Language and Education

ISSN: 0950-0782 (Print) 1747-7581 (Online) Journal homepage: www.tandfonline.com/journals/rlae20

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To cite this article: Alfred W. T. Lo (2025) Unlocking CLIL success: exploring the interplay between students' self-regulation levels, linguistic challenges and learning outcomes in Hong Kong secondary education, Language and Education, 39:2, 433-451, DOI: 10.1080/09500782.2024.2314135

To link to this article: https://doi.org/10.1080/09500782.2024.2314135

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Published online: 26 Feb 2024.

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LANGUAGE AND EDUCATION
2025, VOL. 39, NO. 2, 433–451
https://doi.org/10.1080/09500782.2024.2314135

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Unlocking CLIL success: exploring the interplay between students' self-regulation levels, linguistic challenges and learning outcomes in Hong Kong secondary education

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ABSTRACT

The pedagogical approach—Content and Language Integrated Learning (CLIL)—has been widely adopted around the globe with its dual aims of developing students' second language (L2) proficiency and mastering content knowledge simultaneously. However, its effectiveness remains inconsistent. This inconsistency has led researchers to call for an investigation into the perspectives of CLIL students to understand the factors behind the success and failure of CLIL implementation. To address this gap, this study explores CLIL students' perspectives through the lens of self-regulation and examines the relationships between CLIL students' self-regulation levels, linguistic challenges, and learning outcomes. Involving 167 junior secondary students from three schools in Hong Kong that adopted different CLIL models in Hong Kong, the study revealed moderate self-regulation levels and varying linguistic challenges among CLIL students, with listening being identified as the most difficult skill. A significant, moderately positive correlation was found between self-regulation levels and perceived linguistic challenges. Multiple regression analysis also found that motivation was a key predictor of both L2 proficiency and content subject achievement, while other self-regulation constructs (self-preparation, self-monitoring, and self-reflection) showed non-significant predictive values. Pedagogical implications are provided to develop students' self-regulation skills and address perceived linguistic challenges, ultimately enhancing the learning experience and outcomes for CLIL students of diverse abilities.

ARTICLE HISTORY
Received 27 April 2023
Accepted 24 January 2024

KEYWORDS
Bilingual education; content and language integrated learning; Hong Kong; linguistic challenges; self-regulation

1. Introduction

Content and Language Integrated Learning (CLIL), initially developed in Europe to promote multilingualism, is defined as 'any type of pedagogical approach that integrates the teaching and learning of content and second/foreign languages' (Morton and Llinares 2017, p. 1). This dual-focused approach is designed to facilitate the simultaneous learning of both L2 and content knowledge. Outside of its European origins, Hong Kong has notably adopted CLIL by adapting English Medium Instruction (EMI) to its unique educational context.

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While studies focusing on the product-oriented outcomes of CLIL have shown that learners often exhibit higher levels of L2 English proficiency than their non-CLIL counterparts (Bulté et al. 2022; Shepherd and Ainsworth 2017), there remains a concern regarding the potential compromise in content learning (e.g. Fung and Yip 2014; Fernández-Sanjurjo et al. 2019). The debate over the effectiveness of CLIL has spurred a shift towards process-oriented research focusing on classroom interactions (e.g. Lo and Macaro 2015; Pun and Macaro 2019). However, these approaches might not adequately reflect the students' learning processes that extend beyond the classroom. Therefore, there is a need for research in CLIL to adopt a participant-oriented approach, one that foregrounds the insights of the CLIL learners themselves—who have thus far been underrepresented in the literature (Buckingham and Iwaniec 2023; Fung and Lo 2023; Somers and Llinares 2021). For instance, studies can explore the linguistic challenges CLIL students perceive, or how they prepare, monitor, and reflect on their learning.

This paper seeks to address the gap by exploring the role of self-regulation within CLIL. Self-regulation is defined as the systematic engagement and sustainment of learners' thoughts, motivations, behaviours, and emotions, all directed towards educational objectives (Schunk and Greene 2018). Self-regulation has been prominently featured in research on content learning and L2 learning, especially regarding its beneficial impact on learning strategies, motivation, and learning achievement. Nonetheless, the extent to which it is related to CLIL—an integral construct of language and content learning—is less understood. This paper, therefore, examines the relationships between students' self-regulatory levels, linguistic challenges, and learning outcomes in CLIL. It aims to contribute new perspectives to CLIL research by introducing self-regulation as a novel lens through which to view the complexities of CLIL implementation and to make CLIL more accessible to every learner.

2. Literature review

2.1. Bilingual education in Hong Kong

The integration of L2 with content learning has gained prevalence and recognition through various bilingual programmes. Researchers have reached a consensus that 'CLIL' can serve as an umbrella term for these programmes, which vary in the degree of integration between content and language learning (Cenoz et al. 2014). In the Hong Kong context, the term EMI is often used interchangeably with CLIL. Although EMI and CLIL are expected to offer comparable advantages, the term 'EMI' is sometimes critiqued for lacking a precise definition that fully captures their shared dual focus on content and language learning (Rose et al., 2020). In contrast, 'CLIL' is recognised for its balanced integration of content and language learning. In Hong Kong secondary education, EMI is frequently considered a variant of CLIL (Cenoz et al. 2014; Lasagabaster and Sierra 2010; Lo and Fung 2018). Consequently, this paper adopts 'CLIL' as the overarching term, except when referring to specific contexts or literature where 'EMI' is distinctly presented as a variant of CLIL.

