

Constructing and Regulating Interactive Metacognition in Multilingual Classrooms: The Roles of Dialogic Interaction, Translanguaging, and Semiotic Mediation

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Abstract

Interactive metacognition offers a social perspective on how learners jointly plan, monitor, evaluate, and adapt their thinking during multilingual interaction. This qualitative study investigated how interactive metacognition was constructed and regulated in multilingual classroom practices. Participants comprised five language teachers and thirteen language learners selected purposively based on their involvement in multilingual and collaborative learning activities. Data were collected through semi-structured interviews, classroom observations, field notes, and relevant classroom artifacts. The instruments were reviewed by experts and piloted before implementation. Data were analyzed recursively through data condensation, thematic display, and conclusion drawing, supported by triangulation, member checking, peer review, and an audit trail. The findings revealed that interactive metacognition was constructed through dialogic questioning, clarification, cross-linguistic negotiation, collaborative monitoring, explanation reformulation, semiotic mediation, and collective evaluation. Its effective regulation involved shared goals, structured metacognitive dialogue, strategic translanguaging, distributed learner roles, adaptive teacher scaffolding, process-oriented assessment, and post-task reflection. Multilingual resources supported cognitive regulation when they were used purposefully to clarify, compare, verify, and reconstruct meaning. The study concludes that interactive metacognition is socially distributed across teachers, learners, languages, and semiotic tools. Multilingual instruction should therefore integrate dialogic tasks, collective accountability, strategic language use, multimodal resources, and reflective assessment.

Keywords: Interactive metacognition; Multilingual classroom; Translanguaging; Dialogic interaction; Collaborative regulation

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INTRODUCTION

The globalization of education and the increasing mobility of learners have made linguistic diversity a defining feature of contemporary classrooms. In many educational settings, students no longer learn through a single language but use several linguistic, cultural, and semiotic resources to participate in classroom interaction, interpret disciplinary concepts, and solve academic problems. Multilingualism should therefore not be regarded merely as a challenge to instruction or as a transitional stage toward

proficiency in a dominant academic language. Instead, multilingual repertoires can function as cognitive and communicative resources that enable learners to connect prior knowledge with new information, compare meanings across languages, and construct more flexible conceptual understandings (Domke & Cerrato, 2024; Jessner & Allgäuer-Hackl, 2020; Magangxa & Geduld, 2023). This view is consistent with sociocultural and distributed cognition perspectives, which conceptualize learning as an activity mediated by interaction, language, tools, and participation in socially organized practices (Cogo et al., 2021; Domke & Cerrato, 2024; Yazan & Lindahl, 2023). From this perspective, cognition is not located exclusively within an individual learner but develops through engagement with teachers, peers, linguistic resources, and classroom artifacts.

Metacognition is particularly important in multilingual education because learners must regulate both disciplinary understanding and language use. Traditionally, metacognition has been defined as an individual's knowledge, awareness, and regulation of cognitive processes. It commonly involves planning how to approach a task, monitoring comprehension and strategy use, and evaluating the quality of a solution or learning outcome (Flavell, 1979; Schraw & Dennison, 1994). Although this individual perspective has generated valuable insights into self-regulated learning, it does not fully explain how metacognitive processes operate during collaborative classroom interaction. Learners frequently recognize confusion after receiving a peer's question, revise a strategy in response to teacher feedback, or evaluate their reasoning by comparing it with alternative explanations. Thus, planning, monitoring, and evaluation may be jointly performed rather than independently controlled. Goos, Galbraith, and Renshaw (2002) describe such activity as socially shared metacognition, emphasizing that cognitive regulation can be distributed among participants who collectively define goals, identify problems, assess progress, and revise strategies.

Interactive metacognition extends this social understanding by focusing on how metacognitive activity is constructed, communicated, and regulated through dialogue. It refers to the joint planning, monitoring, evaluation, and adaptation of thinking that emerges when participants make their reasoning visible and respond to one another's contributions. Interactive metacognition can be observed when learners request clarification, challenge an interpretation, justify a strategy, identify a misunderstanding, or reformulate an explanation for a peer. Such exchanges transform implicit cognitive processes into publicly available objects of reflection. Dialogic interaction therefore does more than transmit information; it creates opportunities for participants to examine how knowledge is being produced and whether their strategies are effective. Research on dialogic pedagogy, collaborative questioning, and shared reflection indicates that these practices can strengthen metacognitive awareness and collective knowledge construction (Lee & Al-Adeimi, 2025; Proctor et al., 2021; K. Tang, 2024; Yazan & Lindahl, 2023). Interactive metacognition is consequently both cognitive and relational because it depends on participants' willingness and ability to disclose, question, and revise their thinking.

Multilingual classrooms provide a distinctive context for interactive metacognition because cognitive regulation occurs across languages and modes of communication. Learners may use translanguaging, code-switching, peer translation, gesture, visual representation, or multilingual note-taking to clarify difficult concepts and coordinate collaborative work. Translanguaging is especially relevant because it permits learners to mobilize their complete linguistic repertoires rather than treating languages as separate and competing systems. When students explain an idea in one language and reconsider it in another, they may recognize semantic differences, expose conceptual ambiguities, and evaluate whether their explanation remains accurate across linguistic forms. Cross-

linguistic comparison can therefore stimulate metalinguistic awareness and metacognitive reflection simultaneously (Bui & Tai, 2022; Jessner & Allgäuer-Hackl, 2020; F. Tang & Calafato, 2021; Yazan & Lindahl, 2023; Zano & Mbirimi-Hungwe, 2023). In this sense, multilingual practices are not simply strategies for overcoming vocabulary limitations. They are mechanisms through which learners articulate judgments, test interpretations, and regulate disciplinary understanding.

Interactive metacognition in multilingual settings is also distributed across semiotic and material resources. Glossaries, translated notes, diagrams, digital applications, multimodal texts, and collaborative writing platforms can externalize reasoning and make cognitive processes available for collective examination. These resources may help learners track alternative explanations, compare terminology, document revisions, or identify inconsistencies between linguistic representations. Distributed cognition theory offers an appropriate framework for explaining this process because it recognizes that thinking is mediated by people, signs, technologies, and environmental structures rather than occurring only in the mind of an isolated individual (Bui & Tai, 2022; Cogo et al., 2021; Domke & Cerrato, 2024). However, the presence of multilingual or digital resources does not automatically produce effective metacognitive regulation. Their value depends on how teachers structure participation, encourage reflection, and connect language choices with disciplinary reasoning. Without purposeful instructional support, multilingual interaction may remain limited to literal translation and may not develop into deeper evaluation or strategic adaptation.

