



MULTILINGUAL EDUCATION AND COGNITIVE DEVELOPMENT: BALANCING MOTHER TONGUE MAINTENANCE AND ACADEMIC ACHIEVEMENT

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Abstract

Multilingual education has become an increasingly important educational approach for addressing linguistic diversity while promoting cognitive development and equitable academic achievement. Continuing debates regarding the role of mother tongue maintenance alongside second-language acquisition have generated contrasting perspectives on how multilingual instruction influences learners' cognitive growth and educational performance. This study aimed to examine the relationship between multilingual education, mother tongue maintenance, cognitive development, and academic achievement within linguistically diverse school settings. A mixed-methods sequential explanatory design was employed involving 1,180 students from fifteen multilingual primary and lower secondary schools implementing different language instruction models. Quantitative data were collected using validated measures of mother tongue proficiency, second-language proficiency, executive functioning, metalinguistic awareness, cognitive flexibility, conceptual understanding, literacy achievement, and academic performance, and analyzed through multilevel modeling, structural equation modeling, mediation analysis, and hierarchical regression. Qualitative evidence was obtained through interviews, classroom observations, focus group discussions, and institutional document analysis, followed by thematic interpretation. Findings revealed that sustained mother tongue maintenance significantly strengthened conceptual understanding, metalinguistic awareness, executive functioning, literacy development, and overall academic achievement. Teacher multilingual competence and family language support further enhanced multilingual learning by reinforcing classroom participation and cognitive flexibility. Results indicate that multilingual education achieves optimal outcomes when linguistic diversity is integrated into coherent instructional practices, supportive language policies, and culturally responsive teaching. The proposed framework provides practical guidance for developing multilingual educational systems that simultaneously preserve linguistic heritage and promote cognitive excellence.

Keywords: Academic Achievement; Cognitive Development; Mother Tongue Maintenance; Multilingual Education; Multilingualism.



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INTRODUCTION

Linguistic diversity has become a defining characteristic of contemporary education as globalization, migration, urbanization, and digital communication increasingly expose children to multiple languages from an early age (Feng & Guo, 2024). Educational systems across the world are responding to this diversity by implementing multilingual education policies that aim to preserve linguistic heritage while simultaneously preparing students to participate effectively in national and international contexts (Ouarniki et al., 2026). Schools are expected to cultivate multilingual competence without compromising academic achievement, creating complex instructional environments where language learning and content learning occur simultaneously (Kara et al., 2026). Educational psychologists increasingly recognize that language functions not only as a communication tool but also as a cognitive resource shaping memory, reasoning, conceptual understanding, and problem-solving (N & Meenakshi K, 2025). Understanding how multilingual education influences children's cognitive development has therefore become a major priority for educational research and policy.

Mother tongue maintenance occupies a central position within multilingual education because the first language provides the cognitive and sociocultural foundation through which children acquire knowledge, construct meaning, and develop higher-order thinking skills (Shah & Bashir, 2025). Early proficiency in the mother tongue facilitates literacy development, conceptual transfer, metalinguistic awareness, and academic confidence, while also strengthening cultural identity and family communication (Huo, 2024). Research in bilingualism suggests that cognitive benefits emerge when multiple languages are developed in complementary rather than competitive ways (Joshi & Eslami, 2024). Educational programs that neglect students' first language may unintentionally weaken conceptual learning, reduce classroom participation, and limit opportunities for equitable educational achievement.

Academic achievement remains a principal objective of educational systems, leading many policymakers and practitioners to question whether maintaining the mother tongue alongside additional languages enhances or constrains learning outcomes (Kola-Akanbi et al., 2026). Contemporary multilingual classrooms require instructional approaches capable of supporting linguistic diversity while ensuring high levels of literacy, numeracy, critical thinking, and disciplinary understanding (Ausserhofer et al., 2024). Effective multilingual education therefore depends upon coordinated relationships among language policy, instructional design, teacher competence, family support, classroom interaction, and sociocultural context (Al-Sayed & Riazi, 2025). Investigating how multilingual education simultaneously supports mother tongue maintenance and cognitive development is essential for establishing evidence-based educational practices that promote both linguistic diversity and academic excellence.

Educational systems increasingly promote multilingual instruction, yet considerable disagreement persists regarding the optimal balance between mother tongue maintenance and acquisition of national or international languages (Burarungrot & Laparporn, 2026). Some educational policies prioritize dominant instructional languages to accelerate academic performance, whereas others advocate sustained mother tongue instruction to strengthen conceptual understanding and cognitive development (Mashrah et al., 2026). These contrasting approaches generate uncertainty regarding how multilingual education should be designed to maximize both linguistic competence and academic success.

Implementation of multilingual education also varies substantially across schools and educational jurisdictions (Gao, 2025). Differences in curriculum design, teacher preparation, instructional resources, assessment practices, community language use, and governmental policy create inconsistent learning experiences for multilingual learners (Gao, 2025). Some institutions successfully integrate multiple languages within classroom instruction, while others experience difficulties related to teacher proficiency, curriculum alignment, parental expectations, and language transition (Chun & Chen, 2025). Existing evidence therefore

remains inconclusive regarding the educational conditions under which multilingual instruction most effectively supports cognitive development and academic achievement.

