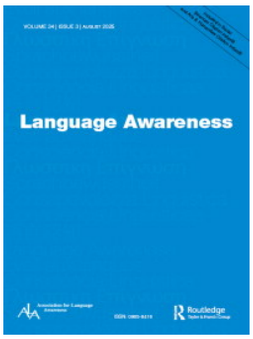

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Exploring the benefits of translanguaging pedagogies on secondary-school students' metalinguistic awareness: the role of language learning aptitude and vocabulary knowledge

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ABSTRACT

While translanguaging pedagogies have gained traction among stakeholders as effective tools for teaching content and language leveraging students' linguistic repertoire, there is a limited body of quantitative evidence on their impact on students' cognitive and linguistic development. Moreover, the mechanisms driving these potential benefits are still unclear. This study explores whether secondary-school students who have been exposed to translanguaging pedagogies over four years (target group) demonstrate superior metalinguistic awareness (MLA) compared to their peers in traditional, monoglossic education (control group). Additionally, the study examines how language-learning aptitude and vocabulary knowledge mediate the effect of the educational context on students' performance in a MLA test, based on the hypothesis that these variables influence MLA rather than the other way round. The findings reveal that students in the target group outperformed their control group peers in both MLA and language-learning aptitude. The positive impact of translanguaging pedagogies on MLA was mediated by an enhancement in language-learning aptitude, suggesting that one mechanism through which translanguaging fosters MLA is by strengthening language-learning aptitude. Furthermore, students in the target group were more likely to leverage their vocabulary resources during the test. All the benefits of translanguaging pedagogies stem from their capacity to foster cross-linguistic awareness.

ABSTRACT (ITALIAN)

Negli ultimi anni, la pedagogia del translanguaging ha guadagnato consenso tra gli educatori come approccio efficace per l'insegnamento dei contenuti disciplinari e linguistici, valorizzando l'intero repertorio degli studenti. Tuttavia, le evidenze quantitative sul suo impatto sullo sviluppo cognitivo e linguistico degli studenti restano ancora limitate, così come la comprensione dei meccanismi che ne determinano i potenziali benefici. Questo studio esamina se gli studenti della scuola secondaria di primo grado che hanno seguito un percorso educativo basato sul translanguaging per quattro anni (gruppo target) abbiano sviluppato abilità metalinguistiche superiori rispetto ai loro coetanei

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inseriti in un sistema educativo tradizionale e monoglossico (gruppo di controllo). Inoltre, analizza il ruolo di variabili come la predisposizione all'apprendimento delle lingue e la conoscenza del vocabolario nel mediare l'effetto del contesto educativo sulla performance in un compito di consapevolezza metalinguistica, sulla base dell'ipotesi che tali variabili contribuiscano allo sviluppo della consapevolezza metalinguistica, e non viceversa. I risultati mostrano che gli studenti del gruppo target hanno ottenuto prestazioni superiori sia nel compito di consapevolezza metalinguistica che nella predisposizione all'apprendimento linguistico. In particolare, l'effetto positivo del translanguaging sulla consapevolezza metalinguistica risulta mediato dal potenziamento delle capacità di apprendimento linguistico, suggerendo che il rafforzamento di tali abilità rappresenta un meccanismo chiave attraverso cui il translanguaging favorisce lo sviluppo metalinguistico. Inoltre, gli studenti del gruppo target hanno dimostrato una maggiore capacità di sfruttare le proprie risorse lessicali per affrontare il compito. Questi risultati evidenziano il ruolo cruciale della pedagogia del translanguaging nel promuovere la consapevolezza cross-linguistica in classe.

PLAIN LANGUAGE SUMMARY

Translanguaging pedagogies integrate students' entire linguistic repertoire when teaching both language—whether the main language or a foreign language in the curriculum—and subject content. In recent years, these approaches have gained popularity among educators, who recognise their benefits for students' learning and well-being. However, research on their effectiveness remains limited, particularly regarding their impact on students' cognitive and linguistic development. This study compares two groups of secondary-school students: one that experienced four years of translanguaging-based instruction and another that followed a traditional, monolingual approach. We assessed both groups on vocabulary knowledge, language-learning aptitude, and metalinguistic awareness. Language-learning aptitude refers to an individual's capacity to acquire languages quickly and efficiently, while metalinguistic awareness is the skill to reflect on the form, nature and function of language. The results reveal that students exposed to translanguaging outperformed their peers in both metalinguistic awareness and language-learning aptitude. Notably, our analysis indicates that translanguaging fosters metalinguistic awareness primarily by enhancing students' aptitude for language learning. Furthermore, students in the translanguaging group made better use of their vocabulary knowledge to complete the tasks. These findings highlight how translanguaging not only strengthens students' ability to reflect on how languages function but also makes them more flexible and resourceful language learners, turning them into young language experts.

Introduction

Over the past two decades, education has experienced a 'multilingual turn', reflecting the growing linguistic diversity in schools as a result of increased mobility and migration. Despite this turn, a widespread belief persists that teaching and learning are most effective when conducted exclusively in a monolingual mode, that is, through the use of only one language at a time –whether the majority language(s) of schooling (e.g. Italian in public schools in Italy) or a foreign language taught as part of the curriculum (May, 2016). However, an increasing number of educators have begun to move away from strict language separation in the

classroom, recognising students' multilingualism as a valuable resource for both language and content learning (García & Wei, 2014; Moraru et al., 2025; Veerman et al., 2025).

Several pedagogical approaches have emerged in response to this perspective shift, such as the 'awakening to languages' (Candelier, 2003; Little & Kirwan, 2019) and translanguaging pedagogy (Cenoz & Gorter, 2022; García & Wei, 2014). While these approaches have gained significant traction (Treffers-Daller, 2025), research on their benefits for student learning has predominantly relied on qualitative and mixed-method studies. Quantitative evidence remains scarce, particularly regarding the extent to which multilingual pedagogies contribute to students' linguistic and cognitive development.

This study aims to address this gap, by investigating whether pedagogical translanguaging enhances students' metalinguistic awareness (MLA, henceforth), defined as the ability to reflect on the nature, form and function of language ('Metalinguistic awareness, implicit language knowledge and language aptitude' section). We focus on MLA because its development involves the interaction of linguistic factors (e.g. implicit syntactic knowledge) and cognitive skills (e.g. metacognition and knowledge redescription) (Bialystok, 2001; Karmiloff-Smith, 1992; Simard et al., 2017). This interplay makes MLA a particularly insightful measure for examining students' linguistic and cognitive development.

The study focuses on students who had engaged with translanguaging pedagogies for nearly four years within the framework of the *L'AltRoparlante* project, where these practices were integrated into their regular classroom activities ('The context: the project *L'AltRoparlante*' section). Their MLA was compared with that of a parallel class in the same school, where students were taught through what we refer to as 'monoglossic' pedagogies. By 'monoglossic', we do not mean that foreign languages were absent from the curriculum: English and French were indeed taught. Rather, monoglossic pedagogies are characterised by language separation, such that students' full linguistic repertoires are not leveraged across classroom activities, whether in the main language of instruction or in foreign language classes (Cummins, 2019 for similar usage). By comparing these two groups, we aimed to determine whether translanguaging pedagogies foster students' MLA.

