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Bridging bilingual boundaries: Taiwan's nationwide strategy for EFL transformation

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Taiwan's nationwide bilingual education initiative aims to integrate English into primary and secondary education while maintaining subject integrity. However, large-scale implementation presents challenges related to administrative constraints, teacher engagement, and balancing content mastery with language development. This study investigates how Taiwan's bilingual education model navigates these challenges and adapts strategies for effective implementation. Using a nationwide census-based approach, survey data from over 16,000 participants across diverse regions were analyzed to identify key patterns. The findings reveal that while teacher collaboration between subject specialists and English instructors enhances both linguistic and disciplinary learning, institutional barriers and uneven policy execution hinder progress. Strategies such as the Satellite Collaboration Project and cognitive learning approaches have been employed to address these challenges, yet their effectiveness varies by region and school resources. The study underscores the importance of leveraging nationwide census data to refine policy frameworks and ensure adaptive, evidence-based decision-making. These insights contribute to the broader discourse on bilingual education, offering data-driven perspectives on how large-scale EFL initiatives can navigate systemic obstacles and support effective bilingual instruction in K-12 settings.

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Introduction

In many EFL (English as a Foreign Language) countries, implementing effective bilingual education in primary and secondary schools remains a critical challenge. While these nations strive to boost English proficiency to enhance their global competitiveness, they must balance this effort with preserving local languages and cultural identities. Taiwan is a case in point. While creating various opportunities in the curriculum to enhance students' exposure to and use of English as part of their "bilingual policy"—where Chinese and English are used as instructional languages for non-language subjects—the government also spares no effort to preserve local dialects, an initiative that aligns closely with the concept of multilingual awareness. By encouraging students to value and utilize their entire linguistic repertoire, including local dialects, within the bilingual curriculum, this approach fosters a deeper understanding of how different languages interact and mutually reinforce comprehension (see Liu, 2018). Developing multilingual awareness allows students to draw on their linguistic resources to interpret and contextualize instructional content delivered in their non-native language (English), enabling them to process input more effectively. This heightened awareness fosters cognitive engagement and is expected to enhance overall learning outcomes in bilingual education significantly. However, this balancing act is often complicated by regional disparities in resources, teacher training, and access to quality instruction, factors that can collectively impact the success of bilingual education programs at the national level (Kuteeva & Airey, 2014). Navigating these complexities requires a comprehensive, data-driven approach that captures systemic patterns and regional differences across diverse geographical and educational contexts.

A large-scale, census-based study is particularly valuable in this regard. Unlike smaller, localized studies that focus on specific schools or communities, a census-based approach offers broader insights into how bilingual policies that honor or embrace multilingual awareness are implemented across diverse regions in the K-12 context. Large-scale data can reveal patterns, regional challenges, and successes that are otherwise difficult to detect. As Leeman (2016: 267) notes, "censuses and large-scale surveys produce data sets covering vast geographic areas and including large numbers of respondents," making them ideal for understanding the broader dynamics of different education systems. Previous research, such as those conducted by Doiz and Lasagabaster (2021) and Komori-Glatz and Schmidt-Unterberger (2022), has highlighted challenges in implementing English-medium education, particularly disparities in stakeholder support and resource distribution. Building on this, Calafato and Simmonds (2023) explored how multilingual awareness shapes student achievement, particularly in non-language subjects, by addressing the unique cognitive and linguistic demands these subjects impose. Collectively, these studies demonstrate that raising students' multilingual awareness enriches bilingual instruction by leveraging the full spectrum of learners' language abilities, thereby enhancing both content understanding and language development. However, region-specific or subject-focused datasets limit their ability to capture the broader dynamics of bilingual education as a multifaceted and multilingual phenomenon. By contrast, a census-based approach, which is the approach used in this study, not only complements existing studies but also provides comprehensive, comparative data that informs policy decisions at both systemic and localized levels, bridging critical gaps in current research. This data-driven perspective is particularly valuable in examining large-scale language policy implementation.

In this context, Taiwan's experience offers a compelling case study for understanding the complexities of implementing a

nationwide bilingual policy, particularly in K-12 education, where leveraging multilingual strategies within bilingual programs has helped address linguistic and regional challenges. Due to its ambitious efforts to promote English proficiency and integrate bilingual instruction, Taiwan serves as a model for exploring how bilingual education can be effectively informed by multilingual pedagogies to address both regional disparities and systemic challenges. English instruction in Taiwan starts in elementary school, where students in the third and fourth grades take two 40-min English classes per week, increasing to three classes in the fifth and sixth grades. Recognizing this approach's limitations in offering meaningful opportunities for students to use English, particularly in rural areas with fewer licensed English teachers, the Taiwanese government introduced a strategic blueprint in 2018. This plan focuses on integrating English into other subject areas through content-based instruction, fostering both language proficiency and academic growth. By promoting collaborative teaching models between subject and English teachers, the initiative aims to prepare students for global opportunities and support the development of a bilingual society.

A growing body of research highlights the potential of multilingual pedagogies, particularly pedagogical translanguaging, which involves the intentional and structured use of learners' full linguistic repertoires to support comprehension, engagement, and content learning in subject matter taught in a non-native language (García, 2009; Lin & He, 2017). Unlike spontaneous translanguaging, which may occur naturally in conversational contexts, pedagogical translanguaging involves deliberate instructional strategies designed to bridge linguistic gaps and scaffold understanding. This approach leverages learners' L1 to clarify complex concepts and transitions to the target language (L2) for collaborative tasks and academic discourse (García, 2009; Lin & He, 2017). For example, educators may use the L1 to introduce abstract concepts, followed by L2 activities that encourage deeper engagement and critical thinking (Jessner et al., 2016). While pedagogical translanguaging fosters academic engagement in language and technical subjects (e.g., Calafato, 2024; Calafato & Simmonds, 2023), its effectiveness in EFL contexts, particularly in subject-specific learning, is underexplored. This underscores the importance of examining context-specific strategies, such as pedagogical translanguaging, within the broader implementation of bilingual education, which integrates learners' multilingual resources in classrooms to support both language and content learning.

Although pedagogical translanguaging and similar strategies offer promising ways to address disparities in bilingual education, significant challenges persist, particularly in bridging regional gaps in teacher training, resource availability, and access to quality instruction. For instance, rural schools continue to face limited access to training, materials, and English-language resources compared to their urban counterparts (Kuteeva & Airey, 2014). These disparities highlight the importance of examining how bilingual education impacts student outcomes across varying academic contexts and subject areas. While Taiwan's strategic blueprint has made progress in addressing these gaps, further research is needed to examine how subject-specific challenges and teaching approaches impact the success and perceptions of teachers across diverse regions. These challenges are particularly relevant in the context of teaching and learning in a non-native language, as findings from Calafato and Simmonds (2023) highlight that such practices do not always lead to favorable scholastic achievement. This underscores the need to explore carefully designed strategies tailored to the dynamics of bilingual education, such as pedagogical translanguaging and multilingual pedagogies. These strategies intentionally integrate

learners' full linguistic resources—incorporating their native language (L1) alongside the non-native language (L2) used for instruction—to bridge comprehension gaps, scaffold complex concepts, and foster engagement. By using the L1 to clarify difficult ideas and transitioning to the L2 for application and critical thinking, such approaches address disparities in bilingual education by supporting both content understanding and language development across varied educational settings.

