MNEMONIC TECHNIQUES AND ARTIFICIAL INTELLIGENCE IN A SLA CONTEXT

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The article highlights the significance of integration of mnemonic techniques and Artificial Intelligence (AI) in foreign language learning in a primary school setting. As English remains a global lingua franca, developing effective and personalized methods for learning this language is crucial. This article offers the study of the potential of combining mnemonic techniques with AI to enhance the memorization and retention of English vocabulary and grammar by young learners. It is noted, by pointing AI's ability to adapt to individual learning needs, these combined methods can offer a more effective and engaging approach to mastering a second language.

Mnemonic techniques have long been recognized as powerful tools in language acquisition, relying on the creation of associations between new words and familiar concepts or images. Artificial Intelligence, through machine learning algorithms and personalized learning paths, has the potential to augment these techniques by tailoring content to the young learner's specific needs. The researchers attempt to examine how AI can create adaptive learning experiences, using mnemonics to reinforce associations and improve memory retention. From dynamic vocabulary drills to personalized grammar exercises, AI-driven platforms and tools offer a modern approach to traditional mnemonic strategies.

The integration of AI into mnemonic-based language learning offers numerous advantages, such as greater personalization, increased engagement, and enhanced learning efficiency. However, challenges remain, including the need for highly accurate AI algorithms and the potential over-reliance on technology. The study concludes by discussing the future of AI in English language education, outlining its potential to transform how we approach language learning while highlighting areas for further research. As AI continues to evolve, it promises to reshape SLA through the power of associative memory and personalized experiences.

МНЕМОТЕХНІКА ТА ШТУЧНИЙ ІНТЕЛЕКТ В КОНТЕКСТІ ЗАСВОЄННЯ ІНОЗЕМНОЇ МОВИ

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У статті висвітлено проблему інтеграції мнемотехніки та штучного інтелекту (ШІ) у вивченні іноземної мови у початковій школі. Оскільки англійська мова залишається глобальною lingua franca, розробка ефективних та персоналізованих методів вивчення цієї мови є надзвичайно важливою. Стаття пропонує дослідження потенціалу поєднання мнемонічних технік із штучним інтелектом для покращення запам'ятовування англійської лексики та граматики молодшими школярами. Зазначається, що вказуючи на здатність штучного інтелекту адаптуватися до індивідуальних потреб учнів у навчанні, ці комбіновані методи можуть запропонувати більш ефективний і привабливий підхід до оволодіння другою мовою.

Мнемотехніка вже давно визнана потужним інструментом у засвоєнні мови, що ґрунтується на створенні асоціацій між новими словами та знайомими поняттями чи образами. Штучний інтелект за допомогою алгоритмів машинного навчання та персоналізованих інструкцій має потенціал для розширення цих методів, адаптуючи зміст до конкретних потреб учня. Представлено аналіз напрацювань, як штучний інтелект може створювати адаптивний досвід навчання, використовуючи мнемоніку для зміцнення асоціацій і покращення запам'ятовування. Авторкою названо платформи та цифрові інструменти, які пропонують сучасний підхід до використання традиційних мнемонічних стратегій, починаючи від динамічних лексичних вправ і закінчуючи персоналізованими граматичними завданнями.

Інтеграція штучного інтелекту в вивчення іноземної мови на основі мнемотехніки має значні переваги (персоналізація, підвищена залученість і ефективність навчання та ін.). Проте проблеми залишаються, зокрема потреба у високоточних алгоритмах ШІ та потенційна надмірна залежність від технологій. Обґрунтовано стратегії використання штучного інтелекту в навчанні англійської мови, окреслено його потенціал щодо зміни підходів до вивчення мови, окреслено сфери для подальших досліджень.

Introduction. In an increasingly globalized world, English has become the primary language of international communication. As a result, mastering English is no longer merely a cultural or educational pursuit but a necessity for career advancement, academic success, and global participation. Traditional language learning methods, such as grammar drills and rote vocabulary memorization, have proven to be somewhat rigid and less engaging for modern young learners, especially with the diverse and fast-paced demands of today's world. Therefore, there is a growing need for more effective, appealing, and personalized methods to facilitate the acquisition of a second language in primary school (in our research English).