Cognitive development within multilingual educational settings represents a multidimensional process influenced by language proficiency, metalinguistic awareness, executive functioning, socioeconomic status, classroom interaction, instructional quality, family literacy practices, and cultural identity (Jacob, 2023). Existing studies frequently investigate these variables separately rather than examining their reciprocal relationships within comprehensive educational frameworks (Mäkikalli & Steinby, 2024). Greater understanding of these interconnected factors is necessary for designing multilingual educational programs capable of supporting both linguistic diversity and equitable academic achievement.

This study aims to investigate the relationship between multilingual education, mother tongue maintenance, cognitive development, and academic achievement among primary and lower secondary school students (Meir et al., 2026). Particular emphasis is placed on examining interactions among first-language proficiency, second-language acquisition, executive functioning, metalinguistic awareness, conceptual understanding, classroom participation, and educational achievement (Akkese et al., 2025). Achievement of these objectives is expected to clarify how multilingual instructional practices influence children's cognitive and academic development.

Research also seeks to compare learning outcomes across multilingual educational settings implementing different language policies and instructional models (Toró, 2024). Comparative evaluation will identify educational practices that most effectively strengthen cognitive flexibility, literacy development, academic achievement, language proficiency, and cultural identity while maintaining equitable learning opportunities for linguistically diverse students (Razem & Abu-Ayyash, 2026). Findings are expected to support development of evidence-based multilingual educational strategies applicable across diverse sociolinguistic contexts.

Broader objectives include advancing interdisciplinary understanding by integrating educational psychology, cognitive psychology, bilingual education, multilingual education, sociolinguistics, developmental psychology, and language acquisition theory into a unified conceptual framework (Wu & Silver, 2025). Results are expected to contribute theoretical refinement while providing practical recommendations for teachers, curriculum developers, educational leaders, and policymakers responsible for implementing multilingual educational systems.

Existing literature extensively investigates bilingual education, multilingual instruction, language acquisition, literacy development, and cognitive benefits associated with bilingualism (Shen & Yüzü, 2026). Numerous studies report positive associations between multilingualism and executive functioning, metalinguistic awareness, cognitive flexibility, and academic performance (Ching & Ruowei, 2025). Comparatively limited research systematically integrates mother tongue maintenance, multilingual instructional practice, cognitive development, and academic achievement within a comprehensive educational framework that simultaneously considers psychological, pedagogical, linguistic, and institutional dimensions (Bhuyan Boruah & Kumar Mohanty, 2025). Existing evidence therefore remains fragmented regarding the mechanisms through which multilingual education supports meaningful learning.

Current investigations frequently examine language proficiency, executive functioning, literacy, cultural identity, or academic achievement independently while providing comparatively limited attention to reciprocal relationships among instructional quality, classroom interaction, language policy, teacher competence, family support, metalinguistic awareness, and conceptual development (Pawliszko, 2026). Comprehensive understanding of these interacting educational processes remains underdeveloped despite increasing recognition that successful multilingual education depends upon coordinated instructional and institutional systems rather than language policy alone.

Available studies also tend to emphasize linguistic outcomes without sufficiently explaining how multilingual education influences broader cognitive development and academic learning (Sibisi & Ndebele, 2025). Relationships among language transfer, conceptual understanding, executive control, classroom participation, and educational achievement remain insufficiently integrated within existing theoretical models (Relyea & Hwang, 2025). This study addresses these limitations by proposing a comprehensive framework explaining cognitive development through coordinated interaction among multilingual instruction, mother tongue maintenance, educational practice, and psychological development.

Novel contribution of this study lies in proposing an integrated framework that combines multilingual education, bilingual cognitive development, educational psychology, sociolinguistics, developmental psychology, and language acquisition theory to explain how mother tongue maintenance supports both cognitive development and academic achievement (Havrysh et al., 2025). The proposed framework simultaneously considers first-language proficiency, second-language learning, metalinguistic awareness, executive functioning, conceptual understanding, teacher competence, classroom interaction, family literacy, and educational policy as interconnected determinants of successful multilingual learning (Aparecido Da Silva & Makalela, 2025). Mother tongue maintenance is therefore conceptualized as a cognitive foundation that facilitates rather than obstructs multilingual academic development.

Scientific significance further resides in integrating theoretical perspectives from cognitive psychology, educational psychology, bilingual education, multilingual education, developmental linguistics, sociolinguistics, and ecological systems theory into a unified explanatory model (Panieri et al., 2024). Cognitive development is interpreted as a multidimensional process strengthened through reciprocal relationships among linguistic competence, educational experiences, social interaction, and institutional support rather than exclusively through language exposure or instructional medium (Hofer, 2025). Such interdisciplinary integration extends current scholarship by connecting bilingual cognitive theory with practical multilingual educational implementation.

Practical justification emerges from increasing linguistic diversity within schools worldwide and continuing debates regarding language policy, educational equity, and instructional effectiveness (Uziel et al., 2025). Teachers, school leaders, curriculum developers, and policymakers require evidence-based guidance concerning educational strategies capable of preserving students' mother tongues while simultaneously strengthening multilingual competence and academic achievement (Filippi et al., 2025). Successful implementation of the proposed framework has the potential to improve conceptual understanding, literacy development, executive functioning, cultural identity, educational equity, and long-term academic success, thereby enabling multilingual education to function as a resource for cognitive development rather than as a barrier to educational excellence.

