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CLIL-based Smart Education in the Teaching of Scientific and Technological Translation

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Abstract: *In the context of economic globalization, countries and regions are increasingly participating more in international engineering projects, international scientific and technological exchanges and cooperation, which has posed great requirements for the cultivation of qualified ST translator in universities worldwide. The integration of artificial intelligence in higher education has changed both the presentation of university courses and professional environment of scientific and technical translators, who must work with new formats and channels of information in a multi-disciplinary context. To meet new challenges, translation teachers must place special emphasis on the application of smart classroom. The study is devoted to the teaching design of scientific and technological (ST) translation based on the Content and Language Integrated Learning (CLIL) model in bachelor's programs. We argue for the inclusion of CLIL model as a new focus, and present the results of a research project aimed at designing teaching materials for scientific and technological translation, which highlights the potential benefits for all users in the acquisition of subject field knowledge and terminology.*

Keywords: *CLIL, scientific and technological translation, instructional design*

1. Introduction

In the context of economic globalization, there is a rising trend of international engineering projects in both number and scale, with a more urgent need for non-literary language services worldwide, as various parties from various backgrounds may be involved. With the blessing of artificial intelligence (AI) technology, scientific and technological translation tends to be shows globalized, industrialized and informatized.

ST translation market demands mainly come from a wide range of fields, including education and training, IT technology, intellectual property, laws and regulations, conferences and exhibitions, finance and economics, cross-border e-commerce, cultural tourism media, international engineering, energy, biomedicine, marine ships, geology and minerals, aerospace and national defense and military industries, etc. the report also shows that the current

The training of translation talents in universities faces some problems such as the scarcity of qualified and experienced teacher, the restriction of ST translator competence, the disconnect between university education and actual work needs. Under this background, the reform of scientific and technological translation classroom teaching in colleges and universities is imperative.

Science and engineering colleges have a natural advantage in cultivating science and technology translation talents. However, for a long time, the science and technology translation teaching in most science and engineering colleges has been split into two modules: foreign language majors and science and engineering majors. Foreign language majors lack of science and engineering knowledge, while science and engineering students have deficiencies in language, culture and translation skills. It is urgent and necessary to reform the scientific and technological translation talent training model, utilize smart classrooms, and carry out teaching innovations based on the CLIL model for scientific and technological translation courses[1-4].

2. Theoretical and methodological framework: CLIL model

CLIL (Content Language Integrated Learning) is a new teaching concept proposed by Finnish comprehensive foreign language training expert David Marsh, based on Hymes' communicative

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competence theory and Halliday's functional linguistics theory. CLIL became popular in Western Europe in the mid-1990s, emphasizing that "language teaching must be based on specific learning content, and language education must be an immersive education that focuses on both language and content." (Dalton,2011) It is based on a certain discipline, uses one or more foreign languages as the teaching language, integrates language learning into the learning of subject knowledge. The CLIL model believes that language teaching and content teaching are two aspects that are inseparable, interdependent but intervening, and promote each other, stressing on a balance between subject knowledge learning and English learning so that the two can develop together. CLIL classroom teaching mainly includes the following four levels: content, communication, cognition and culture. The four Cs fully reflect that CLIL model is content- and culture-oriented, using language as the medium, and focusing on interpersonal communication. It provides an overall framework for teaching methods, places content in the field of "knowledge learning", and integrates language as a culture. A variety of instruments are utilized comprehensively as a medium for learning, and diversified classroom activities such as lectures, audio-visual materials sharing, and internet searches are used to stimulate learners' enthusiasm and independence in learning and provide learners with multi-modal learning based on subject knowledge.

The CLIL model has many advantages. 1) Diversity. It requires students to learn subject content at the same time during the language learning process; 2) Richness. The classroom presents authentic teaching materials and environments to scaffold students in learning knowledge, mastering language, and building confidence in multi-modal classroom activities. 3) Authenticity. Use a large amount of authentic teaching materials to naturally acquire language in authentic contexts, master specific learning content at the same time, and build bridge between learning and life and among learning peers. 4) Positivity. The classroom organizes students-centered activities, and the teacher is just a director who set up and guide language application scenarios for students, so that students can better practice language output based on the subject knowledge acquired. 5) Scaffold learning. CLIL classroom teaching focuses on the connection between learners' interpersonal skills and cognitive abilities, emphasizes the close connection between learning subject knowledge and context, and encourages creative and critical thinking, thereby making content learning more profound and effective. 6) Cooperation. The CLIL teaching model not only requires cooperation between different teachers, but also requires students to cooperate with peers or teachers in a variety of ways. It is strengthens interaction, and replaces memory-based teaching.