Modern technologies have fundamentally reshaped the education process, providing new opportunities to enhance language learning experiences. With the widespread availability of digital devices and Internet possibilities, primary school learners can now access language learning resources at their fingertips, making language learning more interesting and flexible (Hockly, Dudeney, 2018). Platforms such as mobile apps and interactive digital tools enable young learners to study at their own pace and engage in a more dynamic school environment (Blyznyuk, Yatsiv, 2024). The technologies not only foster convenience but also offer opportunities for adaptive learning, helping educators teach English more efficiently based on students' individual needs and progress.

One of the most significant advancements in modern education is the integration of Artificial

Intelligence (AI) into a teaching/learning process. AI offers the potential to transform how languages are taught and learned by providing intelligent, personalized learning experiences (Xodabande, Atai, 2022). AI can analyze a young learner's strengths and weaknesses, adapting the content accordingly to optimize expected outcomes. It helps also create interactive exercises that cater to different learning styles and preferences, making the learning process more effective. As AI continues to develop, it is expected to play an even greater role in shaping educational practices, not only in foreign language learning but across all subjects at school.

Researchers claim that by combining AI's adaptive capabilities with established methods, such as mnemonics and associative learning, educators can create highly effective and personalized learning experiences. For instance, AI can assist in developing customized mnemonic strategies that are tailored to each learner's specific cognitive style, making the memorization of vocabulary and grammar rules more efficient (Baisel, Ramachandran, 2024).

Material and Methods. This study employs a theoretical and analytical approach to examining the integration of mnemonic techniques and artificial intelligence in the context of second language acquisition (SLA) among primary school learners. The research is based on a comprehensive review of scientific literature (Ukrainian and foreign), methodological frameworks, contemporary pedagogical theories, and digital tools applied in English language education. Analysis and synthesis method was applied to systematically review scholarly approaches to the use of mnemonic techniques in language learning, alongside an exploration of the role of artificial intelligence in cognitive memorization processes; comparative method was efficient for examination of traditional teaching methods with AI-driven digital solutions designed to enhance vocabulary retention and language acquisition. Content analysis enabled to review academic articles, monographs, reports, and pedagogical studies and identify key trends and perspectives on the integration of mnemonics and AI in SLA; possible scenarios for the application of artificial intelligence in facilitating mnemonic-based vocabulary acquisition among primary school learners were explored by means of modeling method. Thus, the study is grounded in a comprehensive examination of theoretical sources and methodological recommendations, enabling well-founded conclusions regarding the potential benefits of integrating mnemonic techniques and artificial intelligence into primary English language education.

Results and discussion. Mnemonic techniques have long been recognized as powerful tools for enhancing memory and improving the retention of information. At their core, mnemonics involve creating associations between new, often abstract or complex, information and something familiar or easy to remember. This mental shortcut allows young learners to link new concepts to pre-existing knowledge, making it easier to recall them later. In the context of English language learning, mnemonics can be particularly useful for memorizing vocabulary with correct pronunciation, grammatical structures, and phrasal expressions, which can otherwise be difficult to retain due to their abstract or intricate nature. For instance, when learning new vocabulary, children might use visual imagery, word associations to help make the word more memorable. Grammar rules can be made more memorable through rhymes or "storytelling" techniques that link the rule to a scenario, making it easier to recall when writing or speaking. Phrasal expressions, which are often idiomatic and difficult to understand directly, can be taught through narrative contexts or visual aids that connect the phrase to a familiar action or scenario, making the expression more relatable.

The purpose of the article is to explore the role of mnemonic techniques in the process of learning English in primary school settings, particularly how these techniques can be enhanced through modern technologies such as Artificial Intelligence (AI). The objective is to examine how AI-powered platforms can help primary school educators integrate mnemonic strategies to improve students' memory retention in language. By focusing on vocabulary acquisition and grammar understanding, the article will evaluate how mnemonic methods can be personalized using AI to meet individual learning needs. Additionally, it will look at the potential of AI to offer dynamic and adaptive learning experiences, where the mnemonic techniques are adapted to the young learners' cognitive style and progress. The scope of this paper covers both the theoretical basis of mnemonics and their practical applications in digital learning platforms, providing a comprehensive view of how traditional memory techniques can be enhanced through AI in the context of modern language education in primary school.