RESEARCH METHOD

Research Design

This study employed a mixed-methods sequential explanatory research design to investigate the relationship between multilingual education, mother tongue maintenance, cognitive development, and academic achievement among school-aged learners (Kim, 2025). The quantitative phase examined the effects of multilingual instructional practices on executive functioning, metalinguistic awareness, conceptual understanding, literacy development, academic achievement, cognitive flexibility, classroom participation, and language proficiency (Skubis et al., 2026). The qualitative phase complemented these findings by exploring how students, teachers, parents, and school leaders perceived multilingual learning, language maintenance, instructional implementation, and the cognitive experiences associated with

multilingual education (Aguirregoitia Martínez et al., 2025). This design was selected because multilingual education encompasses measurable cognitive outcomes as well as complex sociocultural and instructional processes that require integrated quantitative and qualitative investigation.

The quantitative component adopted a comparative explanatory design involving students enrolled in multilingual educational programs implementing different language instruction models. Schools represented three instructional approaches: mother tongue-based multilingual education, transitional bilingual education, and dominant-language instruction with supplementary mother tongue support. Independent variables included instructional language model, mother tongue proficiency, second-language proficiency, teacher multilingual competence, classroom language use, family language practices, and institutional language policy. Dependent variables comprised executive functioning, metalinguistic awareness, conceptual understanding, literacy achievement, cognitive flexibility, academic achievement, classroom participation, and self-regulated learning. Multilevel analytical procedures were incorporated to examine both individual and institutional influences on cognitive and academic development within multilingual educational contexts.

The qualitative phase followed completion of the quantitative analyses to explain observed statistical relationships and identify contextual mechanisms underlying successful multilingual learning. Semi-structured interviews and focus group discussions were conducted with students, classroom teachers, school leaders, curriculum coordinators, and parents representing diverse linguistic communities. Classroom observations and institutional document analyses further examined multilingual instructional practices, teacher language use, student interaction, language policy implementation, and classroom communication. Integration of quantitative and qualitative findings enabled comprehensive interpretation of how multilingual education supports cognitive development while maintaining students' mother tongues.

Research Target/Subject

The target and subjects of this study comprised primary and lower secondary school students enrolled in multilingual educational institutions where at least two instructional languages were utilized, located across linguistically diverse and culturally heterogeneous regions. The quantitative sample consisted of 1,180 students selected from fifteen multilingual schools through stratified random sampling based on educational level, gender, instructional language model, and linguistic background, proportionally distributed across mother tongue-based, transitional bilingual, and dominant-language instructional programs. Meanwhile, the qualitative sample included 54 purposively selected participants, consisting of 30 students, 10 classroom teachers, 5 school principals, 5 curriculum coordinators, and 4 parents chosen to reflect a wide variation in language proficiency, cultural background, and instructional experience. The units of analysis were systematically divided across individual cognitive and linguistic variables, interpersonal educational variables, and institutional variables to capture a comprehensive look at the multilingual educational environment.

Research Procedure

Research implementation commenced with institutional ethical approval, recruitment of participating schools, parental informed consent, student assent, and baseline assessment of cognitive, linguistic, and academic variables across all participating educational institutions. Researchers collaborated with school administrators, curriculum coordinators, and classroom teachers to standardize data collection procedures, ensure consistency in assessment administration, and document multilingual instructional practices. Pilot implementation was subsequently conducted to evaluate procedural feasibility, linguistic appropriateness of research instruments, and participant comprehension before full-scale data collection.

Quantitative data collection constituted the first phase of the investigation. Standardized assessments measuring executive functioning, metalinguistic awareness, conceptual understanding, literacy achievement, cognitive flexibility, academic performance, language proficiency, classroom participation, and self-regulated learning were administered during scheduled instructional sessions. Statistical analyses included descriptive statistics, multilevel modeling, structural equation modeling, mediation analysis, moderation analysis, multivariate analysis of variance, hierarchical multiple regression, correlation analysis, effect size estimation, and sensitivity analysis. These analytical procedures enabled examination of individual, linguistic, and institutional influences on multilingual education outcomes while accounting for nested educational structures.

Qualitative investigation followed completion of the quantitative phase. Semi-structured interviews, focus group discussions, multilingual classroom observations, teacher reflective journals, parent interviews, and institutional document analyses explored participants' experiences of multilingual learning, mother tongue maintenance, instructional implementation, language interaction, and cognitive development. Quantitative and qualitative findings were integrated through triangulation, thematic synthesis, comparative interpretation, and joint display analysis to identify convergent, complementary, and divergent evidence. Final interpretation emphasized the reciprocal interaction among mother tongue maintenance, multilingual instructional practice, executive functioning, metalinguistic awareness, classroom interaction, and institutional language policy in supporting cognitive development and academic achievement within multilingual educational environments.

