The impact of digital technology on content and language integrated learning in higher education: a systematic review of literature

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ABSTRACT

With internationalization becoming an increasing trend in higher education, many universities worldwide have been implementing content and language-integrated learning (CLIL) as an innovative approach to teaching and learning English that helps students compete internationally. Alongside this trend, the advance of digital technologies has offered beneficial use in integrating language and content knowledge. Following the conceptual framework of Hallingda (2013), this systematic review has explored the impact of digital technology use in English education related to the CLIL approach by synthesizing studies on various forms of technologies in supporting different aspects of CLIL. Findings revealed a positive interrelation of digital impact on language use and skills and social collaboration, interaction, and motivation. However, a lack of evidence was found regarding the correlation between using digital technologies and enhancing content knowledge in CLIL. This recommended further research delving into how digital use would assist both language and content teaching and learning so that students at higher educational institutes could effectively access the global world.

Keywords: CLIL, ICT, digital technology, higher education, content and language integrated learning

Introduction

Many higher education institutions throughout the world encourage the usage of a foreign language (most frequently English) as a medium of instruction in their academic programs as a response to the influence of internationalization and globalization (Dafouz & Smit, 2016). As a result, over the past few decades, the integration of subject and language has taken off in higher education (Nguyen, 2022, Vo et al., 2021). In research, different labels have been used to address this phenomenon, including *Content and Language Integrated Learning (CLIL), English-medium teaching, English-medium instruction (EMI), and Integrating Content and Language in Higher Education (ICLHE)* (Smit & Dafouz, 2012). CLIL, developed in 1994, is defined as "a dual-focused educational approach in which an additional language is used for the learning and teaching of both content and language" (Coyle et al., 2010, p.1). In this approach, the term "content" refers to the subject matter associated with distinct learning domains, and the medium of instruction is a foreign language.

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CLIL is flexibly implemented in a variety of situations and educational systems, but it demands teachers to place equal focus on both language and content education.

The worldwide education system has also changed to accommodate the digital era (Saltan et al., 2018). Digital technology is being utilized in teaching and learning across disciplines. They include interactive whiteboards, desktop and mobile devices, digital recorders, data logging equipment and related probes, mobile devices, Web 2.0 technologies, other online resources, and a range of educational software applications (Ng, 2015). These educational resources can potentially enhance teaching methods (Kalolo, 2019, Nguyen, 2021). Despite the growing popularity of digital technology in higher education, previous research has revealed little evidence of the intentional integration of digital tools into academic activities to change teaching and learning (Price & Kirkwood, 2014; Selwyn, 2010). The possibilities and innovations provided by digital technology in tertiary teaching, pedagogy, and student learning are currently being discussed in contemporary research (Smale, 2017).

In today's globalized academic environment, the rising popularity of CLIL and the development of digital technology are seen as two of the most important factors influencing higher education (Querol-Julián & Camiciottoli, 2019). Both CLIL and technological integration seem to have an impact on learning. Despite its rapid growth, CLIL has posed substantial difficulties for educators and students who are non-native English speakers, and researchers have looked into whether and how digital technology might support CLIL practices. For instance, Gimeno et al. (2010) investigated the use of InGenio as a web-delivered authoring tool for creating and sharing materials and tasks, enabling CLIL teachers and students to access resources and learning activities via the Learning Environment platform. They made suggestions about the potential uses of technical resources and online learning environments to assist educators and learners in CLIL settings. Other studies have provided empirical evidence in support of the implementation of digital equipment in CLIL settings, such as blended learning improving the effectiveness of CLIL courses (Chuang, 2017), Moodle tools fostering productive interaction in CLIL practices (Paliwoda-Pkosz and Stal, 2015), or flipped classrooms improving the comprehension of content knowledge in CLIL (Choi et al., 2015, Karjanto & Simon, 2018). Having said that, the influence of digital technology on CLIL practices has not yet been sufficiently reviewed in the literature of English language education.

This systematic review has tried to address the above gap by synthesizing studies on the impact of digital technology use in English education related to the CLIL approach through the research question: ***What is the impact of digital technology use on CLIL practices?***

Methods

A systematic review of the literature was conducted following the conceptual framework of Hallingda (2013), which specifies the five criteria for systematic review, including explicit research questions, a conceptual framework guiding the selection, analysis, and interpretation of studies, explicit searching criteria, and procedures, defensible types of sources, and explicit description and justification of data extraction process (Daoud et al., 2020).

