AI-Generated Flashcards in Second Language Acquisition: Promise and Pitfalls in a Digital Age

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In an era increasingly defined by artificial intelligence, language learning is undergoing a profound transformation. Among the various AI-driven tools emerging in educational technology, AI-generated flashcards are becoming particularly influential in vocabulary instruction within second language acquisition (SLA). The critical role vocabulary plays in reading comprehension, fluency, and overall language mastery is well established in SLA research. However, the task of memorizing, retaining, and applying new vocabulary remains a consistent challenge for both learners and instructors. Traditionally, flashcards have been a popular solution for reinforcing vocabulary knowledge, thanks to their adaptability for self-paced, repeated exposure. However, AI technologies now offer advanced flashcard platforms that personalize learning experiences through multimodal inputs, real-time feedback, and data-driven adaptability. Applications such as Canva, Memrizz, NoteGPT, Revisely, Anki, Quizlet, Paperclips, and Coursebox provide learners with dynamic interfaces to study vocabulary tailored to their individual proficiency and pace.

That being said, as with any technology, integrating AI into language pedagogy invites scrutiny. Critics question the reliability, comprehensiveness, and pedagogical soundness of AI-generated content. Others raise concerns about ethical implications, such as user privacy and equitable access to technology. Still, the potential benefits—especially in enhancing learner engagement, reducing cognitive overload, and facilitating differentiated instruction—suggest that AI-generated flashcards may be more than a passing trend. In response to this evolving landscape, this commentary explores the emerging role of AI-generated flashcards in SLA. It examines both their merits and limitations while advocating for thoughtful integration guided by sound pedagogical practices and inclusive design principles.

The ability to learn a second language (L2) depends on several factors, including the comprehension of its syntax and mastery of an extensive lexicon. Vocabulary memorization involves encoding, consolidation, and retrieval, which can be cognitively challenging, as revealed by cognitive load theory (Chandler & Sweller, 1991), underscoring the risk of overwhelming students with vocabulary materials. In addition to vocabulary overload, traditional vocabulary instruction can hinder the effectiveness of L2 vocabulary acquisition due to its inability to easily differentiate and personalize vocabulary learning. Moreover, L2 learners often struggle to acquire and retain new words long-term. The lack of differentiation, personalization in L2 vocabulary learning, and timely feedback can also impact the effectiveness of vocabulary instruction.

Nation (2022) and Webb et al. (2020) agree that acquiring new vocabulary is paramount in language mastery. They also note that using flashcards can effectively help learners acquire new vocabulary when implemented with comprehensive pedagogical approaches. The features of flashcards as a vocabulary learning tool can help L2 learners memorize words with an L2 lexical

item on one side and its meaning, translation, or an image on the other. Traditional vocabulary learning and instruction, however, has shifted toward the use of AI technologies, even though it has its own merits and drawbacks. AI-generated flashcards, in particular, are bringing changes to the benefits of meeting the diverse needs of L2 learners at various linguistic proficiency levels through the development of adaptive, personalized learning approaches, which are acknowledged by many scholars (Bachiri et al., 2023; Kaitsu & Nakata, 2025; Senzaki, 2017).

The integration of AI into second language instruction is not merely a technological novelty—it reflects a paradigm shift toward more personalized, data-informed, and accessible educational models. Building on decades of development from CALL (Computer-Assisted Language Learning) to ICALL (Intelligent CALL), AI now enhances a wide range of instructional tasks: grading, content creation, adaptive testing, and, most relevant here, vocabulary reinforcement through flashcards. Zhu and Wang (2025) posit that generative AI models such as ChatGPT and image-based tools like DALL·E extend beyond traditional flashcard definitions by introducing interactive, multimodal learning experiences. Learners are not only presented with words and meanings but also with visual cues, pronunciation guides, contextual examples, and immediate feedback. These tools embody the ideal of differentiated instruction, adjusting content based on learners' prior knowledge and engagement patterns.

A central advantage of AI-generated flashcards is their ability to enhance learner motivation and engagement. As Xueting Ye and Shi (2023) report, interactive, visually rich, and gamified formats foster a more enjoyable and immersive learning environment. Unlike static paper flashcards, digital platforms allow learners to engage with vocabulary in multiple modes—text, audio, video, and images—thereby increasing cognitive associations and long-term retention.

Personalization is another powerful feature. Many AI-driven platforms track a learner's progress and adjust future vocabulary items based on performance, reducing redundancy and ensuring appropriate challenge levels. This aligns with cognitive load theory, emphasizing the need to manage information flow to prevent learner overload. Tools like Memrizz or Revisely can limit the number of new terms presented, strategically revisiting older ones for reinforcement. This scaffolding fosters deeper learning and long-term memory consolidation.

