Examining the impact of multimodal task design on English oral communicative competence in fourth-grade content-language integrated social studies: A quasi-experimental study

Cheng-Ji Lai[1]*

*Correspondence:
laicj@mail.ntcu.edu.tw

[1] Department of English, National Taichung University of Education, Taichung, Taiwan

Abstract

Content and Language Integrated Learning (CLIL) is increasingly adopted globally, including in Taiwan's educational initiatives, yet challenges remain in implementing effective CLIL practices, such as pedagogy and curriculum design. This study investigated the effectiveness of multimodal task designs, combining hands-on learning with poster presentations, in enhancing oral communicative competence within CLIL contexts. Employing a mixed-methods, quasi-experimental design with a comparative case study framework, the study assessed English oral communicative competence in four intact fourth-grade Taiwanese CLIL Social Studies classes. The hands-on learning group (EG, $n=40$) engaged in activities like Chinese Dumpling Making, Bird's Nest Building, and Succulent Pot Designing, while the non-hands-on learning group (CG, $n=34$) used traditional worksheets on the same topics. Both groups proceeded to poster presentations within their multimodal task design, where students' oral communicative competence was assessed using rubrics developed based on Coyle's 4Cs dimensions, focusing on Content, Communication, and Cognition. Additionally, students' cultural knowledge related to the hands-on topics was evaluated through written tests. To complement the quantitative data, qualitative data from self-reported reflections and video recordings documenting interventions were collected for the assessment of oral communicative competence within a CLIL framework. Results demonstrate that integrating hands-on activities significantly enhanced procedural content, communication (i.e., sentence complexity, pronunciation accuracy for target vocabulary, presentation fluency), and cognitive abilities, confirming the efficacy of multimodal learning approaches in fostering linguistic and cognitive engagement. Post-test comparisons show the EG's superiority in cultural knowledge acquisition across all three hands-on topics. Student reflections endorsed the enrichment of learning experiences through multimodal task design. Video analysis of both groups' interventions revealed that despite significant engagement and autonomy, EG students commonly utilized general English rather than target vocabulary, a pattern similar to that observed in the CG. These findings highlight the potential of diverse

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 2 of 27

modalities in CLIL to enhance English content learning and oral skills, shaping future pedagogy and language strategies in Taiwan. The study also emphasizes the role of embodied learning, the interplay between physical actions and cognitive processes, to facilitate deeper understanding and engagement with subject matter within CLIL settings.

Keywords: Content and Language Integrated Learning (CLIL), Multimodal task design, English oral communicative competence, 4Cs (Content, Communication, Cognition, and Culture), Embodied learning

Introduction

The adoption of bilingual programs in Europe, inspired by successful North American immersion models and content-based instruction (CBI), aims to address language skill deficiencies (Brinton & Snow, 2017; Eurydice, 2006). One prominent approach, Content and Language Integrated Learning (CLIL), emerged in the early 1990s with support from EU institutions, involving the teaching of subjects like history or science in a language different from the mainstream school language (Dalton-Puffer, 2007; Marsh, Maljers, & Hartiala, 2001). Reflecting the 4Cs framework of CLIL (Coyle, 2002; Coyle, Hood, & Marsh, 2010; Marsh, 2006), this methodology not only strengthens foreign language skills (Communication) and subject mastery (Content) but also promotes cognitive engagement (Cognition) and broader cultural perspectives and intercultural competencies essential for global citizenship and communication (Culture). Empirically, CLIL has demonstrated enhancements in vocabulary, listening skills, content knowledge, and learner motivation (Alonso et al., 2008; Bayram, Ozturk, & Atay, 2019; Cambridge Assessment International Education, 2017; Huang, 2020; Marsh, 2000; Pérez Cañado, 2011; Svensson, 2020). However, debates highlight concerns about the selectivity (Lialikhova, 2021), the rush to adopt CLIL (Paran, 2013; Pérez Cañado, 2011), and predominant focus on English (Dalton-Puffer, 2011) within CLIL programs.

As CLIL programs expand globally, Taiwan has embraced this educational model within its bilingual initiative by 2030 to prepare students for global opportunities (Chen et al., 2020; Ferrer & Lin, 2024; Ministry of Education, 2018). This shift is evident in primary schools transitioning from traditional English as a Foreign Language (EFL) instruction to CLIL methods, particularly in non-core subjects during the early stages of implementation (Liaw et al., 2018). Since 2021, the Ministry of Education has been providing resources and training to support the implementation of experimental CLIL programs in core subjects such as science. However, the early stages of CLIL implementation in Taiwan encounter significant challenges, including inadequate English proficiency among content teachers, a lack of familiarity with CLIL methodologies (Yang, 2015), and hurdles in pedagogy and curriculum design (The Language Training & Testing Center, 2021). This has led to the prevalence of a "Soft-CLIL" approach that prioritizes language learning using content to teach language structures and skills (Lyster & Ballinger, 2011).

Despite CLIL's emphasis on receptive skills like listening and reading (Dallinger et al., 2016; Dalton-Puffer, 2008), fostering oral communicative competence is critical in primary education due to its emphasis on multilingualism and global

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 3 of 27

competitiveness (Coyle, 2007). CLIL's Language Triptych framework, integral to the Communication pillar of the 4Cs, enhances language development from subject content, facilitating deeper engagement and comprehension within the learning process (Coyle, Hood, & Marsh, 2010). In Taiwan, the CLIL Social Studies curriculum aims to foster language proficiency as well as critical thinking and cross-cultural understanding (Curriculum and Instruction Resources Network, 2018). However, studies specifically targeting CLIL's effectiveness in Social Studies on oral communicative competence using the 4Cs framework are scarce.

Researchers advocate for the incorporation of multiple semiotic modes, such as visuals, to support CLIL learning (Evnitskaya & Jakonen, 2017; Forey & Polias, 2017; Liu & Lin, 2021). Multimodality, integrating language with various semiotic forms, is pivotal in pedagogy, emphasizing the coordinated use of non-verbal resources alongside verbal and paraverbal elements (Kress, 2000; Stivers & Sidnell, 2005). Combining multimodal pedagogies with hands-on learning, which includes activities like laboratory experiments, practical demonstrations, and interactive tasks, fosters interactive and physically engaging learning environments (Dessie, Gebeyehu, & Eshetu, 2023; Meyer, 2004; Miller, 2014). Hands-on learning, particularly valuable in science education (Nikula, 2015), promotes discovery, critical thinking, and experimentation (Alkan, 2016; Levy & Moore Mensah, 2020; Miller, 2014). Despite its prevalence in science education, hands-on learning practices are less commonly implemented in CLIL social studies in Taiwan, highlighting a gap in the literature on the effectiveness of hands-on approaches in this context. Additionally, regarding students' poster presentations within the CLIL context, while it may be prevalent in classroom practices, empirical studies utilizing poster presentations as a specific multimodal task design are indeed limited.

Drawing upon Lin's (2019) Multimodalities-Entextualization Cycle (MEC) and embodied learning theories, this study designed three hands-on learning activities—Chinese Dumpling Making, Bird's Nest Building, and Succulent Pot Designing—that directly integrated Social Studies content. The aim was to evaluate their impact on fourth-grade students' English oral communicative competence within a CLIL framework, employing the four dimensions of Content, Communication, Cognition, and Culture (4Cs). This quasi-experimental study investigated the comparative impact of hands-on learning versus traditional worksheet-based learning on students' English communicative competence, facilitated by a sequence of multimodal tasks tailored to this context.

Literature review
Multimodal task design using hands-on Learning in CLIL settings
In education, learning is a multimodal process driven by student interests and context, involving visual, actional, and linguistic communication (Jewitt, 2008). In the context of CLIL, the concept of multimodality refers to the use of various semiotic systems—such as visual, auditory, textual, and kinesthetic modes—to facilitate meaning-making and enhance learning outcomes (Bezemer & Kress, 2008; Kress & van Leeuwen, 2001). The term "modes" or "modalities" encompasses the aural and written input learners receive, as well as the oral and written output they produce, and can extend to specific tasks (Gilabert, et al, 2016). This approach aligns with learner-centered philosophies and empowers students to take an active role in their learning process (Bransford, Brown, &

Cocking, 1999). Lin's (2019) Multimodalities-Entextualization Cycle (MEC) provides a theoretical framework for integrating content and language learning through experiential, inquiry-based contexts and academic entextualization (Wu & Lin, 2019). This cycle emphasizes the importance of incorporating multiple modes of communication tasks within CLIL settings to create immersive learning environments that deepen students' understanding and engagement with subject matter. Hands-on learning activities along with poster presentations, which involve direct physical interaction with materials or tasks relevant to the curriculum (Dessie, Gebeyehu, & Eshetu, 2023; Meyer, 2004), are particularly well-suited to this framework.

Scholars advocate for multimodal task design to enhance language acquisition (Hampel & Hauck, 2006; Stein, 2004), yet research in this area remains underdeveloped (Grapin, 2019; Roth et al., 2023). Empirical studies have shown that integrating language with various semiotic forms like images and interactions results in the coordinated use of non-verbal resources alongside verbal and paraverbal elements (Kress, 2000; Stivers & Sidnell, 2005). Furthermore, Yaman Ntelioglou et al. (2014) highlights the positive effects of multimodal task design on improving language and content knowledge acquisition. Notably, Galaviz and Peralta (2019) demonstrates that multimodal tasks, such as whole-class discussions, small group dialogues, and poster presentations, provide students with opportunities to articulate their understanding of subject content and express their ideas and opinions on classroom topics, while employing targeted vocabulary and sentence structures. Despite the recognized benefits of multimodal pedagogies in promoting authentic language use and learner motivation (Abrams, 2016), more empirical studies are needed to explore the specific impact of multimodal task design such as using hands-on learning with poster presentations on learning outcomes within CLIL programs. Addressing these research gaps will contribute to a deeper understanding of how multimodality can be effectively leveraged to enhance CLIL education and promote meaningful learning experiences.

