Artificial Intelligence as a Tool for Personalized Learning in Primary Education

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Abstract: Artificial intelligence (AI) offers new opportunities to personalize learning in primary education, particularly in developing pupils' communication competencies. This paper critically examines the pedagogical potential of AI to support differentiated instruction, formative assessment, and the adaptation of learning experiences to individual needs. Drawing on relevant educational literature and international guidance, the analysis explores how AI can assist teachers in interpreting learning evidence, adapting linguistic resources, providing individualized feedback, and encouraging reflective learning. Particular attention is given to the relationship between technological support and teachers' professional judgment, emphasizing that meaningful personalization extends beyond automated content generation. The paper proposes a five-stage conceptual framework that integrates AI-assisted analysis and instructional planning into a teacher-led process centered on authentic oral and written communication. It also addresses pedagogical and ethical challenges, including the reliability of AI-generated content, data protection, equitable access, and the preservation of human interaction. As a theoretical contribution, the framework highlights the complementary role of AI in supporting responsive teaching while identifying directions for future empirical research.

Keywords: literacy; feedback; adaptivity; teacher agency

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1. Introduction

The rapid development of artificial intelligence (AI) has renewed the debate about how educational systems can respond to the heterogeneity of learners without fragmenting shared curricular aims. In primary education, personalization should be understood as a pedagogical process through which the teacher adjusts the level, sequencing, mediation, and assessment of learning to pupils' emerging needs. This process is not a technological invention: differentiated instruction has long emphasized the purposeful adaptation of content, learning processes and expected products according to readiness, interests and learning profiles (Tomlinson, 2014). AI changes the range and speed of certain available operations, notably the comparison of selected responses, the production of alternative linguistic formulations and the preparation of feedback suggestions (Holmes et al., 2019; Kasneci et al., 2023). Nevertheless, greater technical capacity does not automatically imply better instructional decisions. The central question is not whether a system can generate individualized materials, but whether its outputs help teachers identify a meaningful learning need and design a pedagogically justified response. This distinction is especially important in primary classrooms, where learners' developing literacy and self-regulation require sustained adult guidance.

Communication competencies offer a particularly revealing domain in which to examine these possibilities and limitations. Reading comprehension, vocabulary development, oral participation and written expression involve more than the recognition of linguistic forms: they require the construction of meaning, sensitivity to audience and context, and the ability to negotiate ideas with others. A pupil's performance may vary across tasks because of prior knowledge, confidence, cultural and linguistic experience, or the interpersonal conditions of the activity. From a sociocultural perspective, language learning is mediated through interaction and participation in meaningful practices (Vygotsky, 1978). Accordingly, a technically accurate analysis of word frequency, sentence length or textual coherence captures only part of communicative competence. AI may identify patterns in selected language samples, but it cannot independently establish the intentions, emotional significance or social circumstances underlying a child's utterance. A responsible approach must therefore connect machine-assisted observations to teacher interpretation and to opportunities for authentic communication.

The purpose of this theoretical–applied paper is to clarify the specific functions that AI may perform within a teacher-led model of personalized communication learning in primary education. The analysis is based on a critical conceptual synthesis of

established pedagogical perspectives and literature addressing AI in education, supplemented by international guidance on responsible implementation (Miao & Holmes, 2023; Molenaar, 2022). It does not involve classroom experimentation, interviews, intervention data or quantitative measurement of learning gains. Its contribution is instead analytical and design-oriented: it distinguishes the potential operational contribution of AI from the pedagogical judgments that remain the responsibility of the teacher, and it proposes a coherent sequence through which these contributions may be coordinated. The resulting model is presented as a framework for further inquiry rather than as an empirically validated intervention.

