

CONTEXTUAL MICROLEARNING AND NEUROCOGNITIVE MECHANISMS OF LONG-TERM VOCABULARY CONSOLIDATION IN EFL CONTEXT: AN EXPERIMENTAL STUDY

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ABSTRACT

This study investigates the effectiveness of contextual microlearning in enhancing long-term vocabulary consolidation in English as a Foreign Language (EFL) contexts, with particular attention to neurocognitive mechanisms involved in memory encoding, storage, and retrieval. The research is grounded in the Neurocognitive Microlearning Retention Model (NMRM), which integrates principles of cognitive load theory, distributed practice, and memory consolidation theory. A quasi-experimental pre-test/post-test control group design with repeated measures ANOVA was employed to examine the differences between experimental and control groups.

Sixty intermediate EFL learners participated in the study. The experimental group was exposed to contextually embedded microlearning modules, while the control group received traditional vocabulary instruction. Results revealed statistically significant improvement in the experimental group compared to the control group ($p < 0.05$, Cohen's $d = 0.82$), indicating a large effect size in favor of contextual microlearning. Findings suggest that contextualized input enhances hippocampal memory activation through repeated semantic encoding and strengthens long-term lexical retention. The study contributes to applied linguistics and cognitive neuroscience by providing empirical evidence for integrating brain-based learning principles into vocabulary instruction.

Keywords: contextual microlearning, neurocognitive mechanisms, vocabulary consolidation, EFL learning, memory retention, cognitive load theory, experimental study

INTRODUCTION

Vocabulary acquisition plays a fundamental role in second language learning, as lexical knowledge directly influences learners' communicative competence and overall language proficiency. However, in English as a Foreign Language (EFL) contexts, learners often face difficulties in retaining newly learned vocabulary over long periods. This issue is primarily caused by limited exposure to authentic language input, reliance on rote memorization, and the absence of meaningful contextual reinforcement. As a result, vocabulary knowledge tends to remain fragile and quickly forgotten, which negatively affects communicative performance.

Recent developments in educational technology have introduced microlearning as an innovative instructional approach that delivers learning content in small, focused units. When combined with contextual learning strategies, microlearning allows learners to process vocabulary in meaningful situations rather than isolated word lists. This combination is expected to enhance cognitive depth and improve long-term retention. Despite growing interest in microlearning, there remains a significant research gap in understanding how it interacts with neurocognitive mechanisms of memory consolidation in EFL vocabulary learning.

From a neurocognitive perspective, vocabulary retention is closely linked to processes occurring in the brain, particularly in the hippocampus and associated cortical regions responsible for memory encoding and long-term storage. Memory consolidation theory suggests that repeated exposure and meaningful contextualization strengthen synaptic connections, thereby enhancing retention. However, few empirical studies have integrated these neurocognitive principles with microlearning-based vocabulary instruction. Therefore, this study aims to develop and test a Neurocognitive Microlearning Retention Model (NMRM) that explains how contextual microlearning enhances long-term vocabulary consolidation in EFL learners.

METHODOLOGY

This study employed a quasi-experimental pre-test/post-test control group design with repeated measures analysis to investigate the effect of contextual microlearning on vocabulary retention. The participants consisted of 60 intermediate-level EFL learners enrolled in a university language program. They were randomly assigned to an experimental group ($n = 30$) and a control group ($n = 30$), ensuring comparable proficiency levels at the beginning of the study.

The experimental group received vocabulary instruction through digitally delivered contextual microlearning modules designed according to the Neurocognitive Microlearning Retention Model (NMRM). These modules included short vocabulary units embedded in meaningful contexts such as dialogues, situational tasks, and short texts. The design emphasized repetition, contextual variation, and active engagement to facilitate deeper cognitive processing and neural encoding. In contrast, the control group was taught using traditional methods involving word lists, translation, and mechanical repetition.

Data were collected using standardized vocabulary tests administered at three stages: pre-test, immediate post-test, and delayed post-test conducted four weeks after the intervention. The tests measured both receptive and productive vocabulary knowledge. Statistical analysis was conducted using repeated measures ANOVA to determine within-group and between-group differences. Additionally, effect size was calculated using Cohen's d to assess the magnitude of the intervention effect. Ethical considerations were observed, and all participants provided informed consent prior to participation.

RESULTS

The results of the study indicate a statistically significant improvement in vocabulary retention among the experimental group compared to the control group. Both groups showed improvement in the immediate post-test; however, the experