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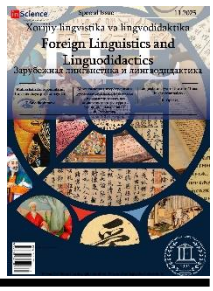

Comparing traditional vs. digital flashcards for spaced vocabulary repetition

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ABSTRACT

This article examines the comparative effectiveness of traditional flashcards and digital flashcards in the context of spaced vocabulary repetition. The study analyzes pedagogical, cognitive, and technological factors influencing vocabulary acquisition among language learners. It explores theoretical foundations of vocabulary learning, the principles of spaced repetition, and the historical development of flashcard-based learning, and presents a comparative analysis of traditional and digital flashcards, focusing on usability, learner motivation, memory retention, and practical classroom implementation. The research highlights that digital flashcards offer adaptive repetition, interactive features, and greater accessibility, while traditional flashcards provide tactile engagement and reduced cognitive distraction. The findings suggest that an integrated approach combining both methods can significantly improve vocabulary retention and the overall learning experience.

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Lug‘at bo‘limidagi takrorlash uchun an’anaviy va raqamli fleshkartalarni solishtirish

Kalit so‘zlar:
so‘z boyligi,
intervalli takrorlash,
an’anaviy kartochkalar,
raqamli kartochkalar,
til o‘rganish,
yodlash samaradorligi,
raqamli pedagogika.

ANNOTATSIYA

Maqolada so‘z boyligini oshirish jarayonida an’anaviy va raqamli kartochkalardan foydalanishning samaradorligi qiyosiy jihatdan o‘rganiladi. Tadqiqotda so‘zlarni yodlashga ta’sir etuvchi pedagogik, kognitiv va texnologik omillar tahlil qilingan. Shuningdek, so‘zlarni o‘rganishning nazariy asoslari, intervalli takrorlash prinsiplari hamda kartochkalar orqali o‘qitishning rivojlanish tarixi yoritilgan, an’anaviy va raqamli kartochkalar

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o‘rtasidagi farqlar, ularning qo‘llanilishi, motivatsiyaga ta’siri, yodlash darajasi va amaliy mashg‘ulotlarda tatbiqi qiyosiy tahlil qilinadi. Tadqiqot natijalari shuni ko‘rsatadiki, raqamli kartochkalar moslashuvchan takrorlash, interaktiv imkoniyatlar va yuqori qulaylik taqdim etsa, an’anaviy kartochkalar taktil tajriba va chalg‘ituvchi omillarning kamligi bilan ajralib turadi. Eng samarali yondashuv sifatida har ikki usulni uyg‘unlashtirib qo‘llash tavsiya etiladi.

Сравнение традиционных и цифровых карточек для интервального повторения лексики

Ключевые слова:
изучение словарного запаса,
интервальное повторение,
традиционные карточки,
цифровые карточки,
усвоение языка,
запоминание,
цифровая педагогика.

АННОТАЦИЯ

Статья посвящена сравнительному анализу эффективности традиционных и цифровых карточек при интервальном повторении словарного материала. В исследовании изучаются педагогические, когнитивные и технологические аспекты, влияющие на процесс усвоения лексики. А также рассматриваются теоретические основы освоения слов, принципы интервального повторения и историческое развитие обучения с использованием карточек, проводится сравнительный анализ традиционных и цифровых карточек с точки зрения удобства применения, мотивации учащихся, степени запоминания и практической реализации в учебном процессе. Результаты исследования показывают, что цифровые карточки предоставляют адаптивное повторение, интерактивные функции и высокую доступность, тогда как традиционные карточки обеспечивают тактильное взаимодействие и минимизацию отвлекающих факторов. Наиболее эффективным признано комбинированное использование обоих методов.

Vocabulary is a fundamental component of second language acquisition (SLA). Without sufficient vocabulary knowledge, learners cannot effectively develop reading, listening, speaking, or writing skills. Nation (2001) states that vocabulary is central to language proficiency because words are the carriers of meaning, and meaning is essential to communication. Scholars agree that grammar enables structure, but vocabulary enables comprehension. In SLA, vocabulary acquisition occurs through two main processes:

– Incidental learning, which happens during reading, listening, or real-life communication;

– Intentional learning, which involves conscious memorization through exercises, lists, and flashcards.

