Google Project Albus Report

Technology Enhancing Bilingual Instruction: A Pilot Study of a Junior High School with Google Solution

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Abstract
The Taiwanese education system is currently going through two major transformations at once. On the one hand, there are policies to make education more accessible, personalised, and resilient to future disruptions with the help of technology. On the other hand, there is the bilingual policy aiming to raise the level of English proficiency among the public and improve Taiwan's global competitiveness. Taiwan wants to become bilingual by 2030 by integrating the English language into its education system and further impacting the language use of the whole society.

With many existing Digital Transformation initiatives around the globe, there are many best practices and lessons learned that Taiwan can already take advantage of to accelerate and optimise its own transformation. Google for Education can become an important part of the Digital Transformation in Taiwan by providing software solutions (e.g. Google for Education Workspace), hardware solutions (e.g. Chromebooks), and unique insights and best practices from 50+ digital transformations with 170M+ students. Overall, the technology transformation is working smoothly and is well on track to support the Taiwanese education system. Our observations of the Taiwanese pilot have shown and proven that technology can easily save time for teachers and students, for example when collecting homework or giving quizzes. Technology benefited Taiwanese teachers in their teaching efforts even in subjects not commonly associated with technological affordances such as physical education.

The Bilingual Transformation is more challenging: While teachers are diligent, there is less of a well established pathway for this kind of transformation. The lack of meaningful insights and best practices make it significantly harder for Taiwan compared to the Digital Transformation. Additionally, there is less of a strong base of English language capabilities (and consequently lower confidence levels) amongst the existing teacher population, implying a need for more long-term, gradual English proficiency training to boost proficiency and confidence.

Doing both transformations at the same time can be overwhelming for teachers. We believe it is important that Digital Transformation and Bilingual Transformation run sequentially instead of simultaneously; more specifically, Digital Transformation needs to precede Bilingual Transformation because technology can help significantly with bilingual teaching and learning. Moreover, as technology saves time, teachers can now optimise their classes and redistribute time to more meaningful activities. Once the technology becomes fully integrated into classrooms, teachers will be able to spend more time enriching their English competence as well as experimenting with bilingual education with students. For the segment of teachers that will find it very difficult to teach bilingually, technology can plug the gap and help in a smoother transition.

I. Introduction

Bilingual education has been developed since the mid-1960s (Lee, 2011; Genessee, 2015) and became one of the educational trends in the 21st century (Sánchez-Pérez & Manzano-Agugliaro, 2021). In the globalised world where communities are interconnected, bilingual education is important in helping students survive and succeed in multifaceted aspects by cultivating their communication competence to speak more than one language (Texas A&M International University, 2021). Bilingual education has been implemented in various forms. For example, the European Commission recommended the implementation of content and language integrated learning (CLIL) for bilingual education in 2004, aiming to teach subjects through a foreign language and to learn the foreign language through subjects (Abubakirova & Zhacheva, 2021). In other words, both the subjects and the foreign language are emphasised in CLIL, and the main principle of this approach is integrated learning (Coyle, 2018).

In Asia, the implementation of English as a medium of instruction (EMI) has been the trend in China, Hong Kong, Singapore, and Taiwan, where the subjects are taught in English and the focus is more on students' acquisition of subject content knowledge (Tsou & Kao, 2017; Li, 2018). The implementation of these different bilingual educational approaches has been considered the means of enhancing students' global competitiveness. In response to globalisation, the implementation of bilingual education has become one of the national policies by many governments. Taiwan is no exception. Implementing bilingual education courses at universities could "attain international images, attract international students, and move up in the world rankings" (Tsou & Kao, 2017, p. 12). Hu and Hsu (2016, p. 476) also suggested that "the number of EMI courses is serving as a crucial indicator of Taiwan's international competitiveness, national appeal, and global influence."

1. Setting the Context: The Development of Bilingual Education in Taiwan

In 2018, the Taiwan government announced the Bilingual 2030 policy, aiming to develop Taiwan into a bilingual nation before 2030 by "cultivating people's English proficiency" and "elevating national competitiveness" (National Development Council, 2018, p. 7). As a nationwide initiative, the bilingual policy has caused a huge debate among the public and the National Development Council (2022) changed the title to the Bilingual 2030 Policy. In moving towards a bilingual nation, education is considered one of the major mechanisms in preparing the future generation with sufficient bilingual competence. The Ministry of Education Taiwan launched several projects to transfer the monolingual instruction education system into a bilingual one. Various key performance indicators (KPIs) have been set for 2030. The KPIs include: 1. 1160 out of 3400 primary and junior high schools will be bilingual; 2. Among 513 senior high schools across Taiwan, 140 will have a bilingual experimental class; 3. There will be 6 beacon universities and more than 40 beacon colleges offering EMI

courses at the higher education level. Currently, there are three key subject areas in primary and junior high schools functioning as the pioneering areas for bilingual teaching. They are Arts, Integrated Activity, and PE and Health Education.

2. Emerging Issues in Practising Bilingual Teaching in Primary and Junior High Schools

Bilingual teaching as a new initiative in Taiwanese schools encounters various issues. As Lin (2021) indicates, the lack of competent bilingual subject teachers is the biggest challenge that undermines the implementation of bilingual teaching in primary and junior high schools. The Ministry of Education requires bilingual subject teachers to have a B2 certificate under the Common European Framework of Reference for Language (CEFR). However, most teachers except English teachers do not have this kind of certificate. The lack of teachers with sufficient English proficiency becomes the first issue while implementing bilingual teaching in schools.

The second issue is related to the pedagogical knowledge (PK) of bilingual teachers. Training bilingual subject teachers was not practised in the teacher training system in Taiwan before 2020. As a result, there was a lack of capable bilingual subject teachers who were equipped with PK for bilingual teaching in primary and secondary schools when the policy was implemented.

Moreover, the achievement gap between urban and rural schools has been a long-lasting issue in Taiwan, especially in two subjects: English and Math. As Lin (2021) pointed out, the student's English proficiency level has a direct link to their readiness to accept bilingual subject instruction. The better their English proficiency is, the easier subject teachers can practise bilingual subject teaching. It is evident that implementing bilingual subject teaching in urban schools is more feasible than in rural ones. Therefore, it may worsen the educational inequality in Taiwan. The fourth issue derives from the previous one. The students in rural areas do not have sufficient English proficiency, so they are in a more disadvantageous position. Other issues include a lack of consensus on what bilingual teaching is like among the Ministry of Education, local authorities, school leaders and teachers. Meanwhile, there is not much incentive for teachers to do bilingual subject teaching. Based on the above discussion, while the 2030 bilingual policy keeps heading forward, how schools can respond to it and how this policy can benefit students are two key questions.

3. Background of this project, Research Objectives and Questions

In order to answer the two key questions, the research team at the National Taiwan Normal University collaborated with Google for Education to design and implement the Taiwan case under Project Albus. This case study aims at **exploring the opportunity of technology in enhancing bilingual teaching in Taiwanese public schools**. As aforementioned, bilingual subject teaching is a relatively new initiative, and there are not many empirical studies investigating the implementation of bilingual subject teaching in public schools. After several rounds of discussion, the NTNU team

and Google team position this case study as a pilot one because it does not make much sense to initiate a large-scale study before we can have some preliminary findings to have a fine-grained research objective and questions. In this pilot study, we propose a model of bilingual subject teaching that is enhanced by technology. To make it short, we name this model as 'technologically enhanced bilingual teaching (TEBT)'.

According to the research objective, the research questions are:

1. To what extent can it be beneficial to apply technology to enhance bilingual subject teaching in a public junior high school?
2. How do teachers respond to this model of technologically enhanced bilingual teaching (TEBT)?
3. What are students' responses to TEBT?
4. What are the advantages and areas of improvement of TEBT?

II. Review of Literature

1. The trend of technology integrated into bilingual education

There has been a growing awareness of integrating innovative technology in bilingual education in recent years (Adipat, 2021; Bakkar, 2021; Kossybayeva et al., 2022; Shadiev et al., 2020; Vinagre, 2016; Waloyo et al., 2021; Zhao & Lei, 2017; Zhao et al., 2021). For example, with the development of technology, researchers have been exploring how the use of mobile devices, such as tablets or smartphones, could enhance students' language learning process and their autonomy in classrooms (Tai & Wei, 2021). Binterová and Komínková (2013) also clearly stated that computer aids were necessary when teaching mathematics in a foreign language, including the digital preparation for instructions and the computer programs used in bilingual classes. At the same time, students' learning discourse could be easily recorded by technology to help bilingual teachers understand their learning process (Zhao et al., 2021). Moreover, one of the benefits of employing technology in bilingual classrooms was that it allowed learning to take place for the students in remote areas without geographical boundaries (Kossybayeva et al., 2022). Through computer networks, students could continue their learning outside the classrooms even for collaborative tasks (Vinagre, 2016). As Bakkar (2021) suggested, many schools have been under lockdown due to the widespread COVID-19 pandemic recently. Teachers in these schools then started to integrate technology, e.g., online distance learning, into their bilingual courses for different subjects as a solution to uninterrupted learning. To adapt to this educational trend, therefore, teachers are not only expected to have knowledge about the subjects (content knowledge) and teaching methods (pedagogical knowledge), but are also required to have knowledge about technology tools (technology knowledge) in their teaching (Koehler & Mishra, 2009). The integration of the three knowledge forms is technological pedagogical content knowledge (TPACK), which is "an understanding that emerges from interactions among content, pedagogy, and technology knowledge" (Koehler & Mishra, 2009, p.