The broader movement from online pedagogical practice toward digitally supported instructional design provides a relevant context for this investigation. Work addressing pedagogical practice in online environments (Popa, 2024) and digital pedagogy in initial teacher education (Popa, 2025) points to themes that are conceptually adjacent to the present discussion, including professional preparation and the organization of technology-mediated learning. Their relevance here is contextual rather than evidentiary: the existence of digitally mediated pedagogical practices does not demonstrate that AI improves young pupils' communication outcomes. Indeed, the transition from digital resources to AI-assisted personalization introduces additional demands, because generated content and automated recommendations can appear authoritative even when they are inaccurate or pedagogically unsuitable. The argument developed below therefore treats teacher competence, transparent purposes and critical evaluation as prerequisites for meaningful integration.

2. From Differentiation to Dynamic Adaptation

Traditional personalization begins with a recurring instructional cycle: teachers observe learners' performances, interpret the evidence in relation to curriculum expectations, identify obstacles or emerging strengths, and adjust support. Formative assessment is central to this process because evidence becomes educationally useful only when it informs subsequent teaching and learning decisions (Black & Wiliam, 1998). In communication education, such evidence may include the way a pupil reconstructs the meaning of a text, explains a choice of words, participates in discussion or revises a written message. AI can potentially assist with the preliminary organization of this evidence, but its usefulness depends on the quality of the task, the criteria chosen and the teacher's interpretation. Personalization should therefore

not be reduced to assigning a different worksheet to each pupil. Its defining feature is the responsive adjustment of support while maintaining shared expectations for meaningful participation and progressive mastery. The teacher also needs to consider whether a perceived difficulty is stable, situational or linked to the form of assessment itself.

An important conceptual distinction must be drawn between generative AI and adaptive learning technologies. Generative language models produce text in response to prompts and may offer alternative explanations, reformulations, questions or feedback drafts. Their fluency, however, is not evidence that they possess a validated model of an individual pupil's linguistic development. Adaptive systems, by contrast, may alter the sequence or difficulty of tasks on the basis of recorded interactions and predefined indicators. Yet adaptation in a technical sense is not synonymous with pedagogically valid personalization: the selected indicators must represent the competence of interest, the adjustment must be educationally appropriate, and the resulting recommendation must be open to scrutiny (Kasneci et al., 2023; Molenaar, 2022). For example, a high error rate in a reading task may signal a decoding difficulty, but it may also reflect unfamiliar subject matter or ambiguous instructions. The distinction matters because teachers should not mistake a system's ability to classify responses for a comprehensive assessment of a child's needs.

The interpretive complexity of communication learning makes the limits of automation particularly visible. A brief oral answer may indicate limited vocabulary, reluctance to speak, fatigue, an economical communication style or a sophisticated understanding expressed concisely. Similarly, a written text with short sentences may be coherent and effective for its intended audience, whereas a longer text may contain substantial misunderstandings. Algorithmic indicators can draw attention to features worth examining, but they cannot by themselves determine their pedagogical significance. Vygotsky's (1978) concept of the zone of proximal development emphasizes the relationship between current performance and what becomes possible through appropriate mediation. In this perspective, effective personalization depends not only on identifying an apparent difficulty but also on selecting the kind, timing and duration of support. The teacher's knowledge of the learner and of classroom interaction remains indispensable when deciding whether to model a strategy, provide a prompt, invite peer dialogue or gradually withdraw assistance.

3. Specific Functions of AI in Communication Learning

A first potential function of AI is the preliminary organization of evidence related to pupils' communication performances. When the educational purpose is explicit and suitable privacy protections are in place, a teacher may use carefully selected and de-identified language samples to explore recurring characteristics such as the sequencing of ideas, use of connective expressions, retrieval of explicit information, or consistency between a claim and its justification. The system's output can serve as a provisional map of possible needs, helping the teacher decide which responses warrant closer attention. This use is distinct from automated diagnosis: linguistic classifications depend on the instructions given to the system and may overlook developmental, cultural, or contextual variation. Assessment-related AI applications have been discussed in the literature, alongside concerns about the limited involvement of educators in some technological developments (Zawacki-Richter et al., 2019). Consequently, any proposed grouping should be checked against the original response, the learning objective, and the teacher's broader observations. The pedagogical benefit lies in supporting professional noticing, not in transferring evaluative authority to an opaque classification.