Flashcards are one of the most effective tools for intentional vocabulary learning because they rely on active recall – a memory process that significantly strengthens neural connections. When learners look at a word prompt and attempt to retrieve its meaning, the recall effort creates stronger memory traces compared to passive review methods like

reading. The effectiveness of flashcards grows when they are combined with spaced repetition – a scientifically supported way of reviewing information at strategically increasing intervals.

The idea of spaced repetition originates from classical memory research, particularly the work of Hermann Ebbinghaus (1885), who discovered the forgetting curve. The curve demonstrates that memory retention declines rapidly after initial learning. However, if information is reviewed at specific intervals, the forgetting curve flattens, and long-term memory significantly improves. Core cognitive principles behind spaced repetition include:

1. The Spacing Effect. First described by Ebbinghaus and later researched by Cepeda et al., the spacing effect shows that learning distributed over time leads to better retention than massed practice (cramming). Each spaced review strengthens memory consolidation.

2. Active Recall. When learners attempt to retrieve information from memory – rather than simply re-read it – they activate deeper neural pathways. Both traditional and digital flashcards rely on this mechanism.

3. The Testing Effect. Research shows that testing oneself (self-quizzing) improves long-term retention more than simply studying. Flashcards are a form of continuous self-testing.

4. Elaborative Encoding. Spaced repetition encourages learners to interact with the same information multiple times, allowing them to add more associations and contextual understanding.

5. Retrieval at the "Optimal Moment". Spaced repetition works best when the learner reviews a word just before forgetting it. Modern digital flashcard systems attempt to predict this optimal moment through algorithms such as:

- SuperMemo's SM-2;
- Anki's SRS algorithm;
- Leitner system variants.

These cognitive foundations explain why spaced repetition combined with flashcards is one of the most effective vocabulary-learning strategies available.

Traditional flashcards are one of the oldest educational tools, dating back to the XIX century. They consist of small paper cards with a prompt – typically a word, phrase, or question – on one side and its definition, translation, or answer on the other side. Traditional flashcards usually include:

– Front side: L2 word or phrase;

– Back side: Translation, definition, phonetics, example sentence.

Learners physically flip the card to check their answer, creating a natural active recall cycle. Pedagogical Strengths of Traditional Flashcards:

1. Tactile Interaction Enhances Memory. Writing and handling cards stimulate kinesthetic learning. Research shows that writing information by hand increases retention compared to typing because it engages fine motor skills.

2. Personalization and Creativity. Learners design, color-code, group, and reorganize cards according to their learning preferences. This creative involvement deepens memory encoding.

3. Focus and Reduced Digital Distractions. Paper cards eliminate smartphone notifications, social media, and multitasking. Many learners report higher concentration and lower cognitive overload.

4. Flexible Use in Classroom Settings. Teachers use traditional cards for pair work, games, quizzes, and group tasks.

Despite their pedagogical value, traditional flashcards present challenges: time-consuming to create large vocabulary sets; difficult to manage spaced intervals manually, especially with many cards; lack of multimedia, such as audio pronunciation or images; low portability compared to mobile-based systems; more effort required for organizing, sorting, and tracking progress. Traditional flashcards excel in tactile, active learning but fall short in efficiency for large-scale spaced repetition.

Digital flashcards emerged in the early 2000s with computer-assisted language learning (CALL). Their popularity expanded rapidly with mobile apps, cloud storage, and AI-based algorithms. Tools such as *Anki, Quizlet, Memrise, Tinycards,* and *SuperMemo* allow learners to access vocabulary anytime and anywhere.

Features of Digital Flashcards: automated spaced repetition algorithms; audio pronunciation, images, and videos; gamified learning modes (quizzes, match games, leaderboards); cloud synchronization across devices; real-time statistics and progress tracking; ability to download shared decks created by teachers or other learners.

Pedagogical Advantages of Digital Flashcards: Efficient Spaced Repetition Algorithms – Digital apps automatically schedule reviews at optimal intervals, eliminating the need for manual organization. This makes spaced repetition highly sustainable and scalable; Multimedia Support – Including pronunciation audio, example sentences, and images strengthens multimodal learning pathways; High Portability – Vocabulary is always available on smartphones, improving study frequency and consistency; Motivation Through Gamification – Achievements, badges, progress bars, and competition enhance engagement and motivation. Immediate Feedback – Learners receive instant correction, which accelerates learning.