The implementation of bilingual programmes in Hong Kong exhibits variation across educational levels, each with its own distinct Medium of Instruction (MoI) policy (see Lo and Lin 2019 for a more thorough description). In primary education, the MoI is predominantly L1 Chinese, commonly referred to as Chinese Medium Instruction (CMI), with English typically taught as a separate subject. Conversely, universities strategically emphasise

EMI to foster internationalisation and adhere to global academic standards. However, secondary education has seen notable shifts in MoI practices over recent decades, influenced by Hong Kong's political transitions and educational reforms. Prior to the handover of Hong Kong from Britain to China in 1997, secondary schools had the autonomy to determine their MoI under a non-interventionist government approach. During this period, there was a predominant preference for EMI, driven by the belief in its potential to enhance employment prospects and social mobility. The post-handover period brought significant changes in MoI policy, namely the mandated use of the mother tongue (Chinese) in education up to Secondary 3 in 1998, prompting schools to re-evaluate the status of EMI and CMI. Despite these shifts, the desire to enhance English proficiency through EMI persisted, culminating in the introduction of a 'fine-tuning of MoI' policy in 2010. This policy has allowed schools greater flexibility in integrating L2 into content learning, resulting in the implementation of varied CLIL models in Hong Kong secondary education (Table 1).

2.2. CLIL Learning Outcomes in Hong Kong

The teaching, learning, and assessment approaches of CLIL vary considerably across countries due to its inherent flexibility, making direct comparisons of findings challenging (San Isidro & Pérez Cañado, 2023). This discussion narrows its focus to Hong Kong specifically, where studies spanning more than two decades have consistently shown that while the integration of content and language instruction can enhance English proficiency, it may negatively affect content learning, particularly for lower-achieving students. The meta-analysis conducted by Lo and Lo (2014) assessed the effectiveness of EMI in Hong Kong and revealed that secondary school students in EMI settings demonstrated higher L2 English proficiency and increased motivation, but their content learning outcomes were less than optimal. However, the analysis also recognised potential biases, such as self-selection and parental support, which might skew results in favour of high-achieving students. For a more comprehensive understanding of CLIL's effectiveness in Hong Kong, an in-depth examination of longitudinal studies is necessary. For instance, a study conducted by Yip et al. (2003) after the implementation of the 1997 compulsory mother tongue policy revealed that EMI students' understanding of abstract concepts and application of scientific knowledge was notably poorer than that of their counterparts in CMI settings. This study also acknowledged the complications arising from the use of different versions of science achievement tests, which could have confounded the results. Additionally, Fung and Yip (2014) compared the physics achievements and motivation of 199 tenth-grade students learning via EMI and CMI, indicating that students performed better and were more motivated when taught in

Table 1. Models of CLIL in the form of EMI in Hong Kong (source from Lin & Lo, 2019).

Models	Student characteristics	Features
Mostly EMI	High English proficiency, academically strong, top schools	English MoI for most subjects; Chinese for related subjects
Mostly CMI	Lower English proficiency, varied academic ability	Content subjects are mainly taught in Chinese MoI; 15-25% English Extended Learning Activities (ELA)
MoI-switching	Average English proficiency, varied academic ability	Chinese MoI (junior secondary), switches to English MoI (senior)
EMI by Class/Subject	Average English proficiency and varied academic ability, including non-Chinese speakers	English MoI for specific classes/subjects, e.g. Math & Science

their L1. However, the scope of this study was limited to a single school and did not provide a comprehensive view of the impact across different EMI models and levels of student ability. Therefore, future research should involve a more diverse range of schools to offer a fuller understanding of the effectiveness of varying student abilities and EMI models in Hong Kong.

2.3. Linguistic challenges in CLIL

CLIL learners often face the challenge of mastering both content and L2 concurrently. This dual objective often places significant linguistic demands on the learners, whether or not they are proficient in L2. Prior research has recognised the linguistic and cognitive challenges faced by CLIL students and highlighted the crucial supportive role played by teachers (Chan 2015; Lo et al. 2019). However, the specific linguistic challenges faced by CLIL secondary school students remain understudied, contrasting with research focusing on the transition from secondary to EMI tertiary education (Aizawa et al. 2020; Kamaşak et al., 2021; Shepard and Rose 2023). An exception is the study by Barrios and Acosta-Manzano (2022), which shifts the focus to primary school students in Spain. The study revealed that the majority of primary students in their study did not perceive CLIL as highly challenging linguistically, but approximately one-fifth of the students faced mild to severe difficulties with the language of instruction. These students reported the least difficulty with writing, possibly due to a perception amongst students that writing involved simply copying or producing words and sentences rather than creating extensive texts. However, this study, despite its limited scope—an instrument with just six items—might not fully capture the complexity of linguistic challenges in CLIL, but its simplicity might be suited to the cognitive level of primary school students. This study nevertheless explored from the students' perspective, shedding light on improving the effectiveness of CLIL. However, advancing the effectiveness of CLIL goes beyond addressing linguistic challenges alone and would necessitate a deeper understanding of how learner perceive their own capabilities and learning processes.