Since students exposed to translanguaging pedagogies outperformed their peers in monoglossic settings in MLA ('Results' section), we further investigated the underlying reasons for this advantage. Specifically, we examined factors known to influence MLA, such as language proficiency and language learning aptitude, based on the hypothesis that these variables influence MLA rather than the other way round. First, we analysed whether these factors affected MLA differently across the two educational contexts, aiming to determine whether the development trajectory of MLA was shaped by the type of language instruction students received. Second, we conducted a mediation analysis to assess whether the effect of educational context on MLA could be explained by its impact on vocabulary knowledge and/or language learning aptitude, which, in turn, influenced students' MLA performance.

Metalinguistic awareness, implicit language knowledge and language aptitude

Like other aspects of metacognition, MLA comprises two components (Flavell, 1979): a control component, which allows individuals to 'stand back' and treat language as an object of thought that can be monitored, controlled, and manipulated; and a knowledge component, which refers to an individual's awareness of the nature, form, and function of language (Gombert, 1992; Roehr-Brackin, 2025). One example of MLA is the ability to notice, correct,

and explain ungrammaticalities or inaccuracies in a sentence. These processes engage both attention to linguistic form (control) and awareness (knowledge) of whether a given form-function mapping is acceptable in the target language (Simard et al., 2017; Torregrossa et al., 2023). Another example is the ability to monitor language use and reflect explicitly on form-function relationships, such as recognising that a single meaning may be conveyed by different forms (as with synonyms; Doherty & Perner, 1998), or that a given form may carry ambiguity depending on context (Karmiloff-Smith et al., 1993). Depending on the domain of language that is the object of control and knowledge, a distinction is usually made between metaphonological, metasyntactic, metasemantic and metapragmatic awareness (Gombert, 1992).

From a developmental perspective, MLA builds upon implicit language knowledge, defined as the 'unconscious processes of understanding and producing sentences' (Simard et al., 2017, p. 440). Through a process of knowledge redescription, children gradually transform this implicit knowledge into an object of cognitive attention. Over time, this knowledge becomes increasingly structured, abstract and verbalisable (Gombert, 1992; Goujon et al., 2014; Karmiloff-Smith, 1992). In other words, implicit knowledge *in* children's mind progressively becomes explicit knowledge *to* their mind (Karmiloff-Smith, 1992).

In second language acquisition, Ellis (2004) similarly distinguishes between levels of explicit language knowledge, introducing the concepts of *analysed knowledge* and *metalanguage*. The former refers to a conscious awareness of grammatical rules or features, which supports tasks such as grammaticality judgement (particularly in untimed tasks), error detection, and correction. Metalanguage, on the other hand, entails the ability to explain why a sentence is ungrammatical, reflecting a deeper, conceptual understanding of language structure. Thus, analysed knowledge and metalanguage represent varying degrees of awareness and learning depth. While error identification and correction rely on noticing and reporting, metalanguage draws on awareness at the level of understanding (Leow, 2015).

When considering the development of MLA in children, literacy emerges as a key factor (Birdsong, 1989; D'Souza & Filippi, 2017; Karmiloff-Smith, 1992; Melogno et al., 2022): Learning to read and write fosters a symbolic and decontextualised representation of language, which encourages children to view it as an object that can be consciously monitored, analysed, and manipulated. In addition, literacy development in educational settings is closely linked to exposure to metalanguage. Teachers usually refer to grammatical categories such as *noun*, *verb*, *subject*, and *object*, thereby providing children with a linguistic toolkit for reflecting on the form and function of language at a 'deep' level, as discussed earlier. Finally, schooling often involves the acquisition of additional languages, further supporting the development of MLA (Roehr-Brackin, 2025), as language learning typically demands conscious attention to form-function mappings in the target language, particularly when compared to learners' first language (Ellis, 2004; Gutiérrez, 2016; Torregrossa et al., 2023).

Children's multilingual experiences can enhance their cross-linguistic awareness, a component of MLA that involves reflecting on and understanding the similarities and differences among the languages in their environment (Angelovska & Hahn, 2014; see also Hofer, 2025; Jessner, 2006). Here, we adopt a broad definition of multilingual experience, encompassing exposure to more than one language at home or at school. In the school setting, this may include formal instruction in foreign languages (as was the case of the school where the present study was conducted), as well as informal exposure through peers who

bring diverse linguistic backgrounds into the classroom. Teachers may recognise, value, and integrate these languages into both content and language learning (Cenoz & Gorter, 2022).

From the preceding discussion, several factors have emerged as predictors of children's MLA, including cognitive maturation, implicit language knowledge, literacy, and multilingual exposure. In the present study, we also explored the role of language learning aptitude (see, however, Calafato, 2025 for an alternative conceptualisation, with MLA affecting language learning aptitude, rather than the other way around). This aptitude is typically described as a set of cognitive abilities that enable some individuals to acquire languages more quickly and easily than others (Dörnyei, 2005; Tellier & Roehr-Brackin, 2013; Wen et al., 2017). According to Carroll (1973), language learning aptitude encompasses four main abilities: phonetic coding, associative memory, grammatical sensitivity, and inductive language learning. Findings on the relationship between language learning aptitude and MLA remain inconclusive. Some studies suggest that the two are overlapping constructs, as both involve language analysis (Jessner, 2006; Ranta, 2002; Roehr-Brackin & Tellier, 2019). In contrast, other research has found either no significant correlation or only marginal associations between the two (El Euch, 2018). Notably, Carroll (1981) argued that, unlike MLA, which is shaped by developmental factors, language learning aptitude is largely innate and remains stable over time. By contrast, the relationship between language learning aptitude and grammatical proficiency in both L1 and L2 appears to be less contested, with studies consistently reporting positive correlations (Dąbrowska, 2018; Li, 2015 for L2; Llompart & Dąbrowska, 2023 for L1).

The factors influencing variation in children's MLA extend beyond those discussed here, encompassing a broad range of cognitive, linguistic, sociolinguistic and educational variables (Bialystok, 2001; Chaney, 1994; Doherty & Perner, 1998; Torregrossa et al., in press). In this study, we focus on a specific aspect of children's language experience: the pedagogical environment in which they are immersed.

Benefits of multi/plurilingual pedagogies on metalinguistic awareness

When Coste et al. (1997/2009) introduced the concept of plurilingual and intercultural competence in a foundational study for the Common European Framework of Reference for Languages (CEFR), they described it as 'a life-long capital and a complex and unique reservoir of co-ordinated experiences, developing differently in relation to individual biographies, social trajectories and life paths' of a plurilingual social agent. This marked a pivotal step in advancing the so-called multi/plurilingual turn, which has begun to shape educational policy over the past decade and is gradually influencing educational practices (Conteh & Meier, 2014; Lüdi, 2021).