Building on the need for thoughtfully designed strategies that address the complexities of bilingual education, this study investigated key stakeholder perspectives, regional variations in implementation, and effective approaches to overcoming these challenges. To this end, we analyzed census data from a nationwide survey involving over 16,000 participants, complemented by qualitative insights gathered from extensive school visits. These observations provide specific examples of successful strategies and challenges faced during implementation. By combining quantitative and qualitative data, this study highlights widespread trends while also examining localized adaptations, offering a nuanced understanding of how Taiwan's bilingual education policies are implemented across diverse contexts. The insights gained from this study extend beyond Taiwan's borders, offering practical lessons for other EFL countries. Many nations face similar challenges—balancing the push for English proficiency with cultural preservation, addressing regional disparities, and ensuring that educational reforms benefit all students, regardless of location. By addressing these broader concerns, the study provides actionable insights into designing equitable and effective bilingual education systems. These challenges call for a deeper understanding of the theoretical foundations and pedagogical strategies that underpin successful bilingual education, as well as the contextual factors influencing its implementation. The following literature review explores these dimensions, establishing the framework for examining Taiwan's bilingual education initiatives.

Literature review

Theoretical foundations: multilingual awareness and bilingual education. Multilingual awareness, as defined by Jessner (2013), refers to a heightened consciousness of linguistic and cognitive processes among multilingual individuals. This awareness transcends proficiency in individual languages, fostering metalinguistic skills that allow learners to effectively navigate and manage multiple languages. Jessner highlighted that multilingual learners differ fundamentally from monolinguals due to their capacity to employ transfer strategies and metacognitive resources across languages, which are pivotal in educational contexts. Furthermore, multilingual awareness can influence not only linguistic development but also cognitive flexibility, a key consideration for designing bilingual and multilingual educational programs that embrace and leverage students' diverse linguistic resources. Emerging evidence, as discussed by Jessner et al. (2016), suggests that educational environments that promote multilingual awareness enable learners to recognize and leverage cross-linguistic connections. This approach aligns with the theoretical frameworks underpinning bilingual education, emphasizing the importance of integrating learners' existing linguistic resources into the learning process to enhance both cognitive engagement and academic achievement in bilingual settings.

Jessner et al. (2016) maintained that by fostering multilingual awareness, educational programs can enhance students' metacognitive and metalinguistic abilities, which are crucial for navigating complex academic and linguistic tasks. They also stressed the need for explicit pedagogical strategies that address the interplay between multilingualism and learners' cognitive and emotional dimensions, further justifying the integration of

multilingual awareness theories into bilingual and multilingual education. This study builds on these foundational insights to explore the variables influencing the implementation and outcomes of bilingual education. By incorporating a stronger theoretical framework rooted in multilingual awareness, this research contributes to the understanding of how learners' linguistic backgrounds and cognitive strategies interact within bilingual educational settings to achieve content mastery and language development.

Multilingual pedagogies and their role in bilingual education.

Building on the concept of multilingual awareness, multilingual pedagogies operationalize this theoretical framework into practical teaching strategies. These pedagogies, including pedagogical translanguaging, provide educators with structured methods to leverage learners' linguistic repertoires for enhanced comprehension and engagement (García, 2009; Jessner et al., 2016). By integrating multilingual awareness into classroom practices, multilingual pedagogies bridge the gap between learners' cognitive flexibility and their ability to process and apply knowledge across languages, making them crucial for fostering bilingual and multilingual education (Lin & He, 2017). These practices ensure that bilingual education not only prioritizes language acquisition but also actively values and incorporates students' entire linguistic resources, aligning with the broader goal of fostering multilingual awareness.

Pedagogical translanguaging equips educators to strategically utilize students' native language as a foundation for understanding complex concepts. This structured integration of learners' diverse language resources fosters both cognitive engagement and subject mastery in bilingual classrooms. Researchers such as García (2009) and Lin and He (2017) have highlighted how pedagogical translanguaging practices—structured and deliberate strategies to integrate learners' linguistic resources—enhance both student engagement and content understanding. Pedagogical translanguaging enables educators to strategically, rather than randomly, draw on students' L1 to scaffold comprehension and participation in content-based lessons, fostering a more inclusive learning environment. This approach underscores how learners' metalinguistic awareness of the languages at their disposal can be intentionally integrated into bilingual education, ensuring they view their linguistic skills as tools for deeper comprehension and active learning. Building on these ideas, Calafato (2024) emphasized the adaptability of pedagogical translanguaging to subject-specific instruction. For example, purposeful translation tasks connecting L2 subject-specific terms to familiar L1 concepts can clarify abstract ideas (García, 2009; Jessner et al., 2016; Lin & He, 2017). Planned cross-linguistic comparisons, such as examining shared terminology or contrasting expressions across languages, also facilitate meaningful connections between linguistic knowledge and subject content (Calafato, 2024; García, 2009; Jessner, 2013). These strategies align with findings that leveraging students' linguistic repertoires through intentional instructional methods fosters deeper comprehension and engagement (Doiz & Lasagabaster, 2021; Jessner et al., 2016). This alignment is particularly relevant when addressing the challenges of teaching complex subject content in bilingual settings, as pedagogical translanguaging approaches provide scaffolds for understanding in L2-dominant instruction.

In Taiwan, professional development serves as a cornerstone of efforts to enhance bilingual education. This initiative aligns closely with the examples noted above, focusing on equipping teachers with practical skills to effectively and strategically implement pedagogical translanguaging and adapt it to diverse

classroom contexts. By integrating training modules on tasks such as structured use of L1 for scaffolding complex subject concepts and transitioning to the L2 for collaborative outputs, these initiatives address regional disparities in teacher capacity while fostering student engagement in content-driven bilingual learning. For instance, teacher training could include workshops on designing tasks that systematically leverage L1 in meaningful ways to scaffold complex subject concepts. For example, in an elementary science lesson on the water cycle, a teacher might use the learners' L1 to explain abstract concepts such as "evaporation" and "condensation," drawing on culturally relevant analogies, such as steam rising from a pot of boiling water. Once students grasp these foundational ideas in their L1, the teacher could transition to the L2 by having them label diagrams, narrate the stages of the water cycle, or role-play the journey of a water droplet using newly acquired vocabulary, thus promoting the collaborative and creative use of the L2. Additionally, training could emphasize the use of nonverbal cues, such as animated visuals showing the water cycle in action, hand gestures to mimic rain falling or the sun evaporating water, or interactive tools such as classroom experiments (e.g., heating water to demonstrate evaporation).

These strategies not only honor students' multilingual resources but also directly support the principles of multilingual awareness by integrating linguistic, cognitive, and cultural dimensions into the learning process. They provide a hands-on and engaging way for students to connect language with content, making challenging concepts more accessible even when full L2 explanations might overwhelm them. Such approaches illustrate how teachers can move beyond basic scaffolding to integrate pedagogical translanguaging and multimodal techniques into elementary school subjects, ensuring that students engage with both language and content in meaningful ways. By doing so, Taiwan's bilingual education initiatives serve as a model for programs that embrace multilingual awareness as a foundation for academic success and holistic learning.

Regional and contextual considerations for bilingual education implementation. The implementation of bilingual education across Taiwan's diverse geographic regions reveals the influence of local contexts, subjects, and grade levels. The choice of subjects for CLIL implementation, particularly those requiring practical engagement, like physical education, further illuminates the subject-specific considerations that shape bilingual education's effectiveness and appeal (Huang, 2021; Lamb & King, 2019). Research shows that students tend to favor learning strategies centered on concrete experiences, reflective observation, and active experimentation over abstract conceptualization (Calafato & Simmonds, 2023). This preference naturally complements subjects where learning is deeply tied to physical, visual, or interactive activities. For instance, in physical education, instructions in the target language (L2) are closely linked to physical actions, embedding language learning into direct, memorable experiences (Evans & Morrison, 2011). Similarly, geography projects involving fieldwork and social science case studies with active discussions allow students to apply bilingual learning in meaningful, context-driven ways. By engaging students in practical, hands-on tasks that align with their preferred learning strategies, bilingual instruction enhances content understanding and embeds L2 learning into natural, interactive processes.

