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Technology-Enhanced CLIL Instruction in Indonesian High Schools: Teachers' and Students' Perspectives

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Abstract

Bilingual education involves various strategies like Content-Based Instruction, English as a medium of instruction, and Immersion Programs. Each one of them integrates language learning and subject learning in different ways. This study addresses the possibility of implementing technology in CLIL in a bilingual classroom from teachers and students. The approach employed was quantity/qualitative. Data collection was done through questionnaire sconsisting of 26 questions for teachers and 30 items for students, and interviews, to acquire a deeper insight. The sample consisted of bilingual learners involved in technology-supported CLIL teaching to explore content language integrated learning challenges encountered, digital technology support, and effects on classroom settings. The results are supposed to indicate that technology can enhance the effectiveness of activities and interest, although digital condition, the issue of content versus language balance, technology restrictions may intervene. The study highlights the importance of strengthening digital support, providing teacher training, and implementing effective scaffolding strategies to improve bilingual instruction.

Keywords: CLIL classroom practices, digital pedagogy, student engagement, technology-enhanced CLIL, teacher readiness

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1. Introduction

In modern globalized classrooms, technology-integrated bilingual learning enhances students' communication, knowledge, and competence. As a lingua franca, English is no longer to teach the language but incorporation into science and technology is more profound (Piacentini, 2021). Schools must adopt innovative approaches by integrating digital resources into English-medium instruction to meet the growing demands for learners' linguistic, cognitive, and technological skills, as technology-enhanced classrooms reshape how student access, collaborate with, and learn from information, making digital literacy a key global competence. Many researches have indicated the advantages of technology in teaching and learning language. Methodologically, Zaki et al. (2024) has found that using technology in teaching English can increase students' motivation and participation. T. L. Pratiwi et al. (2025) found that e-learning have attractive perceptions toward the students if it is providing meaningful interaction. Nevertheless, the success greatly relies on teachers' technological and pedagogical knowledge and skills, particularly in designing interactive learning experiences, selecting appropriate digital tools, and facilitating meaningful communication that supports both language development and content understanding.

Teachers often have a time when they do not have a good understanding of technology or the best ways to teach. Teachers need to design lessons that encourage students to discuss the subject while understanding both the language and the content, rather than simply using apps (Scherer et al., 2023). Without the ability to select appropriate tools and guide meaningful discussions, even the best software will have little impact (Winícius et al., 2023). The way schools help teachers learn and grow doesn't just matter it determines whether technology actually helps students learn and grow (Amemasor et al., 2025; D. I. Pratiwi & Waluyo, 2023). Schools need to support teacher growth so that technology can really help learners. Teachers' professional growth needs to be backed by schools as a tool to enhancing technology in students learning. Constant training, clear guidelines, and chance for skill development both about technology and teaching methods should be provided. Although, it is still difficult for many teachers to match digital tools with good teaching techniques in the classroom mainly because of absence of sufficient support and well-organized guidance. Matching the digital tools with good classroom strategies is still a big challenge, for many teachers because they do not get the guidance they need (Abildinova et al., 2024).

In response to these demands, educators have developed approaches that integrate content knowledge, language, and technology in the classroom. One example is STEM-based learning, which integrates science, technology, engineering, and mathematics to develop critical thinking, problem-solving, and real-world application skills (Gavrilas & Kotsis, 2025). In Indonesia they found out that when students learn with this concept-based STEM way they get a lot better at understanding science and they are more motivated and they learn skills that they will need for the rest of their lives (Farwati et al., 2021). Building on this way of learning that combines lots of things there is something called Content and Language Integrated Learning or CLIL for short which's when you learn a language and other things at the same time. When students do CLIL they learn about things (Coyle et al., 2010; Yumnam, 2023). They get better at thinking. They do this by doing real tasks that are meaningful to them. Studies have shown

that students who do CLIL are more motivated and they believe in themselves more than students who do not do CLIL especially when they have tools, like videos and pictures to help them learn (Bower et al., 2024).