The embodied learning through multimodal pedagogies in language learning

Embodied learning emphasizes adaptive responses to situations through diverse means, fostering deep comprehension of the self-world relationship (Holst, 2013). This perspective recognizes the intricate interplay between the body and cognition, positing that physical actions and sensory experiences shape mental processes (Barsalou, 2008; Beilock, 2015). The theory of embodied cognition suggests that our mental experiences are profoundly influenced by our physical actions and sensory observations, highlighting the significance of embodied interactions in learning processes (Fu & Franz, 2014). In the context of CLIL classrooms, the integration of sensory and motor experiences with cognitive processes can be effectively facilitated through hands-on activities (Coyle & Meyer, 2021). Empirical support for embodied learning strategies is growing, particularly in the realm of language acquisition, where physical engagement has been found to improve understanding and retention (Brooks & Goldin-Meadow, 2016; Horn & Wilburn, 2005; Mavilidi et al., 2015;). Research in this area has also shown that incorporating bodily engagement into educational tasks enhances learning outcomes, with studies highlighting the beneficial impacts of movement and gestures on instructional methods (Barsalou, 2008; Johnson-Glenberg et al., 2014; Ruiter et al., 2015; Wilson, 2003). Despite

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 5 of 27

these advancements, there remains a notable gap in the literature concerning the specific application of embodied learning through hands-on activities in CLIL contexts because most studies focus on theoretical discussions or applications in other subject areas (Skulmowski & Rey, 2018). This gap exhibits the need for focused research on how multimodal task design, such as hands-on learning and poster presentations, can effectively integrate embodied learning into language education to enhance oral communicative competence.

Assessing students' oral communicative competence within CLIL contexts

Assessing students' oral communicative competence within CLIL contexts involves a multifaceted understanding aligned with Coyle's (2007) four guiding dimensions: Content, Communication, Cognition, and Culture (4Cs). This competence encompasses the ability to effectively use language for meaningful interaction particularly in primary schools (Lin, 2016) and requires continuous practice tailored to young learners' developmental stages (Coyle, Hood, & Marsh, 2010; Murillo, Martínez-Garrido, & Hidalgo Farran, 2014). Prior studies collectively highlight the multifaceted impact of CLIL on students' language development, demonstrating strengths in oral communication alongside persistent challenges in writing, syntax, and grammatical accuracy. For instance, Tedick & Wesley (2015) noted that CLIL students often excel in reading and listening proficiency but face challenges with grammatical accuracy in speaking and writing. In contrast, Niteo Moreno de Diexmas (2016) observed significant improvements in oral production and interaction among young CLIL learners aged 9–10. Similarly, Pérez Cañado and Lancaster (2017) discovered positive impacts of CLIL in Spain on productive oral skills, particularly in cognitively complex listening activities. Moreover, Lialikhova's (2021) study on Norwegian ninth graders revealed varying effects of short-term CLIL interventions on oral development across different achievement levels.

Researchers emphasized the strong correlation between hands-on learning and CLIL content acquisition, suggesting that hands-on activities not only enhance interactivity (Nikula, 2015) but also promote learners' communicative competence (Chao et al., 2013; Sheu et al., 2015). This approach aids young learners in developing disciplinary literacy in Science and Engineering, particularly in oral reasoning (Aguirre-Muñoz et al., 2018). Furthermore, poster presentations linked to hands-on, project-based learning themes have shown improvements in English oral expression and vocabulary retention (Galaviz & Peralta, 2019). Despite these insights, the literature presents the need for empirical research to effectively integrate Coyle's (2007) 4Cs framework into the assessment of English oral communicative competence within CLIL contexts, emphasizing areas such as content mastery, effective communication, cognitive engagement, and cross-cultural understanding.

Study purpose and research questions

This quasi-experimental study aimed to investigate the impact of embodied CLIL pedagogical approaches using hands-on activities (making Chinese dumplings, building bird nests, and designing succulent plant pots) on fourth-grade students' English oral communicative competence within a CLIL Social Studies course in Taiwan. The study assessed students' gains in the four guiding dimensions of Content, Communication,

Cognition, and Culture (4Cs) and explored the effectiveness of multimodal task designs (Experimental Group, EG) compared to conventional worksheet-based instruction (Control Group, CG). Additionally, the study utilized qualitative data from self-reported reflections and video recordings to assess students' intervention learning experiences. Three research questions were formulated as follows.

> RQ1: To what extent does hands-on learning influence fourth graders' gains in Content, Communication, and Cognition as assessed by the rubrics within the EG compared to the CG in a CLIL Social Studies course?
>
> RQ2: What are the differences in cultural knowledge acquisition between students in the EG and those in the CG, as assessed by written tests?
>
> RQ3: How do self-reported reflections from students in the EG compare to those from the CG regarding their post-intervention learning experiences within respective pedagogical approaches?

Methodology

Research design

Following recommendations for mixed methods and data triangulation from CLIL scholars (Perez-Canado, 2012), this study adopted a mixed-methods, quasi-experimental, sequential explanatory design, utilizing a comparative case study approach (Ivankova et al., 2006). The sample comprised four intact fourth-grade CLIL Social Studies classes within CLIL-based English immersion program (EIP) across three Taiwanese public elementary schools. This deliberate selection aimed to capture unique contextual features critical to the study's objectives. Participant selection was non-random, based on practical classroom arrangements (Best & Kahn, 2006). However, the assignment of intervention types—hands-on activities for the EG and worksheet activities on the same topics for the CG—was determined by random sampling, despite worksheet activities being commonly used in the program. This approach allowed for a controlled comparison of English oral communicative competence outcomes in their poster presentations.

Research context and participants

Participants in this study were students from four intact fourth-grade CLIL Social Studies classes within a larger CLIL-based English immersion initiative involving eight public schools in Taiwan. This initiative, overseen by a non-profit educational institution, implemented a comprehensive English language development program integrated with content knowledge across grades one to six. The curriculum encompassed various subjects, including Music, Arts, Physical Education, Science, and Social Studies. The program's primary objective was to create an English-native-like environment, facilitated by 26 native English instructors (84%) who supported the English immersion elements of the program. Additionally, the program involved 5 (16%) Taiwanese subject teachers specializing in Music, Arts, Social Studies, and Science, in line with CLIL principles (Dalton-Puffer, 2011). The use of translanguaging practices, which involve bilingual or multilingual discourse (García, 2007), further contributed to the CLIL elements of the program. In terms the pedagogical approaches within the program, instructors predominantly employed multimodal

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 7 of 27

pedagogies across Language Arts and various subjects, including Social Studies and Science. These approaches encompassed learning games, reading activities, Power-Point-led review games, worksheet activities, and expressive modalities such as drawing, video, audio, and written outputs. This study marked the program's inaugural integration of task-based language teaching (Nunan, 2004) with experiential learning through hands-on activities in Social Studies, culminating in poster presentations.

To increase the robustness and sample size of the study, EG1 and CG1 were recruited in one academic year, while EG2 and CG2 were recruited in the following academic year. All classes were taught by the same experienced Taiwanese English teacher, who has near-native proficiency. The EG comprised 40 students—21 in EG1 and 19 in EG2—while the CG consisted of 34 students—16 in CG1 and 18 in CG2. The gender distribution was balanced, with 20 males and 20 females in the EG and 16 males and 18 females in the CG. All participants were native Mandarin Chinese speakers aged 9 to 10. Pre-tests of target vocabulary, procedural knowledge, and cultural knowledge related to three hands-on topics (Chinese Dumpling Making, Bird's Nest Building, and Designing a Pot of Succulents) were administered to these four classes. Independent-samples t-tests on their pre-test scores showed no statistically significant differences (all $p > 0.05$), with t-values ranging from -1.807 to 1.647 and corresponding p-values ranging from 0.075 to 0.885. These results indicate that the EG and CG demonstrated comparable abilities in target vocabulary, procedural knowledge, and cultural knowledge related to the three topics before the interventions.

Research interventions

Intervention baseline

As detailed in Fig. 1, the interventions were conducted in English within the first 9-week period of the CLIL Social Studies curriculum, with each week consisting of
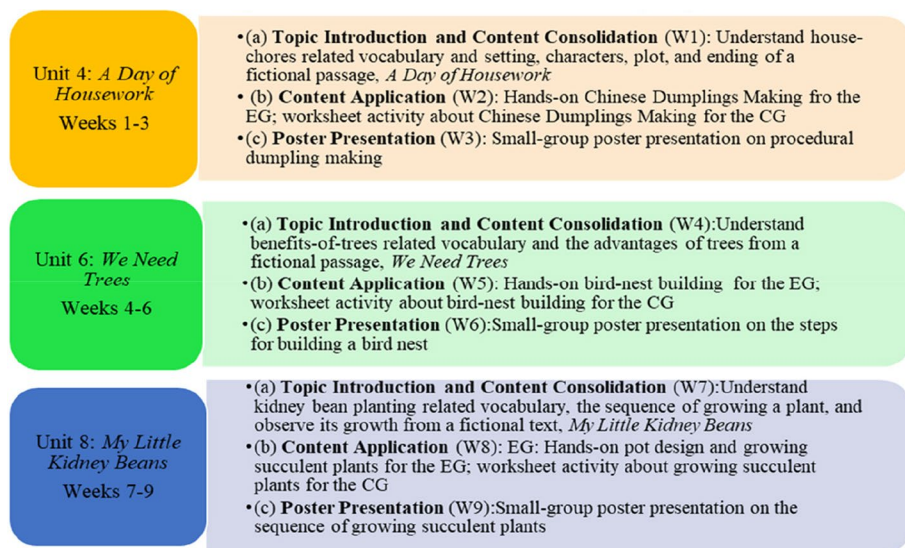
Fig. 1 The intervention procedure

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 8 of 27

3 periods of 40 min each. The instructor followed a three-stage instruction approach across three units:

(1) Topic Introduction and Content Consolidation (Weeks 1, 4, and 7): Both groups were introduced to three topics and reinforced reading skills through reading comprehension, summarizing, and filling in blanks of target vocabulary.
(2) Content Application (Weeks 2, 5, and 8): The EG engaged in hands-on activities related to the topics (Chinese Dumpling Making, Bird's Nest Building, and Succulent Pot Designing), while the CG received traditional lecture- and worksheet-based instruction on target vocabulary and procedural content related to the hands-on activities.
(3) Language Production (Weeks 3, 6, and 9): Both groups participated in small-group multimodal poster presentation tasks, creating posters detailing hands-on topic procedures and providing self-reported reflections on their learning experiences.

