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Exploring the effect of mobile-assisted task-based learning on vocabulary achievement and student attitude

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Abstract

This study explores the effect of mobile-assisted task-based learning (M-TBL) on vocabulary achievement and student attitude among English as a in content and language integrated learning (CLIL) science lessons, the researcher focused on foreign language (FL) students. To investigate this, a quasi-experimental research design was utilized. In the first semester of the 2022–2023 academic year, 34 fourth-grade students from a private school in Istanbul took part in the study. During the course of 6 weeks, the experimental group engaged in six different M-TBL activities and were assigned a one-page worksheet as homework, while the control group completed only the one-page worksheet. Quantitative data for the study were collected through vocabulary achievement tests and a student attitude questionnaire. The data underwent analysis through paired sample t-tests and descriptive analyses. The results indicated a significant difference in vocabulary achievement between the experimental and control groups, and they also revealed a positive impact on student attitudes, igniting their interest in learning the target language. In light of these findings, it can be concluded that mobile-assisted task-based activities yield positive effects on both vocabulary achievement and student attitude in primary FL learners participating in CLIL science lessons.

Keywords: M-TBL, MALL, TBLT, CLIL, Vocabulary achievement

Introduction

In recent years, the demand for English speakers has increased due to technological and accessibility advancements that have allowed internationalization and promoted the use of English as a global language. During the 1980s, English was observed in numerous facets of daily life in Türkiye. In 2013–2014, the Ministry of Education of Türkiye began English education for pupils as young as 8-year (grade two). In addition, English classes and CLIL classes begin at age seven (first grade) in private schools. Despite the enormous amount of time and effort invested in FL instruction in Türkiye, Tuncer and Akpence (2018) observe that the anticipated results cannot be attained during the education process that continues through university. Yelgec and Dağyar (2020) asserted that the subpar performance of Turkish students in the Programme for International Student Assessment (PISA) could be ascribed to various factors. These factors encompassed heightened anxiety regarding learning foreign languages, diminished motivation as highlighted by Demir-Ayaz et al. (2019), a neglect of higher-order skills within English curricula as indicated by Gökdeniz and Demirci (2020), an inadequacy in technical support, and the necessity for audiovisual equipment in the English language learning process. In 2011, Aksoy-Tosun et al. (2020) representing the Ministry of Turkish National Education in Haberturk, made an official statement that Turkish students lacked the knowledge and skills required to meet international standards.

According to Lightbown and Spada (2006), learning a foreign language is a long process that necessitates extensive interaction with the language in natural circumstances for mastery. Students need enjoyable speaking activities that allow them to experience the language directly. According to Hockly (2016), learning technology can provide a dynamic and multidimensional learning environment that places the student at the center of the learning process. According to Moate (2010), the extensive usage of English has created a need for a complete language teaching method and an interest in CLIL lessons.

The research combines task-based language teaching (TBLT) and mobile-assisted language learning (MALL) methodologies. TBLT emphasizes the use of language activities that differ from drills and exercises. It is also considered a kind of communicative language teaching (CLT), in which communication precedes grammar and vocabulary. MALL, on the other hand, is a technique that facilitates language learning through technology. The combination of these approaches is now known as mobile-assisted TBLT (González-Lloret & Ortega, 2014). This study uses cellphones or tablets as the pedagogical delivery method in MALL, with tasks based on the TBLT principles. This study examines the effect of mobile-assisted tasks on vocabulary achievement and student attitude in CLIL science lessons.

Several studies have highlighted the numerous ways mobile technology devices can improve learning. Kim et al. (2013) discovered positive outcomes in literacy, whereas Kantar and Doğan (2015) reported positive outcomes in science education. Nakasugi and Yamauchi (2002) observed positive outcomes in the field of history, while Song and Kim (2015) documented the effectiveness of mobile learning interventions in mathematics. Katz-Buonincontro and Foster (2013) highlighted mobile learning's success in art. In addition, Godwin-Jones (2017) and Liman-Kaban (2022b) acknowledged the widespread use and applicability of smartphones in language learning. Chen and Wang (2016) discovered that using digital technology to teach vocabulary improved student outcomes. Likewise, in a study by Chen et al. (2022), the hypothesis was put forth that maintaining a positive perspective towards acquiring a second or foreign language can enhance students' motivation and simplify language learning tasks. Examining the impact of a mobile-assisted grammar learning tool on students' motivation, Refat et al., (2020) found that carefully crafted instructional materials contributed to heightened motivation and a positive outlook on grammar studies among students. Furthermore, Tahounehchi (2021) reported that the experimental group exhibited superior vocabulary skills compared to the control group and demonstrated a more favorable attitude towards learning vocabulary in foreign languages.

Che Mustafa and Sailin (2022) reported that MALL research predominantly focuses on higher education as the primary level of education. Correspondingly, in Türkiye, universities have been the primary contributors to research on mobile tasks and motivation, with relatively less attention given to the attitudes of primary school students, especially those in CLIL classes. By investigating the impact of mobile tasks on the attitudes and vocabulary achievement of Turkish FL learners in CLIL lessons, this study offers a novel perspective on this rapidly evolving subject.

Despite the extraordinary efforts made by the Ministry of Education to improve English language instruction in Türkiye, the level of English competence among Turkish students remains inadequate. According to the education first (EF) English proficiency index (EPI), which ranks scores on the EF Standard English Test administered in 111 countries, Türkiye was rated 64th in 2022, with a poor competency EF EPI score of 495, comparable to level B1 in the Common European Framework of Reference (CEFR) for Languages (EF, 2018).

These findings underscore the potential of mobile-assisted language learning to enhance educational effectiveness and elevate language learning outcomes. Consequently, the primary aim of this research is to investigate the impact of TBLT combined with the ChatterPix Kids app, specifically in the context of vocabulary acquisition among primary FL learners during their CLIL science lessons. CLIL science lessons offer distinct advantages by intertwining subject content and a foreign language, such as English, thereby fostering improved conditions and practices in science education (Mamykova et al., 2023). Research indicates that instructional approaches that integrate language, like CLIL, provide substantial benefits for science learning (McDougald et al., 2023). Furthermore, CLIL science lessons facilitate the creation of meaningful learning environments for science and foreign language education within schools (Concário et al., 2022). They also enhance students' acquisition of both subject matter knowledge and language skills, ultimately leading to improved learning outcomes (Liman-Kaban, 2022b; Piacentini et al., 2019; Tagnin & Ní Ríordáin, 2021). In the context of science education, CLIL methodologies enable students to simultaneously develop content knowledge and language proficiency. Teachers strategically employ questions in CLIL classrooms to foster comprehension of scientific concepts and promote language development. Additionally, CLIL programs contribute to the internationalization of education and promote visibility and cooperation among institutions. Therefore, CLIL science lessons offer a comprehensive approach to learning that benefits students' academic and linguistic development. The study also aims to evaluate students' attitude toward the impact of task-based mobile-assisted activities on their learning experience to complete their CLIL science class assignments. This study aims to advance the understanding of productive and entertaining language learning techniques for young FL learners by examining the integration of an engaging language learning app.