A lot of studies have been analyzing the use of CLIL in different settings. Setia Negara & Leonor Rafol (2025) described various ways that teachers could adapt in bilingual classrooms in Taiwan while Villabona & Cenoz (2022) argued that it is hard to find a proper ratio of content and language due to different professional background of teachers. While it is true that CLIL has been thoroughly researched all over the world there still remain many unanswered questions about its functioning in contexts like Indonesia, which have very diverse linguistic landscape. As several studies, the teaching method called CLIL may inspire students who are normally not inclined to learning and at the same time, it will help them to better comprehend what they are learning. But, one of the difficulties connected to CLIL is that learners require the appropriate level of language support and this needs to be provided (D. I. Pratiwi & Waluyo, 2023). Similarly, Novitasari et al. (2022) reported increased student confidence in a CLIL-based Tourist Guiding course, while Wahab (2025) highlighted the effectiveness of CLIL-based microteaching in developing pedagogical and linguistic competence among pre-service teachers. Globally, Halyna (2024) and Poveda-Garcia-Noblejas & Antropova (2024) confirmed that CLIL enhances motivation, intercultural competence, and content learning, although challenges related to teacher training, material development, and contextual adaptation persist.

In spite of the growing body of research, studies concerning technology-supported CLIL implementation are still scarce especially in Indonesia. Previous research paid more attention to either teachers' instruction or students' learning in a separate context rather than in integrated environment of the technology-supported CLIL in a whole school setting (Perez Peguero, 2024; Sutrisno & Surono, 2024). While researchers begin to investigate how the technology supports content-language integration in several contexts globally, empirical research in Indonesian secondary schools particularly in the international curriculum is still limited. Due to this situation, a study observing in a technology-supported bilingual classroom (from both teacher and student interaction perspective, in order to provide an insight into a real classroom setting would be valuable to be conducted (D. I. Pratiwi & Waluyo, 2023; Satayev et al., 2022).

Accordingly, this study is guided by the following research questions: How do teachers and students perceive the use of technology in CLIL-based classrooms? What challenges do they encounter in integrating technology into CLIL instruction? And how does technology support bilingual learning in such environments? Through addressing that questions, the study seeks to not only fully comprehend the implementation of Technology-enhanced CLIL from the viewpoints of both teachers and students, but also to recommend ways to effectively make use of digital tools in Indonesian senior high school settings, as it were through this lens that an enriched understanding of the CLIL pedagogy can best be appreciated. To better understand the current development of this topic, several previous studies are reviewed below.

CLIL is a method of teaching a subject through a second or foreign language with the simultaneous learning of that subject and the language. Coyle et al. (2010) speak about 4 Cs Content Communication Cognition and Culture. Where the goal is meaningful communication,

use of contextualized input and authentic materials for meaningful learning, not isolated language learning. Such a method prompts students to work intensively with the content and language in a natural setting. Besides that, it helps learners to develop their cognitive skills as they simultaneously understand the content and use a foreign language. Moreover, CLIL supports the learners' independence by giving them opportunities to gain knowledge through collaboration and authentic tasks. Consequently, support the dual focus on content and language, and to do so by engaging students through tasks and materials that promote meaning, understanding and motivation but using multimedia learning resources to do so (Bower et al., 2024; Yumnam, 2023).

The success of CLIL is always connected with teacher readiness, which refers to pedagogical, linguistic and affective areas. Teacher should not only be aware of how to make various integrated lessons, how to use English as media of instruction, and how to be confident while using bilingualism, but also be aware how students' responses to CLIL is (Jurado et al., 2025). Motivation, learning difficulties and gained benefits from learning are all quite essential to motivate students to join CLIL instruction activities. However, from a constructivist and socio-culturalist view, CLIL requires active participation, interaction and scaffolding, and language and content learning would be achieved through communicative activities, collaborative scaffolding and meaningful use of language, which make CLIL instruction always affected by teacher readiness and student response (Imamyartha, 2026; Zayas-Martínez et al., 2024).

The term bilingual education describes both accessing L1 and L2 as learning tools to facilitate both learning and language development, not just speaking in two different languages but using them as cognitive resources for making meaning and communicating clearly (Bigelow & Ennser-Kananen, 2015). Wright et al. (2015) also add that bilingual education enhances metalinguistic and critical thinking skills; therefore, explains why it provides a solid basis for CLIL. In regard to student response, it becomes undeniable to become a central concern in ESL learners which learning involves an integration of content and language. The interest and motivation contribute to their participation, and the learning difficulty reflecting the problem of content understanding of L2 (Sulyman et al., 2021).