Teacher mediation is therefore central to the construction and regulation of interactive metacognition. Teachers can create opportunities for metacognitive dialogue by using probing questions, inviting multiple explanations, encouraging peer feedback, and asking learners to justify their linguistic and cognitive choices. Questions concerning why a strategy was selected, how an explanation changed, or which language best supported understanding can direct attention toward learning processes rather than answers alone. Teachers can also integrate translanguaging routines into inquiry, problem-solving, Content and Language Integrated Learning, and English-Medium Instruction tasks so that students deliberately plan, monitor, and evaluate their use of linguistic resources while learning disciplinary content (Domke & Cerrato, 2024; Solarte, 2021; Zarobe & Smala, 2020). Furthermore, multimodal artifacts can be used to document collaborative reasoning and support formative assessment. Professional learning is needed to help teachers recognize multilingual interaction as evidence of cognitive regulation and distinguish productive metacognitive dialogue from interaction that merely reproduces information (Almusharraf et al., 2022; Lee & Al-Adeimi, 2025; Proctor et al., 2021).

Despite growing interest in multilingual pedagogy, translanguaging, dialogic learning, and socially shared regulation, these areas have often developed as parallel lines of inquiry. Studies of multilingual education commonly emphasize identity, participation, language development, or access to disciplinary content, whereas metacognitive research frequently concentrates on individual awareness and self-regulation. Consequently, insufficient attention has been given to the moment-by-moment processes through which learners and teachers construct, distribute, and regulate metacognition across multilingual repertoires. Existing scholarship also offers limited integration of dialogic engagement, cross-linguistic negotiation, teacher scaffolding, multimodal mediation, and adaptive regulation within a single analytical framework. Moreover, debate remains regarding the appropriate balance between explicit teacher-guided metacognitive instruction and emergent student-led regulation. Some researchers emphasize structured questioning and clearly articulated strategic

criteria, while others highlight naturally occurring dialogue and collaborative inquiry (Almusharraf et al., 2022; Jessner & Allgäuer-Hackl, 2020; Lee & Al-Adeimi, 2025; Magangxa & Geduld, 2023; Proctor et al., 2021; K. Tang, 2024). These unresolved issues demonstrate the need for a systematic investigation of interactive metacognition as a multilingual classroom phenomenon.

The present study addresses this gap by investigating how interactive metacognition is constructed and regulated through multilingual classroom practices and by examining its implications for instructional design. It focuses on the ways in which dialogic interaction, translanguaging, cross-linguistic comparison, teacher mediation, peer collaboration, and semiotic tools enable participants to plan, monitor, evaluate, and adapt their thinking collectively. The novelty of the study lies in integrating multilingual pedagogy with interactive metacognition within a unified conceptual and analytical framework. Rather than examining multilingual language use and metacognitive regulation as separate phenomena, the study conceptualizes multilingual practices as mechanisms through which metacognitive activity becomes visible, distributed, and jointly managed. It also connects the construction of interactive metacognition with practical decisions concerning classroom dialogue, collaborative tasks, assessment, teacher feedback, and multimodal resources. Accordingly, the study aims to explain the processes through which interactive metacognition emerges in multilingual interaction and to identify pedagogical principles for supporting its effective regulation in classroom practice. The study is guided by the following research questions:

How is interactive metacognition constructed through dialogic interaction, cross-linguistic negotiation, and the use of semiotic resources in multilingual classroom practices?

How can teachers and learners regulate interactive metacognition to support collaborative knowledge construction and effective multilingual classroom practice?

RESEARCH METHOD

Research Design

This study employed a qualitative research design to investigate how interactive metacognition was constructed and regulated through multilingual classroom practices. A qualitative approach was selected because the study focused on processes, meanings, interactions, and participants' interpretations rather than on measuring predetermined variables or testing causal relationships. Interactive metacognition is a dynamic and context-dependent phenomenon that is manifested through questioning, explanation, clarification, monitoring, evaluation, strategy adjustment, and cross-linguistic negotiation. These processes are best examined through close observation of naturally occurring classroom interaction and through participants' accounts of their experiences.

The design enabled the researchers to examine how teachers and learners jointly planned, monitored, evaluated, and adjusted their thinking during multilingual classroom activities. It was particularly suitable for addressing the first research question concerning the construction of interactive metacognition through dialogic interaction, cross-linguistic negotiation, and semiotic resources. Classroom observations allowed the researchers to identify observable instances of metacognitive interaction, including requests for clarification, peer correction, strategy discussion, explanation reformulation, language switching, and collaborative evaluation. Interviews complemented these observations by providing access to participants' intentions, perceptions, and reasons for using particular languages or learning strategies.

The qualitative design was also appropriate for addressing the second research question regarding how teachers and learners regulated interactive metacognition to support collaborative knowledge construction. Regulation may be expressed differently

across tasks, participants, and classroom situations. It may emerge through teacher prompts, peer feedback, translanguaging, gestures, written notes, visual representations, or collaborative problem-solving. A qualitative design allowed these diverse forms of regulation to be interpreted within the social and instructional contexts in which they occurred.

The study was conducted as a bounded classroom-based inquiry involving a specific group of language teachers and learners. The bounded nature of the study provided an opportunity to develop a detailed account of interactive metacognition within an authentic multilingual learning environment. Rather than seeking statistical generalization, the study aimed to generate an analytically rich explanation of how multilingual interaction contributed to collective cognitive regulation. The findings may therefore support theoretical or transfer-based generalization to classrooms with comparable linguistic, pedagogical, and institutional characteristics.

Participants

The participants consisted of 5 language teachers and 13 language learners involved in multilingual language-learning practices. The total sample of 18 participants was considered appropriate for an in-depth qualitative study because it provided perspectives from both instructional and learner groups while remaining manageable for detailed observation, transcription, coding, and interpretation. The inclusion of teachers and learners enabled the study to examine interactive metacognition as a socially distributed process rather than as an individual activity. Participants were selected through purposive sampling. This sampling technique was used because the study required individuals who had direct experience with multilingual classroom interaction and could provide relevant information about the construction and regulation of metacognition. The selection of participants was therefore based on their capacity to contribute information-rich data rather than on random representation of a larger population.