66) and the "integrative and transformative knowledge" for teachers effectively to apply technology into classrooms (Chai, et al., 2013, p. 31). In other words, teachers need to apply appropriate technology and teaching methods to teach subjects based on their understanding of the interaction between the technology, pedagogy, and subject contents (Mudrikah, et al., 2021).

In summary, technology integrated into bilingual education has now been employed in many countries for more than a decade and is the global trend in education. During these years, researchers have shown that applying technology into bilingual classrooms, such as CLIL and EMI courses, can bring many benefits for students. On the other hand, teachers also need to know how to adopt appropriate technology into their bilingual classrooms and integrate it with their understanding of teaching methods and subject contents. To understand the practice of technology integrated in bilingual education in the recent past and the current trend, a review of related studies is thus needed. Therefore, this article briefly reviewed the practice of various technologies integrated in bilingual contexts, the effects of integrating technology into bilingual education, and the potential factors that may influence such integration.

The integration of technology into bilingual education has been employed for more than a decade. During this period, various technologies were adopted by the teachers in Western and Asian countries for the students from different educational levels. In the West, for the students in primary and middle schools, some teachers used videos from YouTube and websites in bilingual teaching (Oddone, 2011). As reported by Oddone (2011), videos were used by teachers to teach scientific subjects for secondary school students in CLIL classes in Italy. These students analysed vocabulary from the videos and acquired subject knowledge at the same time. According to the researcher, students and teachers could not only access authentic language examples by watching different genres of videos but also upload their own videos in these video-sharing websites. Oddone (2011) suggested that in addition to improving students' understanding of cultural issues and providing a language model for them, the multimedia of videos was effective in helping foreign language teachers who did not have certain subject content knowledge in bilingual teaching. These videos contained a wide range of authentic and reliable information about the subject content, such as documentaries or experiments, and they were helpful in expanding students' subject content knowledge and vocabulary. Many other researchers also showed that teachers used computer programs and interactive websites as multimedia technologies in bilingual teaching in primary and middle schools (Ludovico & Zambelli, 2017). For example, Ludovico and Zambelli (2017) implemented multimedia technology through web-based frameworks for primary school students in CLIL classrooms. With the aid of digital images and sounds and computer-based activities, the students were expected to improve their subject knowledge, language proficiency, and digital competence. The researchers suggested that web applications showed many advantages, including "multi-platform portability, compatibility with a wide range of devices, out-of-school availability" (p. 144). At the same time, different

devices were applied to work with computer programs and multimedia technology by teachers in their bilingual teaching. For example, teachers used interactive whiteboards and related programs to create online interactive environments for bilingual students (Binterová & Komínková, 2013; Krajka et al., 2016). Binterová and Komínková (2013) showed that the use of interactive whiteboards and mathematical programs in CLIL could effectively facilitate teachers' mathematics teaching for the students from primary schools. Similarly, teachers in Polish middle schools were offered interactive whiteboards and netbooks to help students learn various school subjects in CLIL classrooms, including biology, chemistry, physics, etc (Krajka et al., 2016). As Ludovico and Zambelli (2017) suggested, one of the features of the interactive boards was that they could develop students' language skills in a motivating way. Moreover, with the advancement of mobile devices, teachers also started to integrate educational technology through tablets in bilingual teaching (Darling-Aduana & Heinrich, 2018). For example, Darling-Aduana and Heinrich (2018) showed that the use of tablets (Kindles/eReaders) improved elementary school students' reading in an English/ Spanish bilingual classroom. Recently, Waloyo et al. (2021) integrated information and communication technology (e.g., Google Classroom, Google Form, and social media) into the CLIL approach for primary school students, aiming to promote their motivation and learning of English and subjects. The researcher claimed that the implementation of information and communication technology in CLIL could help ease learning for primary school students.

On the other hand, technology has also been integrated in bilingual education for university students in Western countries. For example, virtual online learning through asynchronous and synchronous tools has been applied to enhance interaction between students in the digital world. The internet-based learning platform Wikis was employed by teachers as the online asynchronous tools in bilingual contexts (Vinagre, 2016). Wikis could "serve as a platform for scaffolding, foster student-centred learning, allow for the incorporation of multiple perspectives, and facilitate the development of learning communities" (Vinagre, 2016, p. 173). Vinagre, (2016) found that when Wikis was applied in an EMI course by undergraduate students to create a virtual collaboration environment, their online discussions and interaction was effectively promoted (Vinagre, 2016). In addition to the use of asynchronous tools, many other instruments have been employed for virtual online learning in bilingual education, such as information and communication technology-based media, Zoom video conferencing, distance learning and other digital technologies (Adipat, 2021; Bakkar, 2021; Kossybayeva et al., 2022). Adipat (2021) combined the application of Zoom video conferencing and interactive PowerPoint from Google slides in a CLIL context in Thailand. A teaching method was taught to the pre-service teachers through Zoom and they were required to create their lessons by incorporating Google slides, aiming to develop these pre-service teachers' knowledge of educational content and language simultaneously. Bakkar (2021) also applied synchronous virtual classrooms and video conferencing to teach university students

from various majors though EMI in Lebanon. The cloud-based platform and TEAMS virtual classroom were incorporated to help students and teachers interact and discuss synchronously. Similarly, Kossybayeva et al. (2022) adopted distance learning in a CLIL context for the university students who studied mathematics teaching. In this distance learning context, different technologies were also integrated, including online communication tools, mobile applications, virtual reality (VR), augmented reality (AR), etc. These remote communication instruments were employed by teachers to give lectures and interact with the students, and this stream-based learning is the centre of educational trend now (Kossybayeva et al., 2022).

In Asia, teachers also used different technologies in their bilingual teaching for both middle school students and university students. For example, Tai and Wei (2021) reported that the teacher and students in a secondary school in Hong Kong were provided with iPads to learn mathematics through EMI. Their findings showed that the use of tablets in the bilingual classroom successfully created an engaging learning environment. For university students, the PowerPoint, one of the earliest technologies in bilingual education, has been applied widely by teachers to improve the effectiveness of bilingual instructions (Cheng, 2009). Cheng (2009) used PowerPoint for undergraduate students in managerial economics classes in China. The teachers designed and applied PowerPoint in their bilingual teaching, and the students used PowerPoint as a tool for presentations. The researcher found that PowerPoint helped improve the interaction between students and teachers as well as students' competence during their presentations. Moreover, similar to the bilingual contexts in Western countries, teachers in Asian countries also employed virtual online tools in bilingual teaching, e.g., Knowledge Forum. As the computer-supported learning environment, Knowledge Forum was applied by Chinese undergraduate students to develop their subject knowledge and business English language through discussions in a CLIL learning environment (Zhao et al., 2021), and it was also combined with Wikis by Zhao and Lei (2017) to create a technology-enhanced CLIL environment for the university students in China. This virtual online learning tool could enhance students' knowledge-building inquiry process through collaboration, and the students could discuss a topic "by creating, reading, commenting on, and writing build-on notes in a collectively-created space" (Zhao et al., 2021, p. 3). As Bakkar (2021) suggested, the collaboration between students and teachers in a virtual space is emphasised currently to promote effective learning. In addition to these virtual online tools, multimedia technologies have been also applied by teachers in Asian countries as in the West. For instance, Hu and Hsu (2016) applied computer aids to promote university students' school subject learning and their motivation in EMI courses in Taiwan. These computer aids, such as computer programs and interactive websites, offered students different kinds of multimedia in their process of learning, including videos, images, sounds, etc. They helped reduce students' anxiety and enhance their learning through these extra sensory perceptions (Hu & Hsu, 2016).

To sum up, these studies showed that various technologies have been integrated into

bilingual teaching in Western and Asian countries since the past decade, and teachers adopted these different technological tools for different functions and purposes in bilingual teaching. For example, multimedia technologies were offered by teachers to reduce students' anxiety and enhance motivation. They also helped provide authentic materials for language and subject content learning. On the other hand, the virtual online learning instruments could improve students' interaction and collaboration in the digital environment and continue learning without geographical boundaries. Moreover, the use of technology in bilingual teaching has become more advanced due to technological progress, compared to the traditional digital tools used in bilingual classrooms. Many teachers also tended to employ the combination of different technologies in their bilingual teaching, creating a more versatile and engaging learning environment.