Hands-on topic intervention: bird's nest building

Take the second hands-on topic, Bird's Nest Building, as an example, the instructor began the session by engaging students with inquiries about typical bird nesting habitats, showcasing various examples, and illustrating related concepts through a video presentation accessible to both the EG and CG groups. This instructional approach aligns with multimodal task design principles advocated in CLIL contexts (Lin, 2019), aimed at deepening student engagement and comprehension. Subsequently, the instructor introduced key vocabulary terms such as "twigs," "branches," "straws," "bend," and "loop" using physical demonstrations coupled with verbal reinforcement in English, reflecting embodied learning principles that integrate sensory and motor experiences with language acquisition (Barsalou, 2008; Holst, 2013). Both EG and CG students received equivalent instructional scaffolding to develop target vocabulary and procedural knowledge, involving necessary language support and gradual reduction of teacher assistance to foster student autonomy and understanding (Mahan, 2023).

Following this introduction, EG students actively participated in constructing their own bird nests at nearby parks (EG1) or on campus meadows (EG2), as depicted in Fig. 2, reflecting promising hands-on learning approaches shown to enhance language development within CLIL settings (Chao et al., 2013; Nikula, 2015). Throughout the activity, the instructor physically demonstrated each step while verbally reinforcing the target vocabulary and procedural content, facilitating the integration of multimodal task

Fig. 2 The EG's hands-on learning on building a bird nest (Permission obtained to use these pictures)

design with experiential learning to deepen student engagement and oral communicative competence (Coyle, 2007; Lin, 2016). To conclude the activity, students symbolically placed bird eggs in their crafted nests, fostering a meaningful connection to real wildlife nests and enhancing overall engagement and experiential learning outcomes (Abrams, 2016; Svensson, 2020).

In contrast, the CG group participated in worksheet activities, where instructors reinforced target vocabulary and procedural knowledge through teacher-led discussions and interactive games. During these sessions, the instructor utilized worksheets as a primary instructional tool, guiding students through exercises aimed at consolidating vocabulary and procedural understanding. The discussions facilitated by the teacher encouraged students to engage with the material through verbal exchanges, clarifications, and interactive activities. Games were employed to reinforce learning outcomes and promote active participation among students in the CG group.

After completing the Bird's Nest Building hands-on activity for the EG and worksheet activities for the CG, students transitioned to the language production stage in the third week, aligning with CLIL and multimodal task design principles (Brinton & Snow, 2017; Dalton-Puffer, 2007; Lin, 2019). During this stage, students were divided into 3–4 small groups and allocated 1.5 periods to collaboratively create posters in English illustrating the sequential steps of constructing a bird's nest using graphical and textual representations—a practice advocated in CLIL pedagogy (Grapin, 2019; Yaman Ntelioglou et al., 2014). Subsequently, both EG and CG students engaged in collaborative oral poster presentations in English lasting 3–5 min, utilizing their posters as visual aids to verbally explain the sequential procedures for the hands-on topics, demonstrating their oral communicative competence and subject mastery. Prior to the group poster presentations, students from both groups rehearsed their explanations twice to enhance their delivery and comprehension of the content. At the conclusion of the poster presentations, students completed a written test in English assessing cultural or cross-cultural understanding related to the hands-on topics. Additionally, students provided self-reports in the same small groups of poster designs and presentations on their respective learning experiences. Figure 3 presents the EG1's poster designs and presentations.

Comparison of interventions for the EG and CG

The instructional approach for both the EG and CG initially involved introducing the same hands-on topics to prepare students for subsequent activities. Both groups received equivalent time for intervention, with each activity lasting approximately

Fig. 3 Small-group poster designs and presentations on Bird's Nest Building (Permission obtained to use these pictures)

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 10 of 27

40–50 min. However, the key divergence occurred during the core learning activities: the EG participated in hands-on experiences, emphasizing practical application and experiential learning. In contrast, the CG received worksheet-based instruction supplemented by instructor-led discussions to reinforce vocabulary and procedural knowledge theoretically. Following these activities, both groups engaged in collaborative poster presentations conducted in English, requiring them to articulate their learning outcomes. This approach allowed for a comprehensive comparison of the interventions, as summarized in Table 1.

Instruments and analysis

To assess the English oral communicative competence of both the EG and CG participants, this study applied Coyle's (2007) framework encompassing Content, Communication, Cognition, and Culture, utilizing multiple methods. Content, Communication, and Cognition were assessed through students' oral poster presentations using customized rubrics designed for each dimension. The assessment of Culture was conducted via written pre- and post-tests measuring cultural knowledge related to the hands-on topics. This approach acknowledges the diverse semiotic modes emphasized in CLIL learning, which leverage visuals and multimodal pedagogies to enhance language acquisition and cultural understanding (Evnitskaya & Jakonen, 2017; Forey & Polias, 2017). Additionally, students from both groups provided self-reported reflections on their learning experiences. Finally, video recordings were employed to document hands-on activities for the EG and worksheet-based activities for the CG, enriching the analysis by capturing instructional methods and student engagement within the CLIL framework.

Content, communication, and cognition assessment through oral poster presentations

A pivotal aspect of this study involved assessing Content, Communication, and Cognition through small-group collaborative oral poster presentations. The EG participants ($n = 40$) were organized into seven groups (EG1:3; EG2:4), comprising 5–7 students per group. Similarly, the CG participants ($n = 34$) were divided into six groups (CG1:3;

Table 1 Comparison of Learning Activities between the EG and CG

Aspect	EG	CG
Baseline Instruction	Introduced to topics with questions and videos	Introduced to topics with questions and videos
Learning Activities	Engaged in hands-on activities (e.g., Bird's Nest Building, Chinese Dumpling Making)	Participated in worksheet-based instruction and discussions on the same topics
Duration of Interventions	40–50 min per activity	40–50 min per activity
Instructional Emphasis	Practical application and experiential learning	Comprehension and vocabulary reinforcement
Instructor's Role	Physically demonstrated steps and reinforced vocabulary	Led discussions and games for reinforcement
Goals of Activities	Deepen engagement and enhance oral communicative competence	Reinforce vocabulary and procedural knowledge theoretically
Conclusion of Activities	Symbolic placement of bird egg in Crafted nests	Completion of worksheet-based Exercises
Poster Presentations	Collaborative creation and oral presentations in English	Collaborative creation and oral presentations in English

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 11 of 27

CG2:3), with 5–6 students per group. Rubrics for Content, Communication, and Cognition (see Appendix A) were meticulously developed and validated by two CLIL experts within the Taiwanese educational context. Content analysis focused on evaluating the comprehensiveness and depth of procedural explanations. Communication analysis considered various aspects such as target vocabulary usage, sentence structure, pronunciation accuracy, fluency, and complexity. Evaluating syntactic complexity aligns with the goal of assessing students' language production beyond basic vocabulary usage, encompassing grammatical structures and sentence variety crucial for expressive proficiency (Tedick & Wesley, 2015). Cognition analysis appraised participants' understanding of procedural steps and critical thinking abilities. Clear descriptors and criteria were established for each proficiency level (1–5).

The recorded presentations underwent transcription for speech analysis, enabling a quantitative post-intervention comparison between hands-on and non-hands-on teaching approaches. The same two experts applied the rubrics for coding, and inter-rater reliability was assessed using Cohen's Kappa coefficient. In the EG, assessments for Chinese Dumpling Making demonstrated perfect agreement in Content, Communication (target vocabulary usage, sentence length, pronunciation accuracy), and Cognition. Substantial agreement was observed for other Communication dimensions. Succulent Pot Designing exhibited near-perfect agreement across dimensions. Similarly, in the CG, substantial to perfect agreement was observed in various dimensions across the three hands-on activities.

Independent-samples *t*-tests, conducted using SPSS Statistics, version 25, were performed to facilitate the between-group, post-intervention quantitative comparison of the results from two raters. The means, standard deviations (SD), *t*-scores, *p*-values, and effect size (Cohen's *d*) for each distinctive hands-on topic were reported.

Culture assessment through written pre- and post-tests

The written cultural knowledge pre- and post-tests in English (see Appendix B) were designed to evaluate students' understanding of cultural aspects related to the hands-on learning topics, covering cultural practices, traditions, and perspectives. Administered to both the EG and CG before and after their respective activities, these tests featured carefully crafted questions to assess students' familiarity with specific cultural elements associated with each hands-on activity. The design of these cultural tests aligns with the broader objectives of CLIL, emphasizing the development of cultural awareness and intercultural competencies essential for global citizenship and effective communication (Coyle, 2007). For example, the questions on making Chinese dumplings probed students' understanding of the origin of Chinese dumplings and their prevalence globally. Similarly, the test on building a bird nest elicited responses about diverse cultural attitudes towards nature and bird habitats. The succulent pot designing test covered topics related to the global distribution of succulent plants, their adaptations, and propagation methods. These assessments incorporated open-ended inquiries and true/false statements to measure students' cultural awareness and comprehension.

The pre- and post-tests, administered two weeks apart, were intentionally structured to ensure similarity in difficulty, featuring the same items with altered wording to assess consistency in students' knowledge acquisition and retention. The reliability of these tests was

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 12 of 27

confirmed through high Cronbach's alpha coefficients ($\alpha = 0.88$ for pre-tests and $\alpha = 0.87$ for post-tests), indicating strong internal consistency and robustness in assessing cultural knowledge. Paired-samples t-tests were utilized to evaluate changes within each instructional approach, assessing cultural knowledge acquisition within both groups. Independent-samples t-tests were performed to compare the degree of improvement between hands-on and non-hands-on teaching for each relevant hands-on topic. The analyses involved reporting means, standard deviations (SD), *t*-scores, *p*-values, and effect size (Cohen's *d*) for each within-group and between-group comparison.

Self-reported reflections

After each intervention, both the EG and CG groups engaged in small-group self-reflected reflections on their respective learning experiences, guided by high-level prompts designed to encourage in-depth reflections and foster cognitive engagement (Neuman & Danielson, 2020), as presented in Appendix C. The EG prompts focused on sharing post-hands-on learning experiences, while the CG prompts emphasized reflections on worksheet learning experiences. Participants were organized into seven groups for the EG ($n = 40$) and six groups for the CG ($n = 34$), which corresponded to their poster presentation groups. Prompts included questions such as whether they found building a bird nest challenging, what aspects of the activity they enjoyed the most, and whether they felt they gained knowledge about constructing a bird nest after the hands-on learning. For the CG, comprising 4–5 students per group, prompts centered on their experience of learning how to build a bird nest through worksheets, discussions, and games, and whether they felt they acquired knowledge about bird nest construction after the worksheet activity.