A second function concerns the adaptation of linguistic resources while preserving the intended learning objective. Generative tools may help teachers prepare alternative versions of a passage, clarify instructions, adjust lexical density or propose questions that require different levels of inferential reasoning. In a heterogeneous primary classroom, such flexibility may reduce the preparation time associated with designing several pathways toward a common communicative goal. However, a shorter or simpler text is not necessarily a better learning resource. Simplification may remove important conceptual relationships, flatten narrative ambiguity, or deprive pupils of opportunities to encounter productive linguistic challenge. Differentiation requires a careful balance between accessibility and cognitive demand (Tomlinson, 2014). Teachers must therefore inspect generated resources for factual accuracy, age appropriateness, progression of vocabulary, cultural sensitivity and alignment with curriculum expectations. In this sense, AI supports the production of options; the teacher determines which option, if any, is educationally justified for a particular group or learner (Kasneci et al., 2023).

A third function is the preparation of formative feedback that is specific, understandable, and oriented toward improvement. Feedback has educational value when it helps learners recognize the intended goal, understand relevant aspects of their current performance, and identify a feasible next step (Hattie & Timperley,

2007). AI can assist teachers in drafting comments linked to explicit criteria, such as the clarity of a main idea, the sequence of events, the relationship between supporting details and a conclusion, or the appropriateness of language for a reader. This support may be particularly useful when teachers need to review many short written responses while preserving opportunities for individual guidance. Nevertheless, automatically generated comments may be overly generic, excessively corrective or insensitive to a pupil's communicative intention. Feedback should not transform all children's texts into a uniform stylistic model or suppress experimentation and personal voice. The teacher must select, revise, and contextualize suggestions, while the pupil should retain an active role in interpreting feedback and deciding how to improve the text.

The discussion of effective study techniques and personal development (Popa, 2025d) offers a complementary conceptual connection to learning strategies and learner agency. In the present context, however, this connection should not be treated as evidence that AI-based prompts produce measurable improvements in primary-school self-regulation. The developmental characteristics of younger pupils require a more specific account of how strategies are introduced, modeled, and gradually internalized. For communication learning, a useful strategy might involve checking whether a written message answers its intended question, identifying information that a reader may still need, or rereading a sentence for clarity. AI could assist the teacher in formulating such reflective prompts, but the effectiveness of those prompts depends on their integration into instruction and on the pupil's capacity to use them meaningfully. This distinction prevents the conceptual appeal of personalized digital support from being confused with established educational impact.

A fourth function is to support reflection and emerging self-regulation rather than merely provide completed responses. Self-regulated learning involves the coordinated processes of planning, monitoring performance and evaluating outcomes (Zimmerman, 2002). In primary education, these processes are still developing and usually require explicit modeling, dialogue and structured opportunities for practice. AI may help teachers design graduated prompts that invite pupils to explain a reading interpretation, compare two formulations or identify the next revision they wish to make. The central pedagogical requirement is that the pupil remains the author of the communicative act and the active interpreter of its meaning. Direct, unsupervised exchanges between young children and generative systems may introduce risks related to inappropriate content, misleading explanations and personal data disclosure. International guidance accordingly

underscores the importance of safeguards and age-appropriate governance (Miao & Holmes, 2023). The most defensible application in this context is often teacher-mediated use, in which the technology supports the design of reflective learning opportunities without displacing human guidance.