The process of systematically reviewing literature was undertaken in three steps (Figure 1). In the first step, some search tools were used to locate appropriate peer-reviewed research articles based on their titles. The search strategy involves some specific criteria for including and excluding papers. Typically, three main databases were searched: Google Scholar, Proquest (Eric), and Education Source. These databases have been considered great sources of published journals in digital technology and language education. Some search terms related to the topic identified and applied in searching include "CLIL", "content and language integrated learning",

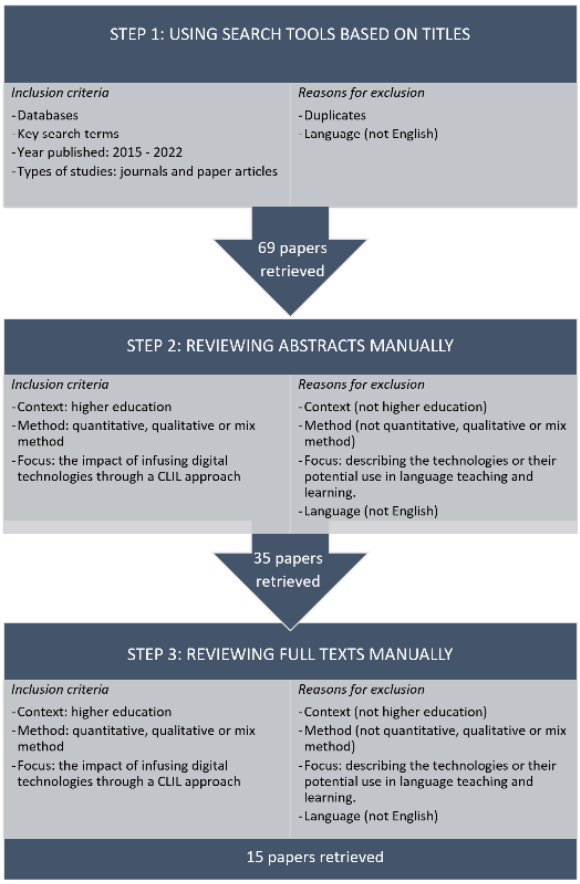
"digital technology", "information communication technology", and "ICT". These terms were flexibly combined to maximize the number of relevant articles. Besides, we decided to restrict the years of publications from 2015 to 2022 as that period is appropriate for the continuous change of technology, its application in education, and the increasing growth of CLIL in language education. After excluding the duplicates and papers published in different languages rather than English, we retrieved a total number of 69 papers.

In the second step, we manually reviewed the abstracts of the articles retrieved in the first step. Two authors reviewed each abstract, and then the results were compared for final decisions. In this step, we also applied some criteria related to the studies' context, methodology, and focus. Specifically, we included qualitative, quantitative or mixed-method research conducted in the context of higher education with empirical findings reported and peer-reviewed in journals. While focusing on exploring digital technology's impacts, we decided to exclude those studies describing the technologies or their potential use in language teaching and learning. At the end of the second step, we had 35 articles for full-text review in the next step.

To start with, we in the research team randomly selected three papers, reviewed thoroughly, and discussed with each other to maintain the consistency in decisions of inclusion, which follows the recommendation of Kitchenham (2004). The full-text review was conducted in the third step, where we applied the same criteria for inclusion and exclusion as those in the second step. After that, each paper included in the second step was reviewed by two authors to ensure the quality of the paper assessment, which is emphasized by Hallinger (2013). Among the 35 reviewed papers, 15 met all the inclusion criteria and proceeded with the synthesis and analysis.

Figure 1.

A summary of the searching procedure.



Data synthesis and analysis of the retrieved articles were critically conducted to reflect the emphasis of a literature review (Torraco, 2016). We started with the descriptive analysis of the methodology used to conduct the studies. We then synthesized the results of the selected papers and identified significant themes associated with the impacts of digital technology on different aspects of CLIL in higher education. The process of synthesizing and analyzing the articles was conducted by all authors independently initially to increase the consistency of judgments (Daoud et al., 2020).