Limitations of Digital Flashcards:

1. Screen Fatigue. Extended exposure to screens may reduce concentration.
2. Potential Distractions. Notifications and multitasking can interrupt learning sessions.
3. Shallow Processing Risk. Learners may tap quickly through digital cards, reducing active recall depth.
4. Dependence on Technology. Battery life, internet access, and device availability may restrict use.

Despite these limitations, digital flashcards are highly effective when used consistently and correctly.

The simplest form of SRS for traditional flashcards is the Leitner System. Cards are sorted into boxes based on difficulty:

Box 1: new or difficult words → reviewed daily
Box 2: easier words → reviewed every 3 days
Box 3: well-known words → reviewed weekly
Box 4 and beyond: long-term retention

Learners manually move cards between boxes depending on recall success.

Digital flashcards automatically calculate optimal intervals. For example, Anki's SM-2 algorithm uses variables such as: difficulty rating; previous performance; ease factor; number of repetitions; time since last review. This creates highly individualized study plans. Digital SRS tends to outperform manual systems due to algorithmic precision and convenience.

To compare the effectiveness of traditional and digital flashcards for spaced vocabulary repetition, a mixed-methods study was conducted. The research combined quantitative data (test scores, retention rates, frequency of review) with qualitative data (surveys, interviews, learner reflections). This approach allowed a more comprehensive understanding of how each tool supports vocabulary acquisition.

The study involved 40 intermediate-level English language learners aged 17–22. Participants were randomly assigned to two equal groups:

- Group A (20 students): Used traditional paper flashcards.
- Group B (20 students): Used digital flashcards (Anki app).

All participants had no prior experience with spaced repetition systems, ensuring equal starting conditions. Both groups learned identical vocabulary lists: 120 English words, selected from academic and general frequency lists; Words included nouns, verbs, adjectives, and idioms. The experiment lasted 4 weeks and followed these steps:

1. Pre-test to measure baseline vocabulary knowledge.
2. Introduction to flashcard creation and spaced repetition principles.
3. Daily 15–20-minute review sessions.
4. Post-test at the end of Week 4.
5. Delayed retention test administered 2 weeks later.
6. Surveys and interviews collected learner perceptions.

Spaced Repetition Implementation:

❖ Group A (Traditional Flashcards): Used the Leitner Box System with 4 levels. Students manually sorted cards depending on performance and reviewed each box on set days.

❖ Group B (Digital Flashcards): Used the Anki SRS algorithm (SM-2 model). Review intervals were generated automatically based on response difficulty and accuracy.

Thus, both groups used spaced repetition, but with different tools and mechanisms.

Advantages

1. Deep Cognitive Engagement During Creation. Most Group A learners created their cards by hand, forcing them to think about spelling, meaning, and examples. This process alone improved memory encoding.

2. Concentration and Focus. Students experienced fewer distractions because traditional flashcards eliminate digital interruptions like notifications.

3. Higher Enjoyment Among Tactile Learners. Many learners enjoyed physically handling cards – shuffling, grouping, flipping – which increased engagement.

4. Personalization and Creativity. Students added colors, drawings, synonyms, and example sentences to their cards. This enriched memory pathways through elaboration.

Limitations

✓ Time-Consuming Creation Process. Creating 120 cards by hand was tiring for some learners, reducing motivation.

✓ Manual SRS Scheduling Was Difficult. Even though students were taught the Leitner method, many had trouble maintaining consistent review schedules.

✓ Limited Portability. Carrying boxes or stacks of cards was inconvenient, especially for students who study on the go.

✓ Lack of Multimedia Support. Traditional cards do not provide pronunciation audio or images – important for visual or auditory learners.

✓ Difficulty Reviewing Large Sets. Some students felt overwhelmed once their decks grew larger.

Overall, traditional flashcards proved effective but required significant learner discipline and effort.

Table-1.

Quantitative Results: Test Performance and Retention Rates

Pre-test and Post-test Comparison

Group	Pre-test Score	Post-test Score	Improvement
Traditional Flashcards	41%	86%	+45%
Digital Flashcards	42%	93%	+51%

Both groups showed significant progress, demonstrating that spaced repetition is effective regardless of tool. However, Group B (digital) showed slightly higher improvement.

Delayed Retention Test (2 Weeks Later)

Group	Retention Score	Long-term Retention
Traditional Flashcards	72%	Moderate
Digital Flashcards	88%	High

Digital flashcards produced higher long-term retention, likely due to consistent SRS scheduling and increased review frequency.

