

Beyond Outcomes: How AI Tools Reshape the Multilingual Learning Process Through Cognitive, Affective, and Autonomy-Building Mechanisms

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Abstract. The rapid integration of artificial intelligence (AI) into language education has attracted growing scholarly attention. However, most of the existing studies have focused on measurable learning outcomes, while the specific mechanisms of AI in reshaping the learning process have not been thoroughly explored or substantiated. Especially in multilingual learning environments, learners typically need to master multiple language systems and face multiple cognitive and emotional challenges. According to the existing systematic literature review, this paper proposes a three-threshold framework (including cognitive threshold, emotional threshold, and autonomy threshold). The analysis shows that the greatest contribution of AI to multilingual learning lies in re-establishing conditions for continuous learning, rather than directly influencing the attainment of learning outcomes. Implications for multilingual pedagogy and AI tool design are also considered, along with the limitations of this non-empirical approach.

Keywords: Artificial intelligence, multilingual learning, learner engagement, learner autonomy, cognitive load, language anxiety, language education.

1. Introduction

In recent years, with the rapid development and promotion of AI technology, the application of AI tools has become a part of most students' daily learning practice. However, at present, most of the research on AI in the field of language education is on the surface, merely focusing on the measurable learning effectiveness, such as test scores, vocabulary mastery, task completion accuracy, and other indicators. Few relatively in-depth discussions on how AI technology intervenes and reshapes the learning process itself.

Especially in the field of multilingual learning, learners need to invest corresponding costs from cognitive level to emotional experience and consider independent participation. From a cognitive perspective, multilingual learners need to constantly switch back and forth between different language systems, and the processing involved is a heavy burden for them. In emotional experience, learners have to continually coordinate between multiple language identities, then leads to a mount of language learning pressure and anxiety. Adjusting to different languages and educational contexts also adds new difficulties to multilingual learning. The above factors invisibly constitute a threshold, determining whether learners participate in multilingual learning and persist.

However, merely lowering these thresholds does not guarantee success in multilingual learning. In the learning process, if AI is not designed properly, it may reduce complex multilingual tasks to simplistic exercises, leaving learners with little engagement and without challenges, and even limit learners' exposure to real multilingual scenarios. The article mainly discusses the following three issues from a process-oriented perspective: (1) How does AI lower cognitive barriers in the multilingual learning process? (2) How does AI influence affective states, particularly language anxiety and motivation? (3) How does AI expand learner autonomy and opportunities for self-directed engagement across different learning contexts?

2. Literature Review

Regarding the application of AI in language education, the number of studies is constantly increasing. Most of the research reveal a similar trend: AI tools are increasingly used throughout the learning process, with less emphasis on their role in final outcomes alone. In most of the studies, it is mentioned that AI is affecting how learners acquire language knowledge, stay engaged and motivated throughout the learning journey.

2.1 AI and the Processing of Language Input

One of the research directions focuses on how AI can assist in processing language input. Existing work show that AI tools can immediately identify errors, provide personalized suggestions, and explain the content in different ways. The system dynamically adjusts the difficulty of tasks and the complexity of materials based on the learner's performance, thereby influencing the way the learner processes language information. Learners no longer receive one-size-fits-all teaching but will interact with content that matches their current level. Existing evidence suggests that learners believe these systems remarkably improve their thinking clarity and writing fluency and are also convenient for repeated revisions. This indicates that besides affecting learning outcomes, AI also participates in and influences the learning process itself. This research explores how AI is embedded into ongoing learning processes.

One of the research directions focuses on how AI can assist in processing language input. Existing studies indicate that AI has been found reliably in instantly detecting errors, offering real-time feedback, and explaining material through multiple approaches [3]. In addition, AI can modify task difficulty and text complexity based on learner performance, allowing the learner to engage with content suited to their current proficiency. Feedback from learners suggests that AI has strengthened their ability to think clearly and write fluently [4]. Therefore, this study explores how artificial intelligence can be integrated into the continuous learning process.

2.2 AI and the Affective Dimensions of Learning

Language anxiety has long been considered a major obstacle to language learning [5]. Multilingual learners will experience a series of emotional and psychological changes in the process of interacting with AI. Switching between different language systems and expressing themselves accurately, this process may cause emotional uncertainty and lead to language anxiety [6].

The interactive environment supported by artificial intelligence can alleviate this problem to a certain extent. In contrast to high-pressure interactions with teachers or peers, chat robot based language practice has been proven to reduce learners' oral expression anxiety and alleviate language expression problems caused by language anxiety [7, 8]. The finding also applies to reading tasks. In AI-supported settings, learners' reduced affective filters tend to encourage greater communicative willingness [9].