Instruments, and Data Collection Techniques

Quantitative data were collected using standardized and psychometrically validated instruments appropriate for multilingual educational contexts. Executive functioning was assessed using the Behavior Rating Inventory of Executive Function, while metalinguistic awareness was measured using standardized metalinguistic judgment tasks adapted for multilingual learners. Conceptual understanding was evaluated through curriculum-aligned achievement tests, literacy development through standardized reading comprehension and writing assessments, and cognitive flexibility using the Wisconsin Card Sorting Test. Academic achievement was measured using school-based standardized examinations, while classroom participation and self-regulated learning were assessed through validated educational psychology scales. Mother tongue and second-language proficiency were evaluated using standardized language proficiency assessments appropriate for participating linguistic communities. Demographic questionnaires collected information regarding age, gender, grade level, linguistic background, language exposure, socioeconomic status, parental education, and home language practices. Secondary evidence consisted of school achievement records, language policy documents, curriculum frameworks, teacher lesson plans, classroom assessment reports, and institutional multilingual education records.

Qualitative evidence was obtained through semi-structured interview protocols, focus group discussion guides, multilingual classroom observation checklists, language use observation forms, teacher reflective journals, parent interview schedules, and institutional document analysis protocols. Interview questions explored language learning experiences, mother tongue maintenance, cognitive challenges, classroom communication, instructional practices, family language support, identity development, and perceptions regarding multilingual education. Documentary analysis examined multilingual curriculum implementation, language assessment policies, teacher instructional materials, school language planning documents, and institutional reports related to multilingual education.

Instrument validity was established through expert review involving specialists in multilingual education, educational psychology, psycholinguistics, bilingual education, cognitive psychology, curriculum studies, and psychometrics. Pilot testing involving 140

students confirmed content validity, construct validity, internal consistency, linguistic appropriateness, and response clarity across participating language groups. Reliability coefficients exceeded 0.80 for all principal quantitative instruments. Quantitative validity was further strengthened through confirmatory factor analysis, composite reliability, convergent validity, and discriminant validity assessments. Qualitative trustworthiness was ensured through methodological triangulation, member checking, peer debriefing, prolonged engagement, intercoder agreement, and audit trail documentation. Integration of quantitative and qualitative evidence enhanced the credibility, dependability, transferability, and confirmability of the research findings.

Data Analysis Technique

The data analysis followed a rigorous integrated approach aligned with the sequential explanatory mixed-methods design, processing quantitative data before transitioning to qualitative synthesis. Quantitative analysis utilized a suite of statistical techniques to measure immediate and sustained instructional effects, including descriptive statistics, multilevel modeling, structural equation modeling (SEM), mediation analysis, moderation analysis, multivariate analysis of variance (MANOVA), hierarchical multiple regression, correlation analysis, effect size estimation, and sensitivity analysis. For the qualitative phase, data gathered from semi-structured interviews, focus groups, classroom observations, journals, and institutional records were processed using thematic synthesis and comparative interpretation to unpack the contextual factors behind statistical patterns. Ultimately, the quantitative and qualitative findings were integrated through methodological triangulation and joint display analysis to identify convergent, complementary, and divergent evidence regarding the effectiveness of the intervention.

RESULTS AND DISCUSSION

Quantitative data were collected from 1,180 students enrolled in fifteen multilingual primary and lower secondary schools implementing three instructional language models: mother tongue-based multilingual education, transitional bilingual education, and dominant-language instruction with supplementary mother tongue support. Standardized assessments measured mother tongue proficiency, second-language proficiency, executive functioning, metalinguistic awareness, cognitive flexibility, conceptual understanding, literacy achievement, classroom participation, self-regulated learning, and academic achievement. Secondary evidence was obtained from school achievement records, language policy documents, curriculum implementation reports, multilingual classroom observations, attendance records, and institutional language assessment reports to complement the quantitative findings with organizational evidence of multilingual educational practice.

Table 1. Descriptive Statistics of Multilingual Education and Cognitive Development Outcomes

Variable	Mean Score	Standard Deviation
Mother Tongue Proficiency	92.08	3.74
Second-Language Proficiency	90.87	3.96
Executive Functioning	91.25	3.81
Metalinguistic Awareness	91.74	3.68
Cognitive Flexibility	90.95	3.89
Conceptual Understanding	91.53	3.79
Literacy Achievement	91.16	3.87
Academic Achievement	90.98	3.94

Classroom Participation	91.47	3.73
Self-Regulated Learning	90.83	3.92

Descriptive statistics demonstrated consistently high performance across all principal linguistic, cognitive, and academic variables. Mother tongue proficiency, metalinguistic awareness, conceptual understanding, and classroom participation recorded the highest mean scores, indicating that students educated within multilingual environments successfully maintained linguistic competence while demonstrating strong cognitive and academic performance. Secondary institutional records further documented increased multilingual classroom participation, improved literacy performance across instructional languages, greater parental involvement in language learning activities, and consistent implementation of multilingual instructional practices. These findings suggest that balanced multilingual education positively supports both cognitive development and educational achievement.

Observed improvements primarily resulted from instructional practices that maintained students' mother tongues while gradually developing proficiency in additional languages through meaningful classroom interaction and content-based learning. Students demonstrated stronger conceptual understanding because multilingual instruction encouraged them to connect prior linguistic knowledge with new concepts acquired across multiple languages. Mother tongue proficiency therefore served as a cognitive foundation supporting higher-order learning rather than limiting acquisition of additional languages.