2. Effects of technology integrated into bilingual education

Based on previous studies, integration of technology into bilingual education has brought many benefits to students. In particular, six main positive effects were indicated by researchers, including **facilitating foreign language learning, promoting subject content knowledge, reducing anxiety, increasing motivation, promoting interaction, and enhancing digital competence**.

2.1 Facilitating foreign language learning

One of the goals of bilingual education is to improve students' foreign language skills. Previous studies have shown applying technology in bilingual instructions facilitated students' foreign language learning (Darling-Aduana & Heinrich, 2018; Kim, 2018; Listiani et al., 2021; Gay, 2022). For example, Darling-Aduana and Heinrich (2018) showed that the application of educational technology through tablets was effective in promoting elementary school students' reading in the English/ Spanish bilingual context. Moreover, based on the review of previous studies, Listiani et al. (2021) concluded that young bilingual students' English skills could be promoted through the use of YouTube videos as the digital learning resources in bilingual instructions. Kim (2018) also showed that when teachers provided audiovisual feedback through the screencast technology to help undergraduate students' writing in the EMI classroom, the students' English writing performance was facilitated by the technology-enhanced feedback. Similarly, Gay (2022) found that the use of technological tools, such as the website app and Moodle platform, helped develop Chinese undergraduate students' language proficiency in an EMI setting. These studies have indicated that technology is effective in improving both younger and older bilingual students' foreign language skills.

2.2 Promoting subject content knowledge

In addition to foreign language skills, bilingual education also emphasised learning of subject contents. Many researchers have shown that integrating technology into bilingual classrooms promotes students' acquisition of subject content knowledge (Oddone, 2011; Hu & Hsu, 2016; Kossybayeva et al., 2022; Zhao et al., 2021). For

example, Oddone (2011) found that using videos in CLIL classes not only improved secondary school students' language competence but also their learning of scientific subjects. Kossybayeva et al. (2022) also showed that students' academic achievement progressed in the mathematics teaching course through the integration of digital technologies into the CLIL context. Zhao et al. (2021) compared the academic performance of business-major students from the regular CLIL environment and from the technology-enhanced CLIL (TECLIL) environment. The researchers found that students in the TECLIL context outperformed the other group in terms of both subject learning and English use. In Taiwan, Hu and Hsu (2016) also found that the use of computer technology was effective in promoting students' content comprehension in the EMI class that introduced contemporary Taiwanese culture in globalisation. These studies have indicated that the use of technology could assist teachers in delivering information relevant to the school subject contents, and it was especially helpful for the language teachers who lack certain subject content knowledge (Oddone, 2011).

2.3 Reducing anxiety

Some studies suggested that students' learning anxiety could be reduced through the application of technology in bilingual instructions (Binterová & Komínková, 2013; Hu & Hsu, 2016; Ludovico & Zambelli, 2017; Min et al., 2019). For example, Binterová and Komínková (2013) found that using interactive whiteboards or computer programs to teach mathematics in CLIL courses decreased primary school students' anxiety of learning both English and mathematics. Min et al. (2019) also revealed that the university students showed reduced anxiety in EMI courses when it was integrated with the cloud learning environment. Similarly, Hu and Hsu (2016) showed that applying technology in bilingual teaching brought amusements and cheerfulness, and they found that university students' language anxiety was reduced through the application of computer programs, websites, and multimedia in EMI courses. As Ludovico and Zambelli (2017) suggested, students in bilingual courses were often familiar with technological devices and these technologies usually focused on the playful aspects of bilingual learning. These two factors may explain why bilingual learners showed reduced anxiety when technology was applied in bilingual education.

2.4 Increasing motivation

Previous studies also showed that applying technology in bilingual classrooms was effective in promoting students' learning motivation and engagement in learning (Binterová & Komínková, 2013; Gay, 2022; Kim, 2018; Ludovico & Zambelli, 2017; Min et al., 2019; Oddone, 2011; Zhao & Lei, 2017). For example, Oddone (2011) found that students' learning motivation and participation in bilingual contexts was enhanced through the use of videos due to the audiovisual materials and authentic scenarios. Binterová and Komínková (2013) also revealed that using computers and programs in CLIL to teach mathematics were attractive to primary school students and they were effective in increasing their motivation. Min et al. (2019) combined a cloud learning environment and EMI for the university students from the Instructional

Technology and Media course in China. The students not only improved their professional skills but also showed enhanced motivation in courses. Gay (2022) also found that some learners were more self-regulated after the technology-enhanced instruction in a bilingual course. Moreover, other studies suggested that the level of students' engagement in bilingual classes was enhanced through the use of Knowledge Forum (Zhao & Lei, 2017), multimedia technologies (Ludovico & Zambelli, 2017), and audiovisual feedback (Kim, 2018). As Zhao and Lei (2017) explained, the combination of technology and CLIL promoted students' concept learning and language skills, which may be related to their engagement in learning.

2.5 Promoting interaction

Some researchers found that using technology in bilingual classrooms effectively promoted students' interaction or social competence (Cheng, 2009; Kossybayeva et al., 2022; Ludovico & Zambelli, 2017; Vinagre, 2016; Zhao & Lei, 2017). For example, Cheng (2009) suggested that the use of PowerPoint promoted the interaction between teachers and students. Ludovico and Zambelli (2017) indicated that the use of multimedia technology in CLIL increased the level of interactivity and that less skilled students were helped by their peers through cooperation. Moreover, certain technologies that focused on virtual collaboration and online communication, such as Google Space, Microsoft Teams, Zoom (Bakkar, 2021), Wikis (Vinagre, 2016), and Knowledge Forum (Zhao & Lei, 2017), were especially effective in promoting students' social competence in bilingual classrooms. The use of these online communication tools not only helped develop students' knowledge but also promoted their interaction through virtual collaboration (Vinagre, 2016). For example, many undergraduate students reported that social competence was essential in this virtual collaboration and was the key competence they had developed the most through Wikis in an EMI course (Vinagre, 2016). In this virtual collaboration environment, students could receive scaffolding from peers during their online discussions and improve their communal understanding (Zhao & Lei, 2017). As Vinagre (2016) argued, in such a learning environment where students' interaction was required, students shared knowledge and had common goals, and technologies served as the meditating tools in their learning process.

2.6 Enhancing digital competence

Through technology in bilingual instructions, many studies have reported that students' digital competence was enhanced (Adipat, 2021; Gay, 2022; Ludovico & Zambelli, 2017; Min et al., 2019; Vinagre, 2016). For example, Ludovico and Zambelli (2017) found that students were more familiar with technological devices after the computer-based activities in CLIL classrooms. Moreover, Adipat (2021) adopted technology-enhanced CLIL instructions for pre-service teachers in Thailand through Zoom conferencing and interactive PowerPoint of Google slides. These pre-service teachers' technological knowledge was enhanced, including their "general cognizance of computer hardware, general cognizance of computer software, ability to solve technical problems, and awareness of specific technology" (p. 6468). In

China, Min et al. (2019) also showed that the combination of a cloud learning environment and EMI helped promote students' access to learning resources, which was consistent with Gay's (2022) claim that technology-enhanced EMI supported bilingual learners' use of online resources. As these studies showed, bilingual students not only learned how to use technology in their language learning process but also knew how to use online resources for their own learning.

3. Influencing factors of technology integrated into bilingual education

Despite these advantages of integrating technology into bilingual education, previous studies have reported that some factors may influence the effectiveness of technology use in bilingual teaching. First, the learning materials or contents should be relevant to the bilingual students' needs. Bakkar (2021) found that when technology was integrated into bilingual instructions, the students may lack commitment and learning motivation because the activities were not meaningful and relevant to them and the students' academic needs were ignored. Similarly, Krajka et al. (2016) showed that although students were generally interested in the learning units from online interactive media integrated in CLIL instruction, they preferred the learning units that were related to the discussion topics in the class. These findings were consistent with Adipat's (2021, p. 6473) observation that learning "was mediated by the usage of content that was usable and relatable to the participants." Therefore, when students were provided with learning materials related to their needs and interests through technology, their motivation and learning in bilingual context would be enhanced.

Second, appropriate technology should be carefully selected and employed for bilingual students by teachers. As Bakkar (2021) suggested, the effectiveness of students' learning was related to appropriate technologies for online learning and their learning could be interrupted by their insufficient digital competence. Bakkar (2021) found that the students showed more commitment to the course during their learning in physical classrooms than online learning where their learning was often interrupted by students' insufficient computer skills. Similarly, when teachers used videos with subtitles for bilingual teaching, students may concentrate on the written subtitles and miss the visual and aural information in the context; the language used in videos may also be too difficult for students to comprehend (Oddone, 2011). Some irrelevant information may also appear when teachers use YouTube videos in bilingual teaching, such as irrelevant ads or next-video suggestions (Listiani et al., 2021). As Adipat (2021, p. 6473) suggested, the critical factor of successful implementation of technology-enhanced CLIL was "not the intense application of technological resources, but whether appropriate pedagogical approaches and technologies are used." Therefore, teachers need to be cautious about the selection of technology types and the potential unfavourable effects of technology.