Despite being grounded in seemingly different epistemological assumptions, numerous projects and initiatives have emerged from this international debate, ultimately sharing a common commitment to integrating linguistic diversity as a cognitive resource in schools, fostering equitable education, and supporting the identity affirmation of minoritised students (Cummins, 2021). In the present study, we adopt the umbrella term of *multi/plurilingual pedagogies* to encompass such projects and initiatives. This term, used by several scholars, serves to transcend the ideological tension between *plurilingualism* and *multilingualism* (Erling & Moore, 2021; Marshall, 2021). In doing so, we place the two concepts in dialogue

with one another, consistent with the orientation of the *L'AltRoparlante* project ('The context: the project *L'AltRoparlante*' section).

Among the various multi/plurilingual initiatives worldwide, two are particularly noteworthy. The first is the set of projects based on the pluralistic approaches promoted by the Council of Europe (Candelier et al., 2012), particularly the *éveil aux langues* (awakening to languages). Rooted in the concept of metalinguistic inquiry, these initiatives encourage students to analyse languages beyond those they already know, identifying similarities, differences, and linguistic functions (Candelier & Kervran, 2018). The second is translanguaging pedagogy, introduced through the CUNY-NYSIEB project in New York. By rejecting monoglossic ideologies, this approach aims to create an educational environment that both reflects and leverages the actual multilingual practices of emergent bilingual students (CUNY-NYSIEB, 2020). Two key aspects distinguish translanguaging pedagogy within the broader landscape of multi/plurilingual education. First, all linguistic and semiotic resources in students' repertoires—including multilingual and multimodal ones—contribute to the construction of meaning and support cognitive processes at both lower and higher levels (Anderson & Krathwohl, 2001). Second, translanguaging pedagogy incorporates a strong and explicitly critical dimension of civic engagement (Phyak et al., 2023, p. 223). While this partially aligns with the European conceptualisation of plurilingualism—particularly with respect to learner agency—it assumes a more radical orientation in the North American articulation of translanguaging (Flores & Rosa, 2015; García, 2009).

Several studies on pedagogical interventions adopting multi/plurilingual approaches have examined their benefits for the development of MLA. These pedagogies promote interactional patterns between students and teachers that foreground cross-linguistic comparisons and explicit metalinguistic reflection (Nap et al., 2025). For example, Candelier (2017) showed that children exposed for at least 35 hours to *éveil aux langue* activities—including tasks in languages not officially part of the school curriculum—developed a heightened ability to distinguish sounds, though they did not show the same progress in metasyntactic awareness. Similarly, Parra and Proctor (2021) found that translanguaging-based practices in English reading lessons for bilingual English-Spanish students made target linguistic structures more salient, thereby enhancing their awareness of morphemes and syntactic features in both languages.

Leonet et al. (2020) investigated morphological awareness in English among fifth and sixth years of primary education students (age 10) engaged in activities in English, Basque, and Spanish through a translanguaging-based approach. The students in the experimental group outperformed the control group on a word formation task and on a subset of morpheme identification items. Expanding on this research, Cenoz et al. (2022) examined cognate awareness using a think-aloud protocol with fifth grade students from a similar linguistic background. Over a 12-week period, the experimental group participated in translanguaging-based activities. Although they did not score significantly higher than the control group in cognate identification, they demonstrated better MLA during task verbalisations, explicitly using the term *cognate* and offering more in-depth explanations of cross-linguistic word relationships across the three languages. On the other hand, some studies have not found clear advantages of multi/plurilingual pedagogies. Hopp et al. (2021), for instance, tracked 128 fourth-grade students in Germany, both majority-language (German only) and minority-language speakers, over six months of English as a Foreign Language instruction. In the

intervention group, approximately 20% of class time incorporated students' minority languages through translanguaging activities. Both majority- and minority-language learners showed significant improvements in English vocabulary, grammar, and MLA. However, likely due to the limited extent of the intervention, the translanguaging group did not significantly outperform the control group, which received traditional English-only instruction. Importantly, the study also confirmed that the intervention had no detrimental effects.

Finally, qualitative research based on Conversation Analysis conducted within the same project (the *L'AltRoparlante* Project, 'The context: the project *L'AltRoparlante*' section) revealed that primary school students engaged in activities grounded in intercomprehension and translanguaging pedagogy were able to produce remarkably sophisticated metalinguistic reflections, including the use of metalanguage (Facciani, 2025). These findings provided the rationale for the present, more quantitatively oriented study.

The study

The study employed a between-groups design, comparing MLA of a target group (students exposed to translanguaging-based pedagogies) with that of a control group (students exposed to traditional monoglossic pedagogies, see 'Introduction' section for definition). The first research question addressed whether the target group demonstrated superior MLA compared to the control group:

> **RQ1:** Do students who have been exposed to translanguaging pedagogies for four years exhibit higher levels of MLA than students who have experienced traditional monoglossic pedagogies?

In addition to this comparison, we also investigated whether vocabulary knowledge—used here as a proxy for students' implicit language knowledge (see 'Metalinguistic awareness, implicit language knowledge and language aptitude' section)—and language learning aptitude influenced MLA differently across the two groups. This analysis aimed to clarify whether these two cognitive and linguistic variables contribute to variation in MLA in distinct ways, depending on students' educational contexts. Our second research question is therefore:

> **RQ2:** Do vocabulary knowledge and language learning aptitude contribute differently to MLA in students from the two educational backgrounds?

The third research question focused specifically on how the educational context influences students' MLA. We examined whether this influence was direct or whether it was mediated by key variables in the study, namely vocabulary knowledge and language learning aptitude, or both. This analysis aimed to identify the mechanisms through which educational context shaped students' MLA. Accordingly, we formulated our third research question as follows:

> **RQ3:** How does the educational context influence MLA in the two programs, and to what extent do vocabulary knowledge and language learning aptitude mediate this effect?

It is important to note that this study did not follow a pretest-posttest design, as no test for MLA was administered before the start of the intervention. Rather, the study was

based on a comparison between two groups after the intervention. To account for this limitation, we ensured that the two groups were comparable with respect to other factors that may influence MLA, such as age, language background, language constellation in the classrooms, socioeconomic status (SES), and literacy outcomes (e.g. reading comprehension in languages taught within the curriculum, such as Italian and English; 'Participants' section). It is also important to note that the study was based on a comparison between two intact classes. While this may raise concerns about validity—specifically, the lack of researcher control over participants' assignments to groups—it reflects the structure of the educational setting in which the study was conducted and hence enhances its ecological validity (J. Rogers & Révész, 2020). In the Italian school system, class assignment is typically randomised, as the selection is not based on academic performance, language background or other individual characteristics. Likewise, the adoption of translanguaging-based pedagogies in one classroom, and not in the other, emerged based on teacher preference (see 'The context: the project *L'AltRoparlante*' section) and not as part of a researcher-led intervention.