A fifth function is decision support for the teacher, integrating the previous four functions into a coherent pedagogical response. AI-assisted summaries, resource variants and feedback proposals may help teachers consider alternative interventions, but they do not determine which intervention is appropriate. Perspectives on hybrid human–AI learning technologies emphasize complementarity and the need to define human control within the educational process (Molenaar, 2022). In communication education, such control is not merely procedural. The teacher evaluates whether a pupil needs linguistic scaffolding, additional opportunities to speak, a more meaningful audience for writing, or reassurance that encourages participation. These decisions depend on social relations, classroom norms and knowledge of the individual learner. AI is therefore most appropriately understood as a source of provisional information and design possibilities. Its contribution becomes pedagogically significant only when the teacher translates these possibilities into responsive, inclusive and contextually grounded teaching.

4. Traditional and AI-Assisted Personalization: Opportunities and Limits

The difference between traditional and AI-assisted personalization is primarily operational rather than a change in educational purpose. Both seek to improve pupils' opportunities to learn, participate, and progress through responsive teaching. AI may accelerate selected tasks such as generating resource variants, organizing response patterns, or preparing initial feedback drafts. Such efficiencies may create additional time for professional dialogue and targeted support, but they can also generate new work associated with checking accuracy, correcting bias and protecting data. Consequently, efficiency should be evaluated in relation to the entire teaching process, not merely the speed of content generation. Furthermore, an improvement in preparation time does not establish an improvement in reading comprehension, oral expression or writing quality. Reviews of AI applications conducted in other educational settings provide useful conceptual background but cannot be uncritically generalized to primary classrooms (Zawacki-Richter et al., 2019). Age, curricular

aims, classroom relationships, and the developmental status of communication competencies must remain central to any claim of transferability.

Taken together, these themes invite consideration of technological innovation alongside professional responsibility, learner development and pedagogical design. Their relevance to the present article is interpretive: the titles and topics of these publications support a broader framing, but they do not, on their own, verify the effectiveness of any specific AI intervention in primary-school communication learning. This distinction is methodologically important because emerging technologies often encourage broad claims about personalization without specifying the targeted competence, the mechanism of support, or the conditions under which benefits might occur. A defensible argument must identify what AI actually contributes to an instructional decision and what evidence would be required to judge that contribution.

Potential opportunities include more flexible preparation of differentiated language resources, systematic organization of selected learning evidence, and the possibility of more timely feedback proposals. Each opportunity is accompanied by risks that are particularly salient for young learners. Generative systems may fabricate information, produce culturally narrow examples, recommend unsuitable levels of linguistic difficulty or present stylistic preferences as objective quality criteria (Kasneci et al., 2023). If teachers rely uncritically on these outputs, pupils' authentic expressions may be standardized and meaningful differences in communication style may be misinterpreted as deficits. The use of pupil work also raises concerns about confidentiality, informed institutional procedures, data minimization and the possibility that ostensibly anonymized text could still contain identifying details. Unequal access to infrastructure and professional development may further widen existing educational differences. International guidance recommends that decisions about generative AI account for educational purpose, protection of learners and institutional responsibility (Miao & Holmes, 2023). Thus, responsible integration requires explicit criteria for acceptable uses and clear boundaries for what should remain outside automated processing.

The concept of augmentation offers a more defensible orientation than substitution. AI may extend teachers' ability to explore patterns and prepare alternatives, while the teacher retains responsibility for interpreting evidence, selecting support and maintaining authentic relationships (Molenaar, 2022). This division of responsibility should be visible in everyday practice: automated scores should not be presented as definitive judgments of a child's communication ability, generated feedback should

be reviewed before use, and decisions affecting pupils should remain explainable in pedagogical terms. Teacher oversight also entails the freedom to reject an AI suggestion when it conflicts with direct observation or with the intended learning objective. In primary education, the quality of personalization is ultimately measured by the appropriateness of learning opportunities and the quality of interaction, not by the number of technological operations performed. Such a position does not minimize innovation; it defines the conditions under which innovation can remain educationally accountable.