As previously mentioned, a significant portion of FL learners lack motivation in their studies, leading to subpar performance in language skills such as reading, writing, speaking, and listening. Given that CLIL science and mathematics classes for the focus groups of this study only convene for 3 h each week, encompassing both subjects, it was unfeasible to encompass all these skills within this study. The experimental group in this research comprises students who engage in mobile-assisted task-based activities as homework for a 6-week period. In contrast, the control group completed traditional paper-based homework over the same timeframe. This study aims to examine the impact of mobile-assisted task-based homework on vocabulary attainment and attitude in CLIL science lessons. To achieve this, the study will investigate the following aspects for both groups:

1. How does mobile-assisted task-based homework influence achievement in CLIL science lessons?
2. How does mobile-assisted task-based homework in CLIL science lessons influence the attitude of the students?

Literature review

Task-based learning/teaching in FL environment

Task-based learning (TBL) is an approach in language education that focuses on using authentic tasks to engage students in the learning process and enhance their language skills. TBL drives skill-based teaching and learning, motivates students, and encourages their imagination (Sholeh et al., 2020). Teachers in Indonesia have positive attitudes towards implementing TBL in the classroom, even though their knowledge of TBL is still low. They believe in the benefits of TBL and plan to continue using it (Prianty et al., 2021). TBL, along with content-based language teaching (CBLT), has been found to be effective in improving language instruction and learning processes in second language acquisition (Amat et al., 2022). In Cotopaxi province, English teachers have sufficient knowledge of TBL concepts and understand its role in language learning. However, some teachers face challenges in implementing TBL due to inadequate texts and large class sizes (Mejía Alvarado et al., 2023). Technology-mediated TBL has been shown to be effective in developing FL learners' writing proficiency and enhancing their enjoyment and use of multiple skills (Wang, 2022). TBLT is an approach in FL classes that focuses on creating real practice for language use and providing a natural context for language study. It involves the use of tasks, which consist of pre-task, during-task, and post-task phases, to enhance students' learning experiences and language acquisition (Mejía Alvarado et al., 2023). TBLT is based on the belief that learners can improve their language skills by engaging in communicative tasks that require them to use language for themselves (Siregar et al., 2022). The principles of TBLT include clear definitions and principles related to communication task design, the use of tasks in all stages of curriculum development, and the impact of task design and implementation on second language outcomes (Jackson, 2022). The content of TBLT can vary, but it is important to incorporate topics that are relevant to students' lives, such as environmental sustainability, to increase motivation and benefit from the learning activities (Amat et al., 2022). TBLT has been shown to be effective in improving language instruction and learning processes in FL classrooms (East, 2021).

The use of MALL and CLIL in FL classrooms

MALL is a field that explores the use of mobile devices for language teaching and learning. It is an area that has gained attention due to the increasing use of sophisticated mobile devices. MALL offers a resource for language teachers and learners, providing insights into how mobile devices can be effectively used for language teaching. It is based on existing research, practice, and theory, and offers a balanced perspective on the limitations and benefits of mobile learning (Stockwell, 2022). CLIL is a method that combines language learning with the study of content subjects. It is considered a problem-solving method for non-philological students, helping them develop professional competence. CLIL focuses on four main components: content, communication, cognition, and culture. It also emphasizes the use of different types of language, including language of learning, language for learning, and language through learning. CLIL is seen as a promising tool for teaching foreign languages to non-philological students, offering advantages such as the use of specialized materials and the development of linguistic abilities (Kamasak et al., 2021). This research studies the usage of mobile-assisted CLIL science lessons and the many hurdles which students face when acquiring FL in order to address these issues. The study proposes using mobile-assisted task-based activities after school to foster learner autonomy and support them in becoming observers of their developing interlanguage systems. Mobile technologies facilitate participation in activities ordinarily performed on a smartphone or laptop, such as interacting with others in online spaces like web services. Recent research indicates that the informal learning environment is one of the most significant benefits of MALL. According to Jarvis and Achilleos (2013), the availability of information anywhere and at any time is the most significant development. As noted by Godwin-Jones (2011), the introduction of digital tools for vocabulary learning has resulted in the development of several applications created and made freely accessible on the Apple and Android app stores. Several experimental investigations have recognized the potential of mobile-assisted language learning in improving educational effectiveness due to the number of FL learning applications (Alhadiah, 2023; Amaraweera, 2022; Kafryawan, 2023; Mehar-Singh, 2023; Yucedal, 2023). These investigations have revealed that the utilization of mobile devices and mobile applications in language learning can lead to notable enhancements in students' grades, motivation, and overall attitudes toward learning the English language. The Unified Theory of Acceptance and Use of Technology 2 has been applied to scrutinize the key factors influencing the acceptance and utilization of mobile-assisted language learning among FL learners. The findings indicate that habit, performance expectations, facilitating conditions, hedonic motivation, and social influence are all noteworthy determinants of learners' behavioral intention to employ mobile-assisted language learning. Furthermore, the effectiveness of teaching language skills through mobile applications has been confirmed, with significant post-test score improvements compared to traditional classroom instruction.

Methodology

Research design and data analysis

The study investigated the utilization of the ChatterPix Kids mobile application in M-TBL. A quasi-experimental approach was employed, featuring both control and experimental groups, as well as pre- and post-testing. The primary objective of this quasi-experimental design was to establish a cause-and-effect relationship between an independent variable and a dependent variable. Unlike random assignment, the grouping of subjects was based on non-random criteria (Fraenkel et al., 2012). Quasi-experimental designs are used in various fields of research where it is not feasible or ethical to randomly assign participants to different interventions. These designs are employed in both interventional and non-interventional studies. In interventional research, quasi-experimental designs are used to compare outcomes between groups that have not been randomized (Andrade, 2021). The participants consisted of two 4th-grade classes, one designated as the experimental group and the other as the control group. Paired sample t-tests were utilized to assess variations in pre-test and post-test outcomes between the two groups, with statistical significance set at P values < 0.05.