The context: the project L'AltRoparlante

L'AltRoparlante is a transformative action-research project led by the University for Foreigners of Siena that has promoted multilingual education from early childhood to lower secondary schooling, particularly in institutions with many emergent bilingual students from migrant backgrounds (Carbonara & Scibetta, 2022). Described by Cummins (2021) as 'the most comprehensive empirical investigation of translanguaging to date' (p. 340), the project is grounded in translanguaging pedagogy following the CUNY-NYSIEB framework (García et al., 2017), and draws on the plurilingual and intercultural principles of the Council of Europe (Byram et al., 2023). Its primary goal is to incorporate students' home languages into curricular practices, fostering multilingualism as a cognitive resource and promoting openness towards linguistic diversity.

The network currently involves six core schools that applied voluntarily through their principals, alongside a broader network of affiliated schools engaged in parallel sub-projects. After an initial yearly training, the research team provides monthly site visits and collaborative planning sessions with teachers, families, and language mediators. The curriculum is reinterpreted through a multi/plurilingual lens across linguistic and non-linguistic subjects, with the degree of translanguaging integration varying by teachers' availability and expertise.

Among the tools used to design activities, teachers draw on FREPA/CARAP (Candelier et al., 2012), which offers descriptors of knowledge, attitudes, and skills for plurilingual and intercultural education, and on Anderson and Krathwohl's (2001) revision of Bloom's cognitive taxonomy. The research team mapped FREPA/CARAP descriptors onto lower- and higher-order linguistic-cognitive processes to guide age-appropriate tasks. Table A1 in Appendix A presents examples of activities organised by increasing cognitive complexity. Overall, the project seeks to move beyond a translational approach by engaging all languages in students' repertoires through cognitively meaningful, curriculum-aligned tasks. Cross-linguistic and metalinguistic dimensions are central and are integrated explicitly and transversally, incorporating Italian, local dialects, students' home languages and curricular languages of study.

Materials and methods

Participants

Sixty-nine students (41 females) from Grade 3 of lower secondary school (the final year) participated in the study. All were enrolled in the same lower secondary school, with most having also attended the same primary school. The target group consisted of 33 students (mean age = 13.78, *SD* = 0.50), including 12 emergent bilingual students from immigrant backgrounds. These students had been continuously engaged in multilingual pedagogies through the *L'AltRoparlante* project since their final year of primary school (5th grade) and throughout lower secondary school. The control group comprised 36 students (mean age = 13.69, *SD* = 0.46), 6 of whom had an immigrant background. They were exposed to instruction exclusively in Italian across all subjects, and in the curricular foreign language classes (English and French, 3 h per week for each language) only the target language and Italian were used—the latter, for example, to provide grammatical explanations about the target language or for classroom management. For the present study, it is important to note that metalinguistic reflection and explicit grammar instruction on Italian formed part of the curricular activities in both groups. However, the pedagogical approaches differed: in the control group, instruction focused on Italian, whereas in the target group, metalinguistic reflection on Italian was carried out through the use of other languages in the classroom, thereby 'softening the boundaries' between them (Cenoz & Gorter, 2022). Therefore, any difference between the two groups in the Italian MLA test used in this study cannot be attributed to unequal exposure to metalinguistic reflection on Italian, as both groups were accustomed to engaging in such activities.

Among the students from immigrant backgrounds, home languages included Romanian, Arabic (Moroccan dialect), Albanian (for both groups), Spanish, Polish, Punjabi (for the control group only), and Ukrainian (for the target group only). To assess differences in language background among participants, a sociolinguistic questionnaire was administered to families (Carbonara et al., 2024; Torregrossa & Carbonara, 2022). The results indicated that all emergent bilinguals were born and raised in Italy, with no reported difference between the two groups in their written or oral competence in Italian, according to parental assessments. On a scale from 1 (cannot understand/read/talk/write in Italian) to 3 (fully proficient in all skills), all parents rated their children with a 3 across all language abilities. In contrast, students' exposure to their home languages varied, and parents generally perceived their children's proficiency in these languages as lower than in Italian. However, no statistically significant differences were found between the two groups of emergent bilinguals in parental ratings of either oral ($U = 13.000$, $p = .240$) or written skills ($U = 12.500$, $p = .190$).

To examine potential group differences in terms of SES and literacy outcomes, we analysed data drawn from the National Institute for the Evaluation of the Education System (INVALSI). SES is calculated by INVALSI based on several indicators, including parents' occupation, level of education, as well as the availability of study-related resources, such as a computer, a personal room, and internet access. The SES index is rated on a scale from 1 (low) to 4 (high). Regarding literacy outcomes, INVALSI provides measures of students' literacy skills in Italian, as well as their reading and listening abilities in English. Specifically, the Italian INVALSI test involves the reading of medium-length to long historical or literary texts, followed by questions assessing both overall comprehension and specific lexical aspects, particularly the

identification of synonyms for adjectives or nouns and the use of connectives. No items target explicit metalinguistic knowledge. For the present study, the INVALSI data were collected simultaneously with our own dataset.

Research instruments

In this study, we employed the following instruments to assess participants' metalinguistic, linguistic and language learning aptitude abilities:

- Selected sections of the TAM-2 test (Pinto et al., 2003), an Italian metalinguistic assessment tool;
- TEST E and F of the LLAMA test (Meara, 2005), which evaluates language learning aptitude;
- The verbal comprehension section of the Primary Mental Abilities test in its Italian version (Rubini & Rossi, 1982), used to assess receptive vocabulary.

The TAM-2 is a comprehensive tool designed to assess MLA in Italian children aged 9 to 14. It includes six subtests (Comprehension, Synonymy, Acceptability, Ambiguity, Grammatical Function and Phonemic Segmentation). Our study focused on the first five subtests, as our primary interest was metasyntactic and metasemantic awareness rather than metaphonological awareness. Completing these subtests requires both language control and domain-specific knowledge (e.g. syntax, semantics or pragmatics; 'Metalinguistic awareness, implicit language knowledge and language aptitude' section). In addition, the test draws on participants' verbalisation abilities and their use of metalanguage. Each item begins with an initial question that taps into participants' analysed language knowledge, as illustrated in (1a) below (from the Acceptability subtest). This question is classified as *linguistic*. A follow-up question then requires a more explicit evaluation of the sentence's form based on metalinguistic categories, as shown in (1b). This question is classified as *metalinguistic*.

(1) Il gatto facevano le fusa (*The cat were purring* – literal translation: *The cat were making the purring*.)
(1a) È giusta o sbagliata? Se è sbagliata, dov'è l'errore? Se la giudichi sbagliata, come bisogna correggere? (Is it right or wrong? If it's wrong, where is the mistake? If you judge it wrong, how should it be corrected?)
(1b) Perché va così? (Why is that the case?)