2.4. Advancing CLIL: from self-concept to self-regulation

Recent studies have increasingly emphasised the importance of insights from CLIL learners, who have been underrepresented in CLIL research (Buckingham and Iwaniec 2023; Lo, under review; San Isidro & Pérez Cañado, 2023; Somers and Llinares 2021). Quantitative analyses in Europe have demonstrated the positive impact of CLIL on students' self-concept. For instance, Buckingham and Iwaniec (2023) reported that 348 fifteen-year-old Spanish students engaged in CLIL showed enhanced self-concept and increased motivation. Roth et al. (2022) in Germany revealed significant and strong correlations between CLIL, creativity, and self-concept, with a particularly significant increase in self-concept among academically lower-achieving students. Meanwhile, the qualitative study conducted by Roiha and Mäntylä (2022) in Finland further supported this viewpoint, demonstrating the significant role of CLIL in fostering a positive self-concept in L2 English learning. While these studies provide valuable insights from CLIL students' perspectives, most employed methodologies are rooted in L2 research. Somers and Llinares (2021) caution against this approach, arguing that factors such as motivation in CLIL should be distinctly conceptualised from L2 motivation to ensure a balanced integration of content and language. Research

tools in CLIL should be specifically designed to cater to its unique context, rather than over-relying on L2 frameworks. Although these studies highlight the positive effects on students' self-concept in CLIL, there remains a significant research gap regarding how students themselves can proactively enhance their CLIL learning experiences.

Building on the recent shift towards a participant-focused approach, this study aims to explore the role of self-regulation in CLIL students' learning by drawing upon Zimmerman's (2000) well-regarded model of self-regulation. It is structured around three sequential phases: *forethought*, *performance or volitional control*, and *self-reflection*. In the forethought phase, students engage in task analysis, goal setting, and strategic planning. Motivational beliefs play a critical role in energising the process and influencing the activation of learning strategies. During the performance phase, students implement their tasks, monitor their progress, and apply self-control strategies to maintain cognitive engagement and motivation to see the task through to completion. In the self-reflection phase, students evaluate their performance on the task and attribute their successes or failures to specific factors. The cyclical phases of self-regulation elucidate the interconnectedness of metacognitive, motivational, and behavioural processes on an individual level. From a social-cognitive perspective, the motivational beliefs that drive students to pursue their goals are considered fundamental, and academic success is often a result of students' metacognitive or strategic abilities.

The exploration of self-regulatory capabilities among CLIL learners, especially concerning their influence on successful CLIL outcomes, is still in its infancy. While recent studies on EMI at the university level have emphasised the importance of self-regulation, results concerning the relationship between self-regulation and EMI achievement have been mixed. For instance, Soruç et al. (2022) conducted the first study within L2-based content learning to examine the interplay between self-regulation and content knowledge performance in Turkish higher education. They investigated both linguistic (general English proficiency) and non-linguistic factors (self-regulation, motivation, and self-efficacy) affecting the academic success of EMI students. Their findings pinpointed self-regulation and self-efficacy as predictors of success, whereas motivation levels did not directly predict achievement but rather impacted English proficiency. Similarly, Thompson et al. (2022) found a positive association between self-efficacy and EMI achievement among 139 business students at a Japanese university, as evidenced by their mid-term and final test scores. Conversely, Xie and Curle (2022) found that neither motivation nor perceived EMI success were reliable predictors of actual success among 100 university students in China. However, it should be noted that they utilised a general English motivation scale to evaluate content-based EMI learning and did not report on construct validity. These studies collectively signal a recognition of the role of self-regulation in determining the success of L2-based content learning. Despite these advancements, there remains a significant research gap concerning secondary school students who are at a crucial stage in education, highlighting the need for further exploration.

2.5. Significance of study and research questions (RQ)

Research from the perspective of CLIL students has been crucial, yet a student-centred approach within CLIL research remains scarce in Hong Kong. This is particularly apparent in the area of self-regulation, which can be an important field of inquiry for enhancing

student learning in CLIL settings. Investigating the language-related difficulties that CLIL students encounter, understanding the relationship between students' self-regulation levels and their linguistic challenges, and examining how self-regulation may predict CLIL outcomes can provide valuable insights. In light of these considerations, this study aims to address the following research questions:

RQ1: Are there differences in language-related challenges and self-regulation levels among students depending on whether the CLIL school operates different CLIL models?

RQ2: How do CLIL students' perceived language-related challenges vary according to their self-regulation levels?

RQ3: To what extent does self-regulation level predict CLIL outcomes, including L2 proficiency and content subject performance?

3. Methodology

3.1. Setting

The study population included secondary school students receiving CLIL instruction in Hong Kong, involving three schools that had adopted CLIL and had accepted invitations to participate in the study. Based on the information from teachers and school documents, School A is classified as a 'mostly EMI' school according to Lo and Lin (2019), employing EMI for all subjects except those related to Chinese. Schools B and C operate under 'EMI by class', where EMI is applied in all subjects except Chinese-related ones within a specific class at each grade level. In the EMI-by-class programmes at Schools B and C, students demonstrated higher English proficiency and academic competence than their non-EMI peers within the same schools. School A, traditionally recognised as a 'top-ranking' school in Hong Kong, has a higher university admission rate compared to Schools B and C, which have moderate rates of university admissions over the years. School A has maintained a strict English-only policy for more than twenty years, excluding classes related to Chinese. In contrast, Schools B and C also promote more frequent use of English in CLIL classes but allow strategic and occasional use of L1 Chinese, for concepts clarification and classroom management between teachers and students.

3.2. Participants

A total of 191 students (Years 7 to 9) participated by completing a questionnaire. However, 19 participants were excluded due to incomplete questionnaires, resulting in a final quantitative data sample of 167 participants ($n = 52$ from School A; $n = 84$ from School B; $n = 31$ from School C). All participants were junior secondary students (Years 7 to 9), responding to Pun and Macaro's (2019) assertion that 'Hong Kong research needs to establish where the actual problem lies in the early years of middle school (lower secondary)' (p.12). The final population included 82 boys and 85 girls, aged between 12 and 15 years, distributed among three-year groups: 74 in Year 7, 54 in Year 8, and 39 in Year 9. The majority were L1 Cantonese speakers ($n = 161$), with a minority of L1 Mandarin speakers ($n = 6$).