In terms of data analysis, the video recordings of these reflections underwent qualitative analysis using the interpretative phenomenological analysis (IPA) approach (Charlick et al., 2015). The process involved transcribing and familiarizing with video content, initial coding to identify meaningful units, theme development, interpretation and analysis, and validation and triangulation. Findings were narratively presented, supported by quotes and excerpts.

Video recordings for the EG's and CG's interventions

Both groups' interventions were video recorded to capture the hands-on tasks for the EG and worksheet-based activities for the CG. Three individuals equipped with phones or cameras stayed with the EG, capturing instructional approaches and teacher-student interactions during each hands-on session in nearby parks or school meadows. Similarly, video recordings were conducted during worksheet-based instructional sessions for the CG, with cameras strategically placed in classrooms to document traditional worksheet-based learning. These video recordings underwent qualitative analysis using the interpretative phenomenological analysis (IPA) approach to extract key insights into instructional approaches and language patterns.

Results

Effects on content, communication, and cognition gains (RQ1)

Table 2 presents the results of independent-samples *t*-tests comparing gains in content, communication, and cognition between the EG and the CG for each hands-on topic. The

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 13 of 27

Table 2 Comparison on content, communication, cognition gains

Independent-samples *t*-tests (EG vs CG)							
Content, Communication, Cognition Gains	Mean		SD		*t*	*p*	Effect Size (Cohen's *d*)
EG = 40, CG = 34	EG	CG	EG	CG			
Chinese Dumpling Making							
Content	4.14	3.08	.663	.793	3.712	.001*	1.46
Communication- target vocabulary usage	4.43	4.17	.938	.577	.839	.409	0.33
Communication- sentence length	4.14	4.00	.864	.000	.571	.573	0.22
Communication- sentence complexity	3.64	2.58	.497	.515	5.329	.000*	2.10
Communication- pronunciation accuracy	4.21	2.33	.579	.492	8.838	.000*	3.48
Communication- presentation fluency	3.50	1.83	.760	.389	6.855	.000*	2.70
Cognition	3.43	2.08	.514	.289	8.036	.000*	3.17
Bird's Nest Building							
Content	4.79	3.33	.426	.492	8.069	.000*	3.19
Communication- target vocabulary usage	4.57	2.83	.514	.718	7.177	.000*	2.82
Communication- sentence length	4.79	2.67	.426	.985	7.312	.000*	2.88
Communication- sentence complexity	3.57	1.58	.514	.515	9.828	.000*	3.87
Communication- pronunciation accuracy	4.00	3.17	.000	.389	8.038	.000*	3.15
Communication- presentation fluency	3.93	1.17	.267	.389	21.350	.000*	8.40
Cognition	4.21	1.92	.426	.669	10.609	.000*	4.16
Succulent Pot Designing							
Content	4.57	3.33	.514	.492	6.245	.000*	2.64
Communication- target vocabulary usage	4.71	2.67	.469	.985	6.934	.000*	2.72
Communication- sentence length	4.71	2.67	.469	.985	6.934	.000*	2.72
Communication- sentence complexity	3.00	1.83	.000	.389	11.254	.000*	4.44
Communication- pronunciation accuracy	3.79	2.67	.426	.778	4.639	.000*	1.83
Communication- presentation fluency	3.57	2.25	.756	.754	4.449	.000*	1.75
Cognition	3.36	1.92	.745	.669	5.150	.000*	2.02

Significance of $p < .05$ is indicated by an asterisk (*)

assessments of content, communication, and cognition were conducted using rubrics with a 1–5 scale to evaluate students' performance across various dimensions of oral communicative competence. For Content gains in Chinese Dumpling Making, the EG demonstrated significantly higher gains compared to the CG ($t = 3.712$, $p < 0.05$, Cohen's $d = 1.46$), suggesting that hands-on activities in the EG led to more detailed and comprehensive understanding of the procedures the hands-on topic. In terms of Communication gains, the EG outperformed in sentence complexity, pronunciation accuracy, and presentation fluency ($t = 5.329$–8.838, $p < 0.05$, Cohen's $d = 2.10$-3.48) but not in target vocabulary usage and sentence length. Regarding Cognition gains, the EG showed significantly higher scores compared to the CG ($t = 8.036$, $p < 0.05$, Cohen's $d = 3.17$), implying that the hands-on activities facilitated a deeper comprehension of procedural steps and improved critical thinking abilities among the EG participants.

In Bird's Nest Building, the EG surpassed the CG in Content and Communication gains significantly across all sub-dimensions ($p < 0.05$, Cohen's $d = 2.82$-8.40). The EG exhibited notable superiority in presentation fluency ($t = 21.350$, $p < 0.05$, Cohen's $d = 8.40$). For Cognition gains, the EG again outperformed the CG ($t = 10.609$, $p < 0.05$, Cohen's $d = 4.16$), indicating a deeper understanding and enhanced critical thinking

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 14 of 27

Table 3 Within-group pre-test and post-test results for cultural knowledge acquisition

Paired-samples *t*-tests	Mean		SD		*t*	*p*	Effect Size (Cohen's *d*)
Experimental Group (N = 40)	Pre-test	Post-test	Pre-test	Post-test			
Chinese Dumpling Making (i = 2)	.53	1.80	.506	.405	-12.599	.000*	-1.99
Bird's Nest Building (i = 2)	.73	1.70	.751	.464	-8.408	.000*	-1.33
Designing a Pot of Succulents(i = 6)	2.55	4.73	1.358	1.261	-8.778	.000*	-1.39
Control Group (N = 34)							
Chinese Dumpling Making (i = 2)	.44	1.12	.504	.640	-5.766	.000*	-0.99
Bird's Nest Building (i = 2)	.68	1.06	.475	.600	-3.419	.002*	-0.59
Designing a Pot of Succulents(i = 6)	2.26	3.09	1.442	1.357	-2.719	.010	-0.47

Significance of *p* < 0.05 is indicated by an asterisk (*)

Table 4 Between-group post-test comparisons for cultural knowledge acquisition

Independent-samples *t*-tests (EG vs CG)	Mean		SD		*t*	*p*	Effect Size (Cohen's *d*)
	EG	CG	EG	CG			
Chinese Dumpling Making (i = 2)	1.80	1.12	.405	.640	5.560	.000*	1.29
Bird's Nest Building (i = 2)	1.70	1.06	.464	.600	5.179	.000*	1.21
Designing a Pot of Succulents(i = 6)	4.73	3.09	1.261	1.357	5.375	.000*	1.26

Significance of *p* < 0.05 is indicated by an asterisk (*). i = number of test items

abilities. Similar trends were observed in Succulent Pot Designing, where the EG demonstrated superior gains in Content and Communication, particularly in vocabulary usage, sentence length, and complexity ($p < 0.05$, Cohen's $d = 1.75$-4.44). Noteworthy differences were observed in sentence complexity ($t = 11.254$, $p < 0.05$, Cohen's $d = 4.44$). The EG also exhibited significantly higher Cognition gains compared to the CG ($t = 5.150$, $p < 0.05$, Cohen's $d = 2.02$), suggesting a more profound understanding of procedural steps and improved critical thinking.

Effects on cultural knowledge acquisition (RQ2)

Table 3 presents within-group pre-test and post-test outcomes for cultural knowledge acquisition, employing paired-samples *t*-tests to evaluate the impact of hands-on and non-hands-on teaching approaches on three distinct hands-on topics. In the EG ($n = 40$), significant enhancements were observed in Chinese Dumpling Making ($t = -12.599$, $p < 0.005$, Cohen's $d = -1.99$), Bird's Nest Building ($t = -8.408$, $p < 0.005$, Cohen's $d = -1.33$), and Designing a Pot of Succulents ($t = -8.778$, $p < 0.005$, Cohen's $d = -1.39$). The CG ($n = 34$) demonstrated substantial gains in Chinese Dumpling Making ($t = -5.766$, $p < 0.005$, Cohen's $d = -0.99$) and Bird's Nest Building ($t = -3.419$, $p < 0.005$, Cohen's $d = -0.59$). However, Designing a Pot of Succulents did not reach statistical significance ($t = -2.719$, $p > 0.005$). The findings suggest that hands-on activities in the EG significantly improved cultural knowledge across all three topics, while the CG exhibited substantial gains in two out of three topics.

Table 4 displays between-group post-test comparisons for cultural knowledge acquisition, utilizing independent-samples t-tests to evaluate the differences between

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 15 of 27

the EG and CG. In Chinese Dumpling Making, the EG exhibited significantly higher cultural knowledge (M = 1.80, SD = 0.405) compared to the CG (M = 1.12, SD = 0.640), with a significant t-value of 5.560 ($p < 0.005$) and a moderate effect size of Cohen's d = 1.29. Similarly, in Bird's Nest Building, the EG demonstrated superior cultural knowledge (M = 1.70, SD = 0.464) compared to the CG (M = 1.06, SD = 0.600), yielding a significant t-value of 5.179 ($p < 0.005$) with a moderate effect size of Cohen's d = 1.21. In Designing a Pot of Succulents, the EG surpassed the CG in cultural knowledge (M = 4.73, SD = 1.261 vs. M = 3.09, SD = 1.357), with a significant t-value of 5.375 ($p < 0.005$) and a moderate effect size of Cohen's d = 1.26.

Comparing reflections on post-intervention learning experiences (RQ3)

Chinese dumpling making

Based on the EG group reflections, the hands-on experience of crafting Chinese dumplings emerged universally enjoyable, fostering a positive learning encounter. This practical approach was embraced for its experiential nature, amplifying content comprehension and enjoyment. Notably, distinct preferences surfaced among groups; while some emphasized the dumpling-making process, others found delight in making different shapes of dumplings or consuming the final product. In contrast, the CG reflections indicated that worksheet-based instruction on the hands-on topics was generally perceived as uncomplicated. Their existing familiarity with dumpling-making likely bolstered their confidence in task completion. Moreover, the CG students' extracurricular attempts at dumpling-making potentially heightened their engagement and understanding. Excerpts from student reflections are presented in Table 5.