In this study, we concentrated exclusively on the metalinguistic scores, employing a structured scoring system:

- 0 points were assigned to responses that provided no analysis or contained irrelevant content (e.g. for item 1b above: 'perché è grammaticalmente sbagliato e senza senso' – because it is grammatically incorrect and meaningless);
- 1 point was given for responses that were partially correct, as they mentioned only one aspect of the ungrammaticality (e.g. for item 1b: 'perché il gatto è uno e non tanti' – because the cat is one and not many);

- 2 points were awarded for responses that provided a completely correct and detailed analysis (e.g. for item 1b: 'perché "facevano" si riferisce a un soggetto al plurale mentre 'gatto' è singolare' – because 'were making' refers to a plural subject, while the 'cat' is singular).

For the statistical analysis, we collapsed the 1-point and 2-point responses into a single category, as even a partial response implied verbalisation and awareness at the level of understanding ('The study' section and Torregrossa et al., 2023 for a similar methodology).

The LLAMA test is a computerised language aptitude assessment consisting of four subtests: vocabulary learning (TEST B), sound recognition (TEST D), sound-symbol correspondence (TEST E), and grammatical inferencing (TEST F). In our study, we focused exclusively on TEST E and TEST F, as they more specifically assess students' language analytic ability and grammatical sensitivity, whereas TEST B and TEST D primarily tap into memory retrieval and phonetic sensitivity (Iizuka & DeKeyser, 2024). We selected the LLAMA test as a reliable measure of language aptitude in a multilingual context. Since it is based on an unfamiliar language derived from Central American languages (Meara, 2005), it ensures that neither native Italian speakers nor emergent bilinguals have an inherent advantage (V. Rogers et al., 2017). Previous research has highlighted some internal limitations in LLAMA version 1 (Bokander & Bylund, 2020). Unfortunately, a revised version (LLAMA version 3), which addressed these issues and improved internal validity, was not released until shortly after our data collection in spring 2021 (V. Rogers et al., 2023).

In TEST E, participants are introduced to 24 syllables written in an unfamiliar alphabet. During the learning phase, they can click on each syllable to hear its corresponding sound. We allowed them to take written notes to facilitate the task, reducing its memory demands, and support their learning process. In the testing phase, the program plays a series of two-syllable words and presents two possible spellings for each. The participant must then select the correct spelling based on their learning. TEST F begins with an interactive learning phase in which participants engage with 20 abstract images, each depicting different combinations of geometric figures paired with brief descriptive sentences. Participants can take notes and analyse the relationship between the images and sentences, allowing them to reflect on syntactic and morphological features, such as word order, singular and plural forms, and prepositions. In the testing phase, the program displays new images composed of elements from the earlier phase, along with two possible descriptive sentences. The participants must then select the sentence that accurately describes the scene. For both tests, we employed a scoring system in which 1 point was awarded for each correct answer, with a maximum score of 20 points for both TEST E and TEST F.

The vocabulary test (Rubini & Rossi, 1982) was administered digitally and consisted of 50 items to be completed within 8 min. In each item, participants had to identify the word that shared the same meaning as a given target word from a set of alternatives. At the end of the allotted time, participants were required to close the application, leaving any unanswered items blank. Scoring followed a binary system, with 1 point awarded for each correct answer, while unanswered or incorrect responses received 0 points.

Statistical analysis

To address the main research questions of the study, we conducted two analyses: a generalised linear mixed-effects model and a mediation analysis. The generalised linear mixed-effects model was conducted using R (R Core Team, 2023) and the lme4 package (Bates et al., 2015). The dependent variable was the production of an accurate metalinguistic response (0 = not accurate vs. 1 = accurate). As predictors in the model, we included the interaction between group (control vs. target) and the three measures considered above: vocabulary, TEST E and TEST F. This allowed us to examine whether the effect of vocabulary or language aptitude (as measured by TEST E and TEST F) on MLA differed between the two groups. Additionally, SES was included as a fixed effect, since this variable can affect student's MLA. We specified a random intercept for participants. Vocabulary, TEST E, TEST F and SES were scaled using the *scale()* function in R. The group variable was contrast-coded as −0.5 for the control group and +0.5 for the target group.[1]

For the mediation analysis, we used the mma package (Yu & Li, 2023). Mediation analysis examines the extent to which the relationship between a predictor and an outcome variable is explained by an intermediate variable (mediator) and whether the predictor has a direct effect on the outcome after accounting for the mediator (Yu & Li, 2017). In our analysis, the predictor was group (control vs. target), representing the type of education participants received. The outcome variable was metalinguistic response accuracy (0 = not accurate vs. 1 = accurate). We selected the vocabulary score and LLAMA TEST E and TEST F scores as mediators. We used the mma function to perform the following steps: i) identifying potential mediators, based on whether a variable was significantly correlated with both the predictor and the outcome—necessary conditions for mediation; ii) estimating mediation effects across the whole dataset; iii) making inferences on the mediation effects, specifically by calculating variances and confidence intervals for the estimated mediation effects using the bootstrap method (Yu & Li, 2017).

Results

We refer to Tables B1 and B2 in Appendix B for the descriptive statistics of participants' background variables (SES, INVALSI tests, vocabulary, and LLAMA tests E and F), as well as the comparisons between the groups. In brief, there were no significant differences between the two groups in vocabulary knowledge (Italian), SES, or any of the INVALSI tests (Italian, English reading, and English listening). However, the target group outperformed the control group on both LLAMA tests. Table C1 in Appendix C presents the descriptive statistics for participants' performance in each section of TAM-2, using the original three-level scoring system discussed above (0, 1, 2). The table also includes the maximum attainable score for each section.

Factors affecting metalinguistic awareness in the control and target group

Table 1 presents the results of the generalised linear mixed-effects model. We found a significant effect of group, indicating that the target group was overall more accurate in their metalinguistic responses. Vocabulary and TEST E also had significant positive effects, meaning that higher scores in these measures were associated with greater response

accuracy. The effect of TEST F was marginally significant. Additionally, SES had a significant effect, suggesting that children from higher SES tended to provide more accurate responses. A significant interaction between group and vocabulary indicated that the effect of vocabulary on response accuracy differed between the two groups. Figure 1 displays the predicted probability of producing an accurate metalinguistic response as a function of vocabulary knowledge in Italian: increases in vocabulary were associated with a steeper rise in response accuracy for the target group compared to the control group. At higher levels of vocabulary knowledge, students in the target group appeared to leverage this knowledge more effectively in their metalinguistic responses than their peers in the control group.

Table 1. Parameters of the generalised linear mixed-effects analysis with the production of an accurate metalinguistic response as dependent variable and participants' SES, as well as the interaction between group and vocabulary, TEST E and TEST F as predictors.