The five teachers were selected according to several criteria. First, they were actively teaching a language course in which learners regularly used more than one language. Second, they had experience managing collaborative activities such as group discussion, peer feedback, problem-solving, text interpretation, oral presentation, or project-based language tasks. Third, they were willing to have their classroom practices observed and to participate in individual interviews. Fourth, they had sufficient familiarity with the learners to explain classroom interaction, language-use patterns, and instructional decisions. Information collected about the teachers included age range, gender, educational qualifications, languages spoken, teaching specialization, length of teaching experience, and prior experience in multilingual instruction. These characteristics were used to contextualize their perspectives rather than to compare teachers statistically.

The 13 language learners were selected from classes taught by the participating teachers. Learner selection was guided by maximum variation within the bounded context. The researchers sought participants with different language backgrounds, levels of classroom participation, patterns of multilingual language use, and academic abilities. This variation was intended to capture diverse manifestations of interactive metacognition rather than privileging only highly proficient or highly active learners.

The learner inclusion criteria required participants to be enrolled in the observed language classes, to have experience using at least two languages in their academic or daily communication, to participate in collaborative classroom activities, and to provide informed consent. Where required by the participants' age, consent was also obtained

from parents or legal guardians. Learners who did not attend the observation sessions consistently or who chose not to participate in interviews were excluded from the final participant group.

Relevant learner demographic information included age range, gender, educational level, first language, additional languages, length of language-learning experience, and self-reported proficiency in the languages used during classroom interaction. These data helped the researchers interpret why particular learners relied on translanguaging, peer translation, gesture, visual resources, or other communicative strategies. The demographic information was not used to rank participants or make deterministic claims about their abilities. Ethical principles were observed throughout participant recruitment and data collection. Participation was voluntary, and participants received information concerning the purpose of the study, the procedures involved, the expected duration of participation, confidentiality, and their right to withdraw without penalty. Pseudonyms were assigned to teachers and learners, while identifying information concerning the school or institution was removed from transcripts and reports. Audio recordings, observation notes, and interview data were stored securely and accessed only for research purposes.

Instruments and Data Collection Technique

Two principal instruments were employed: semi-structured interview guidelines and classroom observation sheets. The use of these instruments enabled the researchers to combine participants' reported experiences with evidence of actual multilingual and metacognitive practices. Interviews captured participants' interpretations and intentions, while observations documented how interactive metacognition unfolded during classroom activity.

Interview Guidelines

Separate semi-structured interview guidelines were developed for teachers and learners. The teacher interview guideline explored instructional planning, perceptions of multilingualism, strategies for encouraging classroom dialogue, use of translanguaging, teacher questioning, peer collaboration, monitoring of learner understanding, feedback practices, and evaluation of collaborative learning. Teachers were also asked to describe situations in which learners changed languages, revised explanations, identified misunderstandings, or jointly adjusted learning strategies. The learner interview guideline focused on how learners selected languages during classroom activities, requested assistance, explained concepts to peers, monitored their understanding, responded to disagreement, evaluated group solutions, and modified strategies when difficulties occurred. Learners were invited to describe specific episodes in which using another language, consulting a peer, translating a term, drawing a diagram, or reformulating an explanation helped them understand a task.

The guidelines were developed deductively and inductively. Deductive development was informed by the study's conceptual framework and relevant dimensions of metacognitive regulation, including planning, monitoring, evaluation, and adaptation. Questions were also informed by concepts related to dialogic interaction, co-regulation, translanguaging, cross-linguistic negotiation, teacher scaffolding, and distributed cognition. Inductive refinement occurred after preliminary classroom familiarization, during which the researchers identified context-specific language practices and interaction patterns that needed to be explored in greater detail. The interviews were semi-structured rather than fully standardized. Core questions were asked consistently across participants, but follow-up questions were used to obtain clarification, examples, and detailed accounts. This format provided comparability

across interviews while allowing participants to explain experiences that had not been anticipated during instrument development.

Observation Sheets

The observation sheet was designed to record naturally occurring instances of interactive metacognition in multilingual classroom interaction. It contained categories related to the classroom context, type of learning activity, participants involved, language or languages used, teacher actions, learner actions, metacognitive function, semiotic resources, and immediate instructional outcome.

The main metacognitive categories included shared planning, monitoring of understanding, identification of confusion, strategy discussion, evaluation of explanations, correction of errors, revision of reasoning, and adaptation of language choices. Multilingual interaction categories included translanguaging, code-switching, peer translation, cross-linguistic comparison, multilingual questioning, vocabulary negotiation, and reformulation across languages. The sheet also provided space for recording gestures, diagrams, written notes, digital tools, glossaries, and other semiotic resources that mediated interaction.

In addition to structured categories, the observation sheet contained an open field-note section. This section was used to document the sequence of interaction, relevant quotations, classroom atmosphere, non-verbal behavior, teacher positioning, learner participation, and contextual information that could not be captured through predetermined categories. The integration of structured and open-ended recording supported both consistency and sensitivity to unexpected events.

Data Analysis

The data were analyzed using the interactive qualitative analysis procedures of data condensation, data display, and conclusion drawing. These procedures were not treated as strictly linear stages. Instead, they occurred recursively throughout data collection and analysis. Preliminary findings informed subsequent observations and interviews, while newly collected evidence was used to refine or challenge earlier interpretations. Data condensation began with the organization and preparation of interview transcripts, observation records, field notes, and classroom artifacts. Audio-recorded interviews were transcribed, and multilingual utterances were retained in their original form before being translated where necessary. The researchers repeatedly read the transcripts and observation notes to gain familiarity with the data and identify meaningful interactional episodes. Irrelevant conversational material, repeated statements, and information unrelated to the research questions were set aside without removing contextual details needed for interpretation.