Bird's nest building

EG reflections collectively highlighted that bird nest construction posed challenges for several students, particularly in intricate steps like loop-making and nest-building. Individual experiences varied, with some finding the activity both enjoyable and creatively engaging. Notably, many students displayed increased confidence in independent bird nest construction post hands-on activity, indicating positive learning outcomes. In contrast, CG reflections reveal divergent perceptions among the three groups regarding bird nest building. While certain students found it challenging, others did not articulate specific hurdles clearly. Pertinent excerpts from student reflections are provided in Table 6.

Table 5 Students excerpts on Chinese Dumpling Making activities

EG	CG
EG1, Group 2: "*Two of us think it was **difficult** to make dumplings because **the fillings come out**. We **enjoyed making the dumpling** and…**making dumplings fillings the most**.*"	CG1, Group 3: "*One of us.. making dumplings **at home**. He enjoyed eating most.*"
EG2, Group 4: "*We **like making dumplings**! It was **hard to fold them nicely first**.., but we can do better. We **enjoyed making the dumpling with different shapes the most**.*"	CG2: Group 3: "*Three of us. think to learning.. making.. dumplings in class are **not difficult**.*"

The italicized and bolded expressions contribute to the results

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 16 of 27

Table 6 Students excerpts on Bird's Nest Building activities

EG	CG
<u>EG1</u>, Group 1: "Three *of us think..It.*. **difficult** *to build a bird nest and they think* **making..making the loop** *is the most difficult.*"	<u>CG1</u>, Group 2: "*Two.. of.. us.. think… it… was* **difficult**.*. to build… a …bird.. nest because… they…. Think they don't..know how..to. make..the nest.*"
<u>EG2</u>, Group 3: "*Two of us say it* **hard**.*. to build a bird nest.* **The most difficult was making the..nest**. **We try many time…s to get them right**"	<u>CG2</u>, Group 3: "*Two….of us think..it was* **difficult** *to..make..nest because they don't.. do it before.*"

Note: The italicized and bolded expressions resonate the findings

Succulent pot designing

EG reflections collectively revealed that students acquired knowledge about succulents, encompassing diverse types and straightforward care prerequisites. Additionally, they displayed self-assuredness in planting and embellishing succulents. Similarly, CG students demonstrated confidence in comprehending succulent care, particularly concerning watering practices. Some CG students noted ease in planting succulents due to worksheet activities, while a minority found it challenging. Pertinent excerpts from student reflections are provided below.

<u>EG1</u>, Group 4*:*

"*Student 1: There are* **10,000 types of…succulents** *in the world.* **Succulents grow in deserts and dry place**."
"*Student 2: Succulents are* **easy to take care**. *Grow succulents* **doesn't require a lot of efforts and watering.**"
"*Student 3: Four people think it was* **not difficult** *to decorate succulent because it was easy to them.*"

<u>CG1</u>, Group 3*:*

"*Student 1: Succu…lents…* **are easy.. to care for**."
"*Student 2: Succ..ulents* **doesn't ..need.. lots. of ..water.**"
"*Student 3:* **No…of us**…….*think .. it.. was..* **difficult**… *to… plant…a succulent.*"
"*Student 4: All..of.. us …think it was… not difficult.. to plant.. suc…cul..ents.*"

Insights from video recordings of both groups' interventions

Hands-on learning for the EG

Observations from video recordings revealed that hands-on tasks in the EG offered personalized, experiential learning opportunities that encouraged self-exploration and autonomy among students. For instance, during the Chinese Dumpling Making activity, students actively engaged in preparing and shaping dumplings according to their preferences and abilities, promoting hands-on engagement and skill development. The instructional structures observed in the videotaped sessions for the EG were characterized by a highly structured format, featuring clear guidelines and step-by-step instructions to support students throughout the activity. Conversely, the Bird's Nest Building activity initially appeared less structured but evolved into a more organized approach

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 17 of 27

as most students encountered challenges in nest construction, demonstrating a flexible blend of structured and unstructured elements tailored to student needs and progression. Similarly, the instructional structure for Succulent Pot Designing fell between these extremes, appearing straightforward and accessible to students while still providing sufficient guidance for effective participation and learning.

During the interventions, analysis of student language usage in the EG, as observed from the videotapes, revealed a tendency to use general English rather than employing specific target vocabulary. Students frequently relied on basic language structures and common vocabulary during hands-on activities, as illustrated by the excerpts below:

> EG1, Student 5: "*Can I cut the vegetable like this?*" [Chinese Dumpling Making].
> EG2, Student 13: "*This is hard to fold.*" [Chinese Dumpling Making].
> EG1, Student 9: "*Can I make my own shape?*" [Bird's Nest Building].
> EG2, Student 17: "*Can you give me rubber bands?*" [Bird's Nest Building].
> EG1, Student 6: "*I think this needs more water.*" [Succulent Pot Designing].
> EG2, Student 11: "*This rocks make them very beautiful*" [Succulent Pot Designing].

Worksheet instructions for the CG

The video recordings of the CG highlighted a teacher-led, group-oriented approach to worksheet activities and games. In contrast to the EG's hands-on tasks that encouraged individual exploration, CG activities emphasized teacher guidance and individual rotations for answering questions and completing worksheets. This instructional format was designed to scaffold learning experiences and provide students with structured opportunities to engage with subject content and language skills. Similarly, students in the CG also employed general English expressions and simple language patterns during worksheet-based tasks and teacher-led activities, as evidenced by the excerpts below.

> CG1, Student 6: "*I don't do it before.*" [Chinese Dumpling Making].
> CG2, Student 10: "*Can you help me?*" [Chinese Dumpling Making].
> CG1, Student 1: "*Me! Teacher, I know!*" [Bird's Nest Building].
> CG2, Student 15: "*I saw it in my grandpa's house.*" [Bird's Nest Building].
> CG1, Student 7: "*I like it very much.*" [Succulent Pot Designing].
> CG2, Student 11: "*My home has it.*" [Succulent Pot Designing].

Discussion

The study investigated the impact of hands-on activities versus worksheet-based learning on fourth-grade students' English oral communicative competence, focusing specifically on Content gains assessed through oral presentations. Results consistently demonstrated that the EG surpassed the CG in Content gains across all hands-on topics, showing significantly higher procedural understanding after engaging in hands-on learning (Cohen's *d* range:1.46–3.19). These findings highlight the effectiveness of hands-on learning in promoting deeper procedural understanding, potentially attributed to the instructor physically demonstrating each step while verbally reinforcing the procedural content. This approach aligns with the theory of embodied cognition (Barsalou, 2008; Holst, 2013), which emphasizes the interaction between physical actions and cognitive

processes, facilitating deeper comprehension and engagement with subject matter (Fu & Franz, 2014).By incorporating embodied learning strategies and multimodal task design, educators can create enriched learning experiences that foster deeper understanding and engagement with subject matter. The study highlights the potential of multimodal task design and embodied learning strategies to enhance language acquisition and content knowledge within CLIL settings, supporting the use of hands-on activities as effective pedagogical approaches.

The comparison of Communication outcomes between the EG and CG demonstrated that the EG consistently exhibited superior language complexity, pronunciation accuracy of the target vocabulary, and presentation fluency (Cohen's *d* range: 1.75–8.40) during their poster presentations. Notably, while target vocabulary use and sentence length were not significantly different in Chinese Dumpling making, the EG showed significant improvements in other aspects of Communication. The EG's enhanced performance can be attributed to several factors. Firstly, the instructor in the EG physically demonstrated each procedural step while reinforcing the target vocabulary and procedural content verbally. This approach integrated multimodal task design with experiential learning, fostering deeper student engagement and enhancing oral communicative competence (Coyle, 2007; Lin, 2016). By combining physical demonstrations with verbal reinforcement, the EG students received a comprehensive learning experience that strengthened their ability to use the target vocabulary effectively in context. In contrast, the CG received worksheet-based instruction supplemented by instructor-led discussions to reinforce vocabulary and procedural knowledge theoretically. While these activities aimed to support learning, they lacked the immersive and experiential elements that hands-on activities provide, potentially limiting the depth of language engagement and communication skills development. The results align with previous research, highlighting the multifaceted impact of CLIL on strengths in oral communication (Lialikhova, 2021; Niteo Moreno de Diexmas, 2016; Pérez Cañado & Lancaster, 2017; Tedick & Wesley, 2015;)), enhancing communicative competence (Galaviz & Peralta, 2019; Nikula, 2015), and fostering language knowledge acquisition (Yaman Ntelioglou et al., 2014).

The study's analysis of Cognition gains highlighted that the EG consistently outperformed the CG across all hands-on activities (Cohen's *d* range: 2.02–4.16) during their poster presentations. This superior performance can be attributed to several inherent factors in the hands-on learning approach. Firstly, hands-on activities engage students in active learning experiences where they directly interact with materials and concepts. This active engagement fosters a deeper understanding of procedural steps and concepts, requiring students to apply critical thinking and analytical skills to solve problems and complete tasks effectively. Secondly, the integration of multimodal task design, including physical demonstrations and verbal reinforcement of procedural content, plays a pivotal role in facilitating cognitive engagement. By combining physical actions with verbal explanations, hands-on activities stimulate multiple sensory modalities, enhancing comprehension and memory retention. Thirdly, hands-on activities align with the principles of embodied learning, where physical actions are intertwined with cognitive processes. This approach emphasizes the interplay between physical experiences and mental processes, fostering deeper comprehension and analytical thinking (Barsalou, 2008; Holst, 2013). Fourthly, engaging in hands-on tasks requires students to navigate challenges,

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 19 of 27

make decisions, and problem-solve in real-time. This active problem-solving process stimulates cognitive processes associated with critical thinking, analysis, and synthesis of information.

