works. We had them cut off the bottom of two plastic cups, connect them together to create a tube, and rotate the tube. This action causes an inserted feather to float up through the tube. Because this was the last class of the four topics carried out in the semester, at the end of class, we also presented a summary of the implementation of our previous bilingual experiments.

In the following section, we provide a more detailed description of how English teaching was implemented in the course using the second topic as an example. In the second topic, we wanted to teach students to make a firing cannon (a toy that can shoot smoke out of a bottle in a circular shape). At the start of the course, we taught students some vocabulary that would be used in lessons, such as "smoke," "hit," and "bottle" to help them acquire the basic vocabulary. Then we started to do the demonstration step by step in English about how to make the cannon. For example, the first step was "Raise up the bottle," so we just said the English sentence "Raise up the bottle" accompanied by exaggerated gestures. In this way, students could learn the toy-making steps and English phrases/sentences at the same time. After finishing the demonstration, we then talked about the corresponding science theory and principles in Mandarin. That is, they didn't learn the science theory (or the content objective) in English. They learned how to make the toy in English.

Data collection

In order to evaluate whether students understood what was taught in the four courses, we designed bilingual worksheets, experiment record sheets, and feedback forms, as well as conducting oral interviews. Details are provided below.

Paper Documents

For the bilingual worksheet, we designed both English and science questions for students to answer. These questions were based on vocabulary training, science principle practice, and demonstration steps. On the experiment record sheet, we asked students to record what they observed when conducting the experiment. Students were encouraged to use as much English as possible to finish this sheet. On the feedback form, we received the most direct reflections from students about their attitudes toward the bilingual classes and whether their English was good enough to take the classes or not. At the end of the project, our team also asked students and their parents to sign consent forms which state that their feedback will only be used for academic purposes and that there should be no concerns about personal data leaking.

Interview

We interviewed some students from the class to understand their learning experience and thoughts about the bilingual classes. During the interview, we encouraged them to say what they wanted to say and not to feel pressured. Although this was a recorded interview, we assured them that what they said would be completely anonymous. Most of them gave positive feedback like the following: “Through this class, I find English interesting” and “I prefer to learn English in this way.” However, some of the students thought that the percentage of English used in classes was too high. During the interviews, we also observed that students were not sure why science subjects should be taught in English, rather than in the traditional teaching mode.

Data analysis

On the bilingual worksheet, we found that most of the students gave the correct answers on the vocabulary section (about 95%), so we can infer that they have the ability to memorize the vocabulary taught in classes. However, for the content section, the number of students who gave the correct answer was lower. We hypothesize that this may result from the difficulty of science subject matter no matter what kind of language is used to teach it. Nonetheless, on the feedback forms, we generally received positive feedback from students about taking the bilingual class. They mentioned that they are more interested in English when it is taught with interesting topics and real life practices, and around 90% of students were more willing to learn English through science class.

On the experimental record sheet, we observed that students were able to answer more fully on the part that could be answered in Chinese, but they only used simple sentence patterns or just a few specific words on the part that could be answered in English. This shows that Chinese is still the student's primary language. In addition, we designed a lot of question types related to English single-word practice. Students got high scores in exercises such as matching or filling in the correct Chinese translations, but once the question types required answering questions in English or spelling out the English words, students had difficulty, especially in spelling the necessary English words. This indicates that students can recognize the meaning of a word after a relatively brief exposure, but it still takes more time to memorize the spelling.

To summarize, in the process of toy-making, we taught a cohort of first-year middle school students the relevant words and sentence patterns that are used in physics toy-making and let them try to use these words in their experimental record sheets and later in the public presentations. The data indicates that most students achieved good results in both English and physics learning when taking our bilingual science courses. Calibrating the percentage and complexity of English used in courses and making it easier for students to absorb the target knowledge are objectives that need to be worked on.

Discussion

Bilingual education is not only a new kind of learning experience for students, but also an emerging challenge for bilingual teachers. Throughout this project, we took into consideration observations from both student and teacher feedback. Below we discuss some of the advantages and difficulties encountered.

Advantages

Historically, Taiwan's educational system has lacked an environment where students could use English outside of the traditional English classroom. CLIL courses create such an English environment. Many schools that implement bilingual education report that children are more willing to communicate in English because they have more opportunities to be exposed to English, instead of just treating it as a subject to be tested. A foreign teacher who teaches in an elementary school told us that the lower-grade students receiving bilingual education in the school are less afraid of using English than the children in the upper grades, and they also like to use English to interact with her outside of the classroom. Most of our students (around 90%) said they had a greater interest in learning English when it is integrated into a bilingual science class. Although some expressed reluctance to speak in English to answer physics-related questions, their varying proficiency levels in English at the start of the course may account in part for this (as noted in section 4.2, issue 4). We also provided other opportunities for them to practice speaking, such as in conversations with teachers.