Third, successful implementation of technology in bilingual education requires support from teachers and schools. As Binterová and Komínková (2013) suggested, teachers need to be willing to support technology integrated into their bilingual

teaching and restructure their teaching methods. Darling-Aduana and Heinrich (2018) also maintained that teachers play an important role in mediating the effects of technology on students' learning, including the way and frequency of technology use in bilingual instructions. Teachers' familiarity with technological devices could also reduce the time spent on solving technical problems. Moreover, Waloyo et al. (2021) found that although teachers had a positive perception of the application of web-based media in bilingual education, many of them were not confident in adopting this approach because of their insufficient English competence, teaching materials, and technology facilities in classrooms. The researchers thus suggested that successful implementation of technology in bilingual education requires appropriate teacher training and school support.

5. Conclusion

This section briefly reviewed the practice of technology integrated into bilingual education in the past decade. Teachers employ various technology tools, such as PowerPoint, videos, computer programs, online learning platforms, and video conferencing, for different purposes in bilingual teaching. Many teachers also tended to employ more than one technology tool in bilingual teaching and created a more versatile bilingual learning environment. Moreover, previous studies revealed that integrating technology into bilingual education has many positive effects, including improving students' foreign language proficiency and subject content knowledge, reducing learning anxiety, enhancing motivation and interaction, and increasing digital competence. On the other hand, some influential factors need to be considered when teachers apply technology in bilingual teaching, including the relevant learning materials for students' needs, the use of appropriate technology, and the support from teachers and schools.

Based on the findings in previous studies, this section provides the following suggestions regarding technology integrated into bilingual education. **First, when designing learning materials through technology, the contents should be relatable to students' needs**. Previous studies have shown that the learning contents related to the students are effective in improving their motivation and overall learning. Therefore, teachers need to know what materials are relatable to the students and how they can be incorporated into their bilingual teaching. Second, **in order to select appropriate technology for bilingual students, teachers need to improve their digital competence.** For certain technology tools, such as information and communication technology, computer programs, mobile devices, or AR, teachers may need relevant knowledge and training to employ them in bilingual teaching. Moreover, since the application of technology in teaching is most effective when it is integrated within teachers' pedagogy (Darling-Aduana & Heinrich, 2018), teachers need to develop their TPACK to integrate their technological knowledge with pedagogical knowledge and content knowledge. Teachers in bilingual education may have already known effective teaching methods and the subject contents, but knowing how to apply appropriate technology in line with pedagogy and subject contents in

bilingual contexts is essential in the educational trend nowadays. **Third, schools should improve technology devices to support their application in bilingual education.** Although more advanced technology has been employed by some teachers recently, it is also noticed that the basic technology tools are still often being used by teachers for language teaching nowadays, such as PowerPoint and videos. This may suggest that these basic technology tools are not difficult to find and easy to operate for teachers who do not need particular training to learn how to use these tools. This may also imply that not all schools have sufficient infrastructure or facilities to support more updated and innovative technology for bilingual students, such as tablets and AR. Therefore, the schools need to update their technological devices, and the government should also mind this issue, especially for schools with limited learning resources in rural areas.

III. Methodology

As discussed previously, technology can be applied to bilingual teaching and have various positive impacts including:

1. **facilitate learning,**
2. **promote subject content knowledge,**
3. **reduce anxiety,**
4. **increase students' motivation,**
5. **promote interaction between teachers and students**
6. **enhance digital competence among teachers and students**

With this prerequisite understanding from the literature review, we started to design a pilot case study. The research approach, methods employed in conducting this study, research participants and procedures are explained in this section.

1. Research Methods

The frame of this research is a case study in its essence. As Shank & Brown (2007: 65-66) explicate:

> A case study is nothing more than a rich and insightful look at an individual or a group. The key to a case study is the fact that it is an in-depth look. Researchers take their time to observe and probe, and often gather information from a variety of sources.

While we plan to acquire an in-depth understanding of the case, we are also doing an intervention as we provide the teacher with TEBT. Teachers working in the case school do not have experience in combining bilingual subject teaching and the use of technology in their teaching. The NTNU team and Google team offer professional development (PD) programmes to teachers so that they can be equipped with the competence to practise TEBT. Paparini et al. (2020) discuss the application of case study in comprehending the complicated consequences that an intervention might

bring.

2. Explicating the Case

The case of this study is Ren-He Junior High (RHJH) School at Taoyuan City. Taoyuan city was upgraded from county to municipality in 2014. Its population is at 5th place among the 22 administrative regions. Unlike the first municipality, Taipei city, the other 5 municipalities have their own developing trajectory. Although they are granted the status of municipality, they all have urban, rural and remote schools. The research team and google team decided to choose an average junior high school in Taoyuan because Taoyuan is the newest municipality in Taiwan. It is still in the process of reforming, and the school system is changing from a cunty-based to a municipality-based one. The Bureau of Education (BoE) in the municipality attempts to upgrade its primary and junior high schools to a level that could be equivalent to the other five municipalities. A system in transformation means that there are resources to support changes and opportunities for more interventions.

Moreover, the school system in Taoyuan municipality is a miniature one of the Taiwanese school system. We are looking for a school representing the average junior high school in Taiwan in terms of its size and socioeconomic status. RHJH is located on the border of urban and rural areas and is a school with 59 classes in three grades and a student population of around 1800. Teachers in RHJH do not have experience in implementing bilingual subject teaching, but they apply technology in their teaching with individual differences. In other words, RHJH represents the ordinariness of a typical Taiwanese junior high school.

To ensure that a piloting school could be secured, the NTNU team has contacted the deputy director of BoE at Taoyuan to further understand the status quo of RHJH. With a positive response from BoE and the school principal, the school administrative team started to get teachers' consent to take part in this pilot study. Meanwhile, one of the PI, Professor Lin, had a session with the principal, the school administrative team, including the Head of Academic Affairs and the Director of Teaching and the Director of IT service, and the teachers who are interested in this study. After a clear explanation of the goals and design of this study. Access to the case school is secured. Teachers gave their consent to have professional development in Google solution and bilingual teaching. Also, a community of practice (CoP) was formed at RHJH.

3. Research Design: Empowering Teachers First

This study started from December 2021 to July 2022. The technologically enhanced bilingual teaching was aimed at being implemented in the second semester of the academic year 2021. There are 21 weeks in that semester. However, there are three weeks for periodical summative assessment and the first week and the last week of the semester are usually for preparing and ending the semester. The actual classroom instruction is about 15 to 16 weeks. At the beginning of this study, it was towards the

end of the first semester of the academic year 2021. How to get teachers ready before the second semester started became an issue.

3.1 Professional Development for Technological Application

In order to prepare the teachers with sufficient competencies to apply technology to conduct bilingual subject teaching, proper professional development is necessary because most of the teachers at RHJH do not have existing experience in bilingual subject teaching. Two sets of professional development programmes are offered to teachers. The first set is to increase their familiarity with technology. In this study, the Google team worked together with a service provider, Shou Yang Digital Technology Co. (Shou Yang team), to offer Chromebooks to students and teachers. Meanwhile, the Shou Yang Team provided a series of professional development on how to use Chromebooks in their subject instruction. The Google Team also invited two Google Certified Educators (GCEs) to share their experience and strategies for applying Google solutions in their teaching practices. The details of the professional development programme from the technology side are listed in Table 1.

Table 1. The Professional Development of Google solutions

Topic	Date	Content
Introduction*	2021/Dec/02	● Introducing the details of professional development programme in Google Solution
Sharing from a Google Reference School (Session 1)**	2021/DEC/22	● How School makes good use of Google Classroom, Google Calendar and other apps in instruction, and curriculum and classroom management.
Preparing teachers to become GCE**	10 sessions between 2021/DEC/30 to 2022/JAN/25	● Introducing Google Drive, Google Doc, Google Slide, Google Meet, Google Jamboard, Google Sheet and Google Classroom. ● Guiding teachers through the process of getting Google Educator Level 1 certificate.
Sharing from a Google Reference School (Session 2)**	2022/JAN/12	● How School makes good use of Google Classroom, Google Calendar, Google Cursive and other apps in instruction. ● A technician from the Shou Yang team introduced the basic functions and usage of Chromebook.
Sharing from a GCE*	2022/MAR/24	• Introducing practical use of Google Classroom, Wrodall, Quizlet, Mentimeter and slido in subject instruction.
Sharing from a Google Reference School (Session 3)**	2022/MAY/05	• Introducing practical use of Google Jamboard, Google Slide, Google Doc smart chips and Mote
Advance session on	2022/MAY/11	• Introducing practical integration of third party

applying third party apps**	apps such as ZeroBlur and Nimbus with Google solutions.

* Face-to-face session
**Online session

Besides the scheduled sessions, the Shou Yang team and Google team also offered the Director of IT service at RHJH training in Google Admin and an individual consultation service for teachers.