To gauge students' attitudes toward mobile-assisted task-based homework, particularly the use of the Chatterpix Kids App, a quantitative analysis of questionnaire data was conducted among participants in the experimental group at the study's conclusion, with means and standard deviations calculated. Quantitative data were collected from multiple sources, including an Achievement Test administered to both groups during the study. Additionally, to gain insights into the preferences of experimental group participants for mobile-assisted task-based activities in CLIL science lessons, a Students Attitude Questionnaire was administered. Table 1 presents an overview of the research design.

Setting and participants

The research was carried out at a private primary school in Istanbul, Türkiye. It is a chain school with branches in Türkiye's largest cities, comprising elementary, middle, and high schools. Language acquisition is one of the core goals of the English department at private primary school. The aim and protocol of the study were explained to the parents. The part of this study that aimed to collect data from students about their perceptions of using the mobile-assisted TBLT to practice new vocabulary in CLIL science classes and about its impact on student attitude and vocabulary achievement was conducted from 21st of November to 20th January 2022–2023 academic year for eight weeks. The research was conducted at a school that utilized an educational website built exclusively for students aged 3–12, with over 10,000 activities in games, interactive videos, and quizzes. The website was the primary source for teaching CLIL subjects in Science and Math. The platform emphasized cross-curricular learning in Math, Literacy, Foreign Languages, and Sciences, as well as social and emotional learning (SEL), global awareness, and the development of cognitive skills. Although the platform is not free and requires a monthly or annual subscription charge, pupils at the private school examined in this research were provided free access. It is accessible on iOS, Android, Windows, and Linux, and each student has been provided with a unique username and password. Upon checking in, students could access topic-specific content, primarily in the form of

Table 1 Research design

Participants	Pre-test	Treatment	Post-test
Control group	X1	Y	X2
Experimental group	X1	Z	X2, X3

X1 = Achievement test (pre-test)

X2 = Achievement test (post-test)

X3 = Students attitude questionnaire

Y = Mobile-assisted online quizzes (self-study), paper worksheets

Z = Mobile-assisted task-based activities videos or games. Teachers assigned related videos and games to each student's account every week. In addition, teachers utilized other videos or those already present on the site to teach the topic. Each topic was assigned a one-page worksheet as homework. The site also had a monitoring function that allowed teachers to track the development of their students. It recorded the time students spent on each game and video and their progress for each vocabulary achievement. This study addressed "Earth and Layers," "Fruits and Vegetables," "Nutrition," "States of Matter," and "Changes in Matters".

The study's focus group consisted of two fourth-grade groups who received 3 h of CLIL science instruction and 7 h of main course English instruction per week. The experimental group consisted of 18 pupils in class 4A between the ages of 10 and 11, while the control group consisted of 18 students in class 4B of the same age. Except for three pupils who were newcomers from state schools or non-Turkish with weak English backgrounds, most students in the experimental group began English instruction at age six. The control group consisted of sixteen pupils who had taken English classes at age six and two non-Turkish students. Both groups had students with academic abilities ranging from weak to exceptional. The total number of participants is presented in Table 2.

Data collection procedure

In this study, the framework suggested by Ellis (2003) was used to develop the activities for each CLIL science homework assignment. This framework includes three stages that are crucial to effective task design. The first stage, pre-task, focuses on preparing pupils for the task by giving them the linguistic forms they will need to complete it. In the second task cycle stage, students collaborate, develop written or oral content, and share it with their teacher and classmates. The third stage, post-task, entails examining what was generated and reporting on what was learned.

The researcher created six M-TBL activities through the yearly academic plan for the treatment process. Two subject matter experts examined and approved the tasks to ensure they were age and academically appropriate. Weekly WhatsApp messages with the activities were sent to the experimental groups. After finishing the exercises, they used the ChatterPix Kids app to record their voices and add mouths to related images to make them animated. The recordings were saved on their smartphone or tablets and posted to a WhatsApp group the teacher and researcher had created. After that, the recordings were reviewed by the teacher and the learners. Table 3 provides details regarding the treatment process.

At the beginning of the 8-week treatment period, the control and experimental groups took the Achievement Test (pre-test). The post-treatment Achievement Test was conducted via Quizizz to the experimental group, while the researcher distributed the Students Attitude Questionnaire via Google Forms. Using the collected data, the quantitative data was examined. The intervention process is demonstrated in Fig. 1.

Table 2 Research groups

Participants	Female	Male	Total
Control group	4	14	18
Experimental group	10	8	18

Table 3 Treatment process

Participants	Week 1	Week 2–3–4–5–6–7	Week 8
Control group	Presentation session Achievement test (pre-test)	Workbook (1 page for each topic) Smile and learn app (self-study)	Achievement test (post-test)
Experimental group	Presentation session	Workbook (1 page for each topic)	Achievement test (post-test)
	Achievement test (pre-test)	Smile and learn app (self-study)	
		Pre-task: extra videos During task: ınteractive visual aid worksheet Post-task: using MALL (Chatter Pix Kids App) and sharing the results	Student attitude questionnaire