The researchers then coded data segments that represented interactive metacognitive processes. Initial codes included shared planning, clarification requests, comprehension checking, peer monitoring, strategy explanation, error identification, collaborative evaluation, reasoning revision, language adaptation, translanguaging, peer translation, teacher prompting, and semiotic mediation. Some codes were derived from the conceptual framework, while others emerged from recurring patterns in the data. Related codes were compared and grouped into broader categories, such as dialogic construction of metacognition, cross-linguistic regulation, teacher-mediated regulation, peer co-regulation, and multimodal externalization of thinking.

Data condensation also involved identifying episodes in which several processes occurred together. For example, a learner might switch languages to clarify an idea, receive corrective feedback from a peer, evaluate the initial explanation, and formulate a revised response. Such an episode was treated as an interactive regulatory sequence

rather than divided into isolated utterances. Attention was given to the order of interaction, the participants involved, the linguistic resources used, and the outcome of the exchange.

Data display was used to organize condensed data in formats that facilitated comparison and interpretation. The researchers prepared matrices that connected participants, classroom activities, multilingual practices, metacognitive functions, regulatory agents, and instructional outcomes. Separate displays were produced for teacher-initiated and learner-initiated episodes. Additional matrices compared interview statements with observed practices to determine whether participants' reported strategies were evident in classroom interaction.

Conclusion drawing involved interpreting the categories, patterns, relationships, and differences identified in the data. The researchers examined how interactive metacognition was initiated, which participants assumed regulatory roles, how multilingual resources shaped cognitive monitoring, and which teaching practices facilitated or constrained collective regulation. Conclusions were developed gradually and were repeatedly tested against the complete dataset. Verification procedures were applied throughout conclusion drawing. The researchers searched for confirming and disconfirming evidence, compared cases across participants, and reconsidered interpretations that were not consistently supported. Observation findings were checked against interview accounts, field notes, and classroom artifacts. Member checking, peer debriefing, and selected intercoder comparison were used to evaluate the credibility of the interpretations.

An audit trail was maintained to document instrument revisions, coding decisions, category development, data displays, and changes in interpretation. Reflexive notes were also used to record the researchers' assumptions and possible influence on the analytical process. Through these procedures, the analysis produced a contextually grounded explanation of how interactive metacognition was constructed and regulated within multilingual classroom practices.

FINDINGS AND DISCUSSION

Research Findings

The findings were organized according to the two research questions. Data were derived from interviews with five language teachers and thirteen language learners, supported by classroom observations and field notes. Interview and observation data were condensed into meaningful codes, displayed in thematic matrices, and interpreted through continuous comparison. Teachers are identified as T1–T5, while learners are identified as L1–L13. The excerpts presented below illustrate the dominant themes identified across the dataset.

Research Question 1: How is interactive metacognition constructed through dialogic interaction, cross-linguistic negotiation, and the use of semiotic resources in multilingual classroom practices?

The analysis indicated that interactive metacognition was constructed through seven interrelated processes: making thinking visible, requesting clarification, comparing meanings across languages, jointly monitoring understanding, reformulating explanations, using semiotic resources to externalize reasoning, and collectively evaluating emerging knowledge. These processes rarely occurred independently. Instead, they developed sequentially during classroom discussions, collaborative tasks, peer explanations, and teacher-guided reflection.

Table 1. Construction of Interactive Metacognition in Multilingual Classroom Practices

Interview or analytical question	Synthesized responses or answers
1. How did classroom dialogue make learners' thinking visible?	Teachers used open-ended and probing questions that required learners to explain how they reached an answer. Learners verbalized reasoning, compared interpretations, and exposed areas of uncertainty that could be examined collectively.
2. How did clarification questions contribute to interactive metacognition?	Clarification questions prompted learners to monitor whether an explanation was understandable, accurate, and sufficiently detailed. They also encouraged speakers to reconsider assumptions and reorganize their explanations.
3. How did learners use different languages to negotiate meaning?	Learners shifted between languages to explain unfamiliar terms, translate disciplinary concepts, compare meanings, and ensure that all group members understood the task.
4. How was understanding monitored collaboratively?	Learners checked one another's comprehension by asking follow-up questions, requesting examples, repeating key ideas, and inviting quieter group members to explain the conclusion.
5. How were explanations revised during interaction?	Explanations were reformulated after peer questions, teacher prompts, or recognition of inconsistencies. Learners often changed vocabulary, language, examples, or the sequence of reasoning.
6. How did semiotic resources support interactive metacognition?	Diagrams, gestures, written keywords, bilingual notes, digital dictionaries, and visual representations helped participants externalize thinking and compare alternative interpretations.
7. How did participants evaluate jointly constructed knowledge?	Teachers and learners evaluated the clarity, logical consistency, linguistic appropriateness, and conceptual accuracy of group explanations before accepting a shared answer.

Dialogic interaction as a means of making thinking visible

Interactive metacognition was initially constructed when teachers and learners externalized their reasoning through classroom dialogue. Rather than merely asking learners to provide correct answers, the teachers frequently invited them to explain the steps, evidence, or assumptions underlying their responses. These questions transformed individual thinking into publicly accessible discourse that could be examined by others. Classroom observations showed that prompts such as "Why do you think that?", "How did your group reach that conclusion?", and "Can someone explain the idea differently?" encouraged learners to reveal both their understanding and uncertainty. One teacher explained: T2: *"I do not stop after a student gives the answer. I ask how the answer was formed because sometimes the answer is correct, but the reasoning is still unclear. When they explain it, other students can check the idea and add something."*

This excerpt demonstrates that teacher questioning functioned as more than a method of assessing factual knowledge. It created opportunities for collective monitoring and evaluation. When reasoning was verbalized, peers could identify missing information, challenge interpretations, or provide alternative explanations. In this way, dialogic interaction created the social conditions through which metacognition became shared rather than remaining an internal cognitive process. Learners similarly reported that listening to different explanations enabled them to compare their own thinking with that of their peers. One learner stated: L4: *"When my friend explained the answer, I realized that I understood the word but not the whole meaning. I asked another question, and then we discussed which explanation was more suitable."*

The learner's realization illustrates metacognitive monitoring triggered by interaction. The learner became aware of incomplete understanding only after comparing an individual interpretation with a peer's explanation. Thus, dialogue did not

merely communicate pre-existing knowledge; it generated awareness of conceptual gaps and encouraged further inquiry.