To assess the effectiveness of CLIL implementation, we measured L2 proficiency and content subject performance among the participants. L2 proficiency was measured based

on students' annual English language scores. The scores encompassed the four language skills and were calculated by the three schools based on the public exam (HKDSE) weighting: Reading (20%), Writing (25%), Listening (30%), and Speaking (25%). Despite potential variations in instructional and assessment approaches, all schools adhered to the curriculum guidelines and assessment frameworks provided by the Hong Kong Education Bureau, contributing to the data standardisation. For content performance, mathematics and science scores were collected as they are the predominant CLIL subjects in Hong Kong (Kan et al. 2011).

Schools A ($M = 64.1$, $SD = 13.3$) and B ($M = 64.2$, $SD = 14.47$) reported similar L2 English proficiency, while School C reported a higher average score ($M = 69.4$, $SD = 20.2$). In terms of content subject achievement, mathematics scores were comparable for Schools A ($M = 62.3$, $SD = 16.2$) and B ($M = 61.1$, $SD = 16.9$), with School C slightly lower ($M = 59$, $SD = 21.6$). Conversely, science scores varied more significantly, with School A achieving the highest ($M = 77.5$, $SD = 16.2$), followed by School B ($M = 72.6$, $SD = 14.0$), and School C with a substantially lower average ($M = 52.2$, $SD = 23.4$).

3.3. Instrumentation

3.2.1. CLIL Linguistic Challenges Scale

The CLIL Linguistic Challenges Scale consists of 26 items rated on a 5-point Likert scale, measuring students' language-related challenges in CLIL. Based on an adaptation of the questionnaire from Evans and Morrison (2011) EMI Challenges, ratings range from 1 to 5 (very difficult, difficult, neither easy nor difficult, easy, and very easy). This Scale covers items that explore students' perceptions of language-related tasks across writing, speaking, reading, and listening skills, such as 'Expressing ideas in correct English in content subjects', and 'Understanding specific vocabulary in content subjects'. After the discussions between CLIL teachers and researchers, four items not pertinent to secondary school settings were removed. Moreover, considering the target demographic of junior secondary students, who typically demonstrate low-level cognitive and linguistic abilities as identified by Lo and Fung (2018), items relating to paragraph-level writing tasks such as essay writing were also omitted.

Confirmation Factor Analysis was conducted to assess the validity of the Scale, resulting in a Chi-Square (χ^2) value of 3503.183 between the expected and observed data with a statistically significant level of $p < .001$. The model fitness indices, including CMIN/DF of 2.039, RMSEA of .072, and a CFI of .916, were within acceptable ranges for good model fit. Reliability was established with Cronbach's alpha (α) coefficients for each skill: writing ($\alpha = .886$), reading ($\alpha = .921$), speaking ($\alpha = .941$), and listening ($\alpha = .923$). These results demonstrated good validity and reliability of the scale for measuring linguistic challenges within the CLIL context.

3.3.2. CLIL Self-Regulation Inventory

The CLIL Self-Regulation Inventory, a 22-item numeric rating scale, was developed to fill the gap of a specialised self-regulation questionnaire for CLIL contexts. Participants rated the accuracy of each item on a scale from 0 (not accurate) to 100 (very accurate), reflecting their self-perceived competence in CLIL-specific behaviours and skills. This inventory is

underpinned by Zimmerman and Moylan's (2009) theoretical framework, which posits self-regulation as the intersection of metacognition and motivation. Items in the metacognition dimension were adapted from Schraw and Dennison's (1994) Metacognitive Awareness Inventory, enabling participants to assess how each item aligns with their learning process. These items include the cyclical process of self-regulation: preparation (e.g. 'I organize my time to best achieve my goals for content subject learning'), monitoring (e.g. 'I find myself analysing the efficacy of strategies while I study content subjects'), and reflection (e.g. 'I question how well I have achieved my goals after completing learning content subjects'). Conversely, the motivation dimension adapted the self-efficacy component from Pintrich et al. (1993) Motivated Strategies for Learning Questionnaire (MSLQ), a tool commonly used in self-regulation research. Items were contextualized for CLIL (e.g. 'I am confident I can perform excellently in assignments and tests in content subject learning').

The validity of the Inventory was evaluated using Confirmatory Factor Analysis, which indicated a Chi-Square (χ^2) value of 4052.059 with a statistically significant level (p <.001). The validity is further substantiated by model fit indices (CMIN/DF = 2.561, RMSEA = .077, CFI = .908). The reliability of the Inventory was determined through Cronbach's alpha (α) coefficients, revealing high internal consistency across the constructs: planning ($\alpha = 0.884$), monitoring ($\alpha = 0.933$), reflection ($\alpha = 0.89$), motivation ($\alpha = 0.936$), and a total scale reliability ($\alpha = 0.972$). These findings confirm that the Inventory can be a psychometrically valid and reliable tool for measuring students' self-regulation levels in the CLIL context.

3.4. Procedure

The study began with a pilot involving 10 CLIL students, representing a range of English proficiency levels, who were not included in the main study. After finalising the instruments, consent was obtained from school principals via online meetings. Information sheets, consent forms, and opt-out forms were then distributed to parents and students through the subject panel chairpersons. Upon receiving the completed forms from the English teachers, the survey link was shared with the participants. Participants accessed the Qualtrics survey using the provided link during an English lesson. The questionnaire was presented bilingually, in both Chinese and English, with the questions displayed in randomised order.