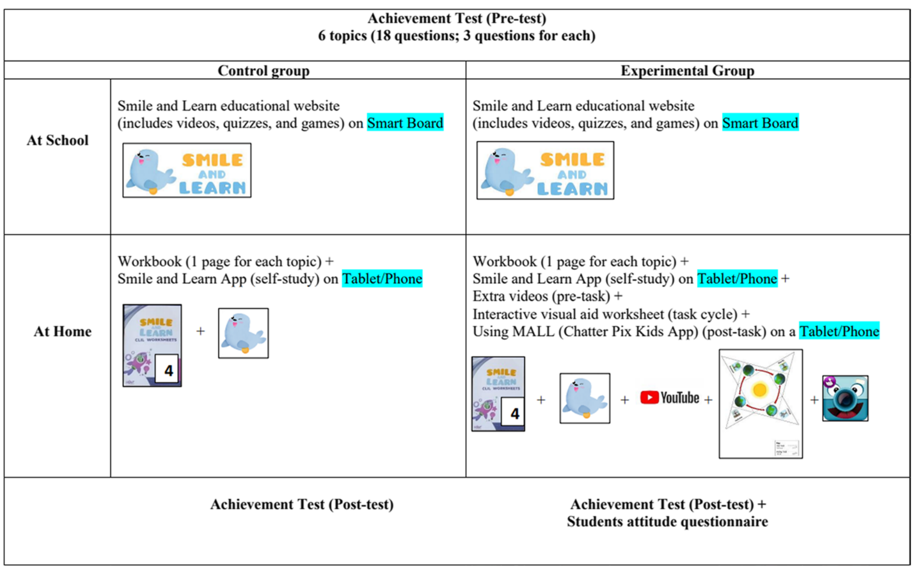

Fig. 1 The intervention processes

Data collection instruments

Achievement test

The researcher created a pre-and post-test under the supervision of subject matter experts. The educational platforms were scanned to generate twenty-four items, which three English teachers and two supervisors assessed with at least 10 years of expertise. The appropriateness of the questions planned to the unit objectives, as well as the questions' structure and the distractors, were all evaluated. Later, ten fifth-grade students from the same school participated in pilot testing to guarantee reliability and item analysis. Analyses of item difficulty index (p) and discrimination (r) were conducted using data collected after the pilot study, which included students who had previously studied the subject. Table 4 displays the Item Discrimination and Difficulty Values of the Achievement Test.

Table 4 Item discrimination and difficulty values of achievement test

Question number	Discrimination value	Difficulty index	Question number	Discrimination value	Difficulty index
1	0.61	0.50	13	0.06	0.90
2	0.87	0.50	14	0.52	0.60
3	0.06	0.90	15	0.65	0.60
4	0.54	0.50	16	0.75	0.60
5	0.75	0.60	17	0.87	0.50
6	0.06	0.80	18	0.75	0.60
7	0.75	0.60	19	0.07	0.40
8	0.87	0.50	20	0.55	0.60
9	0.87	0.50	21	0.71	0.60
10	−0.16	0.40	22	0.75	0.60
11	0.87	0.50	23	0.52	0.60
12	0.54	0.50	24	−0.14	0.80

Table 5 Reliability coefficient, average difficulty, and average discrimination values of achievement test according to pilot study results

Test	Cronbach alpha	Average difficulty	Average discrimination
Achievement test	0.89	0.59	0.53

Table 4 displays the Achievement Test values derived from the analyses, which comprise the item discrimination and difficulty values for each of the 24 questions. After examination, 18 of these items were found to have moderate correlations ($0.50 < r < 0.60$). Questions 3, 6, 10, 13, 19, and 24 were eliminated from the examination due to insufficient discrimination (less than 0.10). Two were considered challenging (0.40), two were regarded as easy (0.80), and two were assessed as extremely easy (0.90). A final version of the Achievement Test with 18 questions was prepared as a pre-and post-test.

A pilot study determined that the average difficulty of the 24 Achievement Test questions was moderate at 0.59. Using SPSS 27.0 (Statistical Program for the Social Sciences), the 0.89 reliability coefficient of the test was calculated (Table 5). Bonett and Wright (2015) categorize Cronbach Alpha scores as excellent (0.90 and above), high (0.70–0.90), moderate (0.50–0.70), and low (below 0.50) in terms of reliability. The test was considered adequate reliability with an average discrimination value of 0.53. Examination of the pilot study values revealed that they fell within the required ranges, showing the high reliability of the Achievement Test.

In summary, the pilot research findings (Table 5) reveal that the Achievement Test had a Cronbach Alpha value of *0.89*, an average level of difficulty of *0.59*, and an average level of discrimination of *0.53*.

Student attitude questionnaire

After completing six M-TBL activities, students were asked to fill out an opinion survey adapted from Zhao (2019) and Waaer and Eid (2021). This survey aimed to collect information regarding student attitude toward implementing M-TBL activities and their vocabulary achievement. The survey's Likert scale was based on Valeski and Stipek's

(2001) evaluation of Feelings about School for preschool, kindergarten, and elementary school children. The survey consisted of 17 Likert-scale questions modified to assess students' actual usage of the ChatterPix Kids mobile app for vocabulary acquisition in CLIL science lessons. The scale was also constructed on a three-point scale to assess how the app's use as a learning aid could affect learners' attitude and vocabulary achievement. To facilitate the completion of the questionnaire by the primary school participants, the scale options were simplified and translated into the student's native language, as approved by the school's language coordinator. Emoticons were added to the three-point scale outlined by Sun (2009), with a happy face expressing approval, a neutral face suggesting indecision, and a sad face signifying disapproval. Illustrations were added to the scale to give learners more specific visual aids and to make the questionnaire more engaging. Although a more significant number of Likert scale items can increase the instrument's validity in assessing attitudes, the number of items was purposefully kept short to accommodate primary school learners' limited attention to complete the survey. Students were directed to rate each sentence on a three-point scale, assigning 1 for a frown and 3 for a smile for each face.

To improve the accuracy of the data and assess the respondents' attention, two negative statements were added to the attitude questionnaire, and students were instructed to select the appropriate emoji. The questionnaire was administered through a Google Forms link sent via WhatsApp to the parents of the learners. To validate the reliability of the questionnaire, correlation coefficients were calculated between the scores of each section and the total score; the results indicated significant correlation coefficients for all three sections at the *0.01* significance level. The correlation coefficient for the first section of the questionnaire was the highest (0.78), followed by the second section (0.73) and third section (0.77). These results indicate that the questionnaire is internally consistent and valid. Moreover, Cronbach's Alpha value for all seventeen items was high at 0.88. Table 6 gives a comprehensive summary of these results.

Mobile-assisted task-based activities

At the beginning of the first week, the researcher held a Zoom meeting with the experimental and control group's parents and students, during which she discussed the procedure and objective of the study. Later, the researcher also provided parents and students of the experimental group with a video demonstrating how to utilize the Bitmoji and ChatterPix Kids applications. To promote community among the pupils, the researcher requested that they make avatars of themselves using the Bitmoji app

Table 6 The reliability and internal consistency of the student attitude questionnaire

Parts of the questionnaire	Number of items	Cronbach's alpha
Vocabulary achievement	5	0.78
Motivation	6	0.73
Overall perceptions	6	0.77
Total	17	0.88

Fig. 2 Snapshots of the student's avatars presenting themselves

Fig. 3 Snapshots of the students in the pre-test

and briefly discuss their interests using the ChatterPix Kids app. The photos of the students' avatars that were shared via the Whatsapp group are shown in Fig. 2.

Quizizz was used to administer a pre-test achievement examination to the experimental and control groups at the end of the first week. Figure 3 shows a sample group of students who participated in the Quizizz pre-test.

By the yearly academic plan, the researcher designed six M-TBL activities for weeks 2–7 and assigned them to be completed over 6 weeks. Table 7 shows the sequence and content of the lesson plan for each topic in three stages: pre-task, during-task, and post-task.