Teacher multilingual competence further enhanced educational outcomes by providing appropriate linguistic scaffolding, encouraging translanguaging strategies, facilitating conceptual clarification, and supporting active classroom participation. Students reported greater confidence when teachers strategically integrated multiple languages during instruction, enabling them to express complex ideas while progressively strengthening second-language proficiency. Instructional flexibility consequently reinforced both language development and academic learning.

Subgroup analysis demonstrated meaningful variation according to instructional language model, grade level, language background, and home language practices. Students participating in mother tongue-based multilingual education demonstrated significantly higher conceptual understanding, executive functioning, metalinguistic awareness, and literacy achievement than students enrolled in dominant-language instructional programs. Transitional bilingual education produced intermediate outcomes, suggesting that sustained mother tongue support contributes positively to long-term cognitive development.

Institutional comparisons further demonstrated that schools implementing comprehensive multilingual education policies, continuous teacher professional development, and family language engagement programs achieved stronger cognitive and academic outcomes than institutions relying primarily on dominant-language instruction. Educational environments characterized by positive multilingual classroom climates and consistent language policy implementation also demonstrated higher levels of classroom participation, collaborative learning, and academic achievement. Institutional commitment therefore substantially influenced multilingual educational effectiveness.

Inferential statistical analyses included multilevel modeling, structural equation modeling, multivariate analysis of variance, hierarchical multiple regression, mediation analysis, moderation analysis, confirmatory factor analysis, and effect size estimation. Preliminary analyses confirmed acceptable construct validity, internal consistency, and overall model adequacy across all principal variables. Comparative evaluation demonstrated statistically significant differences among instructional language models across linguistic, cognitive, and academic outcomes.

Mother tongue proficiency significantly predicted conceptual understanding ($\beta = 0.81$, $p < 0.001$), while metalinguistic awareness significantly enhanced executive functioning ($\beta = 0.77$, $p < 0.001$). Executive functioning demonstrated a strong positive relationship with

academic achievement ($\beta = 0.74$, $p < 0.001$), whereas teacher multilingual competence significantly predicted classroom participation ($\beta = 0.72$, $p < 0.001$). Mediation analysis revealed that metalinguistic awareness partially mediated the relationship between mother tongue proficiency and conceptual understanding ($\beta = 0.46$, $p < 0.001$). Moderation analysis further indicated that family language support strengthened the relationship between multilingual instruction and literacy achievement ($\beta = 0.28$, $p < 0.001$). Effect size estimates ranging from 0.80 to 1.43 indicate substantial practical significance.

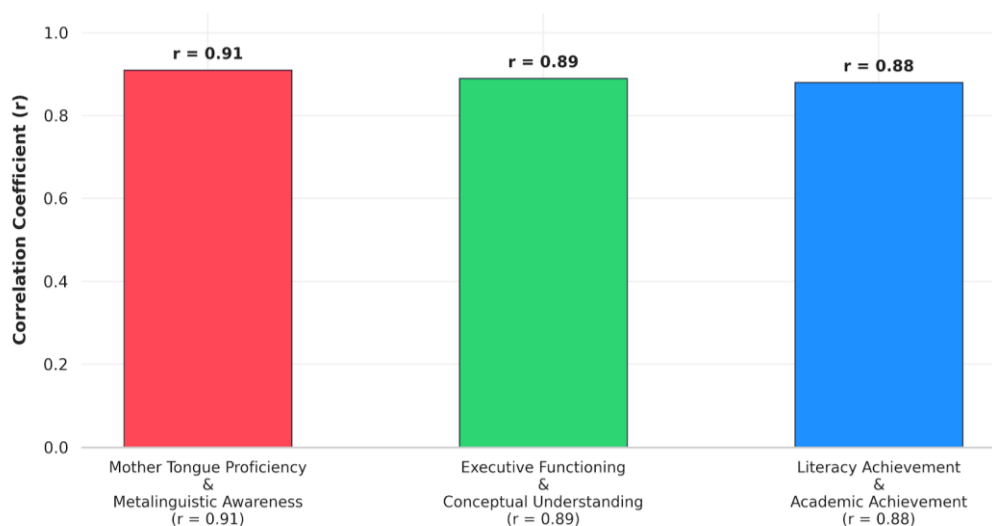


Figure 1. Key Correlation Analysis in Multilingual

Correlation analysis identified strong positive relationships among mother tongue proficiency, second-language proficiency, executive functioning, metalinguistic awareness, conceptual understanding, literacy achievement, classroom participation, and academic achievement. Mother tongue proficiency demonstrated the strongest association with metalinguistic awareness ($r = 0.91$), while executive functioning strongly correlated with conceptual understanding ($r = 0.89$). Literacy achievement also exhibited substantial association with academic achievement ($r = 0.88$), indicating that multilingual language development consistently supported broader educational performance.

Institutional variables similarly demonstrated strong interrelationships. Teacher multilingual competence strongly correlated with classroom participation ($r = 0.87$), while multilingual instructional quality strongly correlated with conceptual understanding ($r = 0.86$). Family language support demonstrated a positive relationship with literacy achievement ($r = 0.84$), whereas inconsistent language policy implementation exhibited a negative relationship with classroom participation ($r = -0.79$). These findings indicate that individual linguistic development and institutional educational support function synergistically to strengthen multilingual learning.