3.5. Data analysis

IBM SPSS (Version 25) was used for the statistical analysis of the online questionnaire data. For RQ1, the mean and standard deviation of students' self-regulation levels and linguistic challenges were calculated to facilitate comparisons between different groups. For RQ2, a correlation analysis using Spearman's rho was conducted to explore the relationships between self-regulation levels and the four linguistic challenges in CLIL. For RQ3, a simultaneous multiple regression analysis was performed to examine how students' self-regulation levels predict their performance in CLIL. The analysis involved two multiple linear regression models, with all predictor variables entered into a single statistical model, to assess the explained variance in the outcome variables, which were students' performances in L2 (English) and content subjects (average scores of mathematics and science).

Prior to the analysis, rigorous diagnostic was conducted to ensure the robustness of the statistical tests. This included verifying the normal distribution of errors, linearity, and homoscedasticity (uniformity of variance across the data), as well as confirming the absence of multicollinearity (ensuring that predictor variables are not too highly correlated with each other). Descriptive statistics confirmed no significant skewness or kurtosis in the variables, and scatterplots of predicted values against standardised residuals showed no discernible patterns, indicating homoscedasticity. Multicollinearity was examined, with all tolerance values remaining above 0.2 and variance inflation factors significantly below 10, suggesting that the predictor variables in the models were sufficiently independent. These careful measures ensured the validity and reliability of the regression analysis results.

4. Results

4.1. CLIL Students' self-regulation levels and linguistic challenges

4.1.1. CLIL Students' self-regulation levels

The study first examined students' self-regulation levels. Overall, students demonstrated a moderate level of self-regulation ($M = 57.69$, $SD = 20.74$). Students from School A and School B displayed similar average levels of self-regulation ($M = 59.48$, $SD = 18.22$) and (M = 60.79, $SD = 19.16$), respectively. In contrast, students from School C exhibited a relatively lower level of self-regulation ($M = 46.29$, $SD = 25.18$). The variation in self-regulation levels may reflect differences in CLIL instructional approaches or environments of the schools.

4.1.2. CLIL Students' linguistic challenges

Figure 1 presents the self-perceived linguistic challenges in CLIL among junior secondary students in Hong Kong. On average, students rated the difficulty of linguistic skills in CLIL as moderate to slightly difficult, with mean difficulty levels ranging from 3.22 to 3.59. Listening was deemed the most challenging skill ($M = 3.59$, $SD = 0.74$), followed by reading ($M = 3.38$, $SD = 0.80$), writing ($M = 3.36$, $SD = 0.78$), and speaking, which was considered

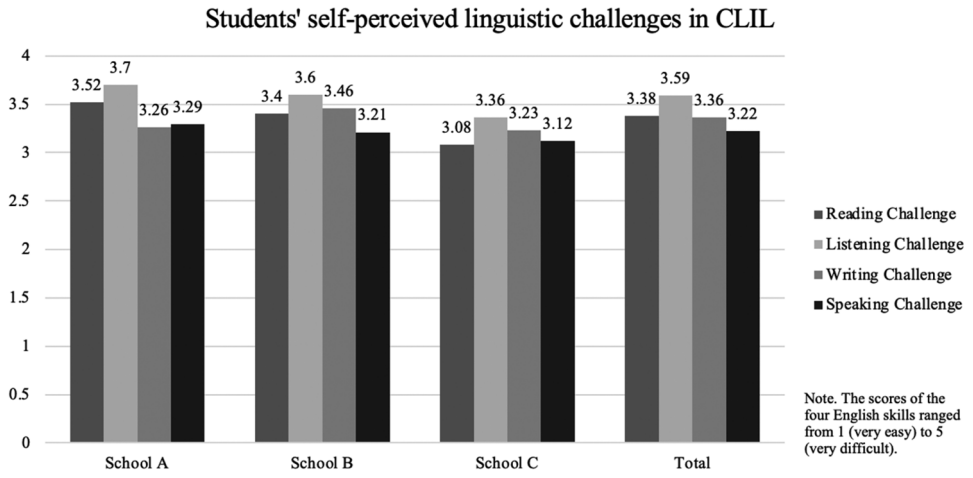

Figure 1. Students' self-perceived linguistic challenges in CLIL.

the least challenging ($M = 3.22$, $SD = 0.83$). The mean difficulty levels suggest that, on average, students found L2 in the CLIL programme to be moderately challenging.

In analysing the data by school, students from School A reported the lowest levels of difficulty across all linguistic skills, with listening being their greatest challenge ($M = 3.70$, $SD = 0.81$). Conversely, School C students indicated the highest levels of difficulty for all skills, with listening again being the most challenging ($M = 3.36$, $SD = 0.87$). At School B, writing was identified as the most difficult skill ($M = 3.46$, $SD = 0.66$). Comparing the CLIL models, School A, operating mostly in EMI, reported higher challenge ratings in listening and reading but lower in writing and speaking, in contrast with Schools B and C, which function under an EMI-by-class model. These differences might imply variations in the effectiveness of the CLIL models or differences in students' experiences and coping strategies in the different CLIL settings.

4.2. The relationship between self-regulation constructs and linguistic challenges in CLIL

This study examined the relationship between CLIL students' self-regulation levels and their linguistic challenges. The findings indicate a moderate, positive correlation between self-regulation and perceived challenges in both receptive (listening and reading) and productive (writing and speaking) linguistic skills. Specifically, the correlation coefficients for receptive skills ($r_s = .569$, 95% BCa CI [.437, 660], $p < .001$) and productive skills ($r_s = .570$, 95% BCa CI [.429, 669], $p < .001$) were nearly identical, suggesting that students who are better at regulating their learning processes tend to perceive tasks in CLIL as more linguistically challenging.