Mnemonic techniques as a psychological phenomenon: a review of the key concepts of mnemonic techniques, their history, and application in foreign language learning

Mnemonic techniques, rooted in cognitive psychology, are strategies used to enhance memory and facilitate the retention of information. These methods rely on the principle that humans are better able to recall information when it is connected to something familiar or more meaningful. The term "*mnemonic*" itself originates from the Greek word "*mnemon*", meaning "*mindful*" or "*of memory*" (White, 2014). Over centuries, various mnemonic devices have been developed to optimize the process of memorization,

leveraging associations, imagery, and patterns to aid recall. Historically, mnemonic techniques date back to ancient Greece and (White, 2014), where orators and scholars developed methods to help remember long speeches and complex texts. The *method of loci*, also known as the "*memory palace*," is one of the oldest and most well-known mnemonic strategies. According to this method, individuals visualize a familiar place and associate the items they wish to remember with specific locations or objects within that place. Over time, mnemonic techniques evolved and expanded to include other strategies such as acronyms, rhymes, chunking, and visual imagery, all of which aim to make the information more accessible and memorable.

In SLA, mnemonic techniques are particularly valuable because they aid in the acquisition of vocabulary as well as grammar rules and structures (Siriganjanavong, 2025; Pillai, 2004), which can often seem challenging for primary school learners to remember. For example, when learning English, students may encounter words that are difficult to recall due to unfamiliarity with the language's phonetic or structural characteristics. Mnemonics address this challenge by associating these new words with familiar concepts, sounds, or visual images. According to R. Petal, using mnemonic techniques can offer numerous benefits for students' memory and learning – improved memory, efficient learning, enhanced problem-solving skills and more (Petal, 2024). For instance, the word "bizarre" (meaning strange or unusual), young learners might create an association by thinking of "a bizarre bear". They could imagine a bear wearing an outlandish costume or doing something unexpected, like riding a bicycle. The word "bizarre" sounds a bit like "bear", so creating a vivid mental image of a "bizarre bear" helps reinforce the meaning and makes it easier to recall the word. This technique connects the word to a memorable image, aiding in retention. Similarly, grammar rules, which often follow abstract and non-intuitive patterns, can be made more accessible through mnemonic strategies such as rhyming or visual stories that illustrate the rule in action.

By transforming abstract words into concrete images or narratives, learners can create a mental "hook" that makes recalling the word easier (Ghoneim, Elghotmy, 2016). Mnemonics can also be applied for the mastery of grammar structures, where rules and patterns are associated with visual cues or stories that highlight their usage. The use of mnemonic devices has been shown to significantly improve retention rates in young language learners, especially when the techniques are personally tailored to the individual's cognitive style and preferences.

Moreover, modern technology has enhanced the application of mnemonic techniques in SLA. Digital tools and platforms have made it easier to implement mnemonic strategies through interactive exercises (Baisel D.A., Ramachandran S. 2024), repetition, and gamified learning experiences. These tools not only help primary school students engage more actively with the material but also enable educators to adapt the mnemonic strategies to fit the learner's unique needs, further enhancing memory retention. As research in cognitive psychology continues to explore the mechanisms of memory and learning, the role of mnemonics in English language education is likely to evolve, with even more sophisticated techniques emerging to support students in the digital age.

The mechanism of associative learning: how associations between words, images, and situations help reinforce knowledge

Associative learning is a fundamental cognitive process by which students connect new information to pre-existing knowledge or experiences, facilitating its retention and recall. This process underpins much of human learning and memory, allowing young learners to make sense of unfamiliar concepts by relating them to familiar ones. In the context of SLA, associative learning plays an essential role in how learners acquire and remember new vocabulary and grammar. By creating associations between new words, images, sounds, or situations, primary school students can reinforce and strengthen their ability to recall and use language more effectively. It is absolutely evident that "*the physical world is dominant at all times. Children are good observers and they make use of such contextual clues like movements (body language), intonation, mimics and gestures, actions, images and messages in order to understand students' literacy growth is totally dependent upon vocabulary knowledge*" (Ghoneim, Elghotmy, 2016).

The mechanism of associative learning relies on the principle that information is more easily remembered when it is linked to something meaningful (Rodchyn, 2021). One of the key ways this process works is through the creation of associative links between pieces of information. For instance, when learning a new word, a learner might link the word with a vivid image or a familiar context (in the native language) that reinforces its meaning. For example, the word "apple" might be more easily remembered if the learner associates it with an image of a bright red apple or a situation where they bite into a crisp, juicy fruit. These associations form a mental network that aids in recall by triggering connected concepts and reinforcing the memory (Михальчук et al., 2023).