By applying the CLIL model to science and technology translation teaching in science and engineering colleges, the combination of "language + subject content" breaks translation teaching away from the dull textbook content, allowing students to learn as close as possible to a specific professional subject. This will lay a good foundation for future translation work related to this subject.

3. Literature review

CLIL is a teaching method that originated in Europe. Its theoretical basis is Canadian "immersion" teaching and American "content-based" teaching. Research on the CLIL model has experienced two turns: from the impact of the implementation of the CLIL model on language learning effectiveness, to demonstrating the need to adopt a true integration of language and content, and then to exploring the potential of the CLILM model in promoting the development of students' subject literacy. (Nikula, 2017). Language courses that introduce subject content can effectively expand the amount of language exposure and create basic conditions for language internalization. They can also create subject contexts, provide context for complex meaning negotiation and advanced thinking activities, and are conducive to the development of higher-order thinking abilities (Nuthall, 2002). Marsh analyzed the development momentum of CLIL from 1996 to 2002 and found that the development of CLIL has maintained a relatively rapid growth momentum. (Marsh, 2002)

Research on CLIL concepts and models in China can be roughly divided into three categories: systematic theoretical research on the CLIL model itself, research on the enlightenment of the CLIL model on a certain course teaching in my country from a broad theoretical perspective, and research on the impact of the CLIL model on non-English speaking countries in the EU. In his book "Theory and Practical Requirements of Bilingual Teaching in Colleges and Universities - Foreign Language Education Perspective", Yan Ming introduced and researched the CLIL model in detail, systematically introduced the current situation of CLIL teaching in Europe, and related theories from CLIL teaching model to CLIL model. (Yan Ming,2009) Zhang Lindong explores the practice of college English teaching integrating CLIL model and POA theory.(Zhang Lindong,2022)Tang Tingting's course team took "Silk Road English - Talking about the Belt and Road" as an example to discuss how to use the basic theory of CLIL to explore and propose innovative MOOC design solutions(Tang Tingting,2021)However, there are

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relatively few localization studies of the CLIL teaching model in China, and there are even fewer studies on the application of the CLIL teaching model in bilingual teaching in professional courses.

This study takes the ST translation course in science and engineering colleges as an example, exploring specific teaching practices in BA program for the undergraduates who take English as a foreign language, and applies the task-driven multi-level progressive smart education model to specific ST translation teaching. On this basis, we contemplate how to better utilize the CLIL model to improve the effectiveness of scientific translation teaching and learning[5-6].

4. Materials and activities in the teaching of scientific and technical translation based on CLIL model

4.1 Overall design

There are duel learning objective in CLIL model: learning the subject knowledge and the language skills. Based on the CLIL model, teachers follow the following steps to develop their own personalized teaching plans:

1) Determine subject content. Teachers need to consider students' cognitive level and subject knowledge reserves, understand the learning content and focus of students at this stage, and determine the main teaching content and learning tasks of a class. Teachers determine the subject content and difficulty involved in scientific and technological translation courses based on the school's characteristic majors, so that scientific and technological translation courses have school-based characteristics and cultivate compound talents who can engage in scientific and technological translation in related professional fields.

2) Develop teaching plans. Teachers select and develop detailed teaching plans based on the 4C framework and subject chapter content. A key difference between the CLIL teaching program and traditional foreign language teaching programs is that the CLIL teaching program has dual teaching goals: "language goals" and "subject content goals." "The teacher lists the content goals to be achieved, and formulates the corresponding language content based on this goal, that is, the language vocabulary, phrases, sentence syntax, etc. needed to understand the subject content. The teacher designs a series of cognitive levels from low to High-level teaching unit activities, such as classroom surveys, discussions, reports, etc., allow students to continuously advance their cognitive level from knowing to understanding to analyzing and applying, and create a context for students to simulate practical applications in teaching, such as small groups Activities, debates, reports and research, etc., preset some value education activities related to the subject content, and flexibly adjust the preset plans in actual teaching.

3) Implement teaching plans. The difficulty in teaching scientific and technological translation is that it is an applied translation of "language + subject knowledge". Translators not only need to have good basic language skills and translation skills, but also have certain subject matter expertise. Technical translation teaching under the CLIL model needs to be carried out in a well-equipped language laboratory or smart classroom, integrating three stages of teaching resources before class, during class and after class to maximize the teaching effect.