2.3 AI and Learner Autonomy

The relevant literature has expounded on the impact of AI on the autonomy of learners. Research on autonomous learning suggests that AI tools support flexible and personalized interactions. These interactions extend learning beyond the classroom. Learners can control their own pace and choose when to practice [10, 11]. This shift gives learners great control and supports the idea of self-determination. In this view, autonomy drives long-term motivation [12]. Research on AI in education shows that learners use AI for both task-based activities and self-directed learning. This pattern find that learning is becoming more continuous and more personalized [3]. In multilingual settings, AI tools help learners move across languages and contexts. Learners can use their full range of language resources. This process supports ongoing engagement in different linguistic environments [13]. Recent studies also show that AI interaction provides immediate and relevant feedback, and those responses may increase learners' willingness to communicate [9, 14].

However, few studies have brought the above perspectives together to explain how AI helps reduce barriers across the whole learning process. This gap motivates the present study, attempting to synthesize existing evidence from a threshold perspective. This paper proposes an original analytical three-threshold framework. Its theoretical basis includes the cognitive load theory [15], the emotion filtering research [5], and the self-determination theory [12].

3. Methodology

3.1 Research Design

This study presents a theory-informed synthesis of existing literature. It aims to identify and explain AI-driven mechanisms reshaping multilingual learning, rather than to test causal relationships. A literature-based approach works suited here, since existing empirical studies on AI in language learning are scattered across varied contexts and tend to examine each mechanism in isolation. Synthesising these findings allows the identification of shared patterns and the construction of a unified explanatory framework. This approach follows the logic of conceptual analysis, and it is suitable when the goal is to clarify constructs and develop theoretical propositions rather than test hypotheses [16].

3.2 Literature Selection

Literature was retrieved from Google Scholar, ERIC, and Scopus using combinations of the following keyword strings: artificial intelligence + language learning; AI + multilingual or bilingual + education; learner engagement; foreign language anxiety + digital or AI; adaptive feedback + second language acquisition; learner autonomy + technology-mediated learning. The initial search found about 120 records, and 32 remained after screening.

Three inclusion criteria were applied. First, only peer-reviewed journal articles and conference papers were included; books were added only for foundational theoretical frameworks. Second, the time span was 2015-2025, with studies after 2019 receiving preference; earlier works were retained only when they established key theoretical constructs still in common use today. Third, studies were required to address at least one of the following: AI tools in language learning contexts; cognitive processing in technology-mediated instruction; affective factors in second language learning; or learner engagement in multilingual or second language settings.

Studies that focused only on monolingual first-language learning without addressing transferable mechanisms were excluded, along with non-peer-reviewed sources and non-English publications. Excluding non-English work is a limitation: the multilingual education research base includes many studies published in Chinese, Spanish, and other languages. Leaving these out may bias the evidence reviewed toward English-language research.

3.3 Analytical Framework

The retained sources were analysed through a three-dimensional threshold framework. This framework is an original construct developed for this study, informed by the theoretical traditions noted above rather than adopted wholesale from any single prior source. It was used as an analytical lens to organise evidence across studies and examine how different AI functions reduce learning barriers. Each source was coded according to the three threshold dimensions, along with instructional context, language background, and type of AI tool.

Table 1. Three-Threshold Analytical Framework

Dimension	Definition
Cognitive threshold	The effort required to process and understand language input
Affective threshold	Emotional barriers such as anxiety or low motivation
Autonomy threshold	Structural and contextual conditions that enable or constrain learners' capacity for self-directed, independent participation in learning across different settings.

3.4 Thematic Analysis

This study followed the procedures of thematic synthesis [17]. The approach was originally developed for qualitative inquiry. Three steps structured the analysis, started with coding the main findings from each source, followed by grouping those codes into descriptive themes, and then developing analytical themes across studies. Since both qualitative and quantitative studies were included, the quantitative findings were not statistically pooled but integrated at the level of broader thematic patterns and general direction of effects. The analysis focuses specifically on identifying the mechanisms by which AI lowers learning thresholds. These include adaptive feedback, conversational interaction, and personalised pacing. Each of these functions affects cognitive load, emotional conditions, and autonomous participation in different ways.

4. ANALYSIS

4.1 How AI Lowers the Cognitive Threshold

Several studies have shown AI tools can effectively reduce the cognitive barrier of learning. Learners are able to interact with AI through language enhance communicative fluency, receive timely feedback, and adjust the overall progress according to their own learning rhythm. Whether to participate in continuous multilingual learning depends to a large extent on timely and targeted feedback [18]. Learners do not need to wait for the teacher's response. They can immediately find and correct mistakes, and maintain the continuity of practice without any interference. In addition, AI can also create personalized learning plans to match the appropriate task difficulty and formulate learning plans in response to the learners' actual quality and academic performance. Research on cognitive load theory shows that learners tend to lose interest when tasks are too difficult or lack the kind of challenge that keeps learners engaged [15]. The use of AI tools can reduce the risks mentioned in the theory. AI also supports multilingual interaction, learners can freely switch languages when interacting with AI, obtain interpretation in familiar languages, and deepen their understanding of multilingual learning [19].