Accessibility and portability also contribute significantly to the appeal of AI-generated flashcards. Learners can study anywhere, anytime, without needing physical materials (Fu et al., 2022). For adult learners or those in multilingual environments, the ability to toggle languages or switch from text to audio on the fly can make a significant difference in learning efficacy. Furthermore, from an instructional perspective, AI flashcards alleviate teacher workload. Educators can generate custom vocabulary sets based on curriculum goals, assessments, or learner needs, saving time while still maintaining instructional alignment. These efficiencies, in turn, can free educators to focus on higher-order teaching tasks, such as facilitating discourse or evaluating writing.

Despite these benefits, AI-generated flashcards are not without drawbacks. A prominent concern is over-reliance on the tool as a passive learning device. As Zhai et al. (2024) argue, students may default to rote memorization without meaningful integration of new vocabulary into real-world contexts. Vocabulary learned in isolation is unlikely to transfer into productive language skills without application through reading, writing, or conversation. Another major concern is the digital divide. Not all learners have equal access to smartphones, stable internet, or compatible software. Huang et al. (2023) highlight that user-friendliness varies widely across platforms, and not all are designed with digital immigrants in mind. This technological barrier can

create or widen equity gaps in learning opportunities, particularly among learners from low-resource settings.

Accuracy and comprehensiveness also come under scrutiny. No matter how advanced, AI algorithms are trained on data sets that can inherit biases or errors. This can lead to definitions or example sentences that are culturally insensitive, grammatically flawed, or contextually inappropriate. As Ashcroft et al. (2018) and Hua et al. (2024) emphasize, AI-generated content often lacks the nuanced understanding a trained educator can provide. Human review is essential to maintain the pedagogical integrity of such tools. Ethical concerns around data privacy further complicate adoption. AI flashcard apps often collect user data to personalize content and improve performance. However, learners may not always be aware of what data is being collected or how it is being used. Pokrivcakova (2019) warns of inadequate privacy protection and the risk of misuse, especially in educational settings where consent protocols may be unclear or inconsistent.

Finally, educators may resist the use of AI technologies in the classroom due to limited digital literacy skills. Teacher readiness remains a barrier to the effective implementation of AI-generated flashcards. Many educators lack the digital literacy or institutional support to confidently integrate AI tools into their practice. Even the most advanced flashcard platforms may be underutilized or misapplied without proper training, negating their potential benefits. They may also believe that AI technologies do not provide reliable and accurate information since they are relatively new compared to other web-based platforms. Although various AI-generated flashcards have been developed for smartphones, not all may have been fully optimized to maximize vocabulary learning. This underscores the need to establish a framework for analyzing flashcard apps grounded in existing research.

To maximize the benefits of AI-generated flashcards while mitigating their drawbacks, several practical steps are recommended:

1. **Integrate with Pedagogy:** Educators must view AI-generated flashcards not as replacements for instruction but as supplements to well-designed pedagogical strategies. Vocabulary learning is most effective when flashcards are embedded in broader instructional contexts, including authentic reading, discussion, and writing tasks.
2. **Improve Teacher Training:** Professional development focused on AI literacy and ethical technology use in the classroom is crucial. Institutions should offer ongoing training on effectively using flashcard platforms, including evaluating their accuracy, customizing content, and integrating them with lesson objectives.
3. **Address Accessibility:** Developers should prioritize inclusive design, ensuring platforms are mobile-friendly, lightweight, and usable offline. Educational institutions must also advocate for equitable access to devices and the internet for all learners.
4. **Encourage Critical Use:** Educators and learners should be trained to critically assess AI-generated content for errors, biases, and contextual relevance. Reflection activities and peer review can encourage a more active, discerning approach to learning.
5. **Advance Ethical Frameworks:** Data privacy must be protected through clear policies, transparent consent procedures, and minimal data collection practices. Institutions should choose platforms with strong privacy guarantees and provide students with information about how their data is used.

AI-generated flashcards present an exciting opportunity to transform second language vocabulary acquisition by making learning more personalized, engaging, and accessible. However, their successful integration requires more than technological adoption—it demands pedagogical

intentionality, ethical responsibility, and inclusive design. While these tools offer clear benefits in improving vocabulary retention and learner motivation, they also pose risks if used without proper oversight or critical reflection. Educators, researchers, and developers must work collaboratively to ensure these tools support, rather than supplant, the human elements essential to language learning. As digital learning continues to evolve, AI-generated flashcards can become a vital asset, but only when embedded within sound instructional frameworks that prioritize learner agency, equity, and real-world application.

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