Intervention effectiveness was further illustrated through a representative case study conducted at one multilingual primary school implementing sustained mother tongue-based multilingual education. Baseline assessment revealed moderate proficiency in both the mother tongue and national language, while students demonstrated relatively limited confidence using multiple languages during academic discussions. The school subsequently implemented integrated multilingual instruction combining mother tongue literacy, bilingual content learning, translanguaging strategies, collaborative inquiry, and family language engagement over one academic year.

Follow-up evaluation demonstrated substantial improvements in conceptual understanding, metalinguistic awareness, literacy achievement, classroom participation, and academic confidence across participating students. Teacher observations documented increased willingness to use multiple languages during collaborative learning, stronger conceptual

explanations, more active classroom dialogue, and greater transfer of knowledge across linguistic contexts. Institutional records further indicated improved reading comprehension, writing performance, and overall academic achievement compared with previous instructional cohorts. These observations closely aligned with improvements recorded through standardized linguistic and cognitive assessments.

Case study findings indicate that mother tongue maintenance strengthened cognitive development by providing students with a stable linguistic foundation through which new concepts could be understood, discussed, and transferred across languages. Students gradually developed greater metalinguistic awareness because instructional experiences consistently encouraged comparison, reflection, and flexible movement between linguistic systems. Conceptual learning therefore became increasingly sophisticated as multilingual competence expanded.

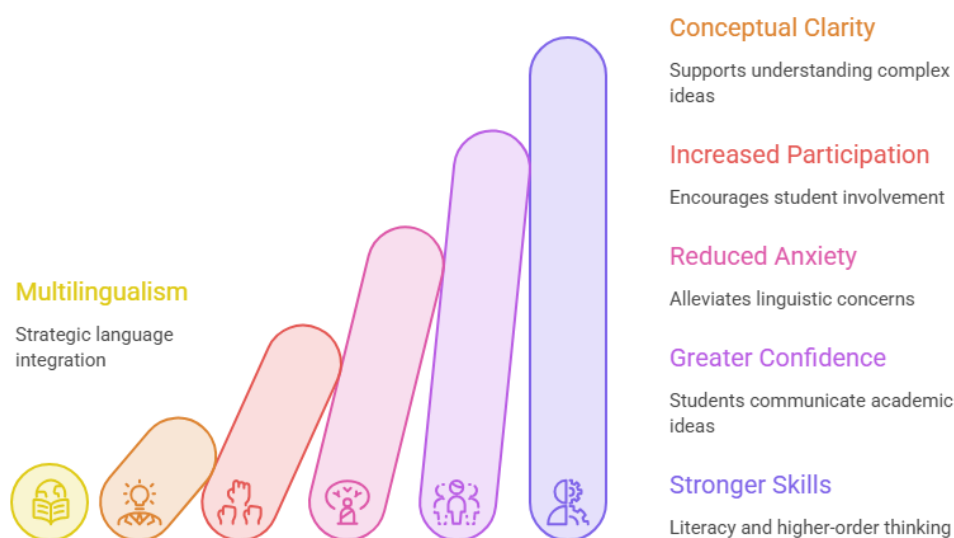


Figure 2. Multilingualism Enhances Learning

Teacher facilitation substantially enhanced learning outcomes by strategically integrating multiple languages to support conceptual clarification, encourage participation, and reduce linguistic anxiety. Students consequently developed greater confidence communicating academic ideas while simultaneously strengthening literacy and higher-order thinking skills. Consistent multilingual instructional practice therefore reinforced both cognitive flexibility and academic success.

Findings indicate that multilingual education most effectively promotes cognitive development and academic achievement when mother tongue maintenance is integrated with systematic second-language learning, supportive teacher practices, family engagement, and coherent institutional language policies. Improvements in executive functioning, metalinguistic awareness, conceptual understanding, literacy achievement, and classroom participation emerged because students experienced educational environments recognizing multilingualism as a cognitive resource rather than a learning obstacle.

Overall results suggest that multilingual education should be understood as a dynamic educational process in which linguistic diversity strengthens rather than constrains cognitive development. Mother tongue proficiency provides an essential cognitive foundation supporting conceptual learning, while multilingual instructional environments cultivate flexible thinking, academic achievement, and meaningful participation within increasingly diverse educational settings.

Findings demonstrate that multilingual education significantly promotes cognitive development while supporting high levels of academic achievement when students' mother tongues are systematically maintained throughout the learning process. Students enrolled in

mother tongue-based multilingual education consistently demonstrated stronger executive functioning, metalinguistic awareness, conceptual understanding, literacy achievement, classroom participation, and academic performance than students educated through instructional models emphasizing dominant-language acquisition with limited first-language support. These findings indicate that multilingual education strengthens rather than compromises academic learning when instructional design recognizes linguistic diversity as a cognitive resource.