Students in the experimental group shared their assignments over WhatsApp throughout the study. The researcher gave each student feedback both individually and as a group. The previous week's tasks and any new vocabulary at the beginning of each week. Examples of homework assignments for science lessons using the CLIL method are shown in Fig. 4. The pictures show how students used the ChatterPix Kids app to take pictures of their assigned subjects and then used voiceovers to turn those photos into "talking" homework.

Table 7 Mobile-assisted task-based lesson plan

Topic	Objectives	Phases
The Earth	Define axis, orbit, rotation, and revolution Demonstrate how the Earth moves around the sun Explain how and why the seasons change	*Pre-task:* Students watch the topic-related links given by the researcher from YouTube (https://www.youtube.com/watch?v=CqkQv617bcw&t=160s) Moreover, the videos embedded in the online educational platform *During task:* Drawing the earth and naming its motions. Completing the Earth's movement flap book. Making a craft about seasons and the Earth's position with an interactive visual aid *Post-task:* Presenting their model Earth. Naming the hemispheres of the Earth. Talking about the Earth and its movements, the result of the Earth's movement on creating seasons and day and night, all through the ChattePix Kids App
Layers of Earth	Identify the different layers of the Earth outline the characteristics of each of Earth's layers create a model of the layers of the Earth	*Pre-task:* Students watch the topic related links given by the researcher from YouTube (https://www.youtube.com/watch?v=eXiVGEEPQ6c), (https://www.youtube.com/watch?v=QYm4ZmReT2g) and the videos embedded in the online educational platform *During task:* Making their model of Earth layers with playdough. Making a craft about Earth's layers with an interactive visual aid *Post-task:* Naming different layers of the Earth in the correct sequence Talking about the characteristics of each layer, all through the ChattePix Kids App
Nutrition	Define nutrients List the four food groups that make up the food pyramid Explain how each of the nutrients helps our body	*Pre-task:* Students watch the topic related links given by the researcher from YouTube (https://www.youtube.com/watch?v=EhfOZMOF9W4) and the videos embedded in the online educational platform *During task*: Creating my healthy plate craft *Post-task:* Naming four types of nutrients. Presenting their healthy plate. Giving an example for each nutrient and talking about their benefits for our body, all through the ChattePix Kids App
Fruits and vegetable	Identify examples of foods that contain each nutrient Naming different fruits Naming different vegetables	*Pre-Task:* Students watch the topic given by the researcher from YouTube (https://www.youtube.com/watch?v=ToNQCpAF0DE) and the videos embedded in the Online educational platform *During task:* Coloring the fruits and vegetable pictures and making a mini booklet *Post-task:* Presenting different fruits and vegetables. Talking about their favorite ones, all through the ChattePix Kids App

Table 7 (continued)

Topic	Objectives	Phases
State of matter	Define matter Identify the three states of matter To understand how particles are arranged in the three states of matter	*Pre-Task:* Students watch the topic-related links given by the researcher from YouTube (https://www.youtube.com/watch?v=jmm1J2yl9tk) and the videos embedded in the online educational platform *During task:* Coloring the different objects for different states of matter. Categorizing different states of matter. Making the mini poster about states of matter with examples *Post-task:* Present their poster by naming the states of matter with examples. Giving a short description of the particle arrangement for each state of matter, all through the ChattePix Kids App
Changes in state	Name the processes that result in changes of states of matter Explain the processes Give examples for each process	*Pre-task*: Students watch the topic-related links given by the researcher from YouTube (https://www.youtube.com/watch?v=SmgiUfHGVe8) and the videos embedded in the online educational platform *During task:* Making a flap book for changes in states of matter *Post-task*: Presenting the flap book and naming the result of changing the states of matter by example, all through the ChattePix Kids App

Fig. 4 Snapshots of the voice recordings done by the students using the ChatterPix Kids App

In the eighth week, post-tests were administered using Quizizz to both the experimental and control groups. At the same time, a Google Forms questionnaire link was sent to the experimental group WhatsApp group to assess students' attitudes.

Data collection procedure

Drisko (2005) stressed the value of involving the researcher as much as the students and surrounding area to boost the research. The researcher in this study gave the treatment, the achievement exam, and the attitude questionnaire to control and experimental groups. She had previously taught both groups. Because the study used various devices, various data collection techniques were used. This is a detailed explanation of each instrument's data collection procedure.

Experimental group

The experimental group had access to an online educational platform covering courses such as Literacy, Math, Science, and Art and a booklet of math and science exercises. The experimental group used both mobile-assisted task-based activities and paper worksheets.

Control group

The control group was taught the same topics as the experimental group and given access to an online educational platform including Literacy, Math, Science, and Art and a booklet containing math and science activities. In the control group, however, the online practice was voluntary, and only one-page paper worksheets were provided for each topic.

Quantitative data analysis

During the test development phase, pilot research data were utilized to assess item difficulty, discrimination, and average difficulty values in Excel. Simultaneously, the SPSS application was employed to compute Cronbach's alpha. Before implementing mobile-assisted, task-based activities, both the experimental and control groups underwent the Achievement Test, and any noteworthy disparities in their scores were documented.

The current study employed pre and post-test data from the Achievement Test to ascertain whether the mean scores of each group exhibited a normal distribution. To evaluate normality, the Shapiro–Wilk's test was utilized, with a p-value exceeding 0.05 indicating normality (Shapiro & Wilk, 1965). The Shapiro–Wilk (S–W) test is considered more suitable for smaller sample sizes (< 50 samples), as suggested by Mishra et al. (2019). Consequently, the Shapiro–Wilk normality test was employed to assess data distribution.

Prior to delving into the analysis of sub-problems in this study, an examination was conducted to determine whether the pre-test and post-test mean scores derived from the Achievement Test exhibited a normal distribution within each group. Table 8 presents the results of the Shapiro–Wilk normality test employed to scrutinize the distribution.

According to the findings, the pre-test and post-test mean scores had a normal distribution, as shown in Table 8.