This concept of association is rooted in classical conditioning, a psychological theory developed by Ivan Pavlov, and more broadly, in the work of cognitive psychologists (Оксентюк, 2015: 194–208). Researchers explore the use of mental maps in teaching psychology, particularly for explaining concepts,

reinforcing material, and assessing students' knowledge. She highlights four key characteristics of intelligence maps: the focal object, themes and ideas, branching lines, and interconnected branches that create a structured system (Оксентюк, 2015: 199). In SLA, classical conditioning is used to link a new word (or concept) with an existing mental image, sound, or emotional response. The more frequently the association is made, the stronger the connection becomes, and the easier it is to recall the word or concept when needed. For example, associating the word "dog" with a specific image or memory, such as a childhood pet, creates a robust mental link that makes it easier to remember the word. Over time, the repeated activation of these associations helps to reinforce and consolidate the new knowledge in long-term memory. Therefore, to increase the efficiency of vocabulary learning it is worth using mnemonic phrases and tools of mind maps (Coggle.it, MindMeister, FreeMind, Mindomo, etc.), which play a significant role among digital means of visualization, structuring, and systematization of educational material. According to T. Kachak, *"the advantages of mind maps compared to traditional means of visualization of educational information are that the mind mapping increases productivity, develops memory, liberates thinking, helps quickly find ways to solve problems, gives a holistic and complete overview of the topic (problems, subject, phenomenon), helps make a choice and generate ideas, allows to plan and develop strategies more effectively"* (Kachak & Kachak, 2022: 94–95).

In addition to visual and emotional associations, situational learning also plays an essential role in reinforcing SLA. Situational associations occur when learners encounter a word or concept within a meaningful context, allowing them to connect the language to real-life experiences. For example, learning a simple phrase "How are you?" in a social situation where someone actually asks the learner how they feel can make the phrase more memorable. By associating language with specific contexts, learners are better able to recall and apply it in similar future situations. This situational aspect of learning deepens the connection between the word or phrase and its practical use, making it easier to use the language fluently in real-life interactions.

In the digital age, technology-enhanced associative learning has taken these principles to a new dimension. Digital tools, platforms and even AI-powered chatbots can generate associations between words, images, sounds, and contexts dynamically. For instance, platforms like Duolingo, Memrise, and Anki help learners find the way with words or phrases in various contexts, reinforcing associations over time and ensuring that the material is retained. Similar apps use neural networks to create associations between new vocabulary and images. When a student learns the word "apple," the app might show a picture of an apple, pronounce the word, and offer an example sentence such as "I eat an apple every morning." This multi-sensory association helps to reinforce the meaning of the word in a memorable way. Additionally, the integration of multimodal learning proves to be helpful – combining text, images, and audio – to deepen the associations and cater to diverse learning styles. The use of gamification and interactive exercises further strengthens these associative links by encouraging students to engage with the material in meaningful, context-based ways. IT technologies enable the creation of both static and interactive associations, including interactive posters. This can be achieved using platforms such as Thinglink, Glogster, Genially, and others.

Ultimately, associative learning enhances the learner's ability to recall and apply the target language because it taps into the brain's natural capacity to form and strengthen connections. By using images, sounds, and situations to reinforce vocabulary and grammar, learners create a web interconnected knowledge that is easier to access and use in the real-world language practice. This mechanism of associative learning is not only effective for memorizing vocabulary but also for fostering deeper understanding and fluency in SLA.

The role of AI in primary school education, its capabilities, and advantages in a SLA

Artificial Intelligence has rapidly transformed various sectors, and education is no exception. In recent years, AI has become an integral part of the learning ecosystem, providing innovative solutions for personalized education, real-time feedback, and scalable learning experiences. In the context of SLA, AI holds immense potential to enhance traditional methods, making the process more efficient, adaptive, and engaging (see Fig. 1).

To specify information of Fig.1, unlike traditional teaching/learning, one-size-fits-all educational models, AI can analyze a learner's strengths, weaknesses, and learning pace to provide customized content that targets specific areas of difficulty. In SLA, this means adjusting the complexity of vocabulary, grammar exercises, or speaking activities based on the learner's performance. For instance, if a student struggles with past tense verb conjugation in English, the AI system could present more exercises and examples focused on this particular grammar rule until mastery is achieved. This adaptability helps to ensure that learners are always challenged but not overwhelmed, fostering a more efficient learning experience.