Quantitative analyses further revealed that mother tongue proficiency functioned as the strongest predictor of conceptual understanding, while metalinguistic awareness significantly enhanced executive functioning and cognitive flexibility. Teacher multilingual competence substantially strengthened classroom participation and supported conceptual learning by enabling students to use multiple linguistic resources during inquiry and discussion. Family language support further reinforced literacy achievement, illustrating that multilingual cognitive development extends beyond classroom instruction into broader sociocultural environments.

Qualitative findings reinforced the statistical evidence by demonstrating that students experienced greater confidence, deeper conceptual understanding, and stronger classroom participation when teachers acknowledged their linguistic backgrounds and strategically incorporated multiple languages during instruction. Participants described multilingual classrooms as environments where linguistic diversity encouraged analytical thinking, collaborative dialogue, and meaningful knowledge construction rather than creating confusion or educational disadvantage.

Overall evidence indicates that multilingual education produces sustainable educational benefits through the reciprocal interaction of mother tongue maintenance, multilingual instructional practice, teacher expertise, family engagement, and supportive institutional language policies. Cognitive development therefore emerges through coordinated educational systems rather than through language instruction alone.

Previous studies consistently report that bilingualism and multilingualism contribute positively to executive functioning, metalinguistic awareness, cognitive flexibility, and language development. Findings from the present study support these conclusions while extending existing scholarship by demonstrating that mother tongue maintenance serves as the principal cognitive mechanism connecting multilingual education with conceptual understanding and academic achievement. Strong first-language development therefore functions as a foundation rather than a competing influence on additional language acquisition.

Earlier investigations frequently examined language proficiency, executive functioning, literacy achievement, or bilingual cognitive advantages independently. Results presented here complement these approaches by integrating linguistic, cognitive, instructional, family, and institutional variables into a comprehensive explanatory framework. Such integration provides a broader understanding of multilingual education by recognizing that cognitive development results from reciprocal relationships among language proficiency, educational practice, and sociocultural support.

Differences also emerge regarding instructional implementation. Existing literature often emphasizes language policy or bilingual curriculum as the principal determinants of multilingual educational success. Findings from this study indicate that teacher multilingual competence, classroom interaction, and family language support substantially strengthen the educational effectiveness of multilingual instruction. Language policy alone therefore cannot ensure successful cognitive development without consistent instructional implementation.

Current research frequently evaluates language acquisition outcomes without fully explaining how multilingual education contributes to broader conceptual learning and academic performance. Findings demonstrate that metalinguistic awareness partially mediates the

relationship between mother tongue proficiency and conceptual understanding, suggesting that cognitive processes deserve greater attention within future multilingual education research.

Observed findings indicate that mother tongue maintenance should be understood as a cognitive asset supporting rather than limiting multilingual academic development. Students who maintained strong first-language proficiency demonstrated greater conceptual understanding, cognitive flexibility, and confidence when learning through additional languages. Linguistic diversity therefore functions as a source of intellectual enrichment instead of educational disadvantage.

Multilingual learning environments emerge as important developmental contexts where language, cognition, and identity interact continuously throughout educational experiences. Students progressively developed metalinguistic awareness by comparing linguistic structures, transferring conceptual knowledge across languages, and reflecting upon multiple forms of communication. Cognitive development consequently became increasingly sophisticated through sustained multilingual engagement.

Teacher competence represents another significant indicator of successful multilingual education. Students consistently demonstrated stronger academic performance and classroom participation when teachers strategically integrated multiple languages, encouraged translanguaging, and provided appropriate linguistic scaffolding. Effective multilingual instruction therefore depends upon pedagogical expertise rather than simple use of multiple instructional languages.

Institutional commitment similarly appears essential because sustainable multilingual education requires coherent language policy, curriculum alignment, teacher professional development, family engagement, and supportive educational leadership. Educational effectiveness consequently reflects coordinated organizational capacity rather than isolated classroom practice.

Scientific implications suggest that future investigations should examine multilingual education through integrated theoretical frameworks combining cognitive psychology, educational psychology, bilingual education, sociolinguistics, developmental psychology, and language acquisition theory. Cognitive development, language learning, instructional quality, and sociocultural support collectively explain multilingual educational outcomes more comprehensively than language proficiency alone. Broader interdisciplinary models are therefore required to strengthen theoretical understanding.

Educational implications encourage schools to design multilingual programs that preserve students' mother tongues while systematically developing additional language proficiency through content-based instruction, collaborative learning, translanguaging strategies, and concept-oriented pedagogy. Classroom instruction should emphasize conceptual understanding, linguistic transfer, and cognitive flexibility rather than treating languages as isolated instructional domains.

Practical implications extend to teachers, curriculum developers, educational leaders, and policymakers responsible for implementing multilingual education. Findings indicate that strengthening teacher multilingual competence, family literacy partnerships, culturally responsive pedagogy, and institutional language planning may substantially improve students' cognitive development and academic achievement. Sustained professional development therefore becomes a critical investment for multilingual educational systems.

Societal implications include preserving linguistic diversity while promoting educational equity, social inclusion, intercultural competence, and lifelong cognitive development. Educational systems implementing comprehensive multilingual frameworks may contribute to strengthening cultural heritage, democratic participation, and economic competitiveness within increasingly multilingual societies.