3.2 Professional Development for Bilingual Subject Teaching

As aforementioned, the bilingual policy is a new initiative, while technology-assisted instruction has been promoted by the Ministry of Education for more than two decades. Compared to the application of technology, teachers at RHJH are even with less experience in bilingual subject teaching. The NTNU team offered a series of workshops for teachers at RHJH to register. These workshops were delivered by Professor Lin's team to promote bilingual teaching in primary and junior high schools.

Table 2. The Professional Development of Bilingual Teaching

Topic	Date	Content
Bilingual Education: An Introduction*	2021/NOV/03	● A three-hour introduction to bilingual education in Taiwanese context by Professor Lin
Bilingual Teaching Demonstration**	2021/DEC/09	● A bilingual teaching demonstration of an expert teacher in Professor Lin's team
Bilingual Teaching Strategies*	2022/JAN/25	● A three-hour workshop offered by Professor Lin's team on the most commonly used bilingual teaching strategies
Bilingual Education: From Theory to Practice*	2022/FEB/08	● A three-hour workshop by Professor Lin
Sharing from a bilingual expert teacher (I)*	2022/MAR/21	● A bilingual teaching sharing by an expert teacher in Professor Lin's team
Sharing from a bilingual expert teacher (II)*	2022/MAR/23	● A bilingual teaching sharing by an expert teacher in Professor Lin's team
Online consultation**	2022/MAY/11	● An online bilingual music consultation with a teacher from Professor Lin's team

* Face-to-face session
**Online session

Besides these courses, Professor Lin's bilingual team also share the lesson plan template, sample lesson plans and access to the Youtube Channel of Professor Lin's bilingual project. There are more than 30 bilingual teaching videos on the channel. However, the attendance of bilingual teachers' sharing was not as good as expected.

4. Research Participants

Two out of the 18 classes were selected as the research participating classes. They are class 708 and 713. The two classes were chosen because the subject teachers who participated in this study were from these two classes. There are 32 students in 708 and 33 in 713. The gender distribution is even in these two classes. The subject teachers took part in this study are listed in Table 3.

Table 3. Research Participants (Subject Teachers)

Name (Pseudonym)	Subject	Classes
Judy	Math	708
Lilian	Biology	708, 713
Mei	Integrative Area	708
Yu	Integrative Area	713
Bei	Science and Reading Comprehension	708, 713
Jay	Living Technology	708, 713
Fen	Performing Arts	708, 713
Jean	Math	713
May	PE	708, 713

Based on the FERTILE bilingual teaching model proposed by Lin (2021), the CoP of bilingual subject teachers needs to incorporate English teachers so that the subject teachers can have language support. Therefore, there are three English teachers, Lean, Yin and Shine[1] being in the CoP.

5. Data Collection

Semi-structured interviews, focused group interviews (FGD), observation and questionnaires are the data collection methods applied in this study. The original plan was to implement TEBT in May so that the teachers could have sufficient time to prepare the lessons. Then, the NTNU researchers could do lesson observations in 708 and 713. Then, the interviews with teachers and FGD with students would be conducted in June right before the semester ended. However, RHJH closed down in April and May because of COVID. The research team had to change the planned schedule and postpone the lesson observation to mid-June and the interviews and FGD to late June and early July. In total, 15 lessons were observed, and ten individual interviews with teachers and one FGD with 10 students were conducted. The interviews are with the nine subject teachers doing TEBT and one English teacher,

[1] These are pseudo names.

Shine, who worked closely with TEBT teachers and also the homeroom teacher of class 713. Two online questionnaires were sent to the students in 708 and 713 with assistance from the school administrative team. One aims to explore students' responses to the application of technology in class; the other is to understand their feedback on teachers' bilingual instruction.

IV. Findings and discussions

This section is to explicate the findings from the pilot study. The first part is teachers' responses to TEBT and followed by the feedback from students. These two parts could answer the second and third research questions. The third part is the discussion and aims to answer the first and fourth research questions.

1. Teachers' response to TEBT: I want to do it, but I do not know how to do it

Eight out of the ten teachers expressed that they were not against the policy initiative that is to teach subject content in two languages. All teachers have confidence in their application of technology because they indicated that they experienced school closure during the first wave of the outbreak of COVID-19 in 2020. As teacher Jean pointed out,

> Jean: I told the Head of Academic Affairs that I would love to join this study. Yes. And, it is coincident that the class I taught was chosen.
> Researcher: So, you are voluntary?
> Jean: I think that we can do bilingual teaching as other countries do. But, I need to admit that my English proficiency is not very good.

Other teachers expressed similar feelings as Jean did. Teacher Bei mentioned that '*I know that bilingual teaching is a trend'* in Taiwan. However, some were more interested in technological enhancement. As teacher Lilian indicated,

> In the very beginning, I was interested in the application of technology when I heard of this study in our school. … … I think the integration of technology can motivate students to learn biology. As to bilingual subject teaching, I have more concerns because the student's English proficiency varies a lot (in a class).

From the extracts, teachers' attitude towards TEBT is that they were not against this initiative, but they did have concerns about their own or students' English proficiency. In other words, teachers were anxious about TEBT. This kind of response is expected by the research team, and that is the reason why the professional development programmes were prepared. Did the two tracks of professional development programmes work for teachers? Teacher Mei's response revealed some effectiveness of these programmes.

> I thought that this study was about applying Google solutions and did not notice that there would be bilingual elements in our subject teaching. I had some doubts

> because I did not think that there would be enough time, and I did not have the energy to do it. … … I share the same thought as Professor Lin said in your first meeting with us. The subject content matters, and the language part is a plus. … … I also listened to your student, Irene. She shared with me that it took time to combine subject content and the use of two languages in class. Also, the technology.

Mei mentioned in the above abstract what she learned from various sessions in the professional development programmes in the aspect of bilingual teaching. One is from the session explaining the foundations of bilingual teaching in Taiwanese schools by Professor Lin, and the other is from a bilingual teacher who shared her practice. Mei got empowered in her understanding of bilingual teaching, while Jean stated that she learned a lot from the professional development programmes on technology.

Based on their responses, all teachers are positive about the technology professional development. They considered that it was very structured, practical and timely. As aforementioned, the school experienced several closures between 2020 and 2022, and the instruction needed to be delivered online. What they learned from the technology professional development was in time, and they can apply it immediately. As to bilingual professional development, only 5 out of the 10 teachers thought it was useful to them. The difficulties they raised are as follows:

- It is not possible to improve one's English proficiency in a short time.
- It is hard to accommodate students' needs because their English proficiency levels are diverse.
- There is no time to register to attend the professional development programme in bilingual subject teaching.
- I had experience in applying technology in my teaching, but I never try bilingual teaching before. I did not know if the way I did is correct or not.

The point about no time to do professional development on bilingual teaching is due to the design of the professional development programme. The professional development offered to teachers at RHJH was for teachers across Taiwan whose schools are in the bilingual teaching project by Professor Lin. Teachers need to go to Taipei to attend those sessions. Although it is only about 40 to 50 minutes of transportation from RHJH to the training place in Taipei, teachers did not register for any single session. However, teachers found that the one-to-one consultation offered by the NTNU team was very helpful to them. Overall, teachers agreed that these professional development programmes eased their anxieties and benefit to them while implementing TEBT.

Regarding the implementation of the TEBT, 8 out of the 10 teachers held optimistic viewpoints, although all teachers expressed that one semester is not enough to make TEBT fully functional. Future continuing professional development, assistance from

the NTNU team and Google team and sufficient lesson preparation time are suggested by teachers. As teacher Fen indicated below:

> Applying Technology. I am fine with that, as I have been doing this in my performing arts classes during the online instruction period. I also learned a lot from the courses this time. As for being bilingual, I did question this kind of teaching practice in the very beginning. But, after joining this study, I started to incorporate English into my instruction. Just like what you mentioned, I started with the instructional language. Also, I let them watch the news about Cirque du Soleil. Giving them input. … … I found that students were able to understand and follow gradually. I will keep doing TEBT.

Another teacher, Judy, also expressed a positive attitude towards TEBT. Her subject area is Math which is often considered a key exam subject. Most Taiwanese junior high school administrative teams refused to use key exam subjects to pilot bilingual teaching. Therefore, what happened in RHJH is special regarding the implementation of bilingual Math lessons. Judy stated that:

> I have confidence in the English proficiency level of my students. I am their homeroom teacher and put emphasis on their English even though I am a Math teacher. Once I knew that my class was chosen, I began to let them practise listening and speaking of English via an app. They not only did that together in class but also came individually to my office if they wanted to. For those who came individually, they got extra points. … … To my surprise, I showed them the Math terminologies in both Chinese and English several times at the beginning of that unit. Then, I kept the English one on the slides, and I found out that my students could understand. I did not ask them to memorise these terminologies. They just learned them through repetition. … … My students like to use Chromebook. It motivated them. TEBT is a practice that I am going to do in my future Maths classes.