Validity and reliability

Several procedures were undertaken during this study's implementation and data collection phases to assure the validity and reliability of the results. According to Drost (2011), reliability refers to the consistency of measurements made in an experiment when

Table 8 Achievement test normality test results

Variables	Group	Shapiro–Wilk		
		Statistic (value)	df	*p*
Achievement test pre-test	Control	0.94	18	0.41
	Experimental	0.95	18	0.43
Achievement test post-test	Control	0.94	18	0.37
	Experimental	0.90	18	0.06

Table 9 Comparison of achievement pre-test results of experimental and control groups

Variable	Group	N	Mean	SD	T	pSig (2-tailed)
Achievement pre-test	Control	18	9.78	2.75	− 13.38	1.86
	Experimental	18	6.17	2.20		

others repeat the measurements under various conditions using the same instruments for measuring the same item. The researcher created an Achievement Test that was verified using a pilot study, item analysis, and subject matter experts' opinions to evaluate student performance. In addition, educational technology specialists and the head of the English department at the school where the study was performed examined the content, the number of questions, and the suitability of the students' attitude questionnaires for the study sample. Cronbach's alpha was used to examine the reliability of the 17-item attitude questionnaire administered to students, and the results indicated acceptable reliability ($\alpha = 0.89$). From January 12th–18th, 2022, the students attitude questionnaire was delivered online via the Google Forms survey provider, and 18 responses were collected. According to George and Mallery (2016), an average measurement value greater than 0.5 is considered acceptable, while an average value greater than 0.9 is considered remarkable.

Findings

M-TBL activities and vocabulary achievement

As a preliminary investigation, the pre-test scores of the experimental and control groups were compared and analyzed to determine whether there were any differences between them prior to the treatment. Prior to initiating treatment, it was necessary to ascertain if there were differences between the two groups.

When Table 9 was analyzed, it was evident that the control group's average pre-test achievement score was $X = 9.78$, the experimental group's score was $X = 6.17$, and the standard deviation value for both groups was 1.86. Based on these results, it can be concluded that there is no significant difference between the experimental and control groups' pre-test mean scores ($p = 1.86 > 0.05$). This result suggests that the knowledge levels of both groups were equal before initiating the experimental treatment.

Examining Table 10 reveals that the average post-test achievement score for the experimental group was $X = 14.11$, whereas the average score for the control group was $X = 8.00$; both groups' standard deviations were 0.00. These results conclude that there is a significant difference between the post-test mean scores of the experimental and

Table 10 Comparison of achievement post-test results of experimental and control groups

Variable	Group	N	Mean	SD	t	p Sig (2-tailed)
Achievement post-test	Control group	18	8.00	2.89	− 5.90	0.00
	Experimental group	18	14.11	3.53		

control groups ($p = 0.00 < 0.05$). This result indicates that the knowledge levels of the two groups were not equal, as determined by the experimental procedure.

The results of the control group's pre-test and post-test achievement tests were compared by the research's goal to see if there was a significant difference.

The control group's pre-test (X = 9.78) and post-test (X = 8.00) mean scores are displayed in Table 11 using descriptive statistics. These results indicate no significant difference between the post-test and pre-test mean scores on the Achievement Test for the control group ($p = 0.19 > 0.05$). Moreover, the Achievement Test scores of the control group did not improve significantly. This result suggests that the instructional methods employed by the control group, such as paper-based worksheets and online exercises, did not significantly improve the success rate of the learners.

Table 12 provides a descriptive analysis of the experimental group, including the number of participants (18) and their pre-and post-test mean scores (X = 6.17 and X = 14.11, respectively). It was determined that there is a statistically significant difference between the experimental group's pre-test and post-test mean Achievement Test scores ($p = 0.00 < 0.05$). The post-test mean score on the Achievement Test in the experimental group was significantly higher than the pre-test mean score, indicating that the applications implemented in the experimental group effectively promoted student success.

The results presented in Table 13 indicate a significant difference between the mean scores of the pre-test and post-test differences in Achievement Test scores for both the experimental and control groups ($p = 0.00 < 0.05$). These findings suggest that the interventions implemented in the study strongly impacted the student's vocabulary achievement.

Students attitude questionnaire towards M-TBL

To evaluate the impact of M-TBL assignments, data were collected and categorized into three categories: vocabulary achievement, motivation, and overall perception. Descriptive statistics, including means and standard deviation, were examined for each

Table 11 Comparison of achievement pre-test and post-test results of the control group

Group	Test	Application	N	Mean	SD	T	pSig (2tailed)
Control	Achievement test	Pre-test	18	9.78	2.75	1.33	0.19
	Achievement test	Post-test	18	8.00	2.89		

Table 12 Comparison of achievement pre-test and post-test results of experimental group

Group	Test	Application	N	Mean	SD	T	pSig (2tailed)
Experimental	Achievement test	Pre-test	18	6.17	2.20	− 8.17	0.00
		Post-test	18	14.11	3.53		

Table 13 Comparison of achievement pre-test and post-test difference results of control and experimental groups

Variable	Group	N	Mean	SD	T	pSig 2-tailed)
Achievement (pre-test and post-test difference)	Control	18	− 1.78	5.63	− 8.32	0.00
	experimental	18	7.94	4.12		

Table 14 Summary of learners' attitude

Students' attitude questionnaire	Mean	SD
Vocabulary achievement items		
(1) Using the ChatterPix Kids app helped me use new vocabulary I recently learned	2.39	0.85
(2) Using the ChatterPix Kids app in my homework helped me practice the vocabulary related to Matter of State, The Earth, and Healthy Food	2.72	0.57
(3) Using the ChatterPix Kids app helped me remember the meaning of English words	2.56	0.78
(4) The vocabulary I practiced with the ChatterPix Kids app helped me improve English	2.72	0.57
(5) The vocabulary I practiced with the ChatterPix Kids app did not help me improve my English	2.72	0.66
Motivation items		
(6) Using the ChatterPix Kids app was effective in increasing my motivation	2.50	0.70
(7) Using the ChatterPix Kids app in doing my homework stimulated my interest in learning English	2.50	0.78
(8) Using the ChatterPix Kids app in doing my homework reduced my anxiety	2.22	0.94
(9) Learning vocabulary with the ChatterPix Kids app has boosted my confidence	2.22	0.87
(10) If I don't like the voice, I recorded it in the ChatterPix app; I could delete it and re-record it, which helped me feel good	2.89	0.47
(11) Doing homework on paper was better than doing homework with the ChatterPix Kids App	2.44	0.85
Overall perceptions items		
(12) The ChatterPix Kids app was easy to use	3.00	0.00
(13) Using the ChatterPix Kids app while doing my homework was fun	2.67	0.68
(14) I liked the features of the ChatterPix Kids app, such as filters, stickers, frames, and text	2.94	0.23
(15) Doing homework with the ChatterPix Kids app was more fun than paper worksheets	2.83	0.51
(16.) Using the ChatterPix Kids app in my homework helped me practice the vocabulary related to my English science lessons	2.61	0.60
(17) I want to use the ChatterPix Kids app more often in the future	2.56	0.61

statement. A mean value close to 1 indicates a negative attitude, whereas a value closer to 3 indicates a positive trend. Table 14 gives an overview of the analysis of the 17 Likert scale items, each of which had three possible responses: disagree (given a value of 1), indifferent (assigned a value of 2), and agree (assigned a value of 3).