Table 2 presents a detailed examination of the correlations between different self-regulation constructs—preparation, monitoring, reflection, and motivation—and the linguistic challenges faced by CLIL students. Motivation was found to have the strongest positive correlation with both receptive ($r_s = .619$, 95% BCa CI [.461, .703], $p < .001$) and productive ($r_s = .611$, 95% BCa CI [.491, .720], $p < .001$) linguistic challenges. This strong positive correlation with motivation implies that CLIL students who are more motivated are also more attuned to the linguistic challenges they face, possibly investing more effort in overcoming these challenges. Notably, students' self-reflection demonstrated a moderate positive correlation with receptive skills challenge ($r_s = .517$, 95% BCa CI [.384, .621], $p < .001$) and productive skills challenge ($r_s = .482$, 95% BCa CI [.342, .614], $p < .001$). Self-monitoring

Table 2. Significant correlations between the self-regulation constructs and CLIL linguistic challenges.

	Level of self-regulation				
Variables	Preparation	Monitoring	Reflection	Motivation	Overall
CLIL Receptive Skills: Overall	.514	.492	.517	.619	.569
Listening Challenges	.475	.466	.471	.571	.528
Reading Challenges	.499	.471	.520	.590	.552
CLIL Productive Skills: Overall	.544	.506	.476	.611	.570
Writing Challenges	.512	.500	.482	.603	.557
Speaking Challenges	.508	.449	.412	.551	.512

Note. Bias-corrected and accelerated (BCa) bootstrap 95% Confidence Intervals (Cis), which were based in 167 bootstrap samples All $p < .01$ (2-tailed).

also displayed a positive correlation with the challenge in receptive skills (r_s = .492, 95% BCa CI [.350, .607], p < .001) and productive skills (r_s = .506, 95% BCa CI [.360, .620], p < .001). Self-preparation also positively correlated with challenges in receptive skills (r_s = .514, 95% BCa CI [.375, .611], p < .001) and productive skills (r_s = .544, 95% BCa CI [.421, .644], p < .001).

4.3. Predicting L2 proficiency and academic performance by students' self-regulation levels

4.3.1. Self-Regulation levels as a predictor of L2 proficiency

This study explored the relationship between students' self-regulation levels and L2 proficiency through multiple regression analysis. The self-regulation constructs (self-preparation, self-monitoring, self-reflection, and motivation) were predictors and L2 proficiency scores as the outcome variable. The model was statistically significant, accounting for 10.7% of the variance in L2 proficiency scores (F (4, 163) = 4.663, p < .001, R^2 = .107, $R^2_{adjusted}$ = .084). Motivation was found to significantly predict L2 proficiency scores (b = .327, p < .001), indicating that for every one-point increase in motivation, there was a predicted increase of .327 points in L2 proficiency. In contrast, self-preparation (b = –.055, p > .05) and self-monitoring (b = –.115, p > .05) were associated with predicted decreases in L2 proficiency scores and were statistically non-significant. Similarly, the predicted increase associated with self-reflection (b = .013, p > .05) was also statistically non-significant. Note that the results represent the unique representation of each self-regulation construct, controlling for the effects of the other three. The impact of each predictor on L2 proficiency scores is distinct and independent of the others (see Table 3).

4.3.2. Self-Regulation levels as predictors of content subject achievement

The study also explored the relationship between the same self-regulation constructs and content subject achievement. The analysis resulted in a significant regression equation, explaining 20% of the variance in content subject achievement (F (4, 163) = 9.77, p < .001, R^2 = .200, $R^2_{adjusted}$ = .180). Similar to the L2 proficiency findings, motivation was a significant predictor (b = .455, p < .001). This suggests that for every one-point increase in motivation, students' content subject achievement is predicted to increase by .455 points. Conversely, the potential decreases in content subject achievement associated with increased self-preparation (b = –.008, p > .05), self-monitoring (b = –.071, p > .05), and self-reflection

Table 3. Multiple regression output: Self-regulation constructs and L2 proficiency.

				Std. Error of the Estimate	Unstandardised coefficients		Standardised coefficient		
	R	R^2	ΔR^2		B	Std. Error	β	*t* value	*p* value
(Constant)	.328	.107	.084	14.474	54.439	3.671		14.831	<.001
Self-preparation					–.055	.131	–.076	–.424	.672
Self-monitoring					–.115	.131	–.166	–.871	.385
Self-reflection					.013	.129	.018	.098	.922
Motivation					.327	.088	.469	3.696	<.001

Note. Dependent variable: L2 English score.

($b = -.078$, $p > .05$) were not statistically significant (see Table 4). Similarly and importantly, these coefficients reflect the unique effect of each construct on content subject achievement after controlling for the others in the model.

5. Discussion

5.1. Linguistic challenges in CLIL

This study is among the first to shed light on the linguistic challenges perceived by secondary school students in CLIL programmes. Statistical analysis showed that students generally face similar challenges across the four language skills, with listening identified as the most challenging, particularly in the mostly-EMI school (i.e. School A). This finding is consistent with previous research on CLIL classroom interaction, which noted the predominance of teacher talk, regardless of whether the teachers were native or non-native speakers (An et al. 2021; Lo and Macaro 2015; Pun and Macaro 2019). Listening, being ephemeral and beyond student control, can pose high demands when content is delivered in a second or an additional language. This challenge may be particularly acute in the context of teacher-dominant classrooms and for less capable learners who require more scaffolding from peers and teachers. Additionally, the study found that students in the mostly-EMI school perceived reading and listening as more challenging than their counterparts in EMI-by-class schools. This could be due to the higher demands on reading comprehension and interpreting complex texts in mostly-EMI school(s), where a strict English-only policy is enforced, compared to EMI-by-class schools where L1 is occasionally used for clarification. Lin (2015) also highlights the importance of L1 in CLIL for expanding students' communicative repertoire, suggesting the need to re-evaluate pedagogical practices and language policies in CLIL contexts to support students' holistic linguistic development.