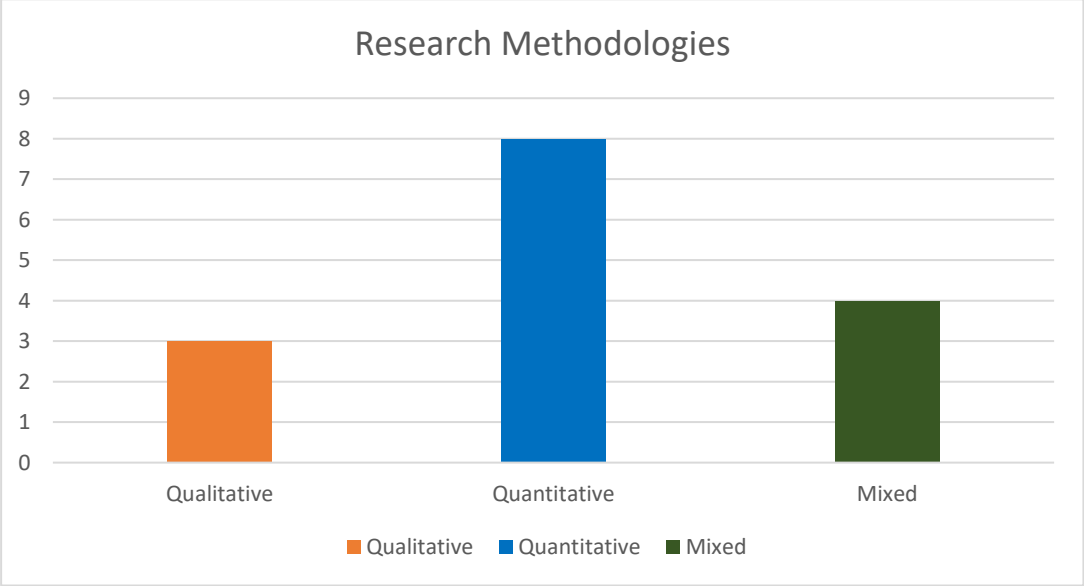
Results/Findings and discussion

General analysis of the reviewed studies

Fifteen studies conducted between 2015 and 2022 used different methods. As shown in Figure 2, the majority of the studies were quantitative (8 studies), with the popular use of surveys and analysis of test scores. Four studies used mixed methods, and three studies exploited qualitative data from participants.

Figure 2.

Summary of research methodologies used in the studies



The reviewed studies explored how digital technologies and CLIL relate to each other in higher education (Table 1). They investigated a range of digital tools. Six studies explicitly looked at the effects of Internet and Web 2.0 tools such as ICT, Web-based tools and e-learning. Other studies explored the influence of specific communication tools, including mobile applications, mind-mapping or telecollaboration tools, or audio and video equipment. Digital technologies related to online teaching and learning, such as virtual laboratories, online platforms, LMS Moodle, blended learning or WebQuest, were also scrutinized in the other five studies.

Several research examined how technology supports language learning and language use. Some delved into students' experience in CLIL learning with the support of digital technologies (Galitsyna & Yesenina, 2020; Salekhova et al.,2019; Zhao et al.,2022). Some looked at the use of technology in designing and developing CLIL materials (Villarreal & Bueno-Alastuey, 2022; Zhyrun, 2016; Lavrysh et al., 2021). Others investigated the role of digital technologies in assisting CLIL pre-service teachers' professional development (Adipat, 2021), collaborative tasks and learning-to-learn competence (Garcia-Esteban et al.,2021), student's motivation and

engagement (Ángel,2015; Zaripova et al., 2019), and learning in a digital environment (Meinecke, 2020; Paliwoda-Pękosz & Stal, 2015). Additionally, researchers investigated the connection between the usage of digital technology and the acquisition of specific language abilities, including science process skills (Firmayanto et al., 2021), reading, and writing (Baranova et al., 2020; Puspitasari, 2020). (Table 1).

Table 1.