4.2 How AI Lowers the Affective Threshold

Artificial intelligence has a great effect on the emotional changes of learners in the overall multilingual learning experience. Research indicate that language anxiety impairs the cognitive processing process in the input, processing and output stages. Reducing emotional stress supports to release cognitive resources, and these cognitive improvements help to achieve stronger learning results [6]. Most people feel nervous and ashamed when making mistakes in front of others, and the use of AI removes the social pressure. Resolving learners' anxiety allows them to try more freely. For example, when practicing oral with chatbots, learners perform better without human evaluators and report lower anxiety [7, 8]. In the process of using AI for language learning, learners can also reduce frustration to practice more and make repeated attempts without thinking about the consequences of failure. The focus of learning shifts from "performance" to "practice" itself. Therefore, learners are more willing to take risks and stay engaged.

Artificial intelligence can also enhance learners' sense of autonomy. Learners believe that they have the discretion to decide the practice time, the area of concern and the learning pace, and can make flexible adjustments whenever they feel necessary. This level of control contributes positively to the development of learner autonomy. And autonomy is the core motivation element in the theory of self-determination [12]. Taken together, reduced anxiety, lower failure cost, and increased autonomy reshape the emotional experience of learning.

4.3 How AI Expands Engagement and Learner Autonomy

Engagement is not static, it shifts with the structural conditions of the learning environment [20]. Engagement can break through these constraints and expand in both breadth and depth with AI. In

formal classroom settings, AI plays a supporting role, it extends practice beyond class time and allows learners to prepare before they enter public activities, and benefits multilingual learners who often hesitate to speak due to anxiety. In self-directed learning, AI steps into a more central position. Learners depend on AI to receive feedback, construct their learning frameworks, and engage in interactive practice, and this reliance reduces the effort required to sustain self-directed learning [11, 10].

Monolingual and multilingual environments present notable differences. In multilingual contexts, AI offers stronger support by enabling language switching and encourages translanguaging. Translanguaging is a dynamic practice and draws on the full range of learners' linguistic resources [13, 21]. Since access to AI tools is unequal, pedagogical design have to place greater emphasis on digital equity.

4.4 Summary of Mechanisms

Across all three dimensions, a consistent pattern emerges. Artificial intelligence reduces the common barriers in multilingual learning. These mechanisms are interrelated and influence one another. Research confirmed that language anxiety impairs cognitive processing. Lower anxiety levels allow learners to release more cognitive resources, and those resources can be directed toward deeper processing of language input [6]. Enhanced cognitive ability often sustains behavioral engagement in study activities, and this sustained engagement does more than reshape the learning experience by encouraging learners to engage with a broader range of tasks. To address the three research questions posed earlier, AI reduces cognitive load through adaptive feedback and personalized learning sequences. It lowers affective barriers by removing the social pressure of evaluation, and fosters learner autonomy by supporting flexible, self-directed practice in both formal and informal settings.

5. LIMITATIONS AND IMPLICATIONS

5.1 Limitations

The study is a conceptual study and does not include empirical data. Another limitation concerns most existing studies targeting English as the main language, this may limit applicability to other language learning contexts. Additionally, non-English publications were excluded from the search, and this may have introduced an English-only bias in the results. Last, the field is evolving rapidly and advances in generative AI may quickly replace earlier findings.

5.2 Implications

Theoretically, the study provides a structured lens to examine how AI affects the learning process rather than just outcomes, and suggests that threshold-reduction is a productive unit of analysis for future empirical research. Pedagogically, effective AI integration in multilingual settings should prioritise three areas: adaptability to learners' current cognitive capacity across multiple language systems; emotional safety, including the reduction of social evaluation pressure in language learning interactions; and support for learner autonomy, including the ability to engage in translanguaging and cross-lingual practice rather than being constrained to monolingual interaction modes. Rather than replacing teachers, AI is better understood as reshaping the structural conditions under which learning becomes accessible — particularly for multilingual learners who face compounded cognitive and affective barriers to participation.

6. Conclusion

This paper has argued that AI's most meaningful contribution to multilingual language learning is process-level rather than outcome-level. At the cognitive level, AI tools reduce unnecessary processing demands through immediate adaptive feedback, personalised difficulty sequencing, and

multimodal input, without simplifying the language itself. At the affective level, AI interaction removes social evaluation pressure, creating lower-stakes conditions in which learners are more willing to take risks and make errors. At the engagement level, AI expands participation opportunities across formal and self-directed contexts, though the extent of this depends on whether the tool is designed to accommodate multilingual learners' full linguistic repertoire.

These three mechanisms are not independent. A reduction in affective pressure tends to free cognitive resources; improved cognitive access tends to sustain behavioural participation. Lowering thresholds does not automatically guarantee better learning. Further research is needed to explore the role of artificial intelligence in different multilingual learning groups, types of tools, and educational contexts. A related concern is the issue of digital equity. The "digital divide" may exacerbate the injustice of access to educational opportunities. As artificial intelligence advances, the key issue is no longer simply whether it can boost learning outcomes, but rather how it reshapes the conditions of access to educational opportunities—and for whom.

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