During the poster presentations, the EG students were required to synthesize their learning and present their understanding coherently. This task not only reinforced their procedural knowledge but also demanded higher-order thinking skills, such as organization, synthesis, and articulation of ideas. The transformative impact of hands-on methodologies propels learners beyond mere retention and comprehension. Consequently, the study posits that the successful implementation of hands-on activities heightened the depth and insight of students' higher-level cognitive processing as outlined in Bloom's revised taxonomy (Krathwohl, 2002). In contrast, worksheet-based instruction and teacher-led discussions may have assisted students like those in the CG in remembering and understanding procedural knowledge, while hands-on learning empowered EG students to move further to apply, analyze, and evaluate concepts (see Fig. 4). This fusion of cognitive development with language learning resonates with the core principles of CLIL pedagogy, emphasizing the dual emphasis on content and language to cultivate comprehensive language and cognitive mastery (Coyle, 2002; Coyle, Hood, & Marsh, 2010; Marsh, 2006).

The study investigated and compared the cultural knowledge acquired by students related to the three hands-on topics implemented in the EG and CG. The analysis yielded significant results, with Cohen's d effect size ranging from 0.843 to 0.898. This indicates that the EG demonstrated notably higher levels of cultural knowledge acquisition compared to the CG across the selected hands-on activities. The observed differences in cultural knowledge between the EG and CG highlight the effectiveness of hands-on learning approaches in enhancing students' understanding of cultural aspects associated with each topic. The EG's engagement in experiential, culturally immersive activities likely facilitated a more comprehensive grasp of cultural practices, traditions, and perspectives compared to the CG's worksheet-based approach. These outcomes resonate with previous research indicating that multimodal CLIL approaches can effectively enhance both content understanding and language skills through culturally enriched, immersive learning experiences (Galaviz & Peralta, 2019; Yaman Ntelioglou et al., 2014),
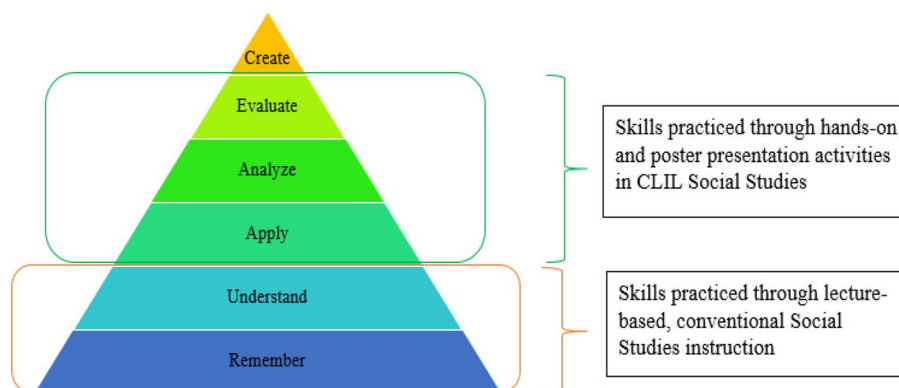
Fig. 4 Cognitive processing levels practiced between hands-on learning and worksheet-based instruction in the study (Krathwohl, 2002)

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 20 of 27

thereby promoting broader intercultural competencies essential for global citizenship. These findings also display the importance of incorporating hands-on activities to promote cultural awareness and intercultural competencies within educational contexts.

The study employed a triangulation approach by integrating self-reported reflections and video analysis with quantitative data to provide a comprehensive understanding of instructional methods and student experiences within CLIL settings. Self-reported reflections from students within the EG revealed the profound benefits of hands-on activities in facilitating enjoyable and enriching learning experiences. For instance, students expressed universal enjoyment and increased content comprehension during the experiential Chinese Dumpling Making activity, which aligned with previous research emphasizing the engaging nature of multimodal methodologies (Lin, 2019). Similarly, students engaging in Bird's Nest Building within the EG encountered challenges that promoted autonomy and problem-solving skills, ultimately contributing to heightened confidence in independent task execution. These self-reported experiences were complemented by video analysis of both groups' interventions, revealing intriguing insights into language use and instructional engagement. Despite the significant autonomy and engagement observed in the EG, students tended to utilize general English rather than target vocabulary, similar to patterns observed in the control group (CG). This finding suggests a nuanced relationship between hands-on activities and language use, warranting further investigation into the effectiveness of multimodal task design in CLIL settings (Lin, 2019).

The comparison between the EG and CG highlighted distinct instructional methods and student experiences. EG students engaged in hands-on tasks such as Chinese Dumpling Making and Bird's Nest Building, benefiting from immersive and individualized learning opportunities that fostered self-exploration and autonomy (Lin, 2019). These experiences were characterized by the utilization of basic language structures and common vocabulary to communicate actions and needs, reflecting the action-oriented nature of hands-on learning (Nikula, 2015). In contrast, the CG predominantly relied on worksheet-based tasks and teacher-led activities, emphasizing a more teacher-centered, group-oriented approach. Students in the CG often exhibited simple language patterns, seeking teacher guidance and using general expressions for communication (Lin, 2019), illustrating distinct differences in instructional structures and language utilization between the two groups.

Conclusions

This research delves deeply into the influence of hands-on methodologies within the CLIL framework, specifically evaluating English oral communicative competence across key dimensions: Content, Communication, Cognition, and Culture. The outcomes highlight the substantial enhancement achieved through hands-on activities, fostering comprehensive procedural explanations, refined communication skills, and heightened critical thinking abilities. The study contributes to bridging gaps in research on multimodal task design within CLIL contexts, an area that remains underdeveloped (Grapin, 2019; Roth, Conradty, & Bogner, 2023). The incorporation of hands-on activities proves

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 21 of 27

instrumental in achieving the 4Cs, providing valuable insights for educators and curriculum designers in similar contexts.

Pedagogical implications and suggestions

The findings offer several pedagogical implications and suggestions:

(1) Striking a balance between hands-on activities and traditional instructional methods can lead to optimal learning outcomes in a CLIL setting.
(2) Integrating hands-on experiences allows students to apply knowledge in practical contexts, while structured instruction ensures comprehensive content coverage and supports learners who may require additional assistance.
(3) The choice between hands-on activities and worksheet-based instruction should align with specific learning objectives, student preferences, and available resources.
(4) A well-designed CLIL curriculum can leverage both approaches to create a dynamic and effective learning environment that fosters students' cultural knowledge acquisition and language development.

Limitations

The study's limitations include the potential influence of videotaped qualitative analysis on participants' behavior during hands-on activities, potentially altering the natural dynamics of the learning environment and restricting the depth of analysis by missing subtle facial expressions or non-verbal cues. Additionally, human raters assessing oral communicative competence can exhibit subjective biases, emphasizing the need for more objective tools. Lastly, the assessment framework based on Coyle's dimensions may not fully capture the complexity of students' language abilities, highlighting the importance of long-term follow-up studies to evaluate the sustainability of observed improvements.

Future directions

The observed commonalities and disparities between the EG and CG in the study highlight the need for further exploration into multimodal task design and embodied learning strategies within CLIL contexts. Continued research could integrate various semiotic modes and physical engagement into educational tasks to explore their impacts on language acquisition and oral communicative competence. Moreover, comparing the language learning effectiveness of using oral and written modes as a task design approach as suggested by Grapin and Llosa (2022) can yield more comprehensive insights into the impact of multimodal approaches on language acquisition. Lastly, understanding teacher perspectives on incorporating hands-on activities in CLIL instruction can also offer valuable insights into implementation challenges and effective instructional strategies.

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 22 of 27

Appendix A: Rubrics for Evaluating Poster Presentations on Hands-on Topics

	Unsatisfactory (1)	Almost Satisfactory (2)	Satisfactory (3)	Good (4)	Excellent (5)
Content	Most/all of the procedural steps described in the oral report are inconsistent with procedural knowledge taught	One of the procedural steps described in the oral report is inconsistent with procedural knowledge taught	All of the procedural steps described in the oral report are consistent with procedural knowledge taught but some descriptions are incomplete	-All of the procedural steps in the oral report are consistent with procedural knowledge taught and in the right order -The procedural steps are provided with brief descriptions	-All of the procedural steps in the oral report are consistent with procedural knowledge taught and in the right order -The report on the procedural knowledge of target hands-on topic is well elaborated with detailed descriptions
Communication	No use of target vocabulary	20% of target vocabulary is used	40% of target vocabulary is used	60% of target vocabulary is used	80% or more of target vocabulary is used
	The average sentence length is more than 5 words	The average sentence length is more than 7 words	The average sentence length is more than 9 words	The average sentence length is more than 11 words	The average sentence length is more than 13 words
	Primarily uses simple sentences with limited variation in sentence structure	Utilizes a mix of simple and compound sentences, though with occasional errors	Effectively employs simple, compound, and occasional complex sentences	Exhibits a wide range of sentence structures, including complex and compound-complex sentences	Consistently employs sophisticated and a variety of complex sentence structures to enhance communication
	- Frequent and significant pronunciation errors - Difficult to understand due to inconsistent or incorrect pronunciation -Pronunciation greatly affects the overall comprehensibility of the oral report	-Pronunciation errors occur regularly but do not hinder overall understanding -Some sounds, stress patterns, or intonation may be mispronounced -Pronunciation occasionally affects the clarity of the oral report	-Generally clear and understandable pronunciation - Pronunciation errors are infrequent and minor - Most sounds, stress patterns, and intonation are accurate	-Clear and accurate pronunciation with few errors - Sounds, stress patterns, and intonation are mostly correct - Pronunciation enhances the overall clarity and coherence of the oral report	-Near-native or native-like pronunciation -Pronunciation is highly accurate and natural - Correct sounds, stress patterns, and intonation contribute to a polished and professional presentation

	Unsatisfactory (1)	Almost Satisfactory (2)	Satisfactory (3)	Good (4)	Excellent (5)
	-Oral report on the procedural steps is fragmented and lacks coherence -Frequent pauses and hesitations disrupt the flow of ideas -Difficulty maintaining a steady pace of speech	-Oral report on the procedural steps is somewhat coherent but may lack smooth transitions between ideas -Occasional pauses and hesitations, though not overly disruptive -Some effort to maintain a consistent pace of speech	- Oral report on the procedural steps is generally coherent with reasonable transitions between ideas -Few pauses and hesitations that do not significantly impede understanding -Maintains a fairly consistent pace of speech	- Oral report on the procedural steps is coherent and well-organized, with effective transitions between ideas -Minimal pauses and hesitations that do not hinder overall understanding -Maintains a consistent and natural pace of speech	-Oral report on the procedural steps is highly fluent and effortlessly coherent -Smooth transitions between ideas enhance the flow of the presentation -Consistently maintains a natural and appropriate pace of speech
Cognition	- Demonstrates minimal understanding of the procedural steps - Lacks critical thinking skills and fails to analyze or evaluate information	- Shows a partial understanding of the procedural steps - Attempts basic analysis and evaluation of information but with limited depth or insight	- Demonstrates a solid understanding of the procedural steps - Engages in some analysis and evaluation of information, though it may lack complexity	- Displays a thorough understanding of the procedural steps - Engages in critical thinking, analysis, and evaluation of information, demonstrating depth and insight	- Exhibits an exceptional understanding of the procedural steps - Engages in advanced critical thinking, analysis, and evaluation of information, showcasing originality and sophistication