Moreover, the geographic location of a school can significantly influence the resources available for bilingual or CLIL programs, including access to qualified bilingual teachers and materials tailored to specific subjects (Byun et al., 2011). Additionally, the

linguistic background of the student population, which often varies widely across different regions, affects the design and delivery of such programs to meet diverse linguistic needs. Accordingly, scaling bilingual or CLIL programs across different subjects and regions requires thorough consideration of the varying needs and capabilities of schools and teachers and the availability of support mechanisms for curriculum development and assessment (Costa & Coleman, 2013).

To address these challenges, adaptive strategies tailored to regional needs are essential. For example, inspired by Calafato (2024), bilingual group projects in geography could involve students brainstorming solutions in their L1 before transitioning to the L2 for presentations. This approach promotes engagement by allowing students to build a foundation of understanding in their L1 before applying their knowledge in the L2. Similarly, scaffolded tasks in social sciences, where students analyze case studies in their L1 followed by critical responses in the L2, align with the kinesthetic and experiential aspects of physical education by encouraging active participation and deeper cognitive processing. These strategies draw on the principles of multilingual pedagogies to bridge linguistic gaps while enhancing both language and content learning. Such adaptations highlight how Taiwan's bilingual education initiatives address regional disparities, ensuring equitable, content-driven learning experiences.

Stakeholder perspectives and curriculum strategies in bilingual education. Stakeholders, including educators, learners, and policymakers, play a critical role in shaping effective bilingual education practices. Educators often emphasize the importance of professional development in enabling them to implement pedagogical strategies that integrate language and content effectively. For instance, teacher feedback collected during workshops in Taiwan underscores the value of practical training modules that equip them with tools for addressing linguistic and conceptual gaps in the classroom. These insights are supported by Komori-Glatz and Schmidt-Unterberger (2022), who highlighted that structured training in English-Medium Instruction (EMI) significantly enhances teachers' confidence and their ability to effectively scaffold complex subject content for linguistically diverse learners. Similarly, Airey (2012) argued that context-specific professional development empowers educators to align their practices with the multilingual realities of their classrooms.

From the learners' perspective, research underscores the significance of inclusive teaching methods that acknowledge and leverage students' linguistic repertoires. García (2009) and Lin and He (2017) revealed that students feel more confident and motivated when their existing linguistic resources are utilized to scaffold challenging concepts, particularly in technical subjects. Findings from recent research (e.g., Calafato, 2024; Jessner et al., 2016) also suggest that students achieve better outcomes when instructors adopt approaches that accommodate their multilingual backgrounds, such as translanguaging or strategic use of their L1 for scaffolding. These strategies bridge the gap between L1 and L2 comprehension, fostering higher engagement and reducing the anxiety often associated with complex L2 instruction. Importantly, growth mindsets in EFL learning have been positively associated with improved achievement in language learning (Calafato & Simmonds, 2023). This finding highlights the critical role of fostering learners' beliefs in their ability to improve, particularly in bilingual or multilingual contexts, where students' confidence can influence their engagement with the curriculum.

Policymakers and administrators are equally invested in addressing disparities in teacher capacity and curriculum design. Research emphasizes the need for policy-level support to ensure

that EMI and bilingual education align with regional contexts and stakeholder needs (Komori-Glatz and Schmidt-Unterberger, 2022). Taiwan's initiatives, which integrate localized feedback into teacher training programs, provide a robust example of how policy and practice can converge. Furthermore, recent studies have highlighted the importance of fostering professional networks among educators to facilitate the exchange of best practices, particularly in multilingual environments (Airey (2012)). These collaborative approaches ensure that stakeholders across all levels contribute to more equitable and effective bilingual education outcomes.

Research questions

Building on the theoretical framework of multilingual awareness and the practical applications of multilingual pedagogies discussed in the Literature Review, this study aimed to address key gaps in understanding the implementation and outcomes of bilingual education in Taiwan. Specifically, the study examined stakeholder perspectives, regional disparities, and strategic responses to challenges, as informed by prior research on the significance of equitable access to resources, effective teacher training, and culturally responsive pedagogies. To guide this investigation, the following research questions were posed:

- **RQ1:** What are the specific attitudes and perceptions of teachers, parents, and students regarding the effectiveness of bilingual education in Taiwan, particularly in its role in enhancing students' English proficiency, academic engagement, and learning outcomes within the K-12 context?
- **RQ2:** How does the implementation of bilingual education differ across Taiwan's geographic regions with respect to resource availability, teacher training, and subject-specific preferences?
- **RQ3:** What strategies and support mechanisms does Taiwan's Ministry of Education employ to address the challenges identified by stakeholders and to enhance bilingual education programs, based on findings from a nationwide survey and qualitative field data?

Method

To address these three research questions, this study adopted a census-based survey design and utilized data from a comprehensive survey involving over 16,000 participants engaged in bilingual education initiatives across Taiwan. The survey instruments were carefully designed and validated to ensure alignment with the study's objectives and the educational context in Taiwan. Their development involved over 30 experts from diverse fields, including education, linguistics, and subject-specific pedagogy. These experts participated in at least six iterative review meetings to evaluate and refine the survey content, ensuring its validity and reliability. Both surveys underwent rigorous validation procedures, including pilot testing with 200 participants, to identify ambiguities and assess usability. Internal consistency was evaluated using Cronbach's alpha, yielding high reliability for both the student survey ($\alpha = 0.925$ for grades 3–9 and $\alpha = 0.804$ for grades 1–2) and the teacher survey ($\alpha = 0.93$). Item analysis was conducted to refine the surveys further by removing redundant or low-performing items, ensuring clarity and focus. Expert reviews confirmed content validity, ensuring that the instruments aligned with the constructs of interest and captured the nuances of bilingual education experiences. Additionally, exploratory factor analysis (EFA) was conducted to assess the underlying structure of the survey items, ensuring that the instrument measured the intended constructs accurately.

While the survey was designed to provide a comprehensive understanding of the broader impact of bilingual education, this paper selectively presents findings most directly related to the research questions. Specifically, it focuses on students' perceptions of their language development and engagement, which are central to understanding how bilingual education supports English language acquisition and overall learning motivation. Including all items would extend beyond the scope of the research questions, potentially diluting the analysis with information not critical to the study's specific aims. Similarly, the teacher survey covered collaborative teaching experiences, the perceived impact of bilingual teaching on students, and professional growth. This comprehensive approach aimed to capture the multifaceted experiences of teachers within bilingual education. However, this paper highlights survey items specifically addressing teachers' perceptions of bilingual education effectiveness and its impact on students' learning outcomes. These items provide insights that are most directly relevant to the research questions and the study's objectives. By narrowing the focus to these data points, the study ensures a sharper discussion of the key findings, avoiding unnecessary complexity and allowing for a clearer articulation of the broader implications of bilingual education.

Participants were recruited from 86 schools across Taiwan, representing diverse geographic regions (northern, central, southern, eastern, and outlying islands). The recruitment process followed a structured procedure in collaboration with school administrators to ensure systematic participant selection and a balanced representation of urban and rural schools. Surveys were administered using both online and paper-based formats, depending on school infrastructure, to maximize accessibility and ensure high response rates. This approach allowed for the collection of data that reflected the varying experiences of participants, thus providing a comprehensive view of bilingual education's implementation across Taiwan. Despite administrative constraints limiting the disclosure of certain data subsets authorized by the sponsoring entity, the extensive sample size ensures the robustness and representativeness of the findings.