Judy's Math lesson is a good example supporting the NTNU team's assumption about bilingual instruction. When you give students enough input, they will remember those words. Based on the lesson observation, two PIs witnessed the students wrote down the maths terminologies on their Chromebook while answering Judy's question. This finding suggests that the definition of subjects that could be done bilingually with the assistance of technology in junior high school could be expanded.

2. **Students' responses to TEBT: The lessons become more fun**

Regarding students' responses to teachers' TEBT, a questionnaire is applied to investigate their responses to bilingual instruction. As aforementioned, the data collection part of this study has been postponed because of the closure of the school. The questionnaire was distributed online via the school administrative team in July when the students were on their Summer break. But the return rate is not bad. 40 out

of the 65 students in class 708 and 713 filled in the online questionnaire. It is 61.5% and should be able to reveal some useful information. The detail questions and descriptive statistics are listed in Table 4.

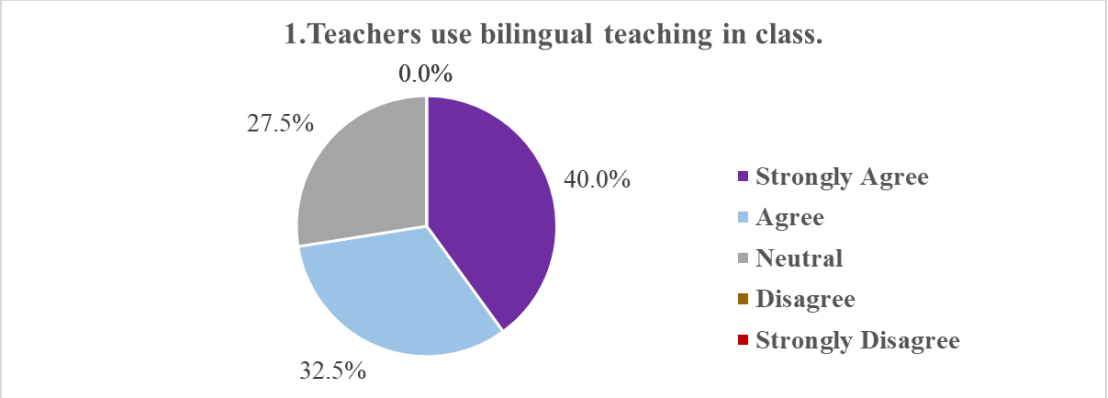
Table 4. Students' Feedback on Bilingual Instruction

Questionnaire item	N	Average	Standard Deviation	Degree of consent (%)				
				Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.Teachers use bilingual teaching in class.	40	4.13	.822	0.0	0.0	27.5	32.5	40.0
2.Teachers use bilingual textbooks or slideshows in class.	40	4.10	.810	0.0	0.0	27.5	35.0	37.5
3.Teachers provide bilingual worksheets or study checklists in class.	40	3.68	.797	0.0	0.0	52.5	27.5	20.0
4.Teachers led students to engage with bilingual activities or games in class.	40	4.08	.764	0.0	2.5	17.5	50.0	30.0
5.Teachers use videos or pictures to help me understand the curriculum content in bilingual class.	40	4.05	.815	0.0	2.5	22.5	42.5	32.5
6.Teachers use body movements (including voices and expressions) to help me understand the curriculum content in bilingual class.	40	3.95	.904	0.0	5.0	27.5	35.0	32.5
7.Teachers use physical teaching aids to help me understand the curriculum content in bilingual class.	40	3.95	.959	0.0	5.0	32.5	25.0	37.5
8.When I don't understand the content taught in English, the teacher would use Chinese to help me understand.	40	4.08	.829	0.0	0.0	30.0	32.5	37.5
9.When I don't understand the content taught in English, the teacher would help me figure it out with simpler English.	40	4.13	.791	0.0	2.5	17.5	45.0	35.0

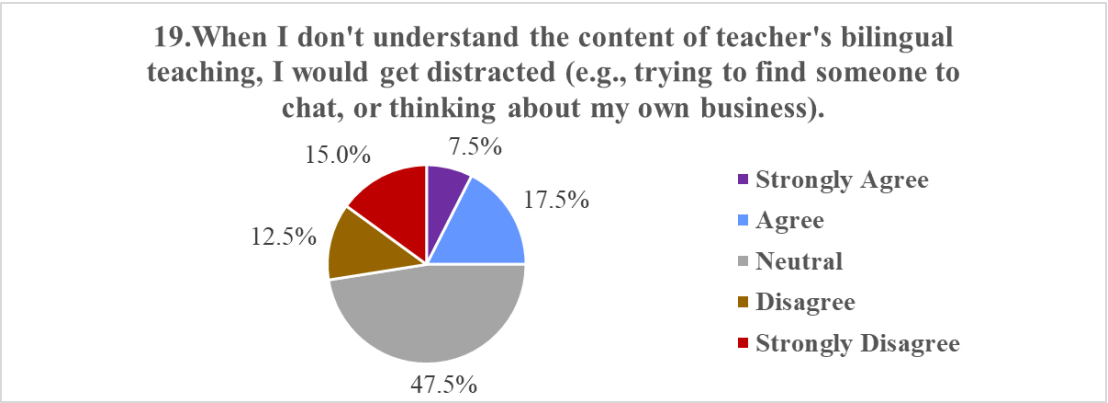
Questionnaire item	N	Average	Standard Deviation	Degree of consent (%)				
				Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
10. When I misunderstand teacher's English instructions or made a mistake, the teacher would help me figure out in Chinese.	40	4.05	.846	0.0	0.0	32.5	30.0	37.5
11. When I misunderstand teacher's English instructions or made a mistake, the teacher would let me figure it out with other expressions (e.g.: movements or sounds).	40	3.95	.876	0.0	2.5	32.5	32.5	32.5
12. I can understand the content of the bilingual teaching from the teacher.	40	3.90	.810	0.0	0.0	37.5	35.0	27.5
13. I can complete the bilingual instruction of the teacher.	40	3.88	.883	0.0	2.5	37.5	30.0	30.0
14. In bilingual classes, students occasionally communicate with each other bilingually.	40	3.60	.871	2.5	0.0	50.0	30.0	17.5
15. In bilingual classes, bilingual discussions are available between teachers and classmates.	40	3.65	.864	2.5	0.0	45.0	35.0	17.5
16. When I don't understand the content of the teacher's bilingual teaching, I would proactively ask for help from teacher.	40	3.33	.797	2.5	5.0	57.5	27.5	7.5
17. When I don't understand the content of a teacher's bilingual teaching, I would proactively ask from classmates or see how they operate.	40	4.13	.686	0.0	0.0	17.5	52.5	30.0
18. When I don’t understand the content of the teacher's bilingual teaching, classmates would assist me to understand.	40	3.98	.832	0.0	2.5	27.5	40.0	30.0
19. When I don't understand the content of the teacher's bilingual teaching, I get distracted (e.g., trying to find someone to chat with, or thinking about my own business).	40	2.90	1.105	15.0	12.5	47.5	17.5	7.5

Questionnaire item	N	Average	Standard Deviation	Degree of consent (%)				
				Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
20.After taking bilingual classes, I learned the knowledge of this course.	40	3.83	.813	0.0	0.0	42.5	32.5	25.0
21.After taking bilingual classes, my interest in learning English has increased.	40	3.75	.899	0.0	0.0	55.0	15.0	30.0
22.After taking bilingual classes, I am more willing to use English in my daily life.	40	3.70	.883	0.0	5.0	42.5	30.0	22.5
23.I don't mind taking a bilingual program.	40	4.18	.844	0.0	0.0	27.5	27.5	45.0
24.The school bilingual courses' content is helpful for my English "listening" ability.	40	3.90	.900	0.0	0.0	45.0	20.0	35.0
25.The school bilingual courses' content is helpful for my English "speaking" ability.	40	3.83	.844	0.0	0.0	45.0	27.5	27.5
26.The school bilingual courses' content is helpful for my English "reading" ability.	40	3.78	.832	0.0	0.0	47.5	27.5	25.0
27.The school bilingual courses' content is helpful for my English "writing" ability.	40	3.58	.747	0.0	0.0	57.5	27.5	15.0
28.In addition to this bilingual course, other teachers would also teach bilingually.	40	3.93	.888	0.0	0.0	42.5	22.5	35.0
29.When I was in school, other teachers would greet me and give instructions in English.	40	3.63	.925	0.0	5.0	52.5	17.5	25.0
30.I will hear bilingual speeches from the Principal or Department Head in the school' public occasion (such as morning meetings, school's anniversary celebrations, etc.).	40	3.05	.986	10.0	5.0	65.0	10.0	10.0
31.I hear bilingual broadcasts in school.	40	3.78	1.025	5.0	0.0	35.0	32.5	27.5
32.The plates, slogans and posters in school are designed bilingually.	40	3.65	.949	2.5	2.5	45.0	27.5	22.5

From the above table, it is evident that all teachers who participated in this study applied bilingual teaching in class. As Figure 1 shows, more than 70% of students agreed that teacher instructed them bilingually.



