

Methodology for Developing Primary School Students' Linguistic Competence through Artificial Intelligence Technologies in Mother Tongue Education

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Abstract: The rapid development of artificial intelligence (AI) has created new opportunities for improving the quality of language education through personalized, adaptive, and learner-centered instructional approaches. This study aims to develop a methodology for enhancing primary school students' linguistic competence through the integration of artificial intelligence technologies in mother tongue education. The proposed methodology is grounded in competence-based education, constructivist learning theory, and contemporary approaches to AI-assisted instruction. A design-based research approach was employed to develop an instructional framework that integrates adaptive learning environments, generative AI applications, intelligent feedback systems, and competency-oriented assessment into primary language instruction. The methodology was designed considering the cognitive and linguistic characteristics of fourth-grade primary school students and emphasizes vocabulary development, reading comprehension, writing proficiency, oral communication, and formative assessment. The study also discusses the pedagogical roles of teachers in AI-supported classrooms and highlights the importance of ethical and responsible AI implementation in education. The proposed instructional framework demonstrates that artificial intelligence technologies can effectively support individualized learning, continuous assessment, differentiated instruction, and active student engagement when integrated through sound pedagogical principles. The findings contribute to the theoretical development of AI-assisted mother tongue education and provide practical recommendations for primary school teachers, curriculum developers, and educational policymakers seeking to integrate artificial intelligence into language teaching. The study concludes that AI should function as a pedagogical support tool that enhances rather than replaces teachers' professional expertise, thereby contributing to the sustainable development of students' linguistic competence in the digital era.

Keywords: artificial intelligence, linguistic competence, mother tongue education, primary school, adaptive learning, language teaching, educational technology

Introduction.

Artificial intelligence (AI) has become one of the most influential technological innovations in the twenty-first century, fundamentally transforming educational systems across the world. The integration of AI into education has introduced intelligent learning environments capable of providing personalized instruction, adaptive assessment, automated feedback, and data-driven decision-making. These innovations have shifted the focus of education from standardized teaching toward learner-centered approaches that accommodate students' diverse needs, abilities, and learning preferences. As digital transformation continues to reshape educational practices, AI is increasingly recognized as a strategic tool for improving the quality, accessibility, and effectiveness of teaching and learning processes. According to UNESCO (2023), AI should be implemented in education to enhance human-centered learning while supporting teachers in designing more inclusive and equitable learning environments.

Language education represents one of the educational domains in which AI technologies demonstrate considerable pedagogical potential. In primary education, mother tongue instruction plays a decisive role in developing learners' linguistic competence, which includes the knowledge and effective use of phonological, lexical, grammatical, semantic, and pragmatic components of language. Strong linguistic competence enables children not only to communicate accurately but also to develop higher-order thinking skills, reading comprehension, writing proficiency, and academic achievement across all school subjects. Consequently, improving linguistic competence during the early years of schooling remains one of the primary objectives of contemporary language education (Cummins, 2021).

Recent technological developments have created new opportunities for integrating AI into mother tongue education. Intelligent tutoring systems, adaptive learning platforms, speech recognition technologies, natural language processing applications, and generative AI tools provide individualized learning experiences that respond to students' cognitive characteristics and language proficiency levels. Unlike conventional instructional approaches, AI-supported educational environments continuously analyze learners' performance and provide immediate feedback, personalized learning pathways, and differentiated instructional materials. Such technologies contribute to increasing student engagement while enabling teachers to make informed pedagogical decisions based on real-time learning analytics (Holmes et al., 2022).

The emergence of generative artificial intelligence has further expanded the possibilities for language learning. Applications such as AI-powered writing assistants, interactive dialogue systems, intelligent reading platforms, and automated vocabulary development tools allow learners to practice language skills in authentic and meaningful contexts. These technologies encourage active participation, creativity, collaborative learning, and independent knowledge construction. Moreover, AI-supported learning environments facilitate differentiated instruction by automatically adjusting educational content according to learners' individual progress, thereby reducing achievement gaps among students with different learning needs (OECD, 2024). Despite the growing body of international research on artificial intelligence in education, previous studies have primarily focused on higher education, foreign language learning, or the technical aspects of AI implementation. Comparatively limited attention has been devoted to developing linguistic competence in primary school mother tongue education through AI-based pedagogical methodologies. Existing research frequently examines individual digital tools rather than proposing a comprehensive instructional methodology that integrates curriculum objectives, teaching strategies, learning activities, assessment procedures, and AI technologies into a unified pedagogical framework. This gap indicates the need for a systematic methodological model specifically designed for primary school mother tongue education.