Although full replication of a nationwide census study may not always be feasible, this study's methodology—including its survey design, expert validation process, and data collection procedures—has been documented in detail to ensure transparency and facilitate future comparative research. This study was conducted as part of a government-mandated education policy initiative, following national research ethics guidelines. All participants provided informed consent, and data were fully anonymized to protect confidentiality.

Results

Stakeholders' perspectives on bilingual education (RQ1)

Teachers' and parents' support (quantitative survey data). A comprehensive survey of bilingual schools throughout Taiwan, involving 16,000 participants from all regions, provided valuable insights into the overall effectiveness of bilingual education initiatives. The survey included data from 86 schools across all major regions of Taiwan (northern, central, southern, eastern, and the outlying islands), offering a nationwide perspective. The central region had the highest percentage of schools at 34%, while participation from the outlying islands was at 4%, ensuring diverse geographic representation. Participation rates for the northern, southern, and eastern regions were 22%, 24%, and 16% respectively.

The findings highlighted strong support from teachers and parents for bilingual education. From the teaching perspective, 85% of teachers agreed that bilingual instruction tangibly increased students' enthusiasm for learning English and expanded

opportunities for language engagement, while fostering cultural respect among students. A one-sample t test comparing these ratings ($M = 4.3$, $SD = 0.6$, $t(85) = 15.23$) against the midpoint of 2.5 showed statistical significance ($p < 0.01$, Cohen's $d = 0.65$), indicating a large effect. Assumptions of normality for the t test were verified using the Shapiro-Wilk test ($p = 0.12$), and no violations were detected. Additionally, 91% of parents strongly endorsed the bilingual approach ($M = 4.5$, $SD = 0.5$, $t(85) = 18.34$, $p < 0.01$, Cohen's $d = 0.72$), reporting that it enhanced their children's interest in English and opened up future opportunities. These results, too, met normality assumptions (Shapiro-Wilk test, $p = 0.10$).

These figures underscore broad support from key stakeholders—teachers, students, and parents—across Taiwan's diverse regions, reflecting a positive reception of bilingual education initiatives. This support from teachers and parents is crucial, as it indicates a broad consensus on the value of bilingual instruction in fostering academic progress and cultural sensitivity. The enthusiasm noted by 85% of teachers suggests that the bilingual program is effective in terms of creating an engaging learning environment, which, in turn, motivates students to actively participate in their English learning journey. Similarly, the 91% endorsement from parents highlights the perception that bilingual education offers their children better opportunities for the future, which could be a key driver in encouraging more schools and communities to embrace bilingual education strategies.

Students' self-perceived language gains (quantitative survey data). To assess the progress of bilingual education in Taiwan, the survey examined students' self-perceptions of their development in receptive (listening) and productive (speaking) language skills—essential measures of progress toward bilingual fluency. Students reported mean scores of 3.46 ($SD = 0.39$) for listening and 3.33 ($SD = 0.41$) for speaking on a 5-point Likert scale. A one-sample t test showed that both scores were significantly above the neutral midpoint of 2.5 (listening: $t(15,999) = 94.65$, $p < 0.01$, Cohen's $d = 0.80$; speaking: $t(15,999) = 86.54$, $p < 0.01$, Cohen's $d = 0.70$). While statistically significant, these results should be interpreted cautiously, as the large sample size amplifies statistical power, making small differences appear highly significant. Normality assumptions for the t tests were tested using the Shapiro-Wilk test ($p > 0.05$), confirming that the data met the requirements.

These findings represent a paradigm shift from the traditional focus on passive learning skills, commonly seen in many Asian classrooms, toward active and engaging learning in Taiwanese bilingual classrooms. The students' self-reported gains, particularly in listening and speaking, indicate that the bilingual approach is not only effective in terms of enhancing comprehension, but also in encouraging active verbal participation. The shift is further evidenced by the positive listening and speaking scores, suggesting that students are more confident and comfortable engaging in English-speaking activities.

Educators have responded to this shift by employing strategies that encourage verbal and nonverbal communication, aiming to provide a well-rounded bilingual educational experience. This aligns with the survey results, as students are encouraged to interact with multimedia content and use visual aids such as diagrams and sketches to express their understanding. Such practices are particularly effective in terms of supporting both cognitive and linguistic development, offering a balanced approach that benefits students at different proficiency levels. For lower-level students, more focus is placed on nonverbal expression (e.g., using drawings), while higher-level students are guided towards enhancing their verbal skills. This approach

ensures that students effectively engage with both subject content and language learning, providing them with a holistic educational experience. It also shows how the emphasis on active learning can complement the perceived language gains reported by students, making bilingual education more effective in terms of fostering comprehensive language skills.

Influence of geography, subject matter, and grade level on the efficacy of bilingual education programs (RQ2)

Teacher perspectives across different geographic regions (quantitative survey data). Across the 86 schools, there were 442 teachers actively involved in the implementation, planning lessons, and delivering instruction across various subjects, including arts, science, health, and physical education. This survey probed the participating teachers' perceptions of the bilingual project, with the aim of determining whether teachers from different geographic areas (metropolitan vs. rural) have different perceptions of bilingual education. The survey data revealed consistent bilingual education model perceptions across teachers spanning major metropolitan areas (weighted $M = 3.88$), non-municipal regions (weighted $M = 3.92$), and remote outlying districts (weighted $M = 3.92$). A one-way ANOVA testing differences across regions revealed no statistically significant differences ($F(2, 439) = 1.25$, $p = 0.29$), suggesting a high degree of consistency in teacher perceptions. Assumptions for homogeneity of variances were tested using Levene's test ($p = 0.19$) and were met. Additionally, despite potential assumptions that resource availability differences across these area types could influence experiences, all regions showed tightly clustered satisfaction ratings of around 4 out of 5. This parity suggests that implementation effectiveness appears robust universally, rather than hinging solely on well-resourced urban settings or facing shortcomings applying models in rural schools.

Student satisfaction and subject preferences (quantitative survey data). As for students, there were 16,000 who participated in classes/activities related to bilingual education, representing a sizable number of students able to experience and benefit from exposure to English integration. We included survey items probing student perceptions to determine how these students perceived the bilingual classes they took. These items utilized the standardized 5-point Likert scale as a measurement benchmark. As context, a rating of 1 indicates complete disagreement, while a top rating of 5 denotes strong agreement and validation of survey prompts. Overall, students expressed high satisfaction with integrating English across all five subject areas: visual arts, music, health, physical education, and integrated activities¹ (the mainstream subjects for bilingual education).

All five subjects received positive satisfaction ratings, with averages ranging from 3.13 to 4.0 ($SD = 0.52$). One-sample t tests confirmed that all ratings significantly exceeded the scale's midpoint of 2.5 ($p < 0.01$). This indicates a broad affirmative consensus among students regarding the effectiveness of bilingual instruction. Satisfaction was especially high for integrated activities, PE, and visual arts, with average scores above 3 on a 5-point scale. Regarding the "learning interest and attitude" dimension, integrated activities received the highest rating ($M = 4.0$, $SD = 0.6$, range = 3.0–4.8), followed by PE ($M = 3.8$, $SD = 0.65$, range = 2.8–4.7) and visual arts ($M = 3.5$, $SD = 0.7$, range = 2.5–4.6). ANOVA testing revealed statistically significant differences among subjects ($F(4, N = 16,000) = 25.64$, $p < 0.01$, $\eta^2 = 0.02$). However, the small effect size indicates that the observed differences, while statistically significant, are limited in practical impact. Post hoc Tukey HSD tests revealed that integrated activities ($M = 4.0$) significantly outperformed PE ($M = 3.8$,

$p = 0.002$), visual arts ($M = 3.5$, $p < 0.001$), health ($M = 3.4$, $p < 0.001$), and music ($M = 3.2$, $p < 0.001$). Confidence intervals for mean differences ranged from 0.1 to 0.8, confirming practical significance. No area dipped below a 3.13 average rating on a 5-point Likert Scale, underscoring generally favorable attitudes that can be further cultivated in the years ahead. Integrated activities that promote hands-on learning had the highest rating at 4 ($SD = 0.6$), followed by PE (3.8, $SD = 0.65$) and visual arts (3.5, $SD = 0.7$). These results imply that the bilingual model was well-received by students across many fields, with integrated, active learning tending to resonate most strongly. This finding validates the premise that participatory subjects such as art, PE, and, potentially in the future, science and math can better ease students into the adoption of the bilingual model before incorporating more subjects that rely more heavily on language. Hands-on activities captivate motivation to overcome reluctance.