5. Discussion and Proposed Conceptual Model

On the basis of the preceding analysis, this paper proposes a cyclical, five-stage conceptual framework for AI-assisted personalization of communication learning. The first stage consists of pedagogical observation: the teacher identifies relevant performances in reading, speaking, listening, and writing, taking account of the task, classroom context, and curricular aims. The second stage involves the selective, privacy-conscious organization of evidence with AI support, where appropriate; any patterns generated at this stage remain provisional and require verification. During the third stage, the teacher interprets these patterns and designs differentiated support, potentially drawing on AI-generated resource variants or feedback drafts. The fourth stage is implementation through authentic communicative activity, including dialogue, comprehension, purposeful writing and opportunities for revision; AI does not replace the interpersonal character of these experiences. The fifth stage involves formative reassessment, through which the teacher examines the pupil's response to support and adjusts subsequent instruction. Because the process is cyclical, reassessment informs renewed observation rather than producing a fixed label of learner ability. Transparency, professional judgment, developmental suitability and data protection are cross-cutting principles governing all five stages.

The framework connects differentiated instruction (Tomlinson, 2014), sociocultural mediation (Vygotsky, 1978), formative assessment (Black & Wiliam, 1998) and the human–AI augmentation perspective (Molenaar, 2022). These traditions contribute different but complementary elements. Differentiation clarifies why instructional responses must vary; sociocultural theory explains why language development depends on meaningful interaction and mediated participation; formative assessment specifies how evidence should inform the next pedagogical step; and augmentation defines a bounded role for technological assistance. The proposed model's

conceptual contribution lies in integrating these elements into a communication-centered cycle in which AI supports selected analytical and design operations without becoming the locus of pedagogical authority. This formulation also provides a criterion for distinguishing substantive personalization from superficial customization: generating multiple versions of a text is not sufficient unless the variation responds to a verified learning need and is followed by observation of the learner's progress.

The model has not been empirically validated, and its practical usefulness should therefore be examined through carefully designed studies rather than assumed. Future research could compare teacher-led planning with and without AI assistance while holding curricular objectives and classroom conditions as consistent as possible. Relevant outcomes would include pupils' understanding of explicit and implicit textual information, coherence and appropriateness of oral and written discourse, capacity to revise work in response to feedback, and gradual development of self-monitoring strategies. Process indicators should include teacher preparation time, the accuracy and usefulness of AI suggestions, the frequency of rejected or corrected outputs, and the extent to which pupils continue to participate in authentic dialogue. Research designs should also examine differential effects across learner groups and document safeguards for privacy, fairness, and age appropriateness. Teachers' capacity to evaluate AI outputs is a necessary condition for meaningful implementation, as reflected in international competency guidance (Miao & Cukurova, 2024). Such research would help determine whether the framework offers educational value beyond operational convenience.

6. Conclusions

Artificial intelligence may support personalized learning in primary education by helping teachers organize selected evidence, prepare linguistically differentiated resources, formulate formative feedback, and design opportunities for reflection. Its potential contribution to communication learning is nevertheless conditional: the technology must serve clearly defined pedagogical purposes, and its outputs must be interpreted in relation to pupils' developmental characteristics, communicative intentions and classroom experiences. Reading, speaking and writing are social as well as cognitive practices, and their development cannot be reduced to automated linguistic indicators. A responsible approach therefore preserves teacher agency, pupil authorship and authentic dialogue while treating AI-generated material as revisable support rather than authoritative instruction.

The five-stage framework developed in this paper provides a conceptual structure for coordinating observation, AI-assisted analysis, teacher-validated planning, authentic communicative practice and formative reassessment. Its principal value is to make explicit the distinction between technical adaptation and educationally meaningful personalization. Because no intervention was implemented and no empirical data were collected, claims about improved learning outcomes, efficiency, or equity remain hypotheses requiring systematic investigation. Future studies should test both the pedagogical usefulness of the framework and the practical costs of ensuring reliable, fair, and privacy-conscious implementation. Within these limits, AI is best understood as a means of extending teachers' capacity to respond thoughtfully to individual differences, not as a replacement for the professional and relational work through which communication competencies develop.

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