Fixed effects	*b*	SE	*z*	*p*
Intercept	0.72	0.06	11.29	<.001
Group (target)	0.46	0.13	3.62	<.001
Vocabulary	0.38	0.07	5.65	<.001
TEST E	0.17	0.06	2.82	.005
TEST F	0.12	0.06	1.91	.057
SES	0.13	0.06	1.97	.049
Group (target) * Vocabulary	0.25	0.13	1.98	.048
Group (target) * TEST E	−0.06	0.12	−0.47	.64
Group (target) * TEST F	−0.03	0.13	−0.19	.85

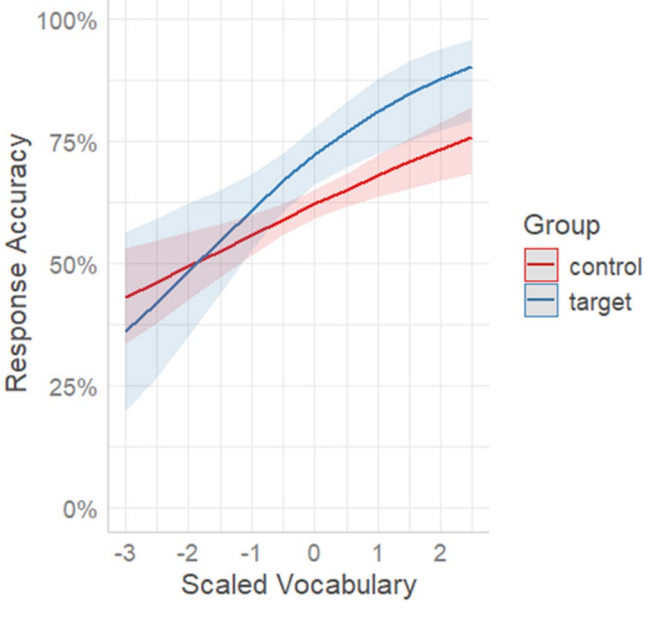

Figure 1. Predicted probabilities of an accurate metalinguistic response as a function of group (control vs. target) and vocabulary. The values for vocabulary were scaled. The shaded lines correspond to a 95% confidence interval. The predicted probabilities were derived using the ggpredict() function in the 'ggeffects' package (Lüdecke, 2018).

Mediation analysis

Table 2 presents the output of the *mma* function, distinguishing between total effects, direct effects, and relative indirect effects (i.e. indirect effects divided by the total effect). In this table, *est* represents the estimated mediation effects using the full dataset, while *mean* corresponds to the average of these estimates obtained from bootstrap samples (Yu & Li, 2017, p. 11). Additionally, the table reports quantile confidence intervals (*lwbd_q* and *upbd_q*) and significance values (*p_quant*). The direct effect of group (control vs. target) accounted for approximately 20% (CI: 12%-29%) of the total effect of group on participants' response accuracy in the MLA test. All three mediators—TEST E, TEST F, and vocabulary—had a significant relative indirect effect on response accuracy: TEST E explained about 4% of the total effect (CI: 2%-6%). TEST F accounted for around 9% (CI: 6%-12%). Vocabulary also explained 9% of the total effect (CI: 6%-12%), but its mediation effect was negative. The positive estimates for TEST E and TEST F suggest that translanguaging pedagogies (target group) exerted a positive indirect effect on response accuracy *via* these two mediators. This indicates that students exposed to translanguaging pedagogies approached the MLA task through their language learning aptitude. Conversely, the negative mediation effect for vocabulary suggests that students exposed to monoglossic pedagogies (control group) solved the MLA task by relying on their vocabulary knowledge in Italian. Figure 2 visually represents these effects, illustrating the total, direct and indirect effects along with their quantile confidence intervals.

Discussion

The first key finding of our study is that participants who had been exposed to translanguaging pedagogies for over four years exhibited significantly better MLA (RQ1, 'The study' section). They were better able to verbalise their metasyntactic and metasemantic knowledge during the task, drawing on appropriate form-function mappings in their analysis of the target sentences. This result emerged consistently across all statistical analyses. The generalised linear mixed-effects model revealed a significant effect of group (Table 1), while the mediation analysis confirmed that group had a direct positive effect on response accuracy (Table 2).

Crucially, the two groups were comparable across several relevant factors that could influence MLA. They did not differ in age, SES, or vocabulary knowledge, which was considered as a proxy for implicit language knowledge in this study (Tables B1 and B2 in Appendix B). Most importantly, their literacy achievements were also similar: both groups obtained

Table 2. Mediation analysis results from the mma function

	Total effect	Direct effect	TEST E	TEST F	Vocabulary
est	.22	.20	.03	.08	−0.09
mean	.24	.20	.04	.09	−0.09
sd	.07	.06	.02	.03	.02
upbd_q	.35	.29	.06	.12	−0.07
lwbd_q	.16	.12	.02	.06	−0.12
p_quant	<.001	<.001	<.001	<.001	<.001

Notes: The table presents the estimated mediation effects using the full dataset (est) and the mean estimates from bootstrap samples (mean), along with standard deviations (sd), quantile confidence intervals (upbd_q, lwbd_q) and significance values (p_quant). The model includes group (control vs. target) as the predictor, TEST E, TEST F, and vocabulary as mediators, and response accuracy in the metalinguistic awareness test as the outcome variable.

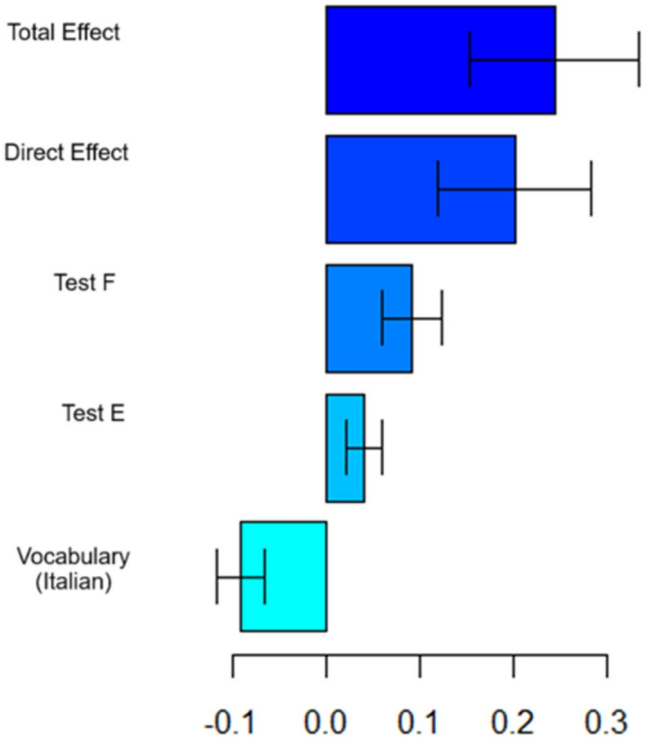

Figure 2. Visualisation of the total, direct, and indirect effects from the mediation analysis with quantile confidence intervals. The model includes group (control vs. target) as the predictor, TEST E, TEST F, and vocabulary knowledge in Italian as mediators, and response accuracy in the MLA test as outcome variable.

comparable scores on the INVALSI tests assessing reading comprehension in Italian as well as listening and reading comprehension in English (Table B1). This is particularly relevant, as stronger reading comprehension abilities typically enhance MLA (and the other way round), given that reading exposes students to more complex syntactic structures than those encountered in spoken language (Tong & McBride, 2017). Similarly, higher proficiency in a second language has been shown to positively affect MLA (Reder et al., 2013; Roehr-Brackin, 2018).