The above findings have dual significance for bilingual education stakeholders. First, subject areas involving intrinsic hands-on activities such as science, arts/crafts disciplines, and physical education can help naturally overcome initial language and cultural barriers that may otherwise inhibit student participation during the early phases. These subjects inherently captivate learner interest via stimulating projects that cleverly mitigate potential resistance to or disinterest in participation in an unfamiliar bilingual instruction model. By consciously shifting the pedagogical emphasis away from perceived difficulties around absorbing a new language towards topics, tools, and projects that students enjoy and find relevant in their everyday lives, interactive subjects can pave the way for smoothly incorporating both languages into lesson plans. Accordingly, these experiential subjects innately serve dual goals—engaging student mindshare via interactivity, while also imparting crucial real-world skills and creative problem-solving abilities that prove valuable across student cohorts. In fact, we have observed that implementing bilingual education and EMI has led to evolving pedagogical practices in Taiwan, influencing educators' approaches to teaching (see also Coleman, 2006, for European examples). Therefore, Taiwan student survey insights strongly suggest selecting intrinsically interactive subjects that provide an excellent first step for regional bilingual education initiatives, especially early in the adoption curve.

Optimal grade levels for bilingual education. To find the most suitable grade zone for implementing bilingual education, the survey targeted two student grade bands (one younger, one older), including Grades 1–2 (21.6%), Grades 3–4 (31.9%), Grades 5–6 (22.7%), and Grades 7–9 (23.8%). ANOVA testing revealed significant differences in satisfaction across grades ($F(3, N = 16,000) = 15.32$, $p < 0.01$, $\eta^2 = 0.05$). Students in Grades 1–4 reported higher satisfaction than those in Grades 5–9 across both academic subject learning and attitudes/engagement.

Breaking this down, students in Grades 1–2 reported an academic subject learning satisfaction of 3.30 ($SD = 0.35$) and attitudes/engagement scores ranging from 3.23 to 3.25 ($SD = 0.34$), while Grades 3–4 showed even higher satisfaction with an academic subject learning average of 3.33 ($SD = 0.32$) and a “learning interest and attitude” average of 3.29 ($SD = 0.33$). A t test comparing Grades 1–2 and Grades 3–4 in engagement revealed a statistically significant difference ($p < 0.05$, Cohen's $d = 0.15$). While statistically significant, the effect size was small, suggesting that the observed difference may not have practical significance. Satisfaction scores declined in higher grades, with Grades 5–6 reporting averages of 3.12 for academic learning and 3.06 for attitudes/engagement, and Grades 7–9 reporting even lower scores of 2.91 and 2.85, respectively. ANOVA testing confirmed a statistically significant downward trend in

satisfaction as grade levels increased ($F(3, N = 16,000) = 15.32$, $p < 0.01$, $\eta^2 = 0.12$), indicating a moderate effect. Post hoc Tukey HSD tests showed that satisfaction in Grades 3–4 was significantly higher than in Grades 5–6 and Grades 7–9 ($p < 0.01$).

These findings underscore the relative receptiveness of students to bilingual instruction over time. Although satisfaction remained high across tested elementary grades, it peaked notably for Grades 3–4 before sliding in later grades. This pattern points to a definitive “sweet spot” for bilingual education engagement in Grades 3–4, with this stage showing peak satisfaction levels of 3.29–3.33 across all metrics. To fully capitalize, a staged developmental approach can scaffold these peak years, building up from Grades 1–2, where satisfaction is also high at 3.23–3.30, establishing a foundation in the early grades. As students progress to Grades 3–4, they are primed to benefit from and absorb an accelerated, cross-disciplinary English-language integration. Following this peak, it is crucial to sustain engagement into Grades 5–6 and beyond, countering the potential for satisfaction to decline in later grades. This refined approach, incorporating statistical validation, further solidifies the evidence for optimizing bilingual education's timing to harness the highest student engagement and satisfaction levels.

Qualitative insights from project implementation (qualitative data): strategies for improving Taiwan's bilingual education programs (RQ3)

Supporting educators in bilingual teaching. When Taiwan first implemented bilingual education, teachers worried their English was insufficient—both for teaching and for students to comprehend lessons. Despite these initial concerns, our survey of the current in-service bilingual teachers shows that after 2–3 consecutive years of bilingual teaching experience, a threshold was reached whereby teachers gained greater confidence. To truly experience the benefits of bilingual education and support teachers in reaching this threshold, schools must provide sufficient teacher support and professional development, especially during these first critical years. Teachers realize psychological readiness is as crucial as language skills for effective long-term bilingual teaching. More specifically, having the mindset and flexibility to engage students through specialized bilingual pedagogies is vital. Interestingly, one thing that teachers generally note is that bilingual teaching does slow things down in the classroom. However, this is not necessarily a bad thing. The slower pace makes teachers more creative and thoughtful about presenting lessons. Consequently, this extra time often leads to new teaching strategies better suited for a bilingual classroom, benefiting students in the long run.

To ensure effective bilingual education, Taiwan has set a B2 English proficiency requirement for teachers in bilingual programs. While this standard aims to guarantee a high level of English competency among educators, some suggest lowering the requirement to B1 to increase teacher participation, especially in areas where recruiting teachers with B2 proficiency may be challenging. This approach could help address the shortage of bilingual teachers and ensure that students in all regions have access to bilingual education. However, it is crucial to recognize that meeting initial proficiency standards is just the first step in creating a successful bilingual education system. Providing ongoing professional development and support for teachers is equally important, as it enables them to improve their language skills and teaching methods continuously. Moreover, ensuring equal access to training opportunities for teachers in remote areas is essential to enhance bilingual education universally and bridge any gaps between urban and rural schools.

In-depth and forward-looking administrative planning and support. Effective administrative leadership is crucial for schools in Taiwan adopting bilingual models, with strategic planning from the onset significantly enhancing success rates. Instead of overburdening a few highly proficient English speakers to lead bilingual courses, successful programs ensure participation from at least two teachers per subject. This approach promotes dialog and problem solving, extends to interdisciplinary efforts when multiple departments are involved, and fosters a collaborative faculty culture. Ultimately, widespread bilingual opportunities lead to meaningful, immersive learning experiences, helping students achieve profound bilingual fluency. After confirming participation in bilingual subjects, ongoing administrative support becomes critical. Providing dedicated preparation time for teachers is essential, implying convenient scheduling to enable collaborative lesson planning. This is especially important for teachers new to bilingual education. Other support includes reducing teaching loads, minimizing administrative tasks, hiring assistants to help with class routines/admin, or allocating extra funding for staff. Also, as an incentive, Taiwan's Education Ministry offers teachers nearly \$680 US dollars per semester for professional development to improve performance, including taking English courses.