Clarification questions and reciprocal monitoring

Clarification questions were another major mechanism through which interactive metacognition was constructed. Both teachers and learners used such questions to determine whether an explanation was understandable and conceptually accurate. Learners asked peers to repeat, simplify, translate, exemplify, or justify a statement. These questions required speakers to monitor the effectiveness of their communication and often led them to reconsider the content of their explanation.

Observation data indicated that clarification episodes frequently began when one learner expressed uncertainty. The uncertainty was then taken up by other group members, who compared interpretations and attempted to resolve the problem collaboratively. This process created reciprocal monitoring because both the questioner and the speaker evaluated the adequacy of the emerging explanation. A learner described the process as follows: L9: *"If I do not understand, I ask my friend to say it in another way. Sometimes the friend also becomes unsure after explaining it again, so we check the text or ask the teacher."*

This excerpt shows that clarification could reveal uncertainty not only in the listener but also in the original speaker. The request to explain differently required the speaker to re-evaluate understanding, while consultation of the text or teacher provided an additional basis for verification. Interactive metacognition was therefore constructed through cycles of questioning, explanation, doubt, checking, and revision.

Cross-linguistic negotiation of meaning

The findings further demonstrated that multilingual language use was central to the construction of interactive metacognition. Learners used their first language, the target language, and other familiar languages strategically to clarify concepts and coordinate collaborative activity. Language switching was particularly common when learners encountered abstract vocabulary, culturally specific expressions, complex instructions, or disciplinary meanings that could not be communicated easily through the target language alone. Cross-linguistic negotiation enabled learners to compare semantic possibilities rather than simply translate words literally. They discussed whether a term in one language carried the same meaning, emphasis, or contextual implication in another. Such comparison stimulated metalinguistic awareness and encouraged learners to evaluate the precision of their interpretations. One teacher observed: T4: *"They usually begin with the target language, but when the concept becomes difficult, they use the local language to check the meaning. After they agree, I ask them to return to the target language and explain the concept again."*

The teacher's account indicates that multilingual resources were used as temporary cognitive scaffolds. Learners first mobilized a familiar language to establish conceptual understanding and then reformulated the conclusion in the target language. This movement across languages required them to monitor whether the conceptual meaning remained consistent during reformulation.

Collaborative monitoring of understanding

Interactive metacognition was also constructed when learners jointly monitored the progress and understanding of their groups. Monitoring practices included asking whether everyone agreed, inviting members to restate the conclusion, checking the task instructions, and reviewing whether all parts of the activity had been completed. In several observed episodes, learners recognized that a group answer could not be considered complete until each member was able to explain it. This form of monitoring

distributed responsibility across group members. More proficient learners did not simply provide answers; they frequently checked whether their peers understood the explanation. Less confident learners contributed by expressing confusion, requesting examples, or identifying differences between the explanation and the written material. Consequently, both expertise and uncertainty became resources for collaborative learning.

The findings also showed that group monitoring supported more equitable participation when it was explicitly encouraged by teachers. In classes where teachers asked groups to ensure that any member could present the result, learners were more likely to check one another's comprehension. This instructional expectation transformed peer explanation from answer sharing into collective preparation and shared regulation.

Reformulation and adaptive explanation

Reformulating explanations represented another important feature of interactive metacognition. Learners adapted their explanations after receiving questions, feedback, or signs of misunderstanding. Adaptation involved changing language, substituting simpler vocabulary, adding examples, reorganizing information, drawing comparisons, or modifying the original conclusion. Reformulation indicated that participants were monitoring both conceptual accuracy and communicative effectiveness. An explanation was not judged successful merely because the speaker understood it; it also had to become intelligible to others. When peers remained confused, the speaker was required to reconsider how the idea had been represented.

In observed discussions, reformulation often occurred across languages. A learner might first explain an idea in the target language, repeat it in the first language, illustrate it through an example, and finally return to the target language with a more precise formulation. These sequences demonstrated the adaptive nature of multilingual cognition. Language choice changed in response to the perceived needs of the group and the complexity of the content.

Semiotic resources as external representations of thinking

Interactive metacognition was not constructed through spoken language alone. Teachers and learners used gestures, diagrams, written keywords, bilingual glossaries, textbook passages, mobile dictionaries, and visual organizers to externalize and regulate thinking. These resources provided stable representations that participants could point to, revise, compare, and evaluate. For example, learners used diagrams to clarify relationships that were difficult to express verbally. Written keywords helped groups track the stages of an explanation, while bilingual notes supported comparison between linguistic forms. Gestures were particularly useful when learners lacked specific vocabulary but wanted to demonstrate direction, sequence, contrast, or spatial relationships.

Collective evaluation of knowledge

The final process involved the collective evaluation of explanations and conclusions. Teachers and learners assessed whether a response was clear, accurate, logically connected, linguistically appropriate, and consistent with the learning material. Evaluation commonly occurred after group presentation, peer feedback, or teacher questioning. Learners were not limited to identifying whether an answer was correct. They also evaluated whether the explanation was sufficiently supported and whether the language accurately represented the intended concept. When disagreement occurred, participants compared evidence, referred to semiotic resources, and revised the conclusion. This process showed that knowledge construction was provisional and open to collective examination. The answer to the first research question is that interactive metacognition was constructed through interconnected dialogic, cross-linguistic, and

semiotic practices. Dialogue made thinking visible, clarification exposed uncertainty, multilingual negotiation supported conceptual comparison, semiotic resources externalized reasoning, and collective evaluation enabled participants to revise shared knowledge.

Research Question 2: How can teachers and learners regulate interactive metacognition to support collaborative knowledge construction and effective multilingual classroom practice?

The findings indicated that teachers and learners regulated interactive metacognition through seven principal practices: establishing shared goals, structuring metacognitive dialogue, using multilingual resources strategically, distributing regulatory roles, providing adaptive scaffolding, evaluating collaborative reasoning, and reflecting on both learning outcomes and learning processes. Effective regulation was achieved when teachers guided interaction without controlling every contribution and when learners assumed responsibility for monitoring the understanding of their peers.