However, based on the responses to question: 4, 5, 6, 7, 9, 11, 13, 14, 15, 16 and 18, there are a small number of students indicating that they did not receive teachers' help on bilingual learning. But, question 19 exposes a big issue. A quarter of students might be distracted or minds-away when they did not understand teachers' bilingual instruction.



Google Standard Survey

Table: Attitude towards using technology in classrooms

Statement \ Frequency (n)	Pre-pilot	Post-pilot
I see technology as being harmful.	0	0
I see no benefit from it	0	0
I don't bother about using technology.	0	0

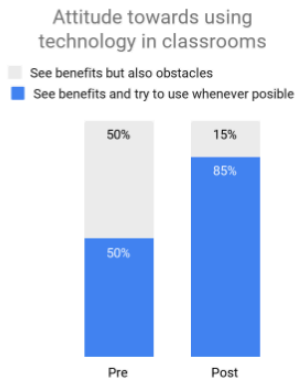
I see benefits but there are obstacles.	6	2
I see the benefits and try to use technology wherever I can.	6	11

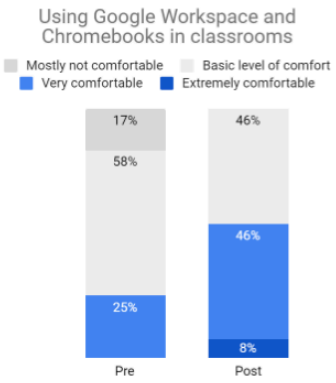
Table: Comfort level with using Google Workspace and Chromebooks in classrooms

Statement \ Frequency (n)	Pre-pilot	Post-pilot
Not comfortable at all, I would not try.	0	0
Mostly not comfortable, I might experiment.	2	0
Basic level of comfort, I could use them.	7	6
Very confident, I know them well.	3	6
Extremely confident, I am well trained in them.	0	1

Table: Comfort level with using Google Workspace and Chromebooks in lesson planning

Statement \ Frequency (n)	Pre-pilot	Post-pilot
Not comfortable at all, I would not try.	0	0
Mostly not comfortable, I might experiment.	2	0
Basic level of comfort, I could use them.	8	9
Very confident, I know them well.	2	4
Extremely confident, I am well trained in them.	0	0





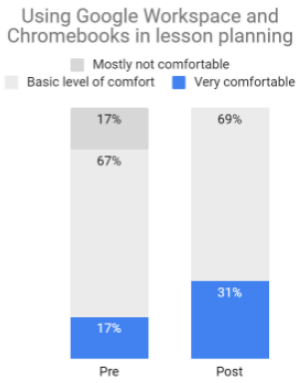


Table 9: Comparison between OECD and teachers' average hours

	OECD teachers' average (hours)	Teachers' average pre-pilot (hours)	Teachers average post-pilot (hours)
How much time do you spend per full working week on "Teaching" activity?	19	16.6	16.9
How much time do you spend per full working week on "Individual planning or preparation of lessons" activity?	7	7.8	8.3
How much time do you spend per full working week on "Marking / correcting of student work" activity?	5	5	5.2
How much time do you spend per full working week on "General admin work (communication, paperwork)" activity?	3	2.7	3.8
How much time do you spend per full working week on "Teamwork and dialogue with colleagues" activity?	3	2.3	3.1
How much time do you currently spend per full working week on "Student counselling" activity?	2.1	2.5	4.0
How much time do you spend per full working week on "Extracurricular activities (clubs, sports)" activity?	2.1	3.7	3.3
How much time do you spend per full working week on "Communication and cooperation with parents / guardians" activity?	1.5	1.1	1.4
How much time do you spend per full working week on "Participation in school management (e.g. Dep Head)" activity?	1.5	0.6	0.5
How much time do you currently spend per full working week on "Other (e.g. Break supervision, Mentoring colleagues, PD)" activity?	1.5	2.2	1.9

Table: Impact of Google Solutions on Learning

Statement \ Frequency (n)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

GS allows students to be more creative and imaginative in their work.	0	0	4	8	1
The use of GS enables students' to express their ideas and thoughts better.	0	0	1	10	2
The use of GS helps students to find related knowledge and information for learning.	0	0	0	10	3
The use of GS encourages students to collaborate more with their classmates.	0	0	0	10	3
The use of GS encourages students to communicate more with their classmates.	0	0	0	10	3
The use of GS increases students' confidence to participate actively in the class.	0	0	0	10	3
The use of GS helps to improve students' ability specifically in reading, writing.	0	0	7	5	1
The use of GS helps to improve students' ability specifically in STEM subjects.	0	0	4	9	0
The students learn more effectively with GS.	0	0	2	9	2
The students are better behaved with the use of GS.	0	0	4	9	0
The use of Chromebooks and GS allows students to absorb the core subject matter quicker.	0	0	3	10	0
The use of Chromebooks and GS helps students to complete assignments quicker.	0	0	3	10	0
The use of Chromebooks and GS allows students to develop a better	0	0	1	11	1

understanding of subjects through their own research.					
The use of Chromebooks and GS helps students to perform better at their studies in general.	0	0	5	7	1
Chromebooks were well suited to my students.	0	0	0	12	1

Table: Impact of Google Solutions on Teaching

Statement \ Frequency (n)	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I have an improved ability to monitor the whole classroom's work	0	0	3	10	0
I have an improved ability to differentiate for specific students' needs	0	0	3	8	2
I can provide more meaningful feedback to students on their work	0	0	3	8	2
I can cover the basic teaching content more efficiently	0	0	3	9	1
I can engage students more deeply in the subject matter	0	0	2	11	0
Students are more engaged and active in general	0	0	4	8	1
I have a better understanding of individual student's capabilities with GS	0	0	3	10	0
I can communicate more efficiently with non-student stakeholders (parents, other teachers, admin)	0	0	5	8	0
Chromebooks were well suited to my needs	0	0	4	9	0

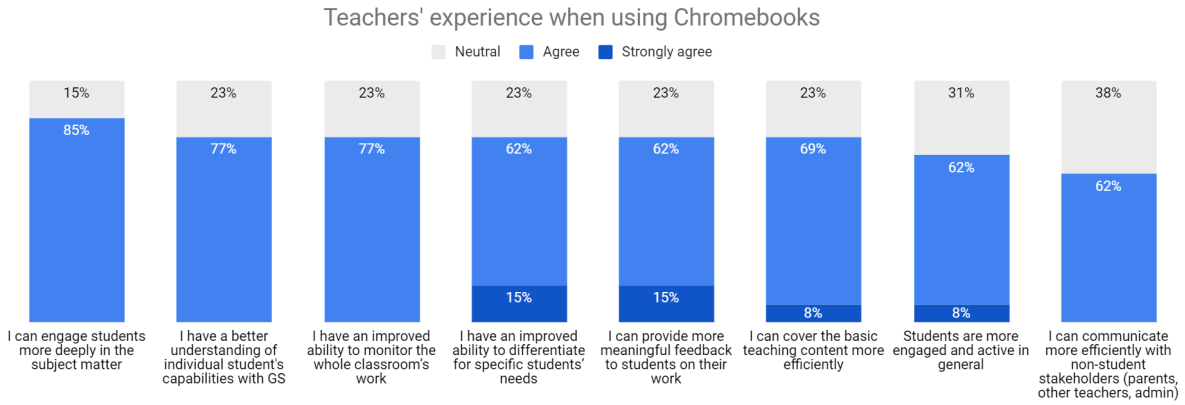


Table: Comfort level with using Google tools and Chromebooks

Application \ Average score (out of 5)	Pre-pilot	Post-pilot
Chromebook	2.8	3.6
Google Classroom	3.5	4.0
Google Drive	3.6	4.1
Google Documents	3.2	3.8
Google Sheets	3.0	3.6
Google Forms	3.2	3.8
Google Slides	3.0	3.6
Google Search	3.8	3.9
Gmail	3.8	3.8
Calendar	3.2	3.7
YouTube	3.7	3.8
Google Maps	3.7	3.8

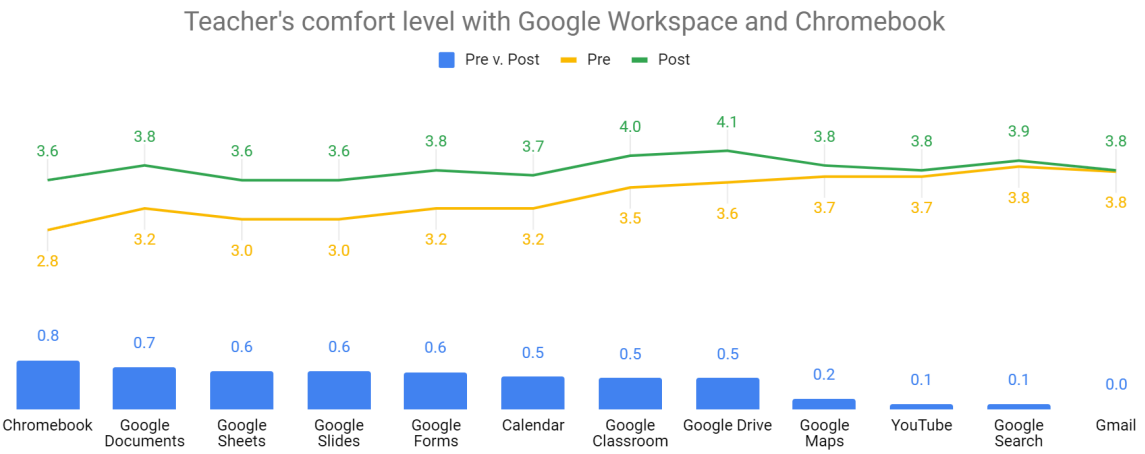


Table: Impact of Google Solution on peer collaboration

Statement \ Frequency (n)	Much less often	Less often	No difference	More often	Much more often
I help my peers in class	2	10	26	18	4
I receive help from my peers in class	2	7	21	24	6
I help my peers on homework assignments	1	9	28	16	6
I receive help from my peers on homework assignments	1	6	26	22	5