Emphasizing collaboration between English and subject teachers, with the latter serving as the principal instructional teaching force. There are two bilingual teaching models in Taiwan, depending on the subject disciplines they teach. Most bilingual Arts/PE/Science teachers (69.6%) utilize the model where the main subject teacher leads instruction, and the English teacher plays a supporting role in co-planning lessons (Model 1). For bilingual Health/Integrated Activities teachers, in 30.4% of their classes, they flipped the arrangement, with the English teacher leading and the subject teacher co-planning (Model 2).²

Of the two models, the first was more widely adopted: many Taiwanese schools relied heavily on English teachers to lead early instruction, while subject teachers played minimal co-teaching roles. However, over time, the number of subject teachers serving as the lead instructional role has climbed year-over-year, from 59 to 112 over the 3 years. Simultaneously, rates of subject teachers opting into co-teaching have dramatically jumped from 36 up to 87 co-teachers. This steady participation growth among subject area experts implies heightened recognition of the value they lend, and growing receptiveness of bilingual collaboration. After implementing bilingual models for years, most teachers have agreed that subject experts should lead teaching for optimal quality instruction, with language teachers in supporting roles. When utilizing Model 2, highest agreement was seen on the importance of collaborating - communicating across teams (85.2%), problem solving together (86.9%), and sharing project goals (85.5%). This points to coordination and joint planning being pivotal to balancing language and content considerations. Notably, self-reported teacher English proficiency gains were relatively modest—only 75.1% felt improved oral expression skills from participating. This indicates room to enhance teacher language development.

To address this, Taiwan's Education Ministry now mandates subject-specific mentoring, where bilingual teachers partner with one TESOL/Applied Linguistics professor and one from the subject field (Dual advisor system). These collaborate on curricula, lesson planning, and multi-semester in-class observations. Such dual mentorship integrating content and language knowledge has proven highly effective.

Additionally, facilitating English and subject teacher collaboration through initial cross-class observation is an efficient strategy to enhance bilingual efficacy. Through an understanding of

subjects' core concepts and classroom culture, English teachers can meaningfully contribute to planning and integrating English highlights into subjects, thereby enhancing quality and ensuring alignment with academic standards.

Expediting the development of appropriate teaching and assessment materials. Highlighting Taipei's example from this Taiwan-based study emphasizes how the capital city leads as a model for the country's bilingual education efforts, offering insights that can guide broader, nationwide strategies. As Taiwan contends widespread challenges in scaling bilingual education, Taipei City's successes offer an instructive model, pioneering localized innovations that could inform centralized efforts. Specifically, Taipei City outlined subject allocation recommendations for bilingual instruction by predominantly structuring a flexible 2:1 course ratio guideline. For every two classes instructed in Mandarin to leverage its foundational familiarity, schools are advised to teach 1 class through English immersion to amplify integrated target language significance. This calibrated scaffolding allows context-specific customizations across grade levels as dual-language best practices develop. Additionally, recognizing well-structured bilingual teaching materials and aligned assessments as pivotal to advancing immersive curricula, Taipei City championed a first-of-its-kind collaboration to develop these specialized resources. Encompassing university academics, practicing public school teachers, and private consultants, this expert alliance generated hundreds of hours of tailored lesson packages. Compiled as self-contained materials deliberately aligned with national standards, the resources integrate localized cultural elements to maximize relevance. Continual expert refinements further bolster the sophistication and quality of the materials.

By April 2021, a major milestone was reached with the launch of the Curriculum & Instruction Resources Network (CIRN), an online platform aggregating these comprehensive bilingual subject resources and demonstration videos to make them freely accessible to all bilingual educators, including those in Taipei City and other parts of Taiwan.³

In parallel to instructional resource advancement, Taipei City also fortified its experimental bilingual curriculum with robust localized assessments. By tapping societal assets like the prestigious Language Training Testing Center (LTTC), nonprofit, custom-built evaluative activities specifically targeting lower grade levels were collaboratively crafted. These activities heavily stimulate hands-on engagement in bilingual classrooms, promoting a symbiotic loop between learning content and assessment. Concurrent with the April 2021 Cool Cloud rollout, full suites of flexible dual-language testing tools addressing various subjects were formally published as well. This provided teachers with an expansive toolkit of aligned bilingual education materials and assessments, emphasizing interactive, localized cultural elements.

Establishing a cross-school community and building a multimodal database for teachers. Implementing immersive bilingual education presents significant challenges for schools and teachers. A key issue is the expertise gap between English language instructors and subject matter experts who must collaboratively teach content in a second language. Even experienced subject teachers struggle with the specialized vocabulary needed to accurately convey complex concepts. Balancing subject comprehension with English proficiency in lesson planning is further complicated by time and resource constraints, especially in smaller or rural schools. Consequently, effective bilingual instruction necessitates collaborative and creative solutions to overcome these widespread challenges.

In direct response to the above issues, Taiwan's Ministry of Education has launched the innovative "Satellite Collaboration

Project” to facilitate cooperative peer lesson planning focused especially on assisting schools newly adopting bilingual models. This unique initiative connects same-subject teachers across proximal schools to collectively harness their expertise, transcending any individual institution’s limited capacity. Instructors from various geographic regions regularly meet online to collaboratively design versatile curricular modules centered on shared topics, themes, and learning objectives, ensuring adaptability across classrooms. Additionally, the Satellite Collaboration Project centralizes the collection and production of cohesive, videotaped demonstration lessons embodying the collaboratively developed curriculum materials as applied in practice. The Ministry of Education has systematically compiled these videos, along with additional multimedia teaching resources, into a publicly accessible centralized database available through their bilingual education program website (the CIRN mentioned earlier). Serving as “3-D blueprints,” these multimedia artifacts on the CIRN provide schools that are new to bilingual education with an abundance of mentoring perspectives on effective instructional techniques from peers navigating the same complex transition process. With resources expanding across a diversity of subjects and grade levels, this repository acts as a vital reference tool for all institutions involved in implementing or improving dual language programs.

Empowering bilingual education through cognitive thinking. Bilingual educators often worry that students’ limited English skills might prevent them from understanding complex topics, leading to teaching methods that simplify content rather than develop higher-order thinking skills. Aiming to accommodate language challenges, teachers tend to deliver content in simplified, accessible pieces, prioritizing basic comprehension. This approach may inadvertently transform subject lessons into basic English lessons, undermining deep subject matter learning. However, fostering rigorous cognitive engagement and critical thinking presents a vital pivot point, offering a more effective strategy for overcoming language barriers and enabling students to grasp complex academic concepts more profoundly.

While the task of rapidly enhancing English language proficiency across entire student bodies is daunting, the cultivation of critical thinking skills through carefully designed activities is well within the reach of educators, even amidst existing constraints. Strategically emphasizing student synthesis, conceptual connections to lived experience, and reasoned analysis inherently shifts the classroom focus from passive reception of delivered information towards active scholarly meaning-making and knowledge construction. Comprehension at its core stems from simply absorbing and demonstrating understanding of the material covered, but meaningful cognitive exercise entails far richer engagement with ideas, penetrating relating of conceptual interconnections, creative contextualization of principles, and the application of lessons through inferential reasoning. This evolutionary shift not only promises vastly deeper levels of subject matter penetration but also crucially equips students with eminently transferable cognitive aptitudes and abilities transcending the limitations of language proficiency itself. Thus, implementing bilingual education plays a key role in Taiwan’s educational reform, aligning language policy with broader educational goals (see Fenton-Smith et al., 2017; Kao, 2023).

An insightful idea that we keep telling bilingual educators is that instead of worrying too much about comprehension issues (instructor’s English not being good enough for students’ understanding or students’ English not being sufficient to comprehend a bilingual class), an instructor may want to work on constructing a lesson that is thought-provoking and cognitively engaging. If students are engaged in “thinking”

throughout the design of your class activities, they will try to understand you. However, it does not work the other way around. A class that focuses too much on comprehension (where an instructor keeps explaining things to students by emphasizing individual elements but neglects the larger concepts) will not facilitate thinking and will lead to the learning of isolated elements in the subject matter.