Table 2. Regulation of Interactive Metacognition in Multilingual Classroom Practice

Interview or analytical question	Synthesized responses or answers
1. How were shared goals and task expectations established?	Teachers clarified the conceptual and linguistic objectives of activities, while learners discussed the procedures, divided responsibilities, and agreed on expected outputs.
2. How did teachers structure metacognitive dialogue?	Teachers used probing questions, wait time, requests for justification, reflective prompts, and peer-response routines to focus attention on how understanding was developed.
3. How were multilingual resources regulated strategically?	Learners were allowed to use familiar languages for conceptual clarification but were encouraged to reformulate conclusions in the target language. Language choice was linked to the purpose of the task.
4. How were regulatory roles distributed among participants?	Teachers acted as facilitators, while learners alternated as explainers, questioners, translators, monitors, note-takers, and evaluators during collaborative tasks.
5. How was scaffolding adapted to learners' needs?	Teachers first encouraged peer assistance and multilingual negotiation before providing direct explanations. Support was gradually reduced as learners demonstrated greater independence.
6. How were group reasoning and learning strategies evaluated?	Teachers and learners evaluated not only the final answers but also the clarity of reasoning, effectiveness of language choices, participation, and usefulness of strategies.
7. How did reflection strengthen future classroom practice?	Post-task reflection helped participants identify successful strategies, communication difficulties, and necessary improvements for future multilingual collaboration.

Establishing shared goals and expectations

Interactive metacognition was more effectively regulated when teachers made both content and process expectations explicit. At the beginning of activities, teachers clarified what learners were expected to understand, how they should collaborate, and how the group product would be evaluated. Learners then translated these expectations into practical plans by assigning roles, selecting resources, and determining the order of the task.

Shared planning reduced the likelihood that one proficient learner would dominate the activity while others remained passive. When all group members understood that they might be asked to explain the conclusion, responsibility for learning became collective. Teachers also emphasized that groups should be able to justify how they

reached an answer, not merely present the answer itself. One teacher explained: T1: *"Before the group starts, I tell them that the result is not enough. They must explain the process, and every member must understand it. This makes them check each other instead of giving all the work to one student."*

This excerpt illustrates how task design regulated interaction before the activity began. By requiring process explanation and shared understanding, the teacher established conditions for peer monitoring and distributed responsibility.

Structuring metacognitive dialogue

Teachers regulated interactive metacognition by deliberately structuring opportunities for questioning, explanation, comparison, and reflection. They used open-ended questions rather than immediately correcting learners. They also provided wait time, invited multiple responses, and asked learners to react to peer explanations. These practices prevented classroom interaction from becoming a sequence of short teacher questions and learner answers. Observation data showed that metacognitive dialogue was strongest when teachers redirected questions to the group. Instead of supplying an answer, a teacher might ask, "Does everyone agree?", "What evidence supports that interpretation?", or "Can another group explain it differently?" Such prompts distributed evaluation among learners and encouraged them to monitor the quality of collective reasoning.

However, the findings also indicated that excessive teacher intervention could reduce learner regulation. When teachers corrected every error immediately, learners tended to wait for confirmation rather than examine the issue themselves. Effective regulation therefore required a balance between guidance and productive uncertainty.

Strategic regulation of multilingual resources

Teachers and learners regulated multilingualism by connecting language choice with cognitive and instructional purposes. The use of a first or familiar language was generally permitted when learners needed to clarify a difficult concept, compare meanings, or support a peer. However, learners were subsequently encouraged to express the agreed understanding in the target language. A learner described this process: L6: *"We use our first language when the meaning is confusing, but after we understand it, we try to say it again in English. It helps because we are not only translating; we have to make sure the idea is still the same."*

This excerpt illustrates strategic translanguaging as a regulatory process. The first language enabled conceptual access, while reformulation in the target language required learners to monitor semantic consistency. The movement between languages was therefore purposeful and connected to both content learning and language development. The findings suggest that multilingual regulation was most effective when language use was neither prohibited nor left entirely unstructured. Strict monolingual policies sometimes discouraged learners from expressing uncertainty, whereas unrestricted language switching could reduce opportunities to develop the target language. Purposeful guidelines helped learners understand when and why different languages could be used.

Distribution of regulatory roles

Collaborative knowledge construction improved when regulatory roles were distributed among group members. During observed tasks, learners acted as explainers, questioners, translators, monitors, evaluators, and recorders. These roles were sometimes assigned by teachers and sometimes emerged naturally in response to group needs. The distribution of roles allowed interactive metacognition to operate as a collective system. A learner with strong target-language proficiency might formulate the group answer,

while another learner with deeper conceptual understanding might identify an error. A third learner might translate the explanation or create a diagram. Thus, authority was not always concentrated in a single participant. One learner stated: L11: *"In our group, one person explained, but another person checked the instructions. I usually asked whether the examples matched the question. We had different jobs, so the answer became more complete."*

The excerpt demonstrates how differentiated contributions supported joint regulation. The learner's role in checking alignment between the example and task functioned as metacognitive evaluation. Collaborative knowledge emerged through the coordination of complementary roles rather than through equal performance of identical actions.

Adaptive teacher scaffolding

Teacher scaffolding regulated interactive metacognition by providing temporary assistance based on learners' needs. Teachers commonly began with prompts, clues, examples, or requests for peer support before offering direct explanations. This sequence allowed learners to attempt self- and co-regulation before relying on teacher authority. One teacher explained: T5: *"When they are confused, I first ask what they already understand and which part is difficult. Then I ask another student to respond. I give the explanation only when the group cannot solve the problem."*

This excerpt reflects graduated scaffolding. The teacher first supported problem identification, then activated peer resources, and finally provided direct assistance when necessary. Such scaffolding maintained learner agency while ensuring that misconceptions did not remain unresolved. Observation data also showed that teachers adjusted scaffolding according to participation patterns. Quieter learners received direct invitations to contribute, while dominant learners were asked to listen or summarize a peer's explanation. These interventions helped regulate social participation as well as cognitive activity.

Evaluating reasoning and strategy use

Interactive metacognition was strengthened when assessment focused on reasoning processes and strategy use in addition to final products. Teachers asked learners to explain why they chose a particular language, resource, example, or problem-solving approach. Peer feedback also addressed clarity, logical sequence, and conceptual accuracy. This form of evaluation encouraged learners to become more aware of the strategies that supported understanding. Rather than viewing multilingual practices as spontaneous or accidental, learners began to recognize translation, cross-linguistic comparison, diagramming, questioning, and peer explanation as deliberate learning strategies. The observation sheets showed that groups revised their responses more extensively when feedback included specific criteria. Criteria such as accuracy, clarity, evidence, participation, and linguistic appropriateness provided a shared basis for evaluation. Without such criteria, peer feedback tended to remain general and affirmative.