In addition, many educational systems are currently undergoing curriculum reforms that emphasize competency-based learning, digital literacy, and twenty-first-century skills. Within this context, the integration of AI technologies into language instruction should not merely involve the use of digital applications but should also be grounded in sound pedagogical principles that promote meaningful language learning. Therefore, developing an evidence-based methodology for integrating AI into mother tongue education has become an important research priority for both educational researchers and classroom practitioners.

Based on these considerations, the present study aims to develop a methodology for enhancing primary school students' linguistic competence through artificial intelligence technologies in mother tongue education. Specifically, the study proposes an AI-based instructional model that integrates adaptive learning strategies, intelligent educational technologies, interactive language-learning activities, and competency-based assessment to improve students' linguistic development. The findings are expected to contribute to the theoretical advancement of AI-assisted language education while providing practical recommendations for primary school teachers, curriculum developers, and educational policymakers seeking to implement innovative language teaching practices.

Findings and Discussion

The proposed methodology demonstrates that the effective integration of artificial intelligence technologies into primary school mother tongue education requires not only the use of digital tools but also a pedagogically structured instructional process. Linguistic competence develops most successfully when AI technologies are employed to support learners' active participation, individualized learning, continuous feedback, and authentic language use. Therefore, the methodology developed in this study combines competence-based language instruction with AI-supported learning environments.

The methodology consists of four interrelated instructional stages: diagnostic assessment, AI-supported learning activities, formative assessment, and reflective evaluation. During the diagnostic stage, teachers identify students' initial levels of linguistic competence by assessing vocabulary knowledge, reading comprehension, grammatical awareness, oral communication, and writing performance. Such initial assessment enables teachers to select appropriate instructional strategies and AI-supported learning activities according to learners' individual needs. Previous studies have similarly emphasized that personalized instruction significantly improves language learning outcomes by adapting educational content to learners' cognitive characteristics (Holmes et al., 2022). The second stage focuses on implementing AI-supported learning activities within mother tongue lessons. At this stage, students engage with intelligent educational technologies that facilitate vocabulary enrichment, reading comprehension, writing development, and oral communication. Generative AI applications can provide writing prompts, model texts, vocabulary explanations, and immediate language feedback, while adaptive learning platforms adjust task difficulty according to students' performance. These technologies encourage learners to become active participants in the learning process rather than passive recipients of information. Consistent with UNESCO (2023), AI functions most effectively when it complements teachers' instructional decisions instead of replacing them.

An important feature of the proposed methodology is the integration of continuous formative assessment. AI technologies enable teachers to monitor students' learning progress through automated quizzes, interactive exercises, and instant feedback mechanisms. Immediate feedback allows learners to recognize language errors, revise their responses, and improve their linguistic performance during the learning process. Such formative assessment contributes to greater learner autonomy while providing teachers with evidence for planning subsequent instructional activities.

The final stage emphasizes reflection and evaluation. Students are encouraged to review their learning progress, identify strengths and weaknesses, and set individual learning goals. Teachers simultaneously evaluate the effectiveness of instructional strategies and AI-supported activities to determine whether modifications are necessary for future lessons. This reflective process strengthens students' metacognitive awareness and promotes sustainable development of linguistic competence.