The only domain in which participants in the target group demonstrated a clear advantage was language learning aptitude, as they outperformed the ones in the control group on the LLAMA E and F tests. Taken together, these findings suggest that the target group's advantage in language learning aptitude and MLA cannot be easily attributed to any of the other variables considered in the study. Instead, their exposure to translanguaging pedagogies appears to be a plausible contributing factor, even if this interpretation must remain tentative given the range of cognitive, linguistic and sociolinguistic factors influencing MLA ('Metalinguistic awareness, implicit language knowledge and language aptitude' section) that were beyond the scope of this study.

As discussed in 'The context: the project *L'AltRoparlante*' section, many of the translanguaging-based activities implemented with the target group involved explicit and implicit reflection on the languages present in the classroom. These activities—such as 'comparing',

'analysing' and 'classifying', based on Anderson and Krathwohl (2001)—require increasingly complex cognitive functions and different levels of explicitness (Table A1). Engaging in such tasks may enhance students' awareness of the nature, form and function of language by encouraging them to reflect on how different languages (the majority language of schooling, foreign languages and home languages) express grammatical functions.

Furthermore, children exposed to translanguaging pedagogies are likely to develop a heightened ability to reflect abstractly on how language(s) function and analyse cross-linguistic similarities and differences (see the concept of cross-linguistic awareness in 'Metalinguistic awareness, implicit language knowledge and language aptitude' section). In this sense, they become 'young linguists' (Martini & Torregrossa, 2023), actively engaging in metalinguistic reasoning. These skills are central to both language learning aptitude—as measured by LLAMA E and F—and MLA, as they both involve language analysis. Additionally, the test for MLA includes a verbalisation component, requiring participants to articulate their reasoning about linguistic structures. Translanguaging pedagogies may be particularly relevant in fostering this ability, as verbalisation reflects a deeper, conceptual understanding of language structure and involves awareness at the level of understanding ('Metalinguistic awareness, implicit language knowledge and language aptitude' section).

It is important to acknowledge that the conclusions drawn regarding the benefits of translanguaging-based pedagogies for students' MLA (RQ1) should be interpreted with caution due to the absence of a pretest-posttest design. Nevertheless, the clear advantage observed in the analyses, combined with the lack of significant difference between the two groups at the outset of the data collection, suggests a promising trend.

RQ2 explored which variables influenced individual variation in students' MLA and whether these effects differed across the two educational contexts. Table 1 showed that vocabulary knowledge in Italian, language learning aptitude and SES significantly affected students' response accuracy in the test for MLA. The effect of Italian vocabulary aligns with previous research indicating that MLA builds on implicit language knowledge ('Metalinguistic awareness, implicit language knowledge and language aptitude' section). The observed significant effect of SES points in the same direction, as SES is a well-established predictor of language knowledge (De Cat, 2021). Notably, we observed an interaction between group and vocabulary knowledge in Italian: students in the target group showed a steeper improvement in response accuracy as their vocabulary knowledge increased. This suggests that vocabulary influenced response accuracy in the MLA test differently across the two groups. Specifically, participants in the target group appeared to benefit more from their vocabulary knowledge when answering the test questions than those in the control group. We interpret this as a potential effect of exposure to translanguaging pedagogies. These pedagogies encourage students to draw on their full linguistic and cognitive repertoire (including multilingual and multimodal resources) throughout the learning process (Cenoz & Gorter, 2022; Torregrossa et al., 2025). As a result, students in the target group seem better able to optimise their linguistic resources in Italian when solving MLA tests in this language. The significant interaction between group and Italian vocabulary knowledge supports the interpretation that a certain threshold of language knowledge may be necessary for the benefits of translanguaging pedagogies on MLA to manifest. While the current data do not allow us to determine this threshold, future research in this direction could help identify the conditions under which translanguaging pedagogies are most effective.

Regarding language learning aptitude, we found a significant effect of TEST E and a nearly significant effect of TEST F, indicating that this variable contributes to explaining individual differences in MLA. These findings support previous research highlighting a strong link between MLA and language learning aptitude, likely due to the involvement of language analysis processes (Roehr-Brackin & Tellier, 2019; contra Carroll, 1981; El Euch, 2018). Notably, we found no evidence that the influence of language learning aptitude on response accuracy differed between the two educational groups. This suggests that students relied on language learning aptitude when solving MLA tests regardless of the educational context, which again underlines the centrality of this variable for the development of MLA, at least within the framework of our study, which assumes that language learning aptitude influences MLA rather than the reverse.

RQ3 examined whether the educational context had a direct effect on students' MLA, or whether this effect was mediated by vocabulary knowledge in Italian or language learning aptitude. This analysis revealed that different mechanisms underlie the development of MLA across the two educational contexts. The mediation analysis indicated that, in addition to a direct effect, the educational context (translanguaging vs. monoglossic pedagogies) indirectly influences MLA test performance through language learning aptitude. Both TEST E and TEST F of the LLAMA test emerged as significant mediators, with TEST F showing the strongest effect. This suggest that the positive effect of translanguaging pedagogies on students' MLA (direct effect) is partially mediated by language learning aptitude. In other words, translanguaging pedagogies not only enhance MLA directly, but also do so by strengthening students' language learning aptitude.

The monoglossic educational context also exhibited an indirect effect on students' MLA, mediated by vocabulary knowledge in Italian. This finding aligns with the slightly (though not significantly) better vocabulary performance observed among the students in the control group (Table B2 in Appendix B). The mediation analysis suggests that the students who had been exposed to monoglossic pedagogies relied more on vocabulary knowledge to respond accurately to the MLA task than students in the target group. Overall, the mediation analysis revealed two distinct developmental pathways for MLA: one through language learning aptitude in the target group exposed to translanguaging pedagogies, and the other through vocabulary knowledge in the control group following monoglossic instruction.[2]

Speculatively, we interpret these findings as showing that translanguaging pedagogies are associated with the development of novel, analytical heuristics for solving MLA tasks. Whereas relying on implicit language knowledge—such as vocabulary knowledge—appears to be the default, more automatic strategy for approaching a MLA task (i.e. reasoning about form–function mappings in Italian based on existing knowledge of Italian), translanguaging pedagogies seem to encourage students to engage more abstract reasoning processes. In particular, the mediation through language learning aptitude suggests that the students in the target group draw on broader cognitive mechanisms related to pattern detection and linguistic analysis, rather than solely on language-specific knowledge. This interpretation aligns with our previous observation that translanguaging pedagogies foster a deeper, more abstract conceptual understanding of language (Cenoz & Gorter, 2022).