Post-task reflection and adaptation

The regulation cycle was completed through reflection after collaborative activities. Teachers asked learners to identify which strategies had helped the group, where communication had failed, and what they would change in future tasks. These reflections connected the immediate classroom experience with future planning. Learners reported that reflection helped them recognize the value of requesting clarification and comparing languages. Some became aware that they had relied too heavily on a more proficient group member, while others recognized that visual resources or first-language explanations had enabled broader participation. Reflection

therefore supported adaptation at both individual and group levels. The findings also suggest that reflection was more productive when it focused on a specific classroom episode rather than asking only whether learners enjoyed the activity. Questions about when confusion occurred, how it was resolved, and which explanation changed the group's thinking generated more detailed metacognitive responses.

The answer to the second research question is that interactive metacognition can be regulated through purposeful task design, dialogic teacher mediation, strategic multilingualism, distributed learner roles, adaptive scaffolding, process-oriented assessment, and post-task reflection. Teachers played a central role in creating conditions for regulation, but effective practice required learners to assume increasing responsibility for questioning, monitoring, evaluating, and adapting collective understanding.

Discussion

This study investigated how interactive metacognition was constructed and regulated within multilingual classroom practices. The findings demonstrate that interactive metacognition did not operate as an exclusively internal or individual process. Instead, it emerged through dialogic interaction, cross-linguistic negotiation, collaborative monitoring, explanation reformulation, semiotic mediation, and collective evaluation. Teachers and learners jointly made reasoning visible, identified gaps in understanding, compared interpretations, and modified their strategies in response to one another. These results support sociocultural perspectives that regard cognition as socially mediated and distributed across participants, languages, tools, and classroom activities. They also extend traditional accounts of metacognition that primarily emphasize individual planning, monitoring, and evaluation by showing how these regulatory processes can become publicly observable and collectively managed during multilingual interaction.

The finding that dialogic questioning made learners' thinking visible confirms previous research emphasizing the role of classroom dialogue in developing metacognitive awareness. Teachers' use of open-ended questions, requests for justification, and invitations to provide alternative explanations encouraged learners to articulate not only what they knew but also how they developed their conclusions. This result is consistent with Proctor et al. (2021), who argue that multilingual literacy instruction becomes more meaningful when student voice and language are placed at the center of classroom activity. It also supports Lee and Al-Adeimi's (2025) dialogic framework, in which questioning and collaborative engagement provide opportunities for learners to examine ideas from multiple perspectives. The current findings extend this scholarship by indicating that teacher questions also functioned as metacognitive prompts. Questions such as why an answer was selected or how a group arrived at a conclusion prompted learners to expose assumptions, evaluate evidence, and reconsider the adequacy of their reasoning. Consequently, classroom dialogue served both an epistemic function, by supporting knowledge construction, and a regulatory function, by enabling learners to monitor and revise the processes through which knowledge was produced.

Clarification questions and reciprocal monitoring were also central to the construction of interactive metacognition. Learners frequently asked peers to repeat, simplify, translate, exemplify, or justify an explanation. These requests revealed uncertainty and transformed misunderstanding into a shared problem that could be addressed collectively. This pattern aligns with Leonet et al. (2024), who found that bilingual learners use metacognitive strategies to overcome comprehension difficulties in foreign-language reading. However, the current study extends their findings beyond

individual strategy use by showing that comprehension monitoring may be reciprocal. A learner's request for clarification sometimes caused the speaker to recognize weaknesses in their own explanation. In this way, the act of explaining became a form of self-evaluation for one learner and comprehension monitoring for another. The results therefore suggest that interactive metacognition is relational: one participant's uncertainty can activate another participant's monitoring, and the resulting exchange can improve the understanding of the entire group.

The strategic use of multiple languages was another major finding. Learners moved between the target language, their first language, and other familiar languages to interpret instructions, compare terminology, clarify concepts, and verify whether an explanation retained the same meaning across linguistic forms. This supports Jessner and Allgäuer-Hackl's (2020) argument that multilingual awareness and metacognition are closely connected. It also corresponds with Tang and Calafato's (2021) finding that multilingual teachers can contribute to the development of learner self-regulation and language awareness. Rather than functioning as evidence of linguistic deficiency, translanguaging enabled learners to access prior knowledge, examine semantic differences, and formulate more precise interpretations.

The findings are also consistent with Bui and Tai (2022), who describe translanguaging as a resource for accomplishing cognitively demanding language tasks. In the present study, learners did not merely replace an unknown target-language word with its first-language equivalent. They used cross-linguistic comparison to evaluate whether concepts were fully equivalent, contextually appropriate, or sufficiently accurate. This process involved metalinguistic and metacognitive judgment simultaneously. The study therefore extends translanguaging research by conceptualizing cross-linguistic movement as a form of collective cognitive regulation. Learners regulated their understanding by selecting the language that best supported clarification and then reformulating the agreed meaning in the target language. Such movement across languages created an iterative cycle of conceptual access, semantic checking, and linguistic reconstruction.

However, the findings also qualify claims that multilingual language use is inherently beneficial. Multilingual interaction supported metacognition most effectively when language choices were purposefully connected to conceptual clarification, peer participation, or target-language reformulation. Unstructured language switching did not necessarily generate reflection or deeper learning. This result supports Hofer and Jessner's (2025) call for movement away from monolingual norms while also demonstrating that multilingual pedagogy requires deliberate instructional design. It also corresponds with Zano and Mbirimi-Hungwe (2023), who emphasize the importance of designing instruction that intentionally promotes translanguing practices. Thus, the value of multilingualism depends not only on permitting several languages but also on helping learners recognize when, why, and how different linguistic resources can support cognitive regulation.

The use of semiotic resources further demonstrated that interactive metacognition was distributed beyond spoken language. Learners used diagrams, gestures, keywords, bilingual notes, glossaries, texts, and digital dictionaries to externalize reasoning and resolve disagreements. This result supports Magangxa and Geduld's (2023) account of semiotic resources in multilingual literacy instruction and Cogo et al.'s (2021) argument that critical language education must attend to the diverse resources learners use to create meaning. Semiotic artifacts gave participants stable points of reference that could be examined, compared, corrected, and revised. A diagram, for example, allowed a

group to evaluate whether relationships among ideas were logically represented, while bilingual notes enabled learners to verify consistency across linguistic forms.