The findings of this methodological study suggest that artificial intelligence technologies should be viewed as pedagogical support tools rather than independent teaching systems. Their educational value depends largely on teachers' methodological competence, instructional planning, and ability to integrate digital technologies into meaningful language-learning activities. Therefore, successful implementation requires appropriate teacher training, curriculum alignment, and ethical use of AI technologies within classroom practice. Compared with traditional teacher-centered instruction, the proposed methodology offers several

pedagogical advantages. It promotes individualized learning, increases student engagement, facilitates differentiated instruction, provides continuous formative feedback, and supports competency-based language education. These characteristics correspond with current international educational priorities that emphasize learner-centered instruction, digital competence, and responsible integration of artificial intelligence into school education (OECD, 2024; UNESCO, 2023). The proposed methodology also contributes to the theoretical development of AI-assisted mother tongue education by integrating contemporary educational technologies with principles of linguistic competence development. Rather than focusing on isolated digital applications, the methodology presents a comprehensive instructional framework that connects learning objectives, teaching strategies, assessment procedures, and AI-supported educational tools within a coherent pedagogical model. This integrated approach may serve as a practical reference for primary school teachers, curriculum developers, and educational researchers interested in implementing artificial intelligence technologies in language education.

Another significant contribution of the proposed methodology is its ability to promote differentiated instruction in primary school mother tongue education. In conventional classrooms, teachers often encounter considerable differences in students' linguistic abilities, learning pace, and cognitive readiness. Such diversity makes it difficult to provide equal learning opportunities for every student using traditional teaching methods. Artificial intelligence technologies offer practical solutions by adapting instructional content, learning tasks, and feedback according to individual learner performance. Adaptive educational systems analyze students' responses and recommend appropriate learning materials, allowing both high-achieving and low-achieving learners to progress at their own pace. This personalized approach is consistent with the principles of learner-centered education and competency-based curriculum implementation (Zawacki-Richter et al., 2019). The proposed methodology also strengthens students' vocabulary acquisition, which represents one of the fundamental dimensions of linguistic competence. AI-supported vocabulary learning applications provide contextual explanations, pronunciation models, interactive exercises, and repeated exposure to newly acquired words. Unlike traditional memorization techniques, intelligent learning environments encourage students to apply vocabulary in meaningful communicative situations through storytelling, dialogue construction, sentence completion, and text production activities. Such instructional practices facilitate long-term vocabulary retention while simultaneously improving reading comprehension and writing performance.

Reading comprehension constitutes another essential component of linguistic competence that can be enhanced through AI-supported instructional strategies. Intelligent reading platforms provide personalized reading materials that correspond to learners' proficiency levels and automatically generate comprehension questions based on the selected texts. Immediate feedback enables students to recognize comprehension difficulties and gradually develop effective reading strategies. Furthermore, AI technologies allow teachers to monitor students' reading progress continuously and identify specific areas requiring additional instructional support. Consequently, reading instruction becomes more responsive to individual learner needs while maintaining alignment with curriculum objectives.

Writing instruction benefits considerably from the integration of generative artificial intelligence technologies. AI-powered writing assistants can guide students during different stages of the writing process, including idea generation, text organization, vocabulary selection, grammatical revision, and self-editing. Importantly, the proposed methodology emphasizes that AI-generated suggestions should serve as instructional scaffolding rather than complete solutions. Teachers remain responsible for encouraging students to think critically, evaluate AI-generated content, and produce original written texts. In this way, AI functions as a cognitive support tool that promotes independent writing rather than replacing learners' creative efforts. Similar recommendations have been highlighted in recent international guidelines for the responsible use of generative AI in education (UNESCO, 2023). Oral communication skills are likewise strengthened through interactive AI applications. Speech recognition technologies provide learners with opportunities to practice pronunciation, fluency, and expressive language in low-anxiety learning environments. Students receive immediate feedback on pronunciation accuracy and speaking performance, enabling continuous improvement through repeated practice. Such interactive learning experiences increase students' confidence in oral communication while creating more engaging classroom activities. An additional pedagogical advantage of the proposed methodology lies in the integration of formative assessment throughout the instructional process. Rather than evaluating students only at the end of a learning unit, AI-supported assessment enables continuous monitoring of learning progress. Teachers receive timely information regarding students' strengths, misconceptions, and learning difficulties, allowing instructional decisions to be adjusted accordingly. Continuous formative assessment also encourages students to become active participants in their own learning by reflecting on feedback and setting personal learning goals. This approach corresponds with contemporary assessment theories that emphasize assessment for learning instead of assessment of learning (Black & Wiliam, 2018). The successful implementation of this methodology, however, depends on several contextual factors. Teachers require adequate digital competence to select appropriate AI tools, evaluate AI-generated outputs, and integrate technology into meaningful pedagogical activities. Schools also need sufficient technological infrastructure, reliable internet access, and institutional support for digital innovation. Moreover, ethical issues such as data privacy, algorithmic bias, transparency, and responsible AI use should be carefully considered during classroom implementation. Therefore, professional development programs focusing on AI literacy and digital pedagogy should accompany the introduction of AI technologies into primary school language education. Overall, the proposed methodology demonstrates that artificial intelligence technologies can substantially enrich mother tongue education when employed within a carefully designed pedagogical framework. Their greatest educational value lies not in technological sophistication alone but in their capacity to support meaningful language