Positive educational outcomes primarily resulted from the cognitive transfer processes supported by sustained mother tongue development. Students acquired new concepts more

efficiently because strong first-language proficiency enabled them to interpret, organize, and connect new information across multiple linguistic systems. Conceptual learning therefore became progressively deeper as multilingual competence expanded.

Metalinguistic awareness further contributed by encouraging students to compare grammatical structures, vocabulary, discourse patterns, and conceptual relationships across languages. Continuous reflection upon linguistic similarities and differences strengthened executive functioning, cognitive flexibility, and analytical reasoning while improving conceptual understanding. Multilingual experience consequently enhanced broader cognitive performance.

Teacher facilitation substantially strengthened intervention effectiveness because educators intentionally incorporated translanguaging, multilingual discussion, contextual explanation, collaborative inquiry, and culturally responsive instruction throughout classroom learning. Students consequently experienced lower linguistic anxiety, greater classroom participation, and stronger academic confidence because instructional practices validated their multilingual identities while promoting conceptual understanding.

Supportive family language practices and institutional educational policies collectively reinforced these improvements by creating consistent multilingual learning environments extending beyond formal classroom instruction. Home language use, school language policy, teacher collaboration, and curriculum coherence therefore interacted to produce sustained improvements in cognitive development and academic achievement.

Future investigations should examine multilingual cognitive development through longitudinal studies following learners across different educational stages. Extended observation would clarify how sustained mother tongue maintenance influences executive functioning, conceptual understanding, academic achievement, multilingual proficiency, and lifelong learning throughout childhood, adolescence, and adulthood. Longitudinal evidence would strengthen theoretical understanding of multilingual cognitive development.

Comparative studies involving indigenous language communities, immigrant populations, urban multilingual schools, rural educational settings, international schools, and diverse sociolinguistic contexts deserve continued attention because multilingual educational experiences vary substantially across cultural and policy environments. Comparative evidence would support development of adaptable multilingual education models suitable for diverse educational systems.

Emerging educational technologies, including artificial intelligence-supported language learning, adaptive multilingual tutoring systems, digital literacy platforms, immersive virtual environments, and multilingual collaborative applications, provide valuable opportunities for strengthening multilingual education (Chen & Dalton-Puffer, 2026). Future research should investigate how technology-enhanced multilingual learning complements classroom instruction while supporting cognitive flexibility, language maintenance, and conceptual development.

Interdisciplinary collaboration among educational psychologists, cognitive scientists, linguists, curriculum specialists, teachers, school leaders, policymakers, and community organizations will remain essential for advancing multilingual education. Continued integration of cognitive theory, language policy, instructional innovation, and sociocultural research will contribute substantially to developing educational systems that simultaneously preserve linguistic diversity, strengthen cognitive development, and promote equitable academic achievement.

CONCLUSION

Findings demonstrate that multilingual education effectively promotes cognitive development and academic achievement when mother tongue maintenance is positioned as the linguistic foundation of the learning process rather than as a competing instructional objective.

Distinctive evidence from this study indicates that mother tongue proficiency directly strengthens conceptual understanding while indirectly enhancing executive functioning, metalinguistic awareness, cognitive flexibility, and academic performance through improved cognitive transfer mechanisms. Teacher multilingual competence, supportive classroom interaction, and family language engagement further reinforce these relationships by creating educational environments in which students confidently utilize multiple linguistic resources to construct knowledge. These findings redefine multilingual education as an integrated cognitive development process in which linguistic diversity functions as an educational asset that simultaneously supports identity, learning, and academic success.

Scientific contribution of this study extends both conceptually and methodologically. Conceptually, the research proposes an integrated framework combining multilingual education, bilingual cognitive development, educational psychology, psycholinguistics, sociolinguistics, and ecological systems theory to explain how mother tongue maintenance, metalinguistic awareness, executive functioning, instructional quality, and institutional language policy collectively shape cognitive development and educational achievement. Methodologically, the mixed-methods sequential explanatory design integrates multilevel modeling, structural equation modeling, mediation and moderation analyses, qualitative interviews, classroom observations, and institutional document analysis to examine both measurable cognitive outcomes and contextual multilingual learning processes. Integration of quantitative and qualitative evidence provides a comprehensive explanation of multilingual education while offering practical guidance for designing sustainable language policies and instructional models in linguistically diverse schools.

Scope of this investigation remains limited to multilingual educational institutions implementing relatively established language policies and structured multilingual instructional practices, thereby limiting direct generalization to educational settings characterized by different linguistic ecologies, resource availability, or policy environments. Variations in socioeconomic conditions, language prestige, teacher proficiency, community language use, and educational governance may influence the applicability of these findings across broader multilingual contexts. Future research should therefore undertake longitudinal, comparative, and cross-cultural investigations involving early childhood education, secondary schools, indigenous language communities, immigrant populations, technology-supported multilingual instruction, and artificial intelligence-assisted language learning while examining long-term cognitive development, identity formation, literacy transfer, and multilingual academic achievement across diverse educational systems.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the author(s) used Grammarly to assist in improving grammar, language quality, and overall readability of the text. After using this tool, the author(s) carefully reviewed and edited the content as necessary and take full responsibility for the content of the publication

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; Investigation.

Author 3: Data curation; Investigation.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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