4.2 Implementation of teaching plan

This article takes the scientific translation course of the mechanical engineering major as an example, selects the translation of intelligent mechanical product description copy as the main teaching content, and develops a hybrid translation teaching design in smart classroom environment. The teaching goal of this chapter is to enable students to master the relationship between science and technology style and translation, as well as to learn the basic knowledge of intelligent mechanical products, and to cultivate students' ability to describe and translate the structure, function, operation and technical parameters of the product. The teaching design is divided into three links before class, during class and after class. It integrates online and offline resources and teaching activities. Students participate in teaching activities in groups.

4.2.1 Pre-translation activities and self-evaluation

The main objective is to prepare students with the knowledge about industrial robot, introduce students to the terminology of the subject fields being translated and to the methodology proposed in this type of technical translation through simple activities which involve textual and video elements.

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The self-evaluation feature helps students check the score achieved on their own, so that they can assess the knowledge acquired in the pre-translation stage, providing background knowledge prior to the translation stage[7].

Activity 1: Literature reading and analysis

Technical documents in Chinese and English about industrial robot are provided for students to read before class, ranging from news report to product descriptions of certain models from industrial robot manufacturers. Students read the documents and collect key points by answering the following questions:

- What is the structure of the model?
- What are the names of different components and accessories?
- What is the work principle of the robot?
- What are the features of this model?

These reading process requires students to mark the structure, components and technical features of the product, and create a glossary of terms. Teachers use the online teaching platform to publish short exercises such as guessing word meanings, word form transformations, and terminology comparisons to help students master scientific terminology and improve their reading comprehension of scientific literature.

Activity 2: video learning

The aim of watching video about industrial robot is to specify the basic concepts of the robot that was obtained from reading literature. A link between written text and video material will turn glossaries into life. Questions will help students to think and express orally:

- How to install the robot?
- How does the robot operate?
- What breakdown may occur in operation?
- How to do troubleshooting and maintenance in case of breakdown?
- What are the technical advantages of this product?
- What is the market competitiveness of the product?

After reading the materials and watching the videos, the students can obtain better understanding of the target robot and conduct group discussions through the online platform. A multi-model pre-class learning will qualify students in speaking and translating about technology. Based on the discussion, students can conclude the answers to these questions and upload the English writing tasks completed to the online platform through the online editing functions of some software.

Through pre-class self-study, students gain knowledge, experience and bilingual corpus about related products. At the same time, through English collaborative writing tasks, they organize bilingual vocabulary and expressions related to the products. Each group conducts mutual evaluation to lay the foundation for further offline teaching activities in the classroom.

4.2.2 Collaborative learning in class

Offline teaching follows the three-stage process of "observation-analysis-application". The objective is to introduce students to the mandarin-English translation of technical texts related to industrial robot.

Activity 1: observation

First, the teacher organizes oral activities to introduce situational learning content, by supposing all students work with a robot manufacturer and attending a high-tech trade fair. The student groups first answered the questions assigned before class in the form of an oral report in English.

Activity 2: analysis

After the teacher commented on the group report, through class discussions, he guided students to think about the difficulties in the pre-class reading and writing tasks, and stimulated students to compare science, technology, culture and style. An excerpt of text may be as follows in figure 1.

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Our new ITS 1090 (payload 3.5kg) robot is the latest educational offering, featuring a fully-customizable education cell powered by our Core controller. The robot is designed to help bridge the skills gap in robotics education by preparing students for the future of work.
Multiple robot models will be carrying out virtual and live demonstrations, from specialized applications to complete production chains within automotive, logistics and machine tending. Our software will demonstrate cutting-edge functions to make manufacturing more efficient.

Figure 1: English product description

Students read this product description and fulfil tasks listed below:

• analyze its linguistic features

•figure out the terminologies inside the text

•list the difficulties in translating it into English

•discuss about strategies of solving the difficult points in translation

Through oral presentations in classroom groups, students integrate scientific reading, scientific writing and speaking to consolidate their existing language knowledge and professional knowledge. Through classroom discussions on the difficulties in pre-class scientific and technological literature reading and writing tasks, teachers guide students to pay attention to the difficulties in external scientific and technological communication, such as terminology, vocabulary, syntactic structure, stylistic style, etc., and understand the basic characteristics of scientific and technological texts.

Activity 3: application

On the basis of understanding the stylistic characteristics of science and technology, teachers organize project-based learning of science and technology translation through smart classrooms.

First, ascertain the language style that is suitable for the translation. The teacher guides students to analyze the stylistic characteristics of scientific and technological texts from different output channels by displaying printed instructions for intelligent mechanical products on multiple screens, product details pages on e-commerce platforms, and B2C after-sales videos, and intuitively integrates stylistic knowledge with scientific and technological translation.