Whereas perceived benefit reflects the students' acknowledgment of the power of bilingual education in enhancing L2 language proficiency as well as academic disciplines (Cenoz & Gorter, 2022). Translanguaging encouraged this process by mobilizing the L1 and L2 flexibly to facilitate cognitive workload (Ertugruloglu et al., 2023). In fact, it indicates that bilingual learning goes beyond language proficiency. It is also a strategy that enhances understanding via language switching (Banegas, 2020). It calls for raising awareness about language learning environments where students are given the opportunity to utilize all their languages without fear or hesitation. Also, the key to getting both languages to work well towards the attainment of learning goals through bilingual teaching lies in the design of the instruction (Adipat, 2021). Definitely But bilingual education would not be a successful undertaking without the enthusiasm and capability of the teachers to handle two languages and provide guidance in an effective way (Banegas, 2020). In the meantime, its effectiveness would depend on whether the teachers are prepared for the bilingual classroom through language balancing and

supporting language users with good scaffolds. Because of this, plainly from these studies that one of the main points of attention put on bilingual learning is the implementation of teacher practices.

Use of Technology is defined as making use of digital tools to support the learning process and enhance students' interaction. In CLIL this approach creates the possibility of expanding the sources of information related to the content and, at the same time, using them as a channel for learning the language mainly via multimedia presentation of content, visual illustration of ideas, and hands-on work (Castillo-Cuesta et al., 2024; Smaldino et al., 2019). Such features are especially beneficial in bilingual classrooms, where learners encounter more cognitive load. In this study, concept of digital support refers to not only to technological readiness, digital literacy and instructional integration for teachers but also digital participation, barriers to learning and self-regulated learning for students (Scherer et al., 2023). Since proficiency in the effective use of technology is largely and ultimately based on the ability to integrate technology with pedagogy and content knowledge, these aforementioned principles and practices have much closer ties with the technology readiness of teachers (Pócsová et al., 2021). The TPACK framework seems to say so. According to students, technology influences student response through motivation, understanding and independent learning (Drugova et al., 2021; Humaera et al., 2025).

Digital technologies can empower students by giving them more control over their folk. By revisiting the lesson materials anytime, students can get the most out of learning supported with online, even outside the school hours, they can acquire skills of personal autonomy and lifelong learning by controlling the pace of their study oneself, whereas digital tools offer personalized learning via interactive multimedia which help deepening the understanding (Faza & Lestari, 2025; Laka et al., 2025). Nevertheless, the above advantages, problems such as insufficient digital literacy, disrupted internet connections and comprimised access of devices might obstruct effective learning. Students without being provided with appropriate instructions and well-arranged support from the teachers may end up misusing digital tools or getting distracted by non-academic stuff (Kitongan & Gutierrez, 2022). Therefore, in the end, technology is a dual acting contributor to learning either as a force that amplifies educational gains or as a source of challenges that call for a thoughtful approach and careful management (Steinhagen et al., 2021).

Research has shown that teachers and students are prone to regard technology-enhanced CLIL favorably. However, there are still several gaps in current research, one of which is the poor understanding of how teacher readiness, student responses, and digital support are linked through the medium of technology-enhanced CLIL classrooms. For that reason, such paper adds to the research by proposing an integrated view of technology-enhanced CLIL classroom practices. We also present theoretically-based views of technology as a facilitator between pedagogy and language acquisition, alongside providing a set of suggestions for teachers and educational policymakers how to create good bilingual learning environment. Digital resources have been reported to facilitate content explanation and language scaffolding by teachers, and motivation, engagement and increased comprehension on the part of students through multimedia and interaction with learning material (Bower et al., 2024; Castillo-Cuesta et al.,