5.2. Self-regulation and linguistic challenges in CLIL

The study further explored the relationship between self-regulation and perceived linguistic challenges among CLIL students. A notable finding was the moderate positive correlation between levels of self-regulation and the perception of difficulties, particularly in receptive skills. This suggests that more self-regulated students are acutely aware of the linguistic aspects of their content learning. Clarkson's (2007) study also showed that high-ability bilingual students can compare the language structures, leading to a deeper metalinguistic

Table 4. Multiple regression output: Self-regulation constructs and content subject scores.

				Std. Error of the Estimate	Unstandardised coefficients		Standardised coefficient		
	R	R^2	ΔR^2		B	Std. Error	β	*t* value	*p* value
(Constant)	.448	.200	.180	15.39	51.404	3.833		13.41	<.001
Self-preparation					−.008	.138	−.009	−.055	.956
Self-monitoring					−.071	.137	−.095	−.521	.603
Self-reflection					−.078	.132	−.099	−.590	.556
Motivation					.455	.095	.587	4.807	<.001

Note. Dependent variable: Content subject score

awareness of different languages. In CLIL, the more heightened metalinguistic awareness can positively influence content knowledge and cognitive development (Murray 2010; Surmont et al., 2014; Ter Kuile et al. 2011).

Motivation was found to have the most significant link, indicating that students with higher motivation levels are more conscious of the challenges they face in CLIL learning. This can be attributed to the theoretical underpinnings of CLIL—the communicative language teaching (CLT) approach (Coyle et al. 2010), which posits that content provides authentic contexts for meaningful L2 communication. Engaging with interesting content allows CLIL students to get more exposure to L2 input and more opportunities for active learning. Thus, this deep engagement may make them more likely to encounter and recognise language challenges. Nonetheless, students in L2-based content learning can overcome linguistic challenges 'through a combination of strong motivation, hard work, and effective learning strategies' (Evans and Morrison 2011, p. 198). Increased motivation can encourage CLIL students to actively engage in self-regulation and problem-solving.

This study also suggests directing attention to the often-overlooked constructs of self-regulation in CLIL: self-preparation and self-reflection. Both were found to have a positive relationship with identifying linguistic challenges. The positive correlation between self-preparation and linguistic challenges can be interpreted as a positive sign as students are more self-prepared, they may be more cognizant of language challenges in their learning. For self-reflection, Bandura (1986) also posits that it is the most significant and central capability in shaping human behaviour. Regular self-reflection on their learning process allows CLIL students to enhance their metalinguistic awareness and learning regulation.

5.3. The role of self-regulation in Predicting L2 proficiency and content knowledge

The study examined self-regulation and its constructs as predictors of outcomes in CLIL, revealing that students' self-regulation levels significantly influenced their L2 English proficiency and content subject achievement. Motivation was found to be the strongest predictor, which can be explained by students' recognition of the opportunity to acquire subject knowledge through authentic and meaningful language use (Bonces 2012). These motivated students might show a greater tendency to engage with the content, persevere through challenges, and employ effective learning strategies. Such involvement is likely to directly influence their success in CLIL outcomes. It also aligns with the finding of Somer and Llinares (2021) that students' intrinsic enjoyment of the integration of content and language in their learning is a second driving force for pursuing CLIL behind instrumental motivation.

Furthermore, our findings are consistent with studies on self-regulation in EMI, or L2-based content learning in general, at the tertiary level. For example, Soruç et al. (2022) demonstrated that non-linguistic factors such as self-regulation and self-efficacy accounted for 26% of the variance in EMI success, whereas the findings in our study explained 20% of the variance in content subject performance and approximately 10% in L2 proficiency. Thompson et al. (2022) also identified a significant relationship between self-efficacy beliefs and EMI success in a Japanese university context, suggesting that increased motivation is associated with enhanced EMI outcomes. Our study thus further supports the notion that an improvement in students' self-regulation skills and motivation levels corresponds with their success in L2 proficiency and content knowledge in any type of L2-based content learning.

It is important to note that the absence of predictive powers from self-preparation, self-monitoring, and self-reflection may not negate their relevance to learning. Their impact might be indirect, multifaceted, or moderated by factors not captured in this model. For instance, their influence could be more cumulative or manifest over a longer term, which may not be fully observable in a cross-sectional study. This perspective is supported by qualitative research, such as that by Hu and Gao (2018), which observed that high-achieving students in Hong Kong secondary schools employed a broad range of strategic processes for self-regulating their academic writing, suggesting that self-regulation strategies may indeed moderate the performance of secondary school students in CLIL.

5.4. Pedagogical implications

To address the linguistic challenges faced by CLIL students and enhance their self-regulatory practice, effective teaching and learning approaches are suggested. Given the particular difficulty of listening, CLIL teachers should consider using multimodal teaching materials instead of relying solely on traditional lecturing. Incorporating translanguaging practices, such as the flexible use of multiple communicative resources (L1, L2, visuals, graphs, diagrams), can facilitate co-construction of knowledge and transcend the limitations of strict school EMI policies (Lin and Lo 2017; Tai & Wei, 2021).