Secondly, traditional methods often lack the ability to provide immediate responses to learners, leaving them uncertain about whether they are using language correctly. AI, however, can instantly assess
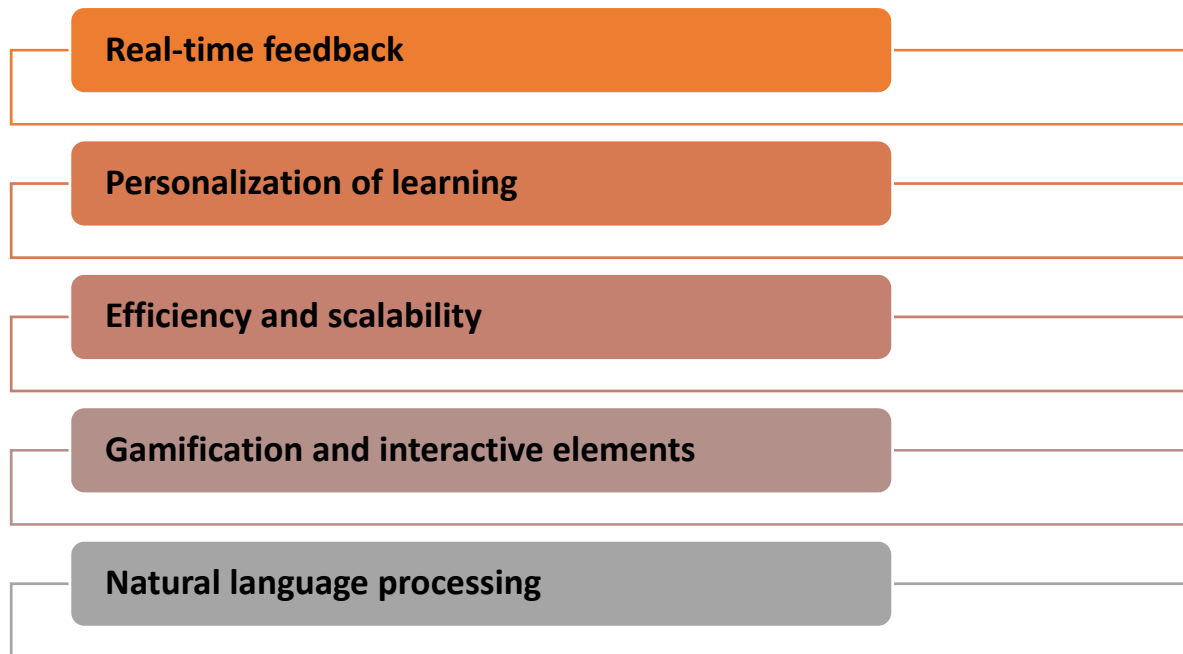
Real-time feedback	
Personalization of learning	
Efficiency and scalability	
Gamification and interactive elements	
Natural language processing	

Fig. 1. Capabilities of AI in SLA

learners' spoken or written responses, providing constructive feedback on pronunciation, grammar, and word choice.

Thirdly, in traditional settings, language teachers struggle to provide individualized attention to every student. With AI, however, learners can receive constant interaction and personalized instruction without time constraints and at their natural speed of learning. AI chatbots, for instance, can engage students in simulated conversations, helping them practice real-life communication in a low-pressure environment. These systems can simulate different scenarios, such as ordering food in a restaurant or visiting a foreign country, allowing learners to practice vocabulary and expressions in context. As AI becomes more advanced, its ability to understand nuances, idiomatic expressions, and contextual meaning which will further help advanced young learners improve the authenticity of interactions.

Finally, AI can integrate gamification and interactive elements into SLA, making the experience more engaging and motivating for primary school students. Through AI, they can participate in language games, challenges, and competitions that make learning fun while reinforcing vocabulary and grammar. AI's ability to create personalized learning paths that are interactive and game-like helps sustain learner engagement and maintain motivation over long periods, which is often a challenge in traditional learning methods. The AI can integrate mnemonic devices such as asking young learners to create a visual image or story for a new word to strengthen the

association between the word and its meaning. For example, when learning the word "moon", the system may prompt the learner to associate the word with an image of the moon and a short phrase like "The moon shines brightly at night," suggesting both visual and contextual association.