These results extend distributed cognition perspectives by showing that classroom artifacts did not merely assist communication; they participated in the regulation of thought. Knowledge monitoring was distributed across speakers, listeners, written texts, visual representations, and digital tools. This finding has practical importance because teachers may overlook nonverbal or material evidence of metacognition when assessment focuses primarily on spoken target-language performance. A learner who uses a diagram, gesture, or bilingual note to identify a conceptual inconsistency may be demonstrating sophisticated monitoring even when target-language proficiency is limited. Multilingual assessment should therefore recognize how learners coordinate linguistic and semiotic resources to regulate understanding.

The second research question concerned how teachers and learners regulated interactive metacognition. The findings showed that regulation was strengthened through shared goal setting, structured dialogue, strategic multilingualism, distributed roles, adaptive scaffolding, process-oriented evaluation, and post-task reflection. This pattern confirms Zarobe and Smala's (2020) claim that metacognitive awareness can be strengthened through explicit strategy instruction in content-and-language learning settings. It also corresponds with Domke and Cerrato's (2024) conclusion that integrated content and language instruction is most productive when linguistic and cognitive goals are deliberately coordinated.

Shared goals and collective accountability were particularly important. When teachers required all group members to understand and explain the group's conclusion, learners were more likely to monitor one another's comprehension. This finding extends collaborative-learning research by demonstrating that group work does not automatically generate co-regulation. Without expectations for shared understanding, a proficient learner may complete the task while others remain cognitively peripheral. Interactive metacognition was more visible when learners were expected to justify the process, distribute responsibilities, and ensure that every member could articulate the result. Consequently, task design influenced whether collaboration became genuinely metacognitive or remained a division of labor.

The distribution of roles among explainers, questioners, translators, monitors, evaluators, and recorders also supported collaborative knowledge construction. These roles allowed different forms of expertise to contribute to regulation. A learner with strong linguistic proficiency could formulate an answer, whereas another with stronger conceptual understanding could detect an inconsistency. This finding supports Panda's (2022) broader argument that multilingual intelligence should be understood in relation to diverse cognitive and linguistic resources rather than through deficit-based judgments. It also suggests that equitable participation does not require all learners to perform identical functions. Productive collaboration may instead depend on the coordination of complementary contributions.

Teacher scaffolding remained essential, but the findings reveal that its effectiveness depended on timing and intensity. Teachers supported regulation most effectively when they first prompted learners to identify what they understood, invited peer assistance, and supplied direct explanation only when necessary. This graduated support aligns with dialogic and sociocultural models of teaching in which assistance is responsive to learners' emerging needs. It also supports Almusharraf et al.'s (2022) emphasis on teacher reflection and professional development. Teachers must be able to recognize when intervention will extend collaborative reasoning and when premature correction will suppress learner monitoring.

A notable finding was that excessive teacher correction could reduce learner regulation. When teachers immediately confirmed or rejected every response, learners became dependent on external judgment rather than evaluating evidence collaboratively. This result complicates approaches that emphasize explicit metacognitive instruction without considering learner agency. Although structured guidance is necessary, overly prescriptive instruction may prevent metacognitive dialogue from emerging naturally. The study therefore identifies a productive balance between teacher-led orchestration and learner-led inquiry. Teachers should establish goals, criteria, and reflective routines while allowing sufficient uncertainty for learners to question, compare, and revise ideas.

Process-oriented assessment and post-task reflection completed the regulatory cycle. Learners demonstrated greater awareness when feedback addressed not only whether an answer was correct but also how language choices, peer explanations, visual resources, and questioning strategies contributed to understanding. This finding supports Weng's (2025) emphasis on the relationship between strategy use and language-learning performance. It also aligns with Tang's (2024) argument that language and literacy perspectives are essential when examining emerging cognitive tools and learning processes. Reflection enabled learners to identify successful strategies, recognize overreliance on proficient peers, and plan improvements for subsequent activities.

CONCLUSION

This study examined how interactive metacognition was constructed and regulated through multilingual classroom practices. The findings demonstrate that it emerged through interconnected processes of dialogic questioning, clarification, cross-linguistic negotiation, collaborative monitoring, explanation reformulation, semiotic mediation, and collective evaluation. Learners developed awareness of their understanding not only through individual reflection but also through comparison with peer explanations, teacher prompts, and multilingual representations. The use of first languages, target languages, gestures, diagrams, bilingual notes, and digital tools enabled participants to externalize thought and evaluate meaning collectively. Multilingual practices therefore functioned as cognitive resources when they were purposefully employed to clarify, compare, verify, and reconstruct disciplinary knowledge. The findings reinforce the view that metacognition is socially distributed and show that its development depends on interactions among participants, languages, tools, and instructional conditions.

The study further concludes that effective regulation requires purposeful task design, shared goals, dialogic teacher mediation, strategic translanguaging, distributed learner roles, adaptive scaffolding, process-focused assessment, and post-task reflection. Teachers should neither impose rigid monolingual practices nor allow multilingual interaction to remain cognitively unstructured. Instead, they should guide learners in selecting linguistic and semiotic resources according to specific conceptual and communicative purposes. Learners should gradually assume responsibility for questioning, monitoring, evaluating, and adapting collective understanding. Although the qualitative and context-bound nature of the study limits statistical generalization, its findings offer transferable principles for comparable multilingual classrooms.

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DECLARATION OF USING AI TOOLS

Generative artificial intelligence tools were used during the preparation of this manuscript to support language editing, improve sentence clarity, reorganize selected paragraphs, and identify repetitive phrasing. The tools were not used to collect data, recruit participants, conduct interviews, perform classroom observations, create empirical evidence, or independently determine the study's findings. All AI-assisted text was critically reviewed, revised, and verified by the authors. The authors retained full responsibility for the research design, data analysis, interpretation, citations, ethical compliance, and final manuscript. No confidential participant information or identifiable research data were entered into publicly accessible AI platforms during manuscript preparation.

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