2024). These have been deemed as important factors leading to effective technology integration. But there are still some disadvantages. Teachers continue to face difficulties in content and language integration and a lack of technological efficiency, learners face problem in comprehension of L2, cognitive load and technical issues (infrastructure and accessibility) hampering the effectiveness of learning (Hüttner et al., 2025; Loan, 2025; Štefková & Danihelová, 2023). These results indicate that just having technology does not ensure learning, and technology needs to be complemented with planning, training etc. In Indonesia, very few studies were conducted and a few focused on some aspects of studies, for examples only studies on teachers or student (Lestari & Setiyawan, 2020; Setyaningrum & Purwati, 2020). Consequently, little attention was paid to the combined interaction of teacher readiness, student response, and digital support. This study combined the three elements as a part of the response to the need of the study. Therefore, the research in this study mainly focuses on the limited understanding of the interplay between the three dimensions in technology-enhanced CLIL classrooms, mainly in the Indonesian secondary school setting. Conceptually, this study adds value to the body of knowledge on technology-enhanced CLIL by offering an integrated view of technological, pedagogical and linguistic dimensions whereas on the practical side, it gives directions to teachers in developing effective digital-supported CLIL classes and to government bodies in enhancing teacher training and institutional support. Lastly, the outcomes might also be used by other academicians who wish to go deeper into looking at technology integration in bilingual instruction in more varied settings and research methods.

2. Method

The present study employed mixed-methods research with both quantitative and qualitative data to explore technology-enhanced CLIL implementation from different perspectives in order to gain a comprehensive understanding of the phenomenon. In the study, quantitative data were gathered through questionnaires as the initial stage followed by qualitative data through interview as the next step to explain and confirm the quantitative data, as Creswell (2018) suggests. This study sets an explanatory sequential design. This research was carried in a top school in Batam, Indonesia. In this school, the school adopted bilingual instruction in which the content was taught through English media-base based on CLIL approach. The participants in this research were one subject teacher (STEM teacher) and 117 high school students who joined the CLIL class. Participants were selected using purposive sampling from those who already experienced in technology-assisted bilingual teachers. Participation was of course voluntary. The procedures in this research complied with ethical considerations like signed consent form, anonymity and confidentiality.

Data were collected using a questionnaire and semi-structured interviews to capture both measurable trends and in-depth perspectives. Questionnaire consisted of 56 closed questions (26 questions for teachers; 30 questions for students) measured on a 4-point Likert scale, and focused on the dimensions of pedagogical, linguistic and technological teacher readiness, digital literacy (ecological dimension of the teachers), and content/learning, content presentation and content assessment (educational dimension of the teachers), as well as motivation, learning difficulties, digital benefits, digital participation and self-regulated learning (the dimensions of respondents' willingness) for students.

All the questions were adapted from previous validated studies Abildinova et al. (2024), Bower et al. (2024), Candel et al. (2021), Castillo-Cuesta et al. (2024), Lap et al. (2025), D. I. Pratiwi & Waluyo (2023), Sandy (2021), Štefková & Danihelová (2023), Yang & Yang (2022) and Yangambi (2022) in order to match the variables of teacher readiness, student response and digital support in CLIL-based learning. Furthermore, semi-structured interviews with 14 open-ended questions were used to investigate participants' experiences and viewpoints of technology enhanced CLIL learning. The interview questions were related to the three themes of linguistic difficulties, pedagogical preparedness and the technology use motivation learning barriers, benefits, and instructional effectiveness. These items were adapted from previous studies Abildinova et al. (2024), Bower et al. (2024), Castillo-Cuesta et al. (2024), Lap et al. (2025), D. I. Pratiwi & Waluyo (2023) and Štefková & Danihelová (2023) to ensure consistency with the research focus.

Data collection was initiated through instrument validation and college approval. Data collection was then furthered through questionnaires that were constructed and administered via e-mail in the form of Google Documents. Data collection proceeded further into interviews with selected participants. Purposive sampling was used based on engagement in the program and reported difficulties. The interviews were held between 15-25 minutes in length with informed participant written permission, audio tape recorded, and later transcribed. All participants' names were anonymousized as participant codes and held file locked.