The Multimodalities/Entextualisation Cycle (MEC), developed by Lin (2015), is a valuable strategy that uses textual and multimodal elements to mediate academic content through three stages: creating a rich experiential context using multimodalities, engaging students in understanding an L2 academic text and unpacking it using everyday language and multimodalities in both their L1 and L2, and involving them in recontextualising the experience using academic genres, supported by language scaffolding. This approach may alleviate CLIL students' listening challenges by providing multimodal scaffolding and simplifying reading tasks by translating complex L2 academic texts into everyday L1 and L2 spoken and written language. It also enhances students' speaking and writing skills, thereby providing comprehensive linguistic support in CLIL settings. Moreover, MEC promotes active student engagement as students learn by doing, enhancing their self-regulation and motivation through structured learning processes involving self-preparation (previewing with multimodal resources), self-monitoring (adjusting their strategies during interactive text analysis), and self-reflection (evaluating their learning). Recognising small successes after each learning experience can boost students' motivation and self-efficacy, fostering their self-regulatory practices and continued effort in CLIL.

6. Conclusion

This study provides critical and novel insights into the interplay between students' self-regulation levels, linguistic challenges and learning outcomes in CLIL. While prior research suggested that CLIL tends to favour higher-achieving students, our findings reveal that enhancing self-regulation skills can aid all learners in attaining better L2 proficiency and content knowledge. By promoting self-regulatory practice, CLIL can serve as a promising pedagogical approach for fostering educational equity. This study also responds to Pérez Cañado's (2023) call about 'whether and how CLIL has the potential to work with all types of achievers' (p.362), presenting self-regulation as a key strategy for success in CLIL learning.

However, several limitations should be acknowledged. The reliance on self-reported measures may lead to bias towards socially desirable responses, indicating a need for future research to incorporate more objective measures such as observational data or microanalytic assessments. Additionally, the cross-sectional design may limit the ability to establish causal relationships, pointing to the need for longitudinal research to fully understand the dynamics between self-regulation and CLIL outcomes. Furthermore, while our study makes methodological contributions in measuring CLIL's linguistic challenges and self-regulation skills, the generalisability of our findings is subject to the inherent flexibility of CLIL across different educational contexts. Future replication studies should be conducted in diverse settings and with varied student demographics to confirm the robustness and wider applicability of our conclusions.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendices

CLIL Linguistic Challenges Scale

(1 = Very difficult; 2 = Difficult; 3 = Neutral; 4 = Easy; 5 = Very Easy)

CLIL Writing Challenges

- Planning written English assignments of content subjects.
- Expressing ideas in correct English in content subjects.
- Revising written work in English of in content subject assignments.
- Expressing ideas clearly and logically in content subject assignments.
- Linking sentences smoothly in content subject assignments.

CLIL Reading Challenges

- Understanding specific vocabulary in content subjects.
- Working out the meaning of difficult words in content subjects.
- Reading carefully to understand a text of content subjects.
- Reading quickly to find specific information in a text of context subjects.
- Identifying the key ideas of a text of content subjects.
- Understanding the organisation of a text of content subjects.

Academic Speaking Challenges

- Speaking accurately (grammar) in English in content classes.
- Speaking clearly (pronunciation) in English in content classes.
- Presenting information/ideas in English in content classes.
- Participating actively in discussion in content classes.
- Communicating ideas fluently in English.
- Asking questions in English in content classes.
- Answering questions in English.
- Communicating ideas confidently with teachers and classmates in English in content classes.

Academic Listening Challenges

- Understanding the main ideas told by teachers in English in content classes.
- Understanding key vocabulary in content classes.
- Taking brief, clear notes in content classes.
- Understanding teacher(s)' accents in content classes.
- Following the pace of a discussion in content classes.
- Identifying different views and ideas in content classes.
- Understanding teachers' and classmates' questions in content classes.

CLIL Self-Regulation Inventory

(from 1-100 - Not Accurate at all--Slightly accurate--Moderately accurate--Very accurate--Extremely accurate)

CLIL Preparation

- I organise my time to best accomplish my goals for content subject learning.
- I read instructions carefully before I begin a task in the content subject learning.
- Before solving a content subject problem, I eliminate information in the problem that I do not need.
- Before solving a content subject question, I think about what a several ways to solve a problem and solve the best one.
- Before I start solving a content subject problem, I plan out how I am going to solve it.

CLIL Monitoring

- While learning content subjects, I ask myself questions about 'how well I am doing'.
- While learning content subjects, I ask myself if I am meeting my goals.
- I consider several alternatives to a content subject problem before I answer.
- I ask myself if I have considered all options when solving a problem.
- I find myself analysing the usefulness of strategies while I study content subjects.
- I find myself pausing regularly to check my comprehension of content subjects.
- After solving a content subject problem, I double check my answer.

CLIL Reflection

- I ask myself if there was an easier way to do things after I finish a task in content subjects.
- I summarise what I've learned in content subjects after I finish.
- I ask myself how well I accomplish my goals once I'm finished learning content subjects.
- After solving a content subject problem, I look back to see if I did the correct procedures.

CLIL Motivation

- I believe I will receive an excellent grade in content subject classes.
- I'm confident I can understand the basic concepts taught in content subjects.
- I'm confident I can understand the most complex concepts in content subject classes.
- I'm confident I can do an excellent job on the assignments and tests in content subject learning.
- I'm certain I can master the skills being taught in content subject classes.
- Considering the difficulty of content subjects, the teacher, and my ability, I think I will do well in the class.