The current study used a Likert scale questionnaire to assess central tendency by calculating the mean range. Scores between 1.0 and 1.6 indicated disagreement, scores between 1.6 and 2.3 indicated indecisiveness, and scores between 2.3 and 3.0 indicated agreement. Scores of 2.6 out of 3, 2.4 out of 3, and 2.7 out of 3 indicated high levels of vocabulary achievement, motivation, and overall perception, respectively, as displayed in Table 14. The standard deviation assessed how much the participants' responses deviated from the mean score. Positive outcomes were indicated by vocabulary achievement, motivation, and overall perception scores exceeding 2.60 out of 3. A descriptive analysis of the data revealed that most students perceived the M-TBL assignments to provide opportunities to practice the vocabulary they had learned in their CLIL science lessons.

Despite some student uncertainty regarding the efficacy of the ChatterPix Kids app in reducing anxiety and boosting confidence, most students reported increased homework motivation and stimulation. These results indicate that participants viewed M-TBL homework favorably, found it user-friendly, and viewed it as more effective than paper-based homework. The study also revealed that students were likely to use the ChatterPix Kids app in future educational endeavors.

Discussion

The study sought to explore how M-TBL assignments affect vocabulary performance among CLIL science students. The first research query explored the impact of M-TBL assignments on the vocabulary performance of CLIL science students. Data analysis uncovered a noteworthy disparity in the mean scores of pre- and post-tests between the control and experimental groups. Over the course of 6 weeks, the experimental group exhibited a substantial rise in vocabulary achievement, while the control group showed no substantial variance in their pre- and post-test results. After implementing mobile-assisted task-based homework every Friday for 6 weeks, the mean score of the experimental group surged from 6.17 to 14.11, accompanied by a p value of 0.00 ($p<0.05$), signifying a substantial boost in vocabulary knowledge. This finding corroborates the conclusions of Lai (2016), who demonstrated that the mobile group retained more vocabulary compared to the textbook group. Furthermore, the literature suggests that associating vocabulary with images or supplementary content augments recognition and retention (Yanguas, 2009).

According to Zhao et al. (2022), technology's capacity to record conversational activities that impact language acquisition and collaborative knowledge creation positions it as a valuable tool for assessing and enhancing CLIL. Consequently, technology can be harnessed to appraise and ameliorate CLIL. Garzon-Diaz (2021) and O'Dowd (2018) emphasize the advantages of technology-enhanced CLIL as a framework that is conducive to science and intercultural learning, as well as its pivotal role in maximizing language utilization in this context. They particularly highlight the potential for technology to enhance CLIL. The findings of this study are consistent with a study by Naz et al. (2022) which demonstrated that M-TBL vocabulary acquisition is effective for ESL students. In the study, students in the experimental group demonstrated the ability and motivation to interact with a new learning method, which contributed positively to their achievement in acquiring vocabulary compared to students in the control group who used the conventional method.

The findings of Wang et al.'s (2015) study, which examined the effect of iPad software on language learners' vocabulary knowledge, are also supported by the current study, which indicates that software users experienced more significant improvement than non-users. Moreover, Ahmadian et al.'s (2015) findings indicate that the software-using group outperformed the other group regarding vocabulary acquisition, confirming the above finding.

Numerous studies, including those conducted by Lu (2008), Thornton and Houser (2005), and Kennedy and Levy (2009), have investigated the use of mobile devices in the process of language acquisition. The results of these studies indicate that sending new vocabulary words in context via SMS to mobile phones can be highly advantageous for vocabulary acquisition. In addition, Thornton and Houser (2005) demonstrated that mobile-assisted vocabulary learning exceeds traditional paper-based methods. Similarly, in research by Dizon (2016), nine Japanese students used a gamified student response application for 10 weeks to improve their vocabulary skills. Significant differences between the pre-and post-test assessments were seen in their vocabulary acquisition. These results indicate that integrating MALL can improve vocabulary learning outcomes. Burston (2012) claims that mobile devices offer numerous learning opportunities that suit a mobile lifestyle and can help instructors and students in language learning, including vocabulary acquisition.

In addition, according to Rassaei (2020), integrating mobile-based applications in improving the vocabulary knowledge of FL learners enhance interactions between instructors and students and foster learner interactions both inside and outside the classroom. This can contribute to increased peer and instructor-mediated vocabulary instruction, improving students' vocabulary knowledge.

The present study's findings align with prior findings on using numerous mobile technology features and tools, such as SMS, smartphone apps, and other mobile systems researchers have created. Studies by Başoglu and Akdemir (2010), Rahimi and Miri (2014), Wu (2015), Zhang et al. (2011), Lu (2008), and Saran et al. (2012) reveal that experimental groups which use mobile technologies displayed more significant improvements in post-test vocabulary scores instruction.

In summary, as a result of this study's investigation of the impacts of mobile-assisted task-based assignments on CLIL science students' learning outcomes, it was discovered that the experimental group's achievement in vocabulary was much higher than that of the control group. These findings are consistent with previous studies on the benefits of mobile device use for vocabulary development. Numerous studies have shown that mobile devices have a unique potential for language learners, expanding vocabulary knowledge and boosting interactions between students and teachers within and outside the classroom.

The impact of M-TBL homework on student attitude was the subject of the second research question. The mobile-assisted task-based activities were considered user-friendly, engaging, and beneficial by the students in their evaluations for reviewing course topics relevant to CLIL scientific vocabulary. The pupils also mentioned how much they like the Chatterpix Kids App's text, frames, stickers, and effects. The mean score indicated that students preferred task-based activities supported by mobile devices to traditional paper-based homework when completing their assignments. This study showed that M-TBL activities positively impacted student attitude and aroused their interest in learning the target language. Most of the activities given to students in various studies matched real-life settings and were made applicable to their everyday lives. These exercises promoted meaningful negotiation among students by integrating real-world resources like emails and videos. Furthermore, some assignments allowed students to take on the role of an expert and communicate in English, which boosted their desire to interact with their classmates in the target language.