For data analysis, a combination of quantitative and qualitative methods was applied to report and interpret data. Quantitative and qualitative approaches are employed in this study. A survey, modified from well- established tools (validated questionnaires) was used to collect responses on aspects of teacher preparedness, student reactions and digital support, which the responses from the questionnaire were organized, coded and interpreted in a descriptive manner to highlight similarities in the perceptions and challenges in the technology-enhanced CLIL classroom. On top of that, semi-structured interviews, which were modified from existing interview instruments employed in other investigations, were thematically analyzed, and the participants responses were coded into the theme of motivation, learning difficulty, technology use, and teaching effectiveness as the major categories. All the data generated have been disguised by coding (e.g. T1, S1) the participants with no identifying attributes and securely stored to guarantee privacy. Lastly, data collected through the two research means were compared and combined to create a more comprehensive view of the situation.

3. Findings and Discussion

3.1. Perceptions of technology in CLIL

The research question focused on the different perceptions towards the use of technology in a CLIL-class. We collected the data from questionnaire and were also supported by theme analysis through semi-structured interviews to capture both general as well as in-depth views about technological integration. Findings from interviews showed participants consistent experiences agreeing with the results of the quantitative analysis. Students mentioned digital tools as one of the methods that supported their grasp of the content through the means of visual explanations and the various interaction elements. The responses in the questionnaire showed that teachers and students were generally in favor of using technology in CLIL learning most

teachers showed high level of preparation (M=3.20), Mostly in being highly skilled at organizing team-based and group activities (M=3.0) and at helping the learners engage in higher-order thinking (M=3.5) while being somewhat limited in the application of authentic materials (M=2.5).

For the use of technology, the teachers reported very much perceived effectiveness of it (M=3.37) with the highest results when talking about student motivation raise (M=3.5) and confidence when digital platforms are used (M=3.5) The students also gave a favorable response when it came to motivation (M=3.10), interest (M=3.12), perceived benefits (M=3.24), digital engagement (M=3.09).

> *"I feel that I can understand the material I learn better when studying math using digital tools."* (S1Q1)

> *"Especially explanation videos from the internet or quizzes like Kahoot or Quizizz."* (S2Q1)

Students also highlighted increased motivation and confidence when using digital tools in learning.

> *"I feel more confident and more enthusiastic when using digital tools."* (S2Q2)

From the teacher's perspective, technology was perceived as useful in supporting instructional delivery, particularly in explaining abstract mathematical concepts.

> *"I create media using GeoGebra… to show how the transformation process happens."* (T1Q2)

The evidence of these research findings suggests that it's technology which makes easier both engagement and a better understanding in bilingual teaching situations. Students' high scores on motivation and their view on the benefits of technology mean that they learn from using digital media because that is the place where pictures, explanations, and hands-on features are brought together (Abildinova et al., 2024). This is in line with the CLIL idea of students handling both language and the subject matter at the same time, so that it is necessary to provide extra help in case they want to understand and use the target language successfully (Coyle et al., 2010). Besides that, the results of the present study suggest the metal as a big production plant of learner independence, the willingness of pupils to learn at the same time, and the re-play of explanations and going for extra resources as some examples in this case the use of digital tools is leading to learning even when the students are not present in the classroom physically (Jurado et al., 2025). Actually, this also supports what many educators are trying these days. The concept of learner-centered teaching where the pupils become the directors of their studies. Also, the student's comments about feeling more confident and getting motivated indicate that the technology is not only enhancing the cognitive side of learning but also the emotional/ affective side of it. When students feel that they are capable and are involved, then they are very likely to participate in CLIL classrooms which can help them to better their language skills at the same time as the subject matter (Poveda-Garcia-Noblejas & Antropova, 2024; Tan & Lan, 2023).

By visualizing mathematical notions with GeoGebra, a math teacher may illustrate how technology has a role in the explanation of challenging and abstract concepts (Scherer et al., 2023). In fact, it may well mean that technology is integrated in CLIL in such a way that its main function is revealing underlying concepts but not mere information delivery. Basically, the findings indicate that making use of technology in CLIL contexts can lead the learning setting not only to be pleasant and enjoyable but also highly engaged and supportive. Yet, how well it works largely hinges on how skillfully the teacher can deploy it as a means of both language learning and content learning.

3.2. Challenges in technology integration in CLIL

This research question explored the challenges experienced by teachers and students in integrating technology into CLIL-based instruction. Data were collected from questionnaire responses and further explained through interview findings to identify both perceived and actual difficulties.