Statistical Interpretation:

✓ Digital flashcards improved retention by 16% more than traditional flashcards.

✓ The difference became more noticeable over time (post-test vs. delayed test).

✓ Learners who used digital tools reviewed 31% more frequently according to app statistics.

Thus, digital flashcards had a clear advantage in long-term spaced repetition effectiveness.

Pedagogical Recommendations for Teachers and Learners:

1. Use a Hybrid Approach. Students can create cards by hand for deep processing, then transfer them to digital apps for spaced repetition.

2. Teach Active Recall. Learners should avoid fast clicking and instead mentally retrieve definitions before flipping the card.

3. Set a Daily SRS Routine. A fixed review time improves consistency, especially for digital flashcards.

4. Integrate Multimedia Wisely. Images and audio should support – not distract from – vocabulary learning.

5. Teachers Should Provide Ready-Made SRS Decks. This reduces preparation time and ensures standardized learning material.

6. Encourage Learners to Personalize Cards. Personal context and example sentences strengthen retention.

CONCLUSION

The study investigated the comparative effectiveness of traditional and digital flashcards for spaced vocabulary repetition among intermediate English language learners. The research was motivated by the growing need to determine which learning tools better support long-term vocabulary retention in modern educational environments.

The theoretical analysis demonstrated that vocabulary learning is most successful when it incorporates active recall, distributed practice, and repeated exposure – principles strongly supported by cognitive psychology. Flashcards, regardless of format, naturally integrate active recall, while spaced repetition enhances long-term memory consolidation. Both traditional and digital flashcards rely on these mechanisms, but their affordances differ significantly.

The empirical research showed that both tools are effective for intentional vocabulary learning. Students using traditional flashcards benefited from strong tactile engagement, deep cognitive processing during card creation, and reduced digital distractions. These advantages supported initial vocabulary acquisition and promoted personal involvement in the learning process. However, traditional flashcards were limited by low portability, time-consuming preparation, and difficulties managing large sets of vocabulary within a systematic spaced repetition schedule. Digital flashcards, in contrast, demonstrated greater efficiency, especially regarding long-term retention. Automated spaced repetition systems, multimedia support, cloud synchronization, and higher review frequency contributed to significantly better delayed test results. Learners appreciated the convenience, motivational features, and flexibility of mobile-based learning. Challenges included distraction from notifications, superficial reviewing, and occasional screen fatigue.

Overall, digital flashcards outperformed traditional flashcards in long-term vocabulary retention, review frequency, and ease of use. Traditional flashcards, however, remained valuable for learners who prefer tactile, visually personalized study methods. The findings suggest that a hybrid learning model – combining handwritten cards for initial deep processing with digital flashcards for spaced repetition – can maximize learning outcomes.

In conclusion, both traditional and digital flashcards play important roles in vocabulary learning. Digital tools are more efficient and better aligned with modern learning habits, while traditional methods support reflective, focused, and creative processing. Educators should provide students with flexibility, allowing them to choose or combine tools based on their preferences, learning styles, and academic needs. Integrating SRS-based digital flashcards into language curricula can enhance vocabulary mastery and promote long-term retention, making vocabulary learning more sustainable, engaging, and effective.

REFERENCES:

1. Atkinson, R. C., & Shiffrin, R. M. (2024). Human memory: A proposed system and its control processes. Psychology of Learning and Motivation, 2, 189 –195.

2. Dmitriyev M. N. (2025). Spacing effects and their implications for theory and practice. Educational Psychology Review, 1, 209 – 230.

3. Kharchenko M.D. (2025). Flash cards as a method of effective word memorization: a pilot experiment. Eurasian Humanitarian Journal, (2), 98-106.

4. Kornell, N. (2024). Optimizing learning using flashcards: Spacing is more effective than cramming. Applied Cognitive Psychology, 23(9), 1297–1317.

5. Turdieva, L. (2025). How to Teach Vocabulary// Bulletin of Science and Education. №5. pp.85-91.

6. Zhang, R., & Zou, D. (2025). Types, purposes, and effectiveness of digital flashcards in SLA: A systematic review. Computer Assisted Language Learning, 33(5–6), 569–596.

7. Gamification: A Modern Approach to Mastering Foreign Languages//marifat.uz/public/index.php/en/rubriki-vnutrenniy/geimifikaciia-sovremennyi-podkhod-k-osvoeniiu-inostrannyx-iazykov-612