To conclude, this study identified specific domains in which translanguaging pedagogies offer clear advantages, which leads to enhancing language learning aptitude and MLA. Students exposed to translanguaging also drew more effectively on their linguistic resources, particularly their vocabulary knowledge, when solving MLA tests. Crucially, this is the first

study to show that the link between translanguaging and higher MLA is mediated by gains in language-learning aptitude. At the same time, we highlighted distinct pathways through which translanguaging and monoglossic pedagogies shape MLA: *via* language learning aptitude and vocabulary knowledge, respectively. We argue that the strong impact of translanguaging pedagogies on students' language learning aptitude and MLA reflects its capacity to foster cross-linguistic awareness in the classroom. In this sense, translanguaging equips students with cognitive tools that may also support their broader academic development.

Notes

1. The resulting model was: m0 = glmer(accuracy ~ 1 + group * (vocabulary + TEST_E + TEST_F) + SES + (1|ID), data = META, family = binomial, control = glmerControl(optimizer = 'bobyqa')).
2. It is important to note that the findings from the mediation analysis are not in contradiction with those of the glmer-analysis. The observation that language learning aptitude influenced individual variation in MLA across both groups is fully compatible with the mediation finding that translanguaging pedagogies appear to enhance MLA through this variable. Similarly, the fact that students exposed to translanguaging pedagogies appeared to leverage their vocabulary resources more effectively is not inconsistent with the observation that students exposed to monoglossic pedagogies primarily relied on implicit language knowledge to solve MLA tasks.

Author contributions

This article is the result of a collaborative research project conducted by both authors. Author 1 was responsible for Sections 1, 1.1, 2, 3.3, and 4. Author 2 contributed Sections 1.2, 2.1, 3.1, and 3.2. Section 5 was jointly written by both authors.

Disclosure statement

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

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Appendix A

Table A1. Examples of activities and learning strategies implemented in the L'AltRoparlante project.

Activity description	FREPA/CARAP descriptors	Linguistic-cognitive activity (Anderson & Krathwohl, 2001 taxonomy)
In a text presented orally or in written form in the home language of one of the students, all classmates independently try to identify a particular linguistic function that was previously introduced.	S-2: Can identify [recognise] linguistic elements / cultural phenomena in languages / cultures which are more or less familiar. S-2.4: Can identify [recognise] grammatical categories / functions / markers {article, possessive, gender, time, plural…}	Remembering – identifying
In a series of texts presented orally or in written form in various languages, students compare a specific linguistic phenomenon across different languages.	S-3.5: Can perceive global similarities between *two / several* languages. S-3.7: Can compare the grammatical functioning of different languages.	Understanding – comparing
Students interview parents on a topic previously identified in class, asking questions in the home languages and engaging in mediation between the home language and Italian.	S-4.4: Can argue about cultural diversity {advantages, disadvantages, difficulties…} and construct one's own opinion about it. S-6.1: Can communicate in bi/ multilingual groups taking into account the repertoire of one's interlocutors.	Applying – interviewing
Students read or listen to a text in Italian on a topic and answer the five *wh*-questions in their own native languages.	S-6.4.1: Can give an account in one language of information encountered in another language / other languages.	Analysing – classifying
Students, individually or in groups, read or listen to a series of plurilingual texts on a topic and prepare a critical commentary on the subject using all the languages in their repertoire.	S-6.4.1.1: Can present a *commentary / exposé* in one language based on a plurilingual set of documents.	Evaluating – commenting
Students, individually or in groups, create a multimodal product (text, presentation, podcast, etc.) on a previously defined topic, using their entire repertoire.	S-5: Can use knowledge and skills already mastered in one language in activities of comprehension / production in another language. S-6.5.2: Can produce a text in which registers / varieties / languages alternate functionally (when the situation allows it).	Creating – composing

Appendix B

Group comparison of background variables

Table B1 reports the values for SES and the INVALSI test scores for Italian, English reading, and English listening for each group (control and target).

Table B1. Descriptive statistics of participants' background variables, including SES and literacy outcomes in Italian and English (reading and listening), for the control and target groups.

	Control group	Target group
SES	2.6 (1.22) (Range: 1–4)	2.32 (1.05) (Range: 1–4)
INVALSI (Italian)	216 (37.4) (Range: 125–296)	206 (38.3) (Range: 137–294)
INVALSI (English reading)	219 (33.5) (Range: 145–270)	217 (36.2) (Range: 134–268)
INVALSI (English listening)	210 (26.6) (Range: 154–262)	211 (33.1) (Range: 117–275)

Notes: The two groups did not differ significantly in their SES scores ($W = 616.5$, $p = .33$). Similarly, no significant differences were observed between the groups in their literacy outcomes: INVALSI in Italian ($t = 1.06$, $df = 62.68$, $p = .29$), INVALSI for reading comprehension in English ($t = 0.24$, df = 61.51, $p = .81$), and INVALSI for listening comprehension in English ($t = -0.02$, $df = 57.49$, $p = .99$). SES and INVALSI in Italian correlated significantly with each other ($r = .48$, $p < .001$). We also found moderately strong to strong correlations between INVALSI Italian and INVALSI reading and listening comprehension in English ($r = .70$, $p < .001$ and $r = .59$, $p < .001$, respectively) and a strong correlation between INVALSI reading and listening comprehension ($r = .81$, $p < .001$).

Group comparison with respect to the variables related to participants' metalinguistic awareness

The mean vocabulary score for the control group was slightly higher than that of the target group. However, the difference between the two groups was not statistically significant ($t = 1.66$, $df = 65.86$, $p = .10$). In contrast, significant differences were observed between the groups on both TEST E and TEST F of the LLAMA, with the target group outperforming the control group ($W = 375$, $p = .04$ for TEST E and $t = -2.12$, $df = 63.00$, $p = .038$ for TEST F). A significant but weak correlation was found between TEST E and TEST F of the LLAMA ($r = .31$, $p = .01$). The correlation between TEST F and vocabulary was nearly significant ($r = .24$, $p = .052$), while the correlation between TEST E and vocabulary was not significant ($r = .07$, $p = .58$). Given these correlation values, we do not anticipate multicollinearity effects in the model.

Table B2. Descriptive statistics of participants' scores in vocabulary and LLAMA Tests E and F for the control and target groups.

	Control group	Target group
Vocabulary (Italian)	29.9 (6.94) (Range: 18–44)	27.2 (6.46) (Range: 11–41)
LLAMA (TEST E)	17.4 (1.97) (Range: 12–20)	18.3 (1.81) (Range: 12–20)
LLAMA (TEST F)	12.9 (2.89) (Range: 6–19)	14.4 (2.62) (Range: 9–19)

Appendix C. Performance in the TAM-2

Table C1. Maximum attainable score, mean score, standard deviation (SD), and score range for each section of the MLA-test.

Section	Maximum Score	*M*	*SD*	Range
Acceptability	26	12.10	4.36	3–24
Ambiguity	14	5.62	2.29	0–12
Comprehension	32	17.90	5.53	3–32
Grammatical function	24	9.86	4.56	1–22
Synonymy	10	3.77	2.04	0–10