The findings revealed several challenges across linguistic, technological, and pedagogical aspects. Linguistic challenges involve difficulties in using English in CLIL classrooms, while technological challenges relate to issues of access, technical problems, and content quality. The linguistic problems have largely been revealed through students' questionnaire and interviews. It was particularly found that students had difficulties understanding mathematical content in English because they first had to comprehend the language, which increased their cognitive load and led to translation being the main strategy. Similarly, the teacher mentioned that he/she did not have much confidence in speaking English due to limited vocabulary, which impacted the use of English as the medium of instruction in CLIL classrooms. Technological problems were also uncovered and included lack of access and usability of platforms issues, e.g. unstable school Wi-Fi and very fast-paced explanations in digital content that were skipping steps leading to confusion and loss of understanding. Lastly, content quality has been a very hot topic, as some digital platforms especially AI-based ones have been giving wrong or partial explanations, so students have had to check the information through other sources like videos or peer discussion.

Teachers showed moderate levels of technology integration (M = 2.71), indicating that technology was only partially implemented in classroom practice. Lower scores were identified in digital assessment (M = 2.5) and collaboration with colleagues (M = 2.5), while technical issues scored as low as (M = 2.0). Linguistic readiness was also moderate (M = 3.00), suggesting that teachers still relied on flexible language use and occasional mixing of English and Indonesian (M = 2.5). The students' point of view was mainly about the persisting difficulties in learning (M = 2.86) which they In particular found tough when the content was in English and also when they had to balance language and subject learning equally. Alongside that they also mentioned technological challenges (M = 2.55), like internet problems and trouble to maintain concentration. These statistical outputs were confirmed by qualitative interview responses, where participants' difficulties matched each other and This way showing a common issue. Both students and teachers acknowledged language barriers. While students

talked about the priority of language over content processing, teachers described how limited was their English language knowledge to be applied in teaching.

> "*I feel that I have to understand the English first before understanding the math problem.*" (S1Q3)

> "*Maybe the obstacle is on my side… my English vocabulary is still limited.*" (T1Q1)

Technological challenges were also frequently reported, particularly related to the quality of explanations and technical access.

> "*Sometimes the explanation is too fast or some steps are skipped, so it is difficult to understand.*" (S1Q3)

> "*The school Wi-Fi often lags, so I prefer using my own mobile data.*" (S2Q3)

From the teacher's perspective, challenges in classroom management and student discipline were also identified.

> "*Students do not always use the technology according to our instructions.*" (T1Q1)

These findings indicate that the difficulties of integrating technology in CLIL settings are not only about one factor, but rather a combination of linguistic, technological, and pedagogical factors. Learners' language capability is still a major challenge in CLIL, as shown by their moderate language readiness and the presence of learning difficulties (Fitrawati et al., 2023). This sheds light on the fact that in a CLIL setting, learners must double up as both content and language processors thus if they are not given sufficient scaffolds, the cognitive load will be increased, and their understanding will be lowered (Hüttner et al., 2025; Satayev et al., 2022). On top of that, the findings point out that technology, by itself, does not ensure that learning will be effective. One can agree with in reality the use of digital tools has become increasingly prevalent, but it is the content delivery, the clarity, pace, and structure of the material presented, that really determines their usefulness. On this students' feedback that explanations are too fast and the steps are omitted shows how poorly designed digital resources could be a hindrance rather than an aid to learning. So, besides the technology, the pedagogical aspect of digital content warrants serious considerations.

In addition to this, factors like technological problems, like unstable internet connectivity and difference in the levels of digital skills among students, restrict the implementation of technology in the classroom setting. These challenges show that infrastructure facilities and availability are among the most significant factors for the students' learning process (Sutrisno & Surono, 2024). If one does not have stable internet connections and access then one cannot make full use of technological advantages. Management of the class and students' level of preparedness make another important part of the equation. It turns out that in the light of research results students' capability of self-regulation and discipline have quite significant influence on the way they apply the technology to support their learning process. However, the teachers' problems related to controlling students' use of devices indicate that technology integrated learning will remain a challenge unless one addresses not only the skill aspect of the technology use but also offers pedagogical support for effective classroom behavior management (Macaraeg et al., 2024). Conclusively, it might help to identify those different

aspects which altogether determine the success of the technology integration in CLIL. These factors include availability support instructional design, infrastructure and class management. That means, we need to deal with the problems as they are interconnected so that, in time, technology-based CLIL learning will bring about the changes we hope for.