Unlike traditional rote memorization of English vocabulary and grammar, the English vocabulary and sentences in our classes were taught in the context of science demonstrations. Not only did students perform well on physics-related English vocabulary tests, but their sensitivity was also raised to English grammar and sentence structures. For example, even for more complex physics content where we put Mandarin translation sentences below the English in presentation materials, students were able to infer English word meanings.

Issues & Difficulties

Even though bilingual education had a positive impact on English learning in our courses, we still encountered many challenges in implementing the CLIL approach. Below we discuss the five primary difficulties we encountered.

Issue 1 Different English levels among students

Although participating students were all in their first year of junior high school, their English ability differed a lot. Because of this, it was hard for teachers to design the material and conduct the experiments in English. Some students whose English level was high thought the simple material didn't fit their needs and felt bored during the class. Others with less English proficiency found the bilingual class too challenging.

Issue 2 Complex content is hard to teach in English.

Bilingual courses are a test of teachers' ability to teach content and apply English. To be frank, some of the physics principles are hard to explain in English. For example, when we talked about the principles of Dynamics, there were so many technical concepts that it was hard to teach in a non-native language. The language teachers of the STEAM+E team are from the Department of Foreign Languages, so teaching physics concepts was the biggest challenge for them. They spent a lot of time preparing and thinking about how to present physics concepts to properly accommodate the English ability of middle school students.

Issue 3 Language switch

How to allocate the ratio between Chinese and English in bilingual teaching and how to properly switch between Chinese and English were also major issues. We tended to use Chinese teaching for the section of courses devoted to teaching physics theories and principles, and did not consider using English because the content itself is already difficult enough. At the same time, we also tried our best to avoid the occurrence of "Jin Jin style." "Jin Jin style" is an expression that is popular in Taiwan and refers to Chinese mixed with English words or phrases that do not form sentences. When our language teachers used "Jin Jin style" when giving instructions, it could be that they were afraid that students might not understand complicated and long sentences. However, this can potentially cause confusion for students trying to understand what the teacher is saying.

Issue 4 Students have difficulty fully presenting their ideas.

We found that students had trouble fully expressing their ideas in English, both verbally and in written form. Because we encouraged students to try to use English, only a few students who were good at English tended to speak up to answer questions, and when writing experimental observations, students might only use single words or simple sentences that didn't fully reflect their actual understanding of the content.

Issue 5 Students & Willingness to Learn Science Subjects is Reduced Because of English.

Bilingual Physics courses will make some students less interested in science subjects. We conducted oral interviews with several students about their thoughts on bilingual courses. One student said that if the courses could be taught in Chinese instead of English, this project would be more interesting for him. In addition, we also observed that some students fell asleep during the class, which may show that some students still have low tolerance for bilingual courses.

Possible Solutions

Below, we have noted some possible solutions to the problems delineated above. We implemented some of these solutions in our CLIL course, but will continue to fine-tune their implementation to further improve our teaching practice and student learning:

Issue 1 Different English levels among students

A possible solution to the issue of the gap in English proficiency among first-year middle school students is to lower the level of English as much as possible. In this way, students who are less proficient in English can absorb the content more effectively, and students who are more proficient can naturally absorb it without issue. Furthermore, it would make it easier for bilingual teachers to design teaching materials.

Issue 2 Complex content is hard to teach in English.

To deal with complex content in physics, we suggest two possible solutions. The first is to reduce the general complexity of English used, as mentioned above, and the second related solution is to avoid the use of technical terms when simpler terms would suffice. Take the first topic of “fly-back paper plane” as an example. The original English translation was “Origami - Paper Airplane”; If we had taught the original English translation, there would have been more instances of difficult English vocabulary. In contrast, we used two simple English words (“fly” and “back”) to point out the specific kind of plane that students would make. Although “fly” and “back” are simple words, they clearly express the scientific concept that the paper airplane will fly back to the hands of the students.

Issue 3 Language switch

The STEAM+E team tried to find the balance point in the proportion of Chinese and English usage and determine when to switch between the two languages. We suggest that language teachers use the primary language for more advanced concepts and the foreign language for less difficult material. For example, during the experiments and for basic classroom language, like greetings and typical classroom instructions, we tended to use simple English to communicate with the students, but we would use Chinese to explain the physics principles and theories. This method reduced the shock of the sudden language switch so students could more easily adapt to the teaching mode.

Issue 4 Students have difficulty fully presenting their ideas.