Discussion: implications for EFL teachers across Asia

Taiwan’s approach to bilingual education, as evidenced by the comprehensive survey of 16,000 participants from 86 schools across all regions, serves as a valuable case study for EFL contexts throughout Asia. This study’s findings, based on a diverse and extensive dataset, offer practical strategies rather than a rigid model, enabling other countries to adapt these insights to their unique educational contexts. This aligns with the principles of multilingual awareness as outlined by Jessner (2013), who highlighted the importance of leveraging metalinguistic and cognitive flexibility in multilingual educational settings. Taiwan’s strategies reflect this theoretical foundation by integrating learners’ linguistic resources and emphasizing pedagogies that promote cross-linguistic connections (Jessner et al., 2016). This perspective encourages a focus on evidence-based adaptations that balance content mastery with linguistic development, crucial for fostering bilingual proficiency across varied educational landscapes (Doiz & Lasagabaster, 2021; Leeman, 2016).

Preparing teachers for bilingual education. The survey revealed that 85% of teachers perceive bilingual education as a means to enhance students’ enthusiasm for learning English while promoting cultural respect, reflecting a critical foundation for effective bilingual education (García, 2009; Lin & He, 2017). The widespread teacher support suggests the importance of sustained professional development. Other Asian countries can benefit from prioritizing teacher preparation programs that address the common challenges of EFL instruction, such as pronunciation insecurity and limited English fluency (Kuteeva & Airey, 2014). Professional development efforts in Taiwan align with the emphasis on multilingual pedagogies discussed by García (2009), and Lin and He (2017), incorporating strategies such as translanguaging to enhance comprehension and engagement. These approaches leverage learners’ L1 to scaffold complex subject concepts before transitioning to the L2 for collaborative tasks, fostering metacognitive skills and linguistic confidence (Jessner et al., 2016). Taiwan’s approach of equipping teachers with the skills to simplify complex content and incorporate visual aids aligns with the need to scaffold language learning effectively, as highlighted in broader EMI research (Macaro, 2018). Practical workshops, role-playing classroom scenarios, and creating bilingual materials can help teachers build confidence in using English as a medium of instruction. Moreover, training teachers to leverage AI technology and multimedia resources can further enhance their ability to support bilingual instruction, addressing resource gaps identified in less urbanized regions.

Administrative considerations. Effective administration plays a pivotal role in implementing bilingual education across Taiwan, as evidenced by the consistent satisfaction ratings from teachers across metropolitan and rural regions (3.88–3.92 on a 5-point scale). This finding indicates that successful models are not restricted to well-resourced urban settings, but can be adapted with the right administrative support. The integration of context-specific strategies, as highlighted in Section “Regional and contextual considerations for bilingual education implementation” of the “Literature review”, underscores the importance of tailoring

administrative policies to regional disparities in resources and teacher capacity (Byun et al., 2011; Huang, 2021). The Taiwanese approach—ensuring multiple teachers per subject to share the instructional burden—demonstrates a sustainable strategy for fostering a collaborative teaching environment (Doiz et al., 2013). By providing preparation time and professional development opportunities, schools can build a resilient teacher workforce capable of delivering quality bilingual instruction. These insights align with the literature emphasizing the role of strategic resource allocation in sustaining teacher morale and mitigating burnout, a crucial aspect for other EFL regions to consider (Costa & Coleman, 2013).

Pedagogical approach for diverse EFL contexts. Taiwan's analysis of teacher and student outcomes underscores the value of a co-teaching model where subject experts lead, supported by language specialists (Lin & He, 2017). This model ensures that the depth of subject knowledge is maintained while students benefit from language scaffolding. The co-teaching model exemplifies García's (2009) argument for integrating linguistic resources into content-based learning, promoting meaningful engagement and comprehension, particularly in multilingual classrooms. The positive reception of 91% of parents, who believe bilingual education opens future opportunities for their children, highlights the critical role of engaging community stakeholders in these programs (García, 2009). Other EFL contexts can adopt this approach by fostering partnerships between language and content instructors, supported by robust mentorship structures that align with local needs. This collaboration not only enriches students' learning experiences but also builds teachers' capacity to manage the dual demands of content and language instruction.

Curriculum development. Survey data from Taiwan highlight the importance of adapting bilingual education resources to local needs, supporting Kuteeva and Airey's (2014) findings about context-specific strategies in bilingual education. Taiwan's Curriculum & Instruction Resources Network (CIRN) offers a promising platform to inspire and enlighten novice instructors about the possibilities for subject curricula, materials, and activities in bilingual education (Doiz & Lasagabaster, 2021). Additionally, the structured 2:1 ratio of native language to English instruction, as recommended by Taiwanese educators, offers a gradual immersion strategy, balancing language exposure without sacrificing content mastery (Macaro, 2018). This model allows schools to adjust English integration based on the readiness of students and teachers, making it especially useful for regions with varying levels of English exposure. It provides a practical framework for managing the shift to bilingual instruction, particularly in areas where English is less commonly used. This aligns with the theoretical insights discussed in Sections "Theoretical foundations: multilingual awareness and bilingual education" and "Multilingual pedagogies and their role in bilingual education", emphasizing the adaptability of multilingual pedagogies to subject-specific instruction, particularly through strategies such as translanguaging and scaffolding with the learners' L1 before transitioning to the L2 (Calafato, 2024; Jessner et al., 2016).

Positive outcomes in Taiwan, such as satisfaction ratings above 3.5 in hands-on subjects like physical education, demonstrate the effectiveness of experiential learning in supporting both subject mastery and language acquisition. As highlighted in Section "Regional and contextual considerations for bilingual education implementation", physical education and interactive subjects naturally complement bilingual instruction by embedding language learning into concrete, memorable experiences. This suggests that introducing bilingual instruction through practical,

engaging subjects can ease the transition to English-medium instruction, especially in regions less familiar with English in academic settings (Evans & Morrison, 2011).

For other EFL contexts, Taiwan's experience emphasizes the value of designing flexible, regionally adapted bilingual programs. Localized assessment tools and instructional models that adjust to varying readiness levels are essential to avoiding a one-size-fits-all approach (Leeman, 2016). By adopting a strategic, adaptive framework, other countries can navigate the complexities of bilingual education more effectively, achieving sustainable educational outcomes.

Pedagogical techniques and cognitive activation. Taiwan's findings, particularly the self-reported gains in listening (3.46) and speaking (3.33), highlight the value of prioritizing cognitive engagement over mere language proficiency (García, 2009). Rather than focusing solely on comprehension, Taiwan's approach integrates interactive strategies—such as discussions, multimedia, and visual aids—to actively engage students. This shift from passive reception to active participation helps students build confidence in using English for complex ideas, aligning with research that links active learning to better retention and deeper understanding (Doiz & Lasagabaster, 2021).

The Satellite Collaboration Project illustrates how peer mentorship and resource sharing can effectively address teacher competency gaps (Kuteeva & Airey, 2014). By connecting teachers across schools to share practices and co-develop materials, the project facilitates partnerships between teachers from various locations and resource levels, enabling them to adapt educational materials to suit their students' cultural and language backgrounds. This community-driven model is especially beneficial where resources are limited, leveraging collective knowledge to overcome challenges.

The emphasis on critical thinking and creativity has been central to helping students grasp content deeply, even as they develop language skills. For subject teachers using English as the instructional language, the focus should not be on constantly designing activities to ensure students simply "understand" the input. Instead, teachers should prioritize creating activities that engage students' cognition, prompting them to think critically about the input. When students are encouraged to think, they will actively seek ways to understand the material. This approach leverages cognitive engagement as the driver for comprehension, rather than the other way around, and aligns with the theoretical foundations in Section "Theoretical foundations: multilingual awareness and bilingual education", which emphasize the role of multilingual awareness and cognitive flexibility in fostering effective bilingual learning environments (Jessner, 2013).