Thus, integration of Artificial Intelligence (AI) and mnemonic techniques in English language learning offers a unique and powerful approach to SLA. Above mentioned findings prove that mnemonic techniques have long been recognized for their ability to enhance memory retention through associations and imagery, AI brings the capability of personalizing and optimizing these techniques based on individual learner needs and cognitive styles.

By combining the strengths of both, educators can create highly adaptive and effective language learning environments that not only foster better retention but also satisfy diverse learning preferences. Artificial Intelligence (AI) has demonstrated immense potential in transforming language learning by enhancing associative learning methods. Through the use of neural networks, interactive systems, and personalized recommendations, AI can create innovative ways to help learners build and reinforce connections between new words, phrases, and grammatical structures.

On the other hand, the integration of AI into foreign language learning, particularly through associative methods, offers a wide range of challenges as well. Among the latter we attempt to mention those related to dependency on technology (Blyznyuk, 2021), the integration of AI into existing educational frameworks, etc.

The table below provides a comparative overview of the advantages and challenges of using AI in learning through mnemonics, highlighting the key aspects that need to be further considered for effective implementation in educational settings of primary school.

Table 1 captures both the positive potential and the downsides that come with integrating mnemonic techniques and AI into the process of associative learning, particularly in SLA. Nevertheless, the future of these innovative means in education looks promising, particularly in the realm of language learning. As machine learning algorithms continue to advance, AI will be able to provide even more personalized learning experiences and digital mnemonics will assist it.

Conclusions. The key findings from the article highlight several significant impacts of how AI can help learn English through associations. Mnemonic techniques have proven to be highly effective in enhancing vocabulary retention and language acquisition among primary school English learners. Given their developing cognitive abilities, children benefit from associations, visual imagery, and technology-enhanced associative learning that make SLA process more engaging and memorable. By incorporating mnemonics into early language education, teachers can facilitate deeper processing of new linguistic structures, leading to improved long-term recall and application in real-life communication. Currently, artificial intelligence offers innovative ways to support mnemonic-based language learning by personalizing instruction and adapting to individual learners' needs. AI-generated applications, such as adaptive flashcards, interactive posters, mind maps and gamified learning environments, create dynamic and motivating experiences for young learners. These technologies can track progress, provide real-time feedback, and suggest tailored mnemonic strategies, thus reinforcing students' engagement and autonomy in SLA.

The integration of mnemonic techniques and AI-driven tools holds great potential for transforming primary education in the context of SLA. Combining memory-enhancing strategies with intelligent digital platforms can address diverse learning styles and promote inclusive education. However, successful implementation requires thoughtful pedagogical design, taking into account both the advantages and challenges of using mnemonic techniques and AI, advanced teacher training for integrating these innovations into school curricula, and access to suitable digital resources.

Best practices in AI's integration with mnemonic learning methods have already shown promising results in making language learning more personalized, engaging, and effective. However, there is significant potential for further advancements in the field, particularly with a focus on diverse learning styles, long-term retention, and the ethical implications of AI in education, in particular. Future research and development in these areas will be essential to maximize the benefits of AI in language learning and ensure its responsible use.

Table 1

Advantages and challenges of using mnemonic techniques and AI in SLA

Category	Advantages	Challenges
Personalization	- AI can tailor learning experiences to individual learners based on their progress, learning style, and needs.	- Over-personalization may limit learners' exposure to diverse methods or broader language contexts.
Efficiency	- Adaptive methods allow learners to progress at their own pace, increasing overall efficiency in learning.	- Learners might become dependent on AI for guidance, reducing self-regulation skills.
Motivation	- AI-based systems, such as gamification or rewards, can keep learners engaged and motivated.	- Potential for learners to focus too much on gamified elements, rather than on deep SLA.
Consistency	- AI systems provide consistent feedback, enabling continuous improvement in learners' understanding and skills.	- The need for more precise AI algorithms to generate accurate, meaningful associations.
Scalability	- AI can be scaled across large numbers of students, providing uniform learning experiences.	- Challenges in effectively integrating AI into existing curricula and educational programs.
Real-Time Feedback	- AI can provide instant feedback, allowing learners to correct mistakes and reinforce associations immediately.	- Risk of students becoming over-reliant on AI feedback, rather than learning to self-correct.

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