During the planning process, we always encouraged students to express themselves in English. Our goal was to encourage the use of English to “speak” and to “create” an English-friendly environment to let students speak English in a non-forced way, which not only reduced their difficulties in spoken production but also reduced their concerns about speaking English. We also told students clearly that if they had difficulty expressing their thoughts in English, they could choose to use Chinese instead.

Issue 5 Students’ willingness to learn science subjects is reduced because of English.

We observed that some students who were good in science subjects showed lower learning motivation in bilingual courses because their English ability was relatively weak. The possible improvement method is to use encouragement instead of correction. We tried to encourage these students to use Chinese when needed or use some simpler words and phrases in English.

Conclusion

Taiwan is now implementing bilingual education. Although there are still many different perspectives on best practices and appropriate subject domains for CLIL, it is undeniable that we are moving in the CLIL direction. How to help all students absorb the course content effectively is the first priority. We should not be too obsessed with teaching theoretical or complex information about physics subjects in English. We should focus on the practical, subject-related English words or phrases students can learn and classroom language or simple English conversation skills with teachers. Among the many problems observed in this project, the biggest issue is nothing more than the students’ unfamiliarity with the English environment and the differences in their English proficiency. The way to overcome it can be to start with relatively simple English content and then make timely adjustments according to the students’ absorption status. Drawing on feedback from teachers and students can help refine CLIL methodology in a variety of subject domains, including physics. Based on our experience teaching an integrated English-physics course, the STEAM+E team can report that using the CLIL approach in this domain is not unfeasible. However, it tests teachers’ classroom planning and teaching ability. Therefore, it is very important that bilingual teachers are adequately trained and supported before this kind of course is widely used.

References

Curran, J. E., & Chern, C. L. (2017). Incorporating English into a science camp: Perspectives from English teachers. *English as a Global Language Education (EaGLE) Journal*, *3*(2), 1–23. https://doi.org/10.6294/EaGLE.201712_3(2).0001

Shao, T. T. (2020). *Teachers' perspectives of implementing CLIL in elementary schools in Taiwan* [Master's thesis, National Taiwan Normal University]. National Digital Library of Theses and Dissertations in Taiwan. https://hdl.handle.net/11296/m79u8h

Chen, H. C. (2019). *The action research of CLIL on 3rd graders: When English encounters science* [Master's thesis, National Taiwan Normal University]. National Digital Library of Theses and Dissertations in Taiwan. https://hdl.handle.net/11296/3mnucw

Huang, J. Y. (2022). *An action research of CLIL science co-teaching design and implementation* [Master's thesis, National Taiwan Normal University]. Retrieved from https://hdl.handle.net/11296/sk37mg

Hsieh, Y. C. (2022, July). *CLIL in a sixth grade health class: Action research in Taiwan* [Master's thesis, National Ilan University]. https://doi.org/10.6820/niu202200232

Chen, Y. T., & Yang, C. L. (2021). Implementation and effectiveness of CLIL in EMI for professional course. *Journal of Contemporary Business and Management*, *6*(1), 89–107. https://doi.org/10.6852/JCBM.202112_6(1).05

Cheng, J. J. (2021). Possible strategies for CLIL promotion in schools. *Taiwan Educational Monthly Review*, *10*(12), 64–69. http://www.ater.org.tw/journal/article/10-12/free/03.pdf

Ho, Y. T., Kao, C. F., & Chang, H. C. (2021). A visual arts CLIL course design: Taipei bilingual teaching resources in perspective. *Journal of Educational Research and Practice*, *68*(2), 75–89. https://doi.org/10.6701/JEPR.202112_68(2).0003

Tsou, W. L. (2018). CLIL lesson writing and interdisciplinary teacher collaboration. In W. L. Tsou & S. M. Kao (Eds.), *Exploring CLIL: A resource book* (1st ed.). Bookman Bookstore.

Huang, C. Z., & Pan, J. L. (2021). Introduction and teaching practice sharing of CLIL bilingual physical education textbook compiled by Taipei City. *School Physical Education*, *182*, 50–68.

Yang, Y. S., & Hsu, Y. H. (2021). Life and natural science bilingual curriculum design and evaluation. In W. L. Tsou & S. M. Kao (Eds.), *Exploring CLIL: A resource book* (1st ed.). Bookman Bookstore.

Author Profile

Pei-Jung Kuo is a Professor at Department of Foreign Languages, National Chiayi University, Taiwan. She is also the Chief of the Division of Foreign Languages in the Language Center of NCYU, and her major interests are Formal Syntax, Language Acquisition, Chinese Linguistics, and Teaching Chinese as a Second Language.

https://sites.google.com/g.ncyu.edu.tw/domo/ domo@mail.ncyu.edu.tw