learning, individualized instruction, continuous assessment, and the comprehensive development of students' linguistic competence. This perspective reinforces the view that effective educational innovation emerges from the thoughtful integration of technology, pedagogy, and curriculum rather than from technology alone.

Conclusion

The integration of artificial intelligence technologies into primary school mother tongue education represents a significant pedagogical innovation that can enhance students' linguistic competence through personalized, adaptive, and interactive learning experiences. This study proposed an AI-based instructional methodology that combines learner-centered pedagogy, competence-based education, and intelligent educational technologies to support the development of vocabulary, reading comprehension, writing proficiency, oral communication, and formative assessment. Rather than replacing teachers, artificial intelligence functions as an instructional partner that facilitates differentiated instruction, continuous feedback, and data-informed pedagogical decision-making. The proposed methodology contributes to the theoretical development of AI-assisted language education by presenting a comprehensive instructional framework that integrates curriculum objectives, learning activities, assessment strategies, and artificial intelligence applications into a coherent pedagogical model. Unlike many previous studies that have focused primarily on individual AI tools or technological aspects of educational innovation, this research emphasizes the systematic integration of AI technologies within the broader context of primary school mother tongue instruction. Such an approach supports the development of linguistic competence while simultaneously fostering learner autonomy, critical thinking, creativity, and digital literacy.

From a practical perspective, the findings highlight that successful implementation of AI-supported language instruction depends largely on teachers' methodological competence, professional readiness, and responsible use of educational technologies. Effective integration of AI requires careful instructional planning, alignment with curriculum objectives, and continuous monitoring of students' learning progress. Consequently, teacher professional development programs should include training on artificial intelligence literacy, digital pedagogy, and ethical principles governing the educational use of AI technologies. The study also underscores the importance of maintaining a balanced relationship between technological innovation and human-centered education. Artificial intelligence should serve as a supportive educational resource that strengthens teachers' instructional capacity while preserving meaningful teacher–student interaction and promoting active student engagement. Responsible implementation of AI in language education requires attention to issues of data privacy, transparency, fairness, and equal access to digital learning opportunities. Several limitations should be acknowledged. The proposed methodology was developed within the context of primary school mother tongue education and therefore may require adaptation before implementation in other educational levels or subject areas. In addition, the present study primarily focuses on methodological development rather than large-scale empirical validation. Future research should investigate the effectiveness of the proposed methodology through experimental and longitudinal studies involving diverse educational settings, larger participant groups, and various artificial intelligence applications. Comparative studies across different educational systems would also provide valuable evidence regarding the broader applicability of AI-supported methodologies for developing linguistic competence. In conclusion, artificial intelligence technologies possess considerable potential to transform primary school mother tongue education by creating more personalized, engaging, and effective learning environments. When integrated through pedagogically sound methodologies, AI can significantly contribute to the comprehensive development of students' linguistic competence while supporting educational innovation in the era of digital transformation. The methodology proposed in this study provides a conceptual and practical foundation for future research and classroom implementation aimed at improving language education through responsible and meaningful use of artificial intelligence.

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