3.3. Technology support in CLIL learning

The research question of this study was a combination of how technology supports the bilingual development among students learning through the CLIL approach and a review of questionnaire responses and a thematic analysis of interview data. When talking about the survey there was an identification of multiple ways in which technology contributes to bilingual development in bilingual students. First of all, students considered technology as a very beneficial partner in their learning (M = 3.24), implying that the combination of CLIL and technology-enhanced learning helped not only English language skills but also content learning. Besides, digital workability got a high score (M = 3.11), which can be interpreted as students encountering digital tools as very efficient in helping them understand and be attentive. On the other hand, self-regulated learning got a rating of (M = 3.10) showing that students often resorted to digital materials independently after school hours.

Likewise, teachers perceived that technology-assisted bilingual learning can help students in comprehension and communication with average scores (M 3.0). Besides, these numerical results were supported by the interviews which shed more light on the role of technology in bilingual learning. Students mainly emphasized that digital resources, because of clear explanations, visuals, and examples, help them in understanding better.

> *"I feel that I can understand the material I learn better when studying math using digital tools."* (S1Q4)

> *"The platform helps explain the questions and their answers."* (S1Q4)

> *"It helps us answer questions that involve graphs or algebra."* (S2Q5)

In addition, students emphasized the role of repetition and accessibility in supporting comprehension and language processing (C2).

> *"I can also review and strengthen my knowledge again by watching explanation videos on YouTube."* (S2Q8)

> *"We sometimes practice again at home to prepare ourselves before exams."* (S1Q8)

> *"I can learn to answer questions more independently without help from the teacher or my friends."* (S2Q8)

Students also highlighted that interactive platform contributed to engagement and active learning (C6).

> *"Especially explanation videos from the internet or quizzes like Kahoot or Quizizz."* (S2Q7)

> *"The questions are not only on paper, but also online."* (S1Q7)

From the teacher's perspective, technology was perceived as an effective tool to support conceptual explanation and classroom interaction, particularly through visualization (C1).

> *"I create media using GeoGebra… to show how the transformation process happens."* (T1Q3)

> *"When I have to teach calculus, for example, I need to show graphs."* (T1Q7)

These results imply that technology in a way act as a mediating tool that helps in combining language and content learning in the CLIL context. Using visual and interactive materials not only make the students' work easier but also leads to better understandings of difficult things (Candel et al., 2021). This is especially crucial in bilingual classes, where the students have to understand both the subject matter in one language and a foreign language. Besides that, technology is a great support for learner autonomy and lifelong learning (Li et al., 2022; Van Viegen & Lau, 2022). The comparatively high level of self-regulated learning, as evidenced by multiple student responses, reveals that learners are quite resourceful in utilizing digital tools for revising materials, practicing independently, and reinforcing their understanding of the content outside the classroom. This is in line with self-regulated learning where learners actively manage their learning activities. In fact, the study showed that technology can help attract students more effectively and get them to participate. Through interactive learning tools like quiz and picture, lessons become more engaging and may ultimately lead to higher motivation level and students' attention retention (Smaldino et al., 2019; Tan & Lan, 2023). The finding supports that technology is not only an intellectual learning facilitator but emotional one as well.

However, the results show that technology only does not make an efficient bilingual learning environment. There was reliance on teachers and peers still for clarification; that means technology is just another way to provide instructional support and not a substitute for it. Language proficiency, background knowledge, and the quality of digital resources are still factors with a lot influencing learning outcomes. This is an example of the necessity that teachers should not only have technical skills but also knowledge in teaching methods to identify needs, change teaching methods. As a result, and bring digital learning resources efficiently into learners' activities. Ren & Li (2026) argue that to carry out a fair and effective technological language education for different learners and their different needs, a combination of technological capability, knowledge, and teaching methods with contextual understanding of teachers is needed. But Istrate (2026) says that, on the contrary, teachers should not replace learning strategies by digital technologies like generative and multimodal tools, but rather use them to improve teaching practices. After all, it is not the tools alone but rather their design, development, and implementation that determine the learning's depth and quality. To wrap up, the study results have supported the idea that technology aids bilingual learning Mostly through boosting understanding, fostering independence, and creating interest. Yet, success heavily depends on the combination of technology, language, and pedagogy with a good CLIL class plan involving these three factors.