Garzón-Diaz (2021) investigated the feasibility of integrating scientific and multicultural instruction in a technologically enhanced, CLIL environment. This case study demonstrated how CLIL, facilitated by technology, was utilized to achieve the national curriculum's bilingual education objective. Further, it is acknowledged that integrating technology into CLIL lectures has numerous benefits and that scientific projects foster student interdependence and motivation to learn.

Students have profited from the combination of CLIL education and digital technologies in a variety of ways, according to a report produced by Scott and Beadle (2014) for the European Commission. The report's foundation was a thorough examination of the use of technology and CLIL in language acquisition. The benefits of using technology with CLIL education may generally be divided into four categories: improved language competency, expanded learning possibilities, boosted student confidence and motivation, and expanded number of learning chances. Additionally, Zhu and Chan (2023) assert that digitally delivered tutor feedback is more efficient than traditional input from tutors. Because it gives students a greater role in the learning process and gives them the chance to reflect on their progress and get feedback, technology utilization can boost student motivation.

Rachels and Rockinson-Szapkiw (2018) stated that M-TBL instruction improves FL students' attitudes toward vocabulary learning. This approach seems sensible, considering that using mobile devices can offer students chances for teamwork both inside and outside of the classroom, which can encourage enthusiasm for learning. Many features of mobile applications make it easier and more enjoyable for students to participate in vocabulary activities.

The effects of using Kahoot! Application instead of traditional teaching approaches in foreign language classes were examined by Montaner-Villalba (2018). To gather data, the study used an action research methodology. The results showed that Kahoot! was a simple to use classroom tools that boost students' interest and enthusiasm in a particular topic. In conclusion, the study found that using Kahoot! increased the success of learning outcomes.

In a study including 32 intermediate-level students, Sadeghi et al. (2022) investigated the effects of gamified vocabulary teaching in contrast to traditional vocabulary teaching on both vocabulary acquisition and motivational status. Semi-structured-test assessments, motivation survey, and other data-gathering methods from the study's qualitative and quantitative aspects were used. The results showed that gamifying language instruction improved students' motivation. Similarly, Karabacak (2018) and Liman-Kaban (2022a) looked into how gamification affected kids in primary schools.

Conclusion

In conclusion, this study delved into the impact of M-TBL assignments on vocabulary performance among CLIL science students and investigated the influence of these assignments on student attitudes. The results provided compelling evidence in support of the use of mobile technology in the classroom. Firstly, concerning vocabulary performance, the data analysis demonstrated a significant difference between the control and experimental groups' pre- and post-test mean scores. The experimental group, which received M-TBL homework, exhibited a substantial increase in vocabulary achievement over the 6-week period. This finding aligns with previous research, emphasizing the effectiveness of mobile technology in enhancing vocabulary acquisition, as demonstrated by Lai (2016), Naz et al. (2022), and others. The use of mobile devices, such as smartphones and tablets, offers students unique opportunities to engage with language content in interactive and dynamic ways, leading to improved vocabulary knowledge. Additionally, the study explored the impact on student attitudes, revealing that students found M-TBL activities to be user-friendly, engaging, and beneficial for reviewing course topics related to CLIL scientific vocabulary. This positive reception of M-TBL aligns with the broader literature, which highlights the motivational benefits of technology in education. Students expressed a preference for these activities over traditional paper-based homework, emphasizing the potential of mobile technology to foster enthusiasm and engagement in language learning. Furthermore, integrating technology into CLIL instruction, as demonstrated by Garzón-Diaz (2021), Scott and Beadle (2014), and others, offers numerous advantages, including improved language competency, expanded learning opportunities, increased student confidence and motivation, and greater learning chances. Digital tools and platforms provide students with interactive, real-world experiences that enhance their language skills while promoting meaningful interactions both in and out of the classroom. The outcomes demonstrated that the gamified learning environment helped students enhance their sense of responsibility, teamwork, and coordination while also making learning English enjoyable.

To sum up, it has been found that engaging in M-TBL activities and gamified vocabulary training increases students' interest in learning a new language. Additionally, student attitude has been significantly enhanced by allowing students to speak in the target language and take on the role of an expert. These results suggest that integrating games and technology into language training may improve student learning and results. This study also contributes to the growing body of evidence supporting the integration of M-TBL assignments in CLIL science education. It highlights the positive impact on vocabulary performance and student attitudes, aligning with previous research and emphasizing the potential of technology-enhanced CLIL to enhance language acquisition and student motivation. As technology continues to evolve, its role in CLIL education is likely to become even more prominent, providing educators with valuable tools to enrich language learning experiences.

For future researchers and practitioners interested in exploring the use of M-TBL assignments in CLIL education and its impact on vocabulary performance and student attitudes, here are some suggestions:

Conducting longitudinal studies to assess the long-term effects of mobile-assisted task-based assignments will help to determine whether the observed improvements in vocabulary performance and student attitudes are sustained over time.

Including a broader range of participant groups, such as different age groups, proficiency levels, and cultural backgrounds will allow for a more comprehensive understanding of how mobile technology affects various learners.

Investigating the training needs of CLIL educators regarding the effective integration of mobile technology into their teaching practices to develop professional development programs to support teachers in utilizing these tools effectively.

Considering accessibility and inclusivity issues when implementing mobile technology in CLIL education ensures that M-TBL assignments are accessible to students with disabilities and those from diverse backgrounds.

Exploring the use of real-time feedback mechanisms within mobile applications to enhance student engagement and provide immediate guidance for improvement.

Developing mobile-assisted tasks and assignments that allow for personalized and adaptive learning experiences, catering to individual student needs and preferences.

Collaboration with experts from both the language education and technology fields to design innovative mobile-assisted CLIL programs that integrate the latest advancements in educational technology is needed.

Investigating the role of parents in supporting M-TBL at home and encouraging parental involvement and providing resources for parents to understand and engage with their children's learning through technology.

By addressing these areas of research and practice, future researchers and educators can contribute to the ongoing enhancement of CLIL education through mobile technology, ensuring that it remains a relevant and effective approach for language learning and content integration.

Abbreviations

CLIL	Content and language integrated learning
CBLT	Content-based language teaching
CEFR	Common European framework of reference
CLT	Communicative language teaching
EF	Education first
EPI	English proficiency index
FL	Foreign language
PISA	Programme for international student assessment
TBLT	Task-based language teaching
MALL	Mobile-assisted language learning
M-TBL	Mobile-assisted task based learning
SEL	Social and emotional learning
TBL	Task-based learning

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Declarations

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Competing interests
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