Summary of reviewed studies' general information

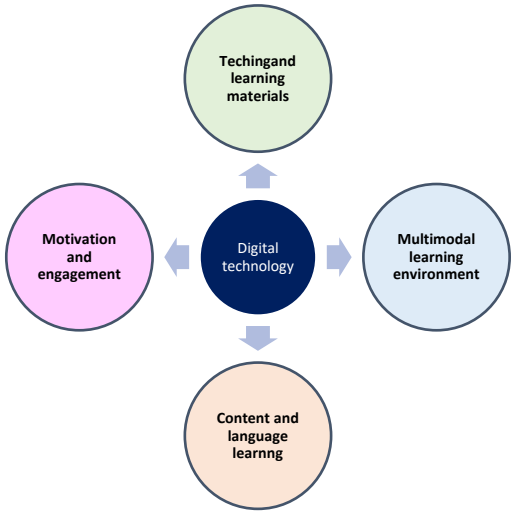
Authors	**Technology**	**CLIL aspects**
Adipat (2021)	Digital technologies	Teacher training and TPACK
Baranova et al. (2020)	Mobile applications	Reading and Writing
Firmayanto et al. (2021)	Virtual laboratory	Science process skills
Galitsyna & Yesenina (2020)	Digital technologies	Language and content acquisition
Meinecke (2020)	Online flatform	Online learning of CLIL
Villarreal & Bueno-Alastuey (2022)	Digital technologies	CLIL materials
Lavrysh et al. (2021)	Digital technologies	Authenticity of CLIL
Paliwoda-Pękosz & Stal (2015)	Blended learning	CLIL learning
Salekhova et al. (2019)	LMS Moodle	CLIL learning
Ángel (2015)	WebQuest	Students' motivation and engagement
Garcia-Esteban et al. (2021)	Telecollaboration	Learning to learn competence
Zhao et al. (2022)	Digital technologies	Content knowledge co-construction and business English language use
Puspitasari (2020)	Mind-map tools	Reading comprehension
Zaripova et al. (2019)	Digital technologies	Students' motivation
Zhyrun (2016)	Audio and video technologies	Digital materials

Impacts of digital technology use on CLIL practices

The synthesis identified four key themes in CLIL practices that were affected by the integration of digital technologies. (Figure 3)

Figure 3

Impacts of digital technology on CLIL practices



Creating a multimodal learning environment

Multimodal learning refers to the use of different modes of delivery in supporting students' learning. Modes of delivery in the digital age include both online and face-to-face platforms where teachers and students can conduct their teaching and learning process. This is how digital technology can be beneficial to CLIL practices. In the reviewed studies, this might be one of the overarching themes when quite a few studies showed considerable impacts of digital technology use on the creation of a multimodal learning environment. Typically, digital technologies offer great platforms for online learning integrated with a wide range of functions, which can be used to enhance students' interaction, communication, and collaboration. The increasing popularity of Learning Management Systems (LMS), Moodle tools, or Blended learning has created opportunities for CLIL practices to develop in a multimodal learning environment. Salekhova et al. (2019) explored the use of the LMS with Moodle in CLIL courses and found that students could benefit from Moodle in accessing learning materials, seeking support from peers, and interacting with teachers, which accordingly helped them learn their subjects more effectively. Similarly, Meinecke (2020) investigated the application of online CLIL courses and reported that students appreciated the course organization and easily understood the content and quality of course materials. These findings reflect the potential impacts of digital technologies on enhancing content knowledge comprehension and supporting course materials accessibility, which are typical aspects of CLIL practices. Such research results echo the findings reported in different research conducted by Paliwoda-Pekosz and Stal (2015), Galitsyna and Yesenina (2020), and Zhao et al. (2022). Having said that, researchers also revealed limited interactions in online or blended CLIL classes. Despite the development of communication technology, the interaction between teachers and students in online platforms appears not to be effective (Meinecke, 2020).

Assisting the development of teaching and learning materials

Digital resources have been increasingly popular in teaching and learning these days. This explains why digital technology might be useful in assisting the curating and developing of CLIL teaching and learning materials. As a dual-focus approach where both content knowledge and language competence are equally emphasized, CLIL requires customized materials to

ensure the achievement of both goals. Villarreal and Bueno-Alastuey (2022) studied the integration of digital technology in creating CLIL materials by surveying students and reported the capacity of technology in all stages of the CLIL approach. This echoes a previous study by Zhyrun (2016) on using technology to design audio and videos for CLIL courses. The audio and video materials designed appeared to be more appropriate for students in terms of language use and content selection. The CLIL videos also "bridge the gap between the concepts studied and a local culture, making the learning more meaningful and enjoyable" (p. 23). However, this might raise a question about the authenticity of the materials. Given that awareness, Lavrysh et al. (2021) addressed the issue by analyzing teachers' perceptions of authenticity and the ways authenticity was introduced in CLIL classes through educational materials and tasks. The authors found that accessibility to multiple digital resources helped teachers curate and develop materials with opportunities to link their teaching with the real world and add a variety of authentic learning activities.