Second, build the translator with culture awareness. Teacher helps students to connect technical text with its delivery settings, and master the scientific and technological language characteristics of different stylistic styles. Teachers build scaffolding by asking questions about the stylistic style of scientific and technological texts from the aspects of vocabulary, syntax, and discourse structure, leading students to think about the influence of the original manuscript's stylistic style on the practice of scientific and technological translation and the effectiveness of translation communication from the perspective of cross-cultural communication.

Comparison of styles can cultivate students' culture awareness in translating and reviewing the translated text based on the purpose of translation. They also understand that product characteristics and pragmatic functions must be weighted properly in the process of translation, and different stylistic styles must be used to meet the needs of various translation missions.

Cross-culture communication encourages students to analyze translation methods and techniques applied, and connect translation theories to real translation cases. At the same time, students are encouraged to compare cultures and ways of thinking, pay attention to the translation of copywriting related to Chinese science and technology products, view Chinese and Western cultural exchanges with a scientific spirit, exploration and innovation spirit.

Activity 4: PBL translation

Students are divided into groups to participate in classroom translation project tasks. Teachers release practical project tasks such as translation of technical product description copy through the smart classroom system.

The teacher displays the content of the translation project through PPT, and the students are divided into groups to analyze the stylistic features of the text and collaborate to translate the first draft through online WPS or Kingsoft Documents.

During the translation process, students can use external resources for interactive verification of scientific terms, use smart classroom systems to test the readability of translations, and use artificial

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intelligence tools for grammar proofreading and translation scoring.

During the group translation practice, the teacher asked questions to guide the group to have a more detailed discussion on the translation process, such as:

1) Does the sentence need to be adjusted in word order?

2) What methods or tools are used for interactive verification of terms?

3) Does the translation comply with Chinese language habits? Is the translation readable?

4) What is the pragmatic purpose of the translation?

5) Can the translation achieve its pragmatic purpose?

Through interactive translation training with practice and discussion, students are encouraged to consider not only translation methods and techniques, but also the differences in Chinese and Western thinking during the translation process, conduct logical analysis of the original text and the translated text, grasp the translation of Chinese culture-loaded words, and encourage students to View translation from the perspective of cross-cultural communication and actively explore ways to tell Chinese stories well.

At the end of the translation training, the translation results of each group will be displayed on multiple screens in the smart classroom, and each group will conduct mutual evaluation and reflection on the translation process. During the process of reflecting on classroom translation exercises, the group discusses translation quality monitoring plans, such as translation content, division of labor, use of tools, etc. The teacher can randomly select a translation work to comment on and provide modification suggestions, which can lead to and arrange the next lesson in advance. Pre-learning tasks "Translation of scientific terms" and “Application of smart sensors”. Through different learning tasks, teachers connect the learning content of each module with each other, cultivate students' reflective practice, and strengthen students' professional qualities, professional ethics, and professional norms.

4.2.3 After-school extension

After class, each group collaborates to polish the translation and submit it to the online platform, conduct peer review and teacher evaluation, and share the translation log on the online platform. Teachers can also issue extended learning tasks, such as writing similar product evaluation and comparison reports, product market research reports, product SWOT analysis reports, shooting similar product evaluation videos and adding bilingual subtitles, etc., to guide students to further expand related knowledge areas and within the scope of the subject. Course evaluation integrates result evaluation, process evaluation, and value-added evaluation in the result evaluation dimension, such as oral reports to test students' oral expression ability on scientific and technological topics; online platforms evaluate students' learning progress, accuracy rate, and discussion participation in English report writing and translation practices; The evaluation of after-class extended learning works focuses on key indicators such as students' professional qualities, critical thinking abilities, and political literacy. The content- and language-based model makes full use of the resources of the online teaching platform and smart classrooms to achieve more timely interaction and feedback on the three-stage teaching activities, access more translation tools and translation corpus, and scaffold to improve students' practical ability in scientific and technological translation. .

5. Conclusion

The hybrid teaching design based on the CLIL model can organically integrate online and offline teaching, take the practice of scientific text translation as the task driver, and use the output-oriented method as the guide to create simulated language application scenarios so that students can achieve dual learning goals in the scenarios. It should be noted that the use of CLIL teaching model in scientific and technological translation teaching in science and engineering colleges puts forward higher requirements for teachers. To carry out effective CLIL teaching, teachers must not only design teaching content and teaching activities that conform to the CLIL teaching model, but also strive to improve students' knowledge and language abilities. Teachers need to continuously improve their teaching abilities and professional levels.

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