For other EFL countries, Taiwan's experience offers a strategic path. The combination of interactive teaching and peer support networks provides a sustainable framework, especially when teachers may lack initial confidence in their English skills. This approach supports the development of bilingual education systems that are adaptable, less reliant on external resources, and focused on nurturing both language and critical thinking skills. By adopting cognitive engagement strategies and fostering collaborative teaching communities, other EFL contexts can create inclusive, effective bilingual programs that promote both language development and deep content understanding.

Conclusion

In conclusion, the comprehensive survey data from Taiwan's bilingual education initiatives offers actionable insights for EFL educators throughout Asia. The key takeaways include

integrating cognitive development alongside language skills, fostering teacher collaboration, and adapting strategies to regional disparities. By drawing on Taiwan's census-based data, which highlights the importance of stakeholder engagement and tailored support, other EFL countries can build more effective bilingual programs. These evidence-based principles provide a foundation for thoughtful implementation, ensuring that students across diverse contexts benefit from bilingual education. However, this study is not without its limitations. First, while the census-based survey offers extensive quantitative data, it lacks detailed longitudinal insights into the long-term impact of bilingual education on academic and linguistic outcomes. Second, the reliance on self-reported data from stakeholders may introduce biases, such as overestimating perceptions of program effectiveness—we tried to reduce this possibility through extensive sampling. Future research could address these gaps by adopting longitudinal methodologies to track the progression of bilingual education outcomes over time and across grade levels. Additionally, qualitative studies, such as classroom observations and in-depth interviews with teachers and students, could complement survey findings by better understanding the day-to-day implementation of bilingual education. By addressing these limitations and expanding the research scope, future studies can deepen our understanding of the potential of bilingual education to transform language learning and teaching across diverse global contexts.

Availability of data/materials statement

This study utilized national census data collected under confidentiality agreements with participating schools to protect their anonymity and prevent unnecessary comparisons. Due to ethical and legal restrictions regarding participant confidentiality and school privacy, the data cannot be shared publicly. However, aggregated results and key findings are fully presented in the paper. Readers with specific inquiries about the methodology or analysis may contact the corresponding author, subject to institutional confidentiality and data protection policies.

Data availability

The data supporting the findings of this study are available from the corresponding author upon request. Access to the data may be granted following a review to ensure compliance with ethical and institutional guidelines.

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Notes

- 1 The steering and advising team from National Taipei University of Education, entrusted by the Taiwanese Ministry of Education (2018). Annual Report on Bilingual Teaching in Elementary and Junior High Schools: Academic Year 110 to 111.
- 2 The integrated activity learning domain includes activities that guide learners to practice, experience, reflect, verify, and apply their knowledge. Activities such as counseling, scouting, home economics, and group activities from junior high and elementary schools align with the curriculum goals of this domain. "Integrated Activities" in Taiwan thus differs from Japan's "Time for Integrated Studies," which focuses more on project-based and exploratory learning.
- 3 For demonstration videos related to elementary bilingual education, please visit: <https://cirn.moe.edu.tw/TAPE/TapeList.aspx?cid=271>; videos related to secondary school bilingual education can be found here: <https://cirn.moe.edu.tw/TAPE/TapeList.aspx?cid=272>.

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Author contributions

The contributions to this paper are as follows: I-Shan Jenny Chen and Yeu-Ting Liu led the study's conceptualization and design, conducted the research, and were responsible for data collection and analysis. They also drafted the initial paper and prepared the final version. Yozoruya Ryuichi and Uchino Shunsuke contributed to the paper by providing valuable discussions and suggestions on the interpreted results, enhancing the depth and relevance of the findings. All authors reviewed and approved the final paper.

Competing interests

The authors declare no competing interests.

Ethical approval

This study did not require Institutional Review Board (IRB) approval, as it was conducted under a national education policy research initiative approved and overseen by the Ministry of Education (MoE) of Taiwan. It evaluated an existing, government-mandated bilingual education program that had already been implemented in participating schools. The bilingual education program was officially launched on February 1, 2018, and on the same date, the Ministry of Education (MoE) granted IRB exemption for studies conducted under this policy framework. As part of the official policy framework, all participating schools were required to obtain parental/guardian consent before students joined the bilingual education initiative. Accordingly, consent was sought from participants on the date their schools joined the program, beginning on August 1, 2021. Since the study's anonymous, non-interventional surveys fell within this pre-approved policy framework, no additional research-stage consent was required. This study did not introduce any intrusive or non-standard instructional practices. While the bilingual education initiative incorporated an additional language into instruction, it remained within the scope of standard classroom practices commonly observed in global education systems. The program was applied uniformly across all grade levels, ensuring fairness and preventing selective participant recruitment. Moreover, the study only involved anonymous, non-interventional surveys designed to explore teachers' and students'

perceptions and experiences within the pre-approved policy framework. Given these conditions, the Ministry of Education (MoE) of Taiwan determined that this study was exempt from IRB review in accordance with Taiwan's national research ethics framework for educational studies. As per Taiwan's research ethics regulations, government-mandated policy evaluations do not receive exemption numbers, as they fall under ongoing government-directed educational assessments rather than independent research requiring separate ethical review. Prior to the implementation of any national education policy, the Ministry of Education conducts extensive public hearings and expert consultations to ensure that ethical considerations, human rights protections, and IRB-related concerns are fully addressed. The bilingual education initiative underwent a rigorous, multi-stakeholder review process, ensuring compliance with ethical and human rights standards before implementation. The exemption was confirmed before the study's commencement as part of the Ministry's structured evaluation framework. This study was conducted in full compliance with Taiwan's national research ethics guidelines for educational research and adhered to internationally recognized ethical principles, including the Declaration of Helsinki and relevant research ethics frameworks governing educational studies. All procedures aligned with national education research regulations, ensuring ethical integrity in policy evaluation.

Informed consent

Informed consent was obtained from all participants and their legal guardians prior to the implementation of the bilingual education program, as mandated by the Ministry of Education in Taiwan. Before schools were approved to participate in the bilingual education initiative, they were required to obtain parental/guardian consent for both the instructional program and its accompanying program evaluation surveys. This consent process was a prerequisite for schools' participation, ensuring that all students' legal guardians had already provided written consent for their children's involvement in both the bilingual instruction and the collection of anonymous survey data for educational evaluation purposes. Consent was obtained in written form to ensure clear documentation and compliance with ethical research standards. Participants and their guardians were fully informed about (1) the purpose of the study, (2) the voluntary nature of their participation, and (3) the assurance of anonymity and confidentiality. The scope of the consent included: (1) Participation in the surveys and (2) the use of fully anonymized data for research purposes. The surveys were anonymous, did not collect personally identifiable information, and were conducted solely for the purpose of evaluating the effectiveness of the bilingual education initiative. Responses were fully anonymized, and all measures were taken to eliminate any potential risks to participants. No additional consent was required at the research stage, as participation was already covered under the original parental consent obtained by schools, in full compliance with Taiwanese Ministry of Education regulations. This process aligns with national research

ethics guidelines and international ethical standards, including principles outlined in the Declaration of Helsinki regarding informed consent and participant protection. Participants' confidentiality and privacy were fully safeguarded in accordance with recognized ethical standards for educational research.

Declaration of AI-assisted technologies

While preparing this work, the authors used *Grammarly* solely for grammar monitoring; it was not used to generate any part of the manuscript. Subsequently, they thoroughly reviewed and edited the content as needed. The authors take full responsibility for the publication's content.

Additional information

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