Moreover, incorporating digital tools in bilingual and CLIL learning environments is a demand on teachers in the sense of digital literacy to guarantee a proper use of technology for

learning and teaching activities. Diaz (2024) pointed out that just the presence and use of digital tools do not mean digital literacy skills are developed as the major factors for effective integration lie in the quality of teaching and the design of meaningful learning activities. In CLIL settings, technology should not be only for conveying materials but also to language learning, subject understanding, and learner engagement with planned activities. This viewpoint reveals that bilingual learning assisted by technology is mainly dependent on the teachers' capacity to identify, modify, and assess digital materials for learning targets. As such, programs targeting professional growth of teachers' mastery in digital tech is necessary to be certain that deployment of tech will lead towards in-depth learning and not to additional challenges to the students' cognitive or instructional processes.

Largely, one factor contributing to the effectiveness of digital technologies in bilingual education is their use and multimodal learning approaches that feature the integration of multiple modes like text images audio, and web-based tools. Bewersdorff et al. (2025) argued that with AI multimodal, environments could enhance learning by allowing for representations of adaptively changing types of resources and giving personal support which does not exclude the role of the teacher as a decision maker in planning instruction. Same here, research in EFL on digital multimodal strategies revealed that mostly, how students use meaning and how they interact with lessons depend on to what extent teachers are able to merge multiple digital materials (Ghamarian et al., 2024). In regard to Indonesian education setting, Han et al. (2026) emphasized further that in English language instruction digital literacy is not the only thing teachers are expected to be familiar with; they are also supposed to come up with pedagogical ways of using technology efficiently. These results confirm that, in bilingual classrooms, the use of new technologies should be seen as a teaching approach change process, teachers being the ones who connect between digital tools, subject matter knowledge, and student language growth.

4. Conclusion

The purpose of this research was to make an investigation of how teachers and students perceive the use of technology in the CLIL environments as well as the problems faced and the role of technology in bilingual education. Results have shown that both the teachers and the students have a positive attitude towards the use of technology and especially to the factors of engagement, motivation, and understanding through the use of visual and interactive materials. Evidently, the study also highlights that the impact of technology in CLIL was mediated by the combination of the three dimensions of language, technology, and pedagogy. Firstly, the students who are learning two languages at the same time are facing some difficulties at the same time due to the dual processing of language and content, and secondly, instructors' limited command of English leads to low confidence in language use as well as a reduction in the clarity of instructional communication. Moreover, technology-related problems such as unstable internet connection, different levels of digital competence, and not always good quality content are the reasons why the influence of digital media is not running at full power.

An additional aspect brought up by the research is that the use of a technology is seen mainly as a helping instrument and not as a substitute to the teacher, the end result being contingent

on a well-thought-out lesson plan, the use of scaffolding techniques, and effective classroom management. Even though technology gives more freedom and responsibility to the learner and, at the same time, makes it possible to learn outside school, the benefits are to a large extent dependent on the self-discipline and preparedness of the learners. On the other hand, several limitations of this study should be mentioned. This research was done only in one school and with a small number of teachers so the results may not be very representative of other situations. Moreover, the data were collected from questionnaires and interviews which, being a reflection of the participants' personal opinions, can be very subjective. Therefore, it would be great if the upcoming studies can involve a bigger number and a more diverse group of people coming from various schools in order to get a wider viewpoint. Combining self-reported data with observation or experimental methods would help to get more objective insights. Besides, studies can be done on the long-term effects of technology use in CLIL classrooms and investigation of the digital tools or teaching approaches that best support bilingual learning can be carried out. Future research could examine to what extend the teachers' technical skills, the use of certain teaching techniques, and backing from the school administration are factors determining the effective use of technology to support bilingual teaching of CLIL. Research comparing different educational levels, regions, and implementations of CLIL teaching could help identify best practices and lead to the creation of a wider variety of teaching methods that make better use of technological support.

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