Enhancing language and content learning

This appears to be the most significant aspect in CLIL practices. There have been concerns about how language and content learning can be successfully achieved in CLIL classrooms. Having said that, little evidence has been reported to address this issue. Among the fifteen reviewed studies, only two explicitly examined the impacts of digital technology us on students' learning of content and language in CLIL classes. Baranova et al. (2020) explored whether the use of mobile applications could help enhance students' reading and writing in CLIL classes. The authors found that mobile note-taking apps had a great didactic potential in enhancing students' reading and writing skills. In other words, the students not only gained their comprehension of the subject matter but also developed their language skills, namely reading and writing. Another study conducted by Puspitasari (2020) also revealed that students' reading comprehension could be improved using mind-mapping tools. Although few studies examined the students' development of content knowledge and language competence with the support of digital technologies, some research has raised valuable implications that both content and language learning in CLIL practices can be enhanced with digital technology (Zhao et al., 2022; Firmayanto et al., 2021; Garcia-Esteban et al., 2021; Galitsyna & Yesenina, 2020; Adipat, 2021).

Improving students' motivation and engagement

Students' motivation and engagement play a significant role in their learning process. In the context of CLIL, students are required to achieve dual goals of learning both subject matter and language skills. This has challenged a number of students due to their language proficiency or content knowledge background. Researchers have questioned how students are motivated and engaged effectively in their learning. To answer the question, Angel (2015) delved into students' perceptions of the adoption of WebQuest, a virtual laboratory, in CLIL science courses. She found that the students were "more motivated and learn[ed] more" as WebQuest offered them sufficient applied practical content and empowered their independent work. These findings are aligned with what Zaripova et al. (2019) found in their study on the academic motivation of Master students in CLIL courses with the integration of Information and Communication Technology (ICT). The students possessed various motives, and using digital technologies in learning helped them accommodate challenges in CLIL classes, which increased their academic motivation.

Conclusion

The systematic review summarizes fifteen pieces of research that investigated how various facets of CLIL practices relate to digital technologies. The study identifies certain digital tool and device potentials that might enhance CLIL teaching and learning. Generally speaking, using digital technology into CLIL classes may aid in developing a multimodal learning environment for students, facilitate the creation of CLIL materials, increase language and subject acquisition, and raise student motivation and engagement. Having stated that, few studies have been done to examine how digital technology affects students' acquisition of disciplinary knowledge or how well the integration of content and language operates in CLIL contexts, despite the fact that technology has advanced quickly in the digital age. Some academics say it could be difficult for pupils to comprehend complicated subject matter in a foreign language if they have poor English skills. (Hajer, 2000). It explains why they have been attempting to get digital assistance to get over language hurdles while ignoring the assistance for subject-specific knowledge. As a result, there is a dearth of research on the use of digital technology to aid educators and learners in improving topic knowledge transmission and acquisition. Particularly in CLIL contexts, it is crucial to investigate more into how the three domains of disciplinary content, language, and digital technology interact.

Despite the abundance of studies examining the use of digital technologies in language instruction, there is a lack of empirical research on a CLIL approach in higher education. Current research, which examines the effectiveness of specific technologies in enhancing certain areas of students' language ability, depends on quantitative data from survey questions, pre-tests, and post-tests, which may not fully convey the complexity of the learning process. It is yet unclear how digital technologies will be used to facilitate sophisticated CLIL elements like student-student and teacher-student interactions, the blending of language and subject, or collaborative learning and teaching. By employing observations and surveys of a small sample, action research has restricted its results to specific situations with specific individuals. The problems and advantages of integrating digital technology in the classroom have received a lot of attention in research on teachers' perspectives and experiences, while CLIL practices have received less attention. Thus, it is crucial to carry out qualitative research that investigates the ways in which digital technologies are integrated into teaching strategies in a CLIL context.

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