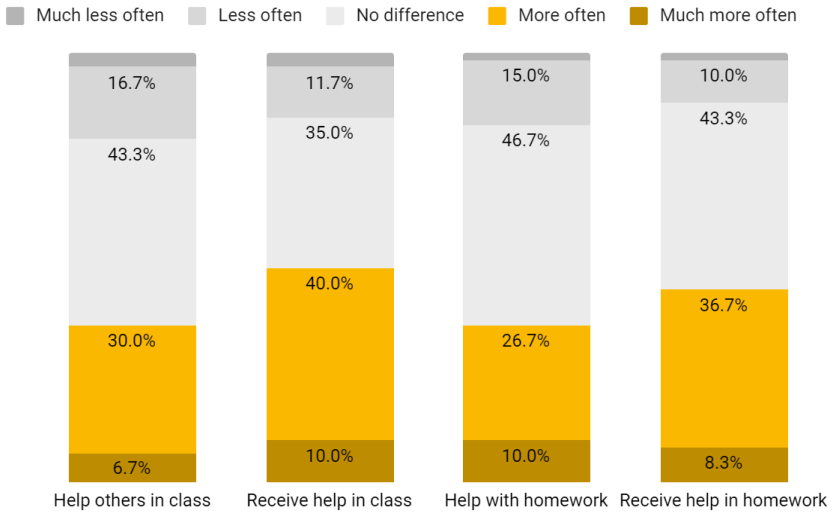


Table: Impact on classroom experience

Statement \ Frequency (n)	Less enjoyable	No difference	More enjoyable
The classroom becomes ….	1	10	49

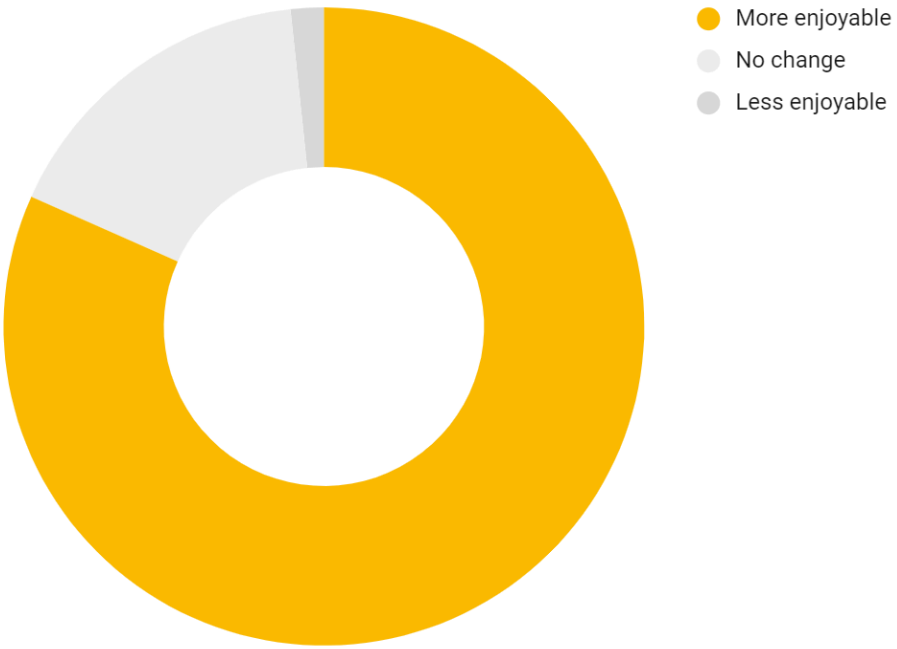


Table: Chromebooks' performance on teaching and learning activities, as compared to tablets (rated by teachers)

	Chromebooks	Tablets
Teacher lesson planning	4.1	3.2
Teacher feedback to students	4.1	3.5
Student homework completion	4.1	3.6
Teacher classroom instruction	4.1	3.6
Student problem solving activities in class	4.0	3.7
Focusing student attention on the learning tasks	4.0	3.7
Student creative activities in class	4.0	3.7
Student collaboration activities in class	4.0	3.8

Table: Chromebooks' performance on educational and recreational activities in comparison to smartphones, tablets, and laptops

	Chromebooks	Smartphones	Tablets	Laptops
Collaborating for study	4.0	3.4	3.9	4.1
Completing homework	3.9	3.6	3.9	4.1
Problem solving for study	4.0	3.9	3.9	4.1
Finding information in class	4.1	4.0	3.9	4.1
Creative work for study	3.9	4.0	3.9	4.1
Watching movies	3.4	3.2	3.9	4.1
Reading eBooks	3.7	3.6	3.9	3.9
Exploring the Internet for fun	3.0	3.9	3.5	3.7
Gaming	2.9	3.9	3.7	3.6
Keeping in contact with friends	3.0	4.3	3.6	3.5

Before conducting the two questionnaire surveys, an online FGD was implemented with 10 students selected randomly by the school administrative team. In the FGD, all students were positive towards the TEBT model. As student A and C mentioned:

> I can use Chromebook to look up the subject content and the English word that I do not know. It is very convenient and useful. (student A)

> I like the teacher to test us with the app, Kahoot. It is just like playing game. You do not feel that it is in class and doing the test. When teachers use technology, the lessons are more fun. (student C)

As student A indicated, she applied Chromebook to help her search for information related to the subject content and new English words. Another student (F) even mentioned that Google translate is very useful. Moreover, student H pointed out that Google Spreadsheet has been applied in his maths lesson. He likes it a lot because he prefers to write English terminology on Chromebook while answering teachers' questions. When the researchers asked student H to elaborate further on the reason why he prefers to write in English, he said that it is simpler to write that particular terminology in English than in Chinese because the three Chinese characters are more complicated and with more strokes. Other students mentioned the use of Jamboard in class.

3. The advantages and areas of improvement of TEBT

Based on the findings reported above, it is evident that applying technology in bilingual instruction facilitates students' learning as well as increases their motivation. The students used Google translate, Google Spreadsheet and Google Chrome browser and other apps during their bilingual lessons. Moreover, students described that having Chromebook and apps make the lessons more fun and this is also mentioned by teachers who considered that the use of technology increases students' motivation.

Although teachers and students are willing to continue to do TEBT, the teachers did point out various challenges. Teachers are not too worried about students' English and technology readiness. On the contrary, what teachers worried about the most is the lack of time to do better lesson preparation and learn more about bilingual instruction. Also, they have some complaints that the two tracks of professional development programmes were time-consuming and were not aligned with each other. Teachers need to combine what they learned from technology professional development and bilingual ones. In other words, they could not conceptualise the two sets of new knowledge by themselves. This is a finding that is worth noticing for future improvement if there are more research attempts on TEBT.

V. Conclusions and Suggestions

As a case study conducted in about 6 months, the findings of this study can not be generalised to other Taiwanese junior high schools. However, some implications could be extracted from the findings. The proposed TEBT model is a good start to integrate the positive elements of technology to enhance the effectiveness of bilingual teaching in schools. The discussions lead to two implications:

1. The time to act on Digital Transformation for Taiwan is now. The strong benefits of technology-enabled classrooms will lay strong foundations for Bilingual Transformation and help Taiwan in its ambitious goals.
2. Taiwan needs to invest more in its Bilingual Transformation initiatives. For the existing teacher population, there is a clear need for more professional support and long-term, gradual English proficiency training.

However, it could be argued that more research evidence is necessary to refine TEBT model. For future studies, three suggestions can be offered from the finding.

1. More time should be offered to teachers so that they can have sufficient time to learn two sets of new ideas. Moreover, they can prepare better before doing TEBT.
2. A well-designed professional development programme will excel the current two-track of professional development. The future professional development programme should be based on the structured professional development programme of technology and add-in the example of bilingual teaching

strategies and lived bilingual teaching demonstrations with technology.

3. A measurement instrument of TEBT should be development according to the findings from this case study. Currently, there are two questionnaires: one is on bilingual perception and the other is on technology.

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