Appendix B: Cultural Knowledge Pre-tests

Topic #	Cultural Knowledge Test Questions
Topic 1: Making Chinese Dumplings (Weeks 1–3)	1. Do you know where Chinese dumplings come from? 2. Do you know if other countries also have dumplings? If yes, where are they?
Topic 2: Building a Bird Nest (Weeks 4–6)	Write True (T) or False (F) on the line next to each sentence 1._____ Birds would lay their eggs in bushes, tall trees, on the ground, rocks, or even on people's buildings 2._____ Different cultures have different thoughts about trees. In some cultures, trees are considered very sacred
Topic 3: Pot Designing Succulent Plants (Weeks 7–9)	Write True (T) or False (F) on the line next to each sentence 1._____ Taiwan has the greatest variety of succulents in the world 2._____ There are more than 10,000 types of succulents in the world 3._____ Succulents mostly grow in deserts 4._____ Succulents have thick, fleshy stems, or leaves to take in and store a lot of water when it rains 5._____ Some succulents have thorns to store water for themselves 6._____ We can grow a new succulent plant from its leaves

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 24 of 27

Appendix C: Prompts for Self-Reported Reflections on Building a Bird's Nest

Topic #	Group	Prompts
Topic 2: Building a Bird Nest (Weeks 4–6)	EG	Work in a group of 5–6 people and answer the questions below. Q1: Do you think it was difficult to build a bird nest? If yes, what did you think was the most? (Any step? Working alone? Working with others? Doing something creative?)
		Q2: Did you enjoy the hands-on experience? If yes, what did you enjoy the most? (Any step? Working alone? Working with others? Doing something creative? Exploring new ways to make dumplings?) If no, what did you NOT enjoy?
		Q3: After the hands-on learning, do you think you know more about how to build a bird nest? If yes, how? If no, why not?
	CG	Work in a group of 4–5 people and answer the questions below. Q1: Do you think it is going to be difficult to build a bird nest? If yes, what do you think would be the most difficult part? (Any step? Working alone? Working with others? Doing something creative?)
		Q2: Do you think you would enjoy building a bird nest? If yes, what would you enjoy the most? (Any step? Working alone? Working with others? Doing something creative? Exploring new ways to make dumplings? If no, what would you NOT enjoy?
		Q3: After the worksheet activity, do you think you know more about how to build a bird nest? If yes, how? If no, why not?

Declarations

References

Abrams, Z. (2016). Possibilities and challenges of learning German in a multimodal environment: A case study. *ReCALL*, *28*(3), 343–363. https://doi.org/10.1017/S0958344016000082

Aguirre-Muñoz, Z., Sankaranarayanan, A., Pando, M., & Pantoya, M. (2018). *Engineering make science beder Miss.": Developing ELLs' engineering literacy with focused specialized language interactions*. New York, NY: Paper presented at the Annual Meeting of the American Education Research Association.

Alkan, F. (2016). Experiential learning: Its effects on achievement and scientific process skills. *Journal of Turkish Science Education, 13*(2), 15–26.

Alonso, E., Grisaleña, J., & Campo, A. (2008). Plurilingual education in secondary schools: Analysis of results. *International CLIL Research Journal, 1*(1), 36–49.

Barsalou, L. W. (2008). Grounded cognition. *Annual Review of Psychology, 59*, 617–645. https://doi.org/10.1146/annurev.psych.59.103006.093639

Lai *Asian. J. Second. Foreign. Lang. Educ. (2024) 9:64*

Page 25 of 27

Bayram, D., Öztürk, R. Ö., & Atay, D. (2019). Reading comprehension and vocabulary size of CLIL and non-CLIL students: A comparative study. *Language Teaching and Educational Research (LATER), 2*(2), 101–113. https://doi.org/10.35207/later.639337

Beilock, S. (2015). *How the body knows its mind: The surprising power of the physical environment to influence how you think and feel.* Atria Books.

Best, J. W., & Kahn, J. V. (2006). *Research in education.* Pearson Education, Inc.

Bezemer, J., & Kress, G. (2008). Writing in multimodal texts: A social-semiotic account of designs for learning. *Written Communication, 25*(2), 166–195. https://doi.org/10.1177/0741088307313177

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (1999). *How people learn: Brain, mind, experience, and school.* National Academy Press

Brooks, N., & Goldin-Meadow, S. (2016). Moving to learn: How guiding the hands can set the stage for learning. *Cognitive Science, 40*(7), 1831–1849.

Brinton, D. M., & Snow, M. A. (2017). *The evolving architecture of content-based instruction. The content-based classroom* (2nd ed). University of Michigan

Cambridge Assessment International Education. (2017). *Bilingual learners and bilingual education.* https://www.cambridgeinternational.org/Images/271190-bilingual-learners-and-bilingual-education.pdf

Chao, K. J., Huang, H. W., Fang, W. C., & Chen, N. S. (2013). Embodied play to learn: Exploring Kinect-facilitated memory performance. *British Journal of Educational Technology, 44*(5), E151–E155. https://doi.org/10.1111/bjet.12018

Charlick, S. J., McKellar, L., Fielder, A., & Pincombe, J. (2015). Interpretative phenomenological analysis: Implementing research to influence breastfeeding education. *International Journal of Childbirth Education, 30*(2), 49–54. https://www.proquest.com/scholarly-journals/interpretative-phenomenological-analysis/docview/1677665921/se-2

Chen, F., Kao, S.-M., & Tsou, W. (2020). Toward ELF-informed bilingual education in Taiwan: Addressing incongruity between policy and practice. *English Teaching & Learning, 44*, 175–191. https://doi.org/10.1007/s42321-020-00055-1

Coyle, D. (2002). Against all odds: Lessons from content and integrated learning in English secondary schools. In D. W. C. So & G. M. Jones (Eds.), *Education and society in plurilingual contexts* (pp. 37–55). Brussels University Press.

Coyle, D. (2007). Content and language integrated learning: Towards a connected research agenda for CLIL pedagogies. *International Journal of Bilingual Education and Bilingualism, 10*(5), 543–562. https://doi.org/10.2167/beb459.0

Coyle, D., Hood, P., & Marsh, D. (2010). *CLIL: Content and Language Integrated Learning.* Cambridge University Press

Coyle, D., Meyer, O. (2021). *Beyond CLIL: Pluriliteracies teaching for deeper learning.* Cambridge University Press

Curriculum and Instruction Resources Network. (2018). 十二年國民基本教育課程綱要綜合型高級中等學校–社會領域. *[Twelve-Year Mandatory Education Curriculum Syllabus for Secondary Schools – The Social Studies Discipline]*. https://cirn.moe.edu.tw/WebContent/index.aspx?sid=11&mid=6889

Dalton-Puffer, C. (2007). *Discourse in CLIL Classrooms.* John Benjamins

Dalton-Puffer, C. (2008). Outcomes and processes in Content and Language Integrated Learning (CLIL): Current research from Europe. In W. Delanoy & L. Volkmann (Eds.), *Future Perspectives for English Language Teaching* (pp. 139–157). Carl Winter.

Dalton-Puffer, C. (2011). Content-and-language integrated learning: From practice to principles? *Annual Review of Applied Linguistics, 31*, 182–204.

Dallinger, S., Jonkmann, K., Hollm, J., & Fiege, C. (2016). The effect of content and language integrated learning on students' English and history competences – Killing two birds with one stone? *Learning and Instruction, 41*, 23–31. https://doi.org/10.1016/j.learninstruc.2015.09.003

Dessie, E., Gebeyehu, D., & Eshetu, F. (2023). Enhancing critical thinking, metacognition, and conceptual understanding in introductory physics: The impact of direct and experiential instructional models. *EURASIA Journal of Mathematics, Science and Technology Education, 19*(7), em2287. https://doi.org/10.29333/ejmste/1327

Eurydice. (2006). *Content and Language Integrated Learning (CLIL) at School in Europe.* European Commission

Evnitskaya, N., & Jakonen, T. (2017). Multimodal conversation analysis in CLIL class-room practices. In A. Llinares & T. Morton (Eds.), *Applied linguistics perspectives on CLIL* (pp. 201–220). John Benjamins Publishing Company.

Ferrer, A., & Lin, T. B. (2024). Official bilingualism in a multilingual nation: A study of the 2030 bilingual nation policy in Taiwan. *Journal of Multilingual and Multicultural Development, 45*(2), 551–563. https://doi.org/10.1080/01434632.2021.1909054

Forey, G., & Polias, J. (2017). Multi-semiotic resources providing maximal input inteaching science through English. In A. Llinares & T. Morton (Eds.), *Applied linguistics perspectives on CLIL* (pp. 145–166). John Benjamins Publishing Company.

Fu, Y., & Franz, E. A. (2014). Viewer perspective in the mirroring of actions. *Experimental Brain Research, 232*(11), 3665–3674.

Galaviz, S., & Peralta, C. (2019). Inquiry-Based Science in a Fifth-Grade Multilingual Classroom: The Zero Waste Day Project. *The Reading Teacher, 73*(2), 247–255. https://doi.org/10.1002/trtr.1851

Garcia, M. L. (2007). Design and evaluation of physical protection systems. Elsevier

Gilabert, R., Manchón, R. M., & Vasylets, O. (2016). Mode in Theoretical and Empirical TBLT Research: Advancing Research Agendas. *Annual Review of Applied Linguistics, 36*, 117–135. https://doi.org/10.1017/s0267190515000112

Grapin, S. (2019). Multimodality in the New Content Standards Era: Implications for English Learners. *TESOL Quarterly, 53*(1), 30–55. https://doi.org/10.1002/tesq.443

Grapin, S. E., & Llosa, L. (2022). Multimodal Tasks to Assess English Learners and Their Peers in Science. *Educational Assessment, 27*(1), 46–70. https://doi.org/10.1080/10627197.2022.2028139

Hampel, R., & Hauck, M. (2006). Computer-mediated language learning: Making meaning in multimodal virtual learning spaces. *JALT CALL Journal, 2*(2), 3–18. http://oro.open.ac.uk/5418/2/HampelHauck.pdf

Holst, J. (2013). Re-educating the body. *Educational Philosophy and Theory, 45*, 963–972.

Horn, J., & Wilburn, D. (2005). The embodiment of learning. *Educational Philosophy and Theory, 37*(5), 745–760. https://doi.org/10.1111/j.1469-5812.2005.00154.x

Huang, Y.-C. (2020). The effects of elementary students' science learning in CLIL, English Language Teaching, *13*(2). https://doi.org/10.5539/elt.v13n2p1

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 26 of 27

Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using mixed-methods sequential explanatory design: From theory to practice. *Field Methods, 18*(1), 3–20. https://doi.org/10.1177/1525822X05282260

Jewitt, C. (2008). Multimodality and literacy in school classrooms. *Review of Research in Education, 32*(1), 241–267. https://doi.org/10.3102/0091732x07310586

Johnson-Glenberg, M. C., Birchfield, D. A., Tolentino, L., & Koziupa, T. (2014). Collaborative embodied learning in mixed reality motion-capture environments: Two science studies. *Journal of Educational Psychology, 106*(1), 86–104.

Kress, G. (2000). A curriculum for the future. *Cambridge Journal of Education, 30*(1), 133–145. https://doi.org/10.1080/03057640050005825

Kress, G. R., & Leeuwen, T. V. (2001). *Multimodal discourse: The modes and media of contemporary communication*. Hodder Education

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory into Practice*, 41(4), 212–218

Levy, A. R., & Moore Mensah, F. (2020). Learning through the experience of water in elementary school science. Water, *13*(1), 43. https://doi.org/10.3390/w13010043

Lialikhova, D. (2021). The impact of a short-term CLIL intervention project on Norwegian different ability ninth graders' oral development. *International Journal of Bilingual Education and Bilingualism, 24*(5), 671–692. https://doi.org/10.1080/13670050.2018.1509055

Liaw, W., Wei, H. Y., Lin, I. K. Huang, M. T., & Hung, Y. C. (2018). *Exploring CLIL: A resource book*.National Cheng Kung University

Lin, A.M.Y. (2016). Programming for Integration of Content and Language Learning. In: *Language Across the Curriculum & CLIL in English as an Additional Language (EAL) Contexts*. Springer, Singapore. https://doi.org/10.1007/978-981-10-1802-2_7

Lin, A. M. Y. (2019). Theories of trans/languaging and trans-semiotizing: Implications for content-based education classrooms. *International Journal of Bilingual Education and Bilingualism, 22*(1), 5–16. https://doi.org/10.1080/13670050.2018.1515175

Liu, J. E., & Lin, A. M. Y. (2021). (Re)conceptualizing "Language" in CLIL: Multimodality, translanguaging, and trans-semiotizing in CLIL. *AILA Review, 34*(2), 240–261. https://doi.org/10.1075/aila.21002.liu

Lyster, R., & Ballinger, S. (2011). Content-based language teaching: Convergent concerns across divergent contexts. *Language Teaching Research, 15*(3), 279–288.

Mahan, K. R. (2023). Instructional scaffolding in CLIL: An overview of theory and research. In *The Routledge Handbook of Content and Language Integrated Learning* (1st ed., pp. 15). Routledge

Marsh, D. (2000). *Using Languages to Learn and Learning to Use Languages*. University of Jyväskylä

Marsh, D. (2006). *English as a medium of instruction in the new global linguistic order: Global characteristics, local consequences*. University of Jyväskylä

Marsh, D., Maljers, A., & Hartiala, A. K. (2001). *Profiling European CLIL Classrooms: Languages Open Doors*. European Platform for Dutch Education

Mavilidi, M. F., Okely, A. D., Chandler, P., et al. (2015). Effects of Integrated Physical Exercises and Gestures on Preschool Children's Foreign Language Vocabulary Learning. *Educational Psychology Review, 27*, 413–426. https://doi.org/10.1007/s10648-015-9337-z

Mayer, R. E. (2004). Should there be a three-strikes rule against pure discovery learning? The case for guided methods of instruction. *American Psychologist, 59*, 14–19.

Miller, D. K. G. (2014). *The effect of inquiry-based, hands-on labs on achievement in middle school science*. Liberty University. ProQuest Dissertations Publishing. (Accession No. 3630936)

Ministry of Education. (2018). Implement in full scale bilingual ideation of Taiwan educational system; cultivate bilingual talents to bring Taiwan to the world. https://english.moe.gov.tw/cp-117-21632-46F55-1.html

Murillo, F. J., Martínez-Garrido, C., & Hidalgo Farran, N. (2014). The Impact of the Evaluation Methodology of the Primary Education Teachers on the Performance of the Student in Spain. *Estudios Sobre Educación, 27*, 91–113. https://doi.org/10.15581/004.27.91-113

Moreno, N., & de Diezmas, E. (2016). The impact of CLIL on the acquisition of the learning to learn competence in secondary school education in the bilingual programmes of Castilla-La Mancha. *Porta Linguarum, 25*, 21–34.

Nikula, T. (2015). Hands-on tasks in CLIL science classrooms as sites for subject-specific language use and learning. *System, 54*, 14–27. https://doi.org/10.1016/j.system.2015.04.003

Nunan, D. (2004). *Task-based language teaching*. Cambridge University Press.

Neuman, S. B., & Danielson, K. (2020). Enacting Content-rich Curriculum in Early Childhood: The Role of Teacher Knowledge and Pedagogy. *Early Education and Development*, 1–16. https://doi.org/10.1080/10409289.2020.1753463

Paran, A. (2013). Content and language integrated learning: Panacea or policy borrowing myth? *Applied Linguistics Review, 4*(2), 317–342.

Pérez Cañado, M. L. (2011). The effects of CLIL within the APPP: Lessons learned and ways forward. In R. Crespo & M. García de Sola (Eds.), *ESP teaching and methodology: English studies in honour of Ángeles Linde López* (pp. 389–406). Universidad de Granada.

Perez-Canado, M. L. (2012). CLIL research in Europe: Past, present and future. *International Journal of Bilingual Education and Bilingualism, 15*(3), 315–341. https://doi.org/10.1080/13670050.2011.630064

Pérez Cañado, M. L., & Lancaster, N. K. (2017). The effects of CLIL on oral comprehension and production: A longitudinal case study. *Language, Culture and Curriculum, 30*(3), 300–316. https://doi.org/10.1080/07908318.2017.1338717

Roth, T., Conradty, C., & Bogner, F. X. (2023). The relevance of school self-concept and creativity for CLIL outreach learning. *Studies in Educational Evaluation, 76*, 101175. https://doi.org/10.1016/j.stueduc.2022.101175

Ruiter, M., Loyens, S., & Paas, F. (2015). Watch your step children! Learning two-digit numbers through mirror-based observation of self-initiated body movements. *Educational Psychology Review, 27*(3), 457–474. https://doi.org/10.1007/s10648-015-9324-4

Svensson, H. (2020). *The usage of CLIL in the classroom and its influence on L2 learners' motivation* (Doctoral dissertation, Malmö University). Retrieved from https://urn.kb.se/resolve?urn=urn:nbn:se:mau:diva-32611

Lai *Asian. J. Second. Foreign. Lang. Educ.* (2024) 9:64

Page 27 of 27

Sheu, F. R., Lee, Y. L., Yang, S. J., & Chen, N. S. (2015). User-centered design of interactive gesture-based fitness video game for elderly. In G. Chen, V. Kumar, Kinshuk, R. Huang & S. C. Kong (Eds.), *Emerging Issues in Smart Learning* (pp. 393–397). Springer. https://doi.org/10.1007/978-3-662-44188-6_54

Skulmowski, A., & Rey, G. D. (2018). Embodied learning: Introducing a taxonomy based on bodily engagement and task integration. *Cognitive Research: Principles and Implications, 3*(1), 6. 1–10. https://doi.org/10.1186/s41235-018-0092-9

Stein, P. (2004). Representation, rights, and resources: Multimodal Pedagogies in the language and literacy classroom. In B. Norton & K. Toohey (Eds.), *Critical Pedagogies and Language Learning* (pp. 95–115). Cambridge University Press.

Stivers, T., & Sidnell, J. (2005). Introduction: Multimodal interaction. *Semiotica, 156*(1/4), 1–20.

Tedick, D. J., & Wesely, P. M. (2015). A review of research on content-based foreign/second language education in US K-12 contexts. *Language, Culture and Curriculum, 28*(1), 25–40.

The Language Training and Testing Center. (2021). *CLIL的關鍵詞有哪些?* [What Are the Keywords in CLIL?]. https://lttc-li.tw/clil101_002/

Wilson, M. (2003). Six views of embodied cognition. *PSychonomic Bulletin and Review, 9*(4), 625–636.

Wu, Y. A., & Lin, A. (2019). Translanguaging and trans-semiotising in a CLIL biology class in Hong Kong: Whole-body sense-making in the flow of knowledge co-making. *Classroom Discourse, 10*(3–4), 252–273. https://doi.org/10.1080/19463014.2019.1629322

Yaman Ntelioglou, B., Fannin, J., Montanera, M., & Cummins, J. (2014). A multilingual and multimodal approach to literacy teaching and learning in urban education: A collaborative inquiry project in an inner city elementary school. *Frontiers in Psychology, 5*, 533. https://doi.org/10.3389/fpsyg.2014.00533

Yang, W. H. (2015). Content and language integrated learning next in Asia: Evidence of learners' achievement in CLIL education from a Taiwan tertiary degree programme. *International Journal of Bilingual Education and Bilingualism, 18*(4), 1–22. https://doi.org/10.1080/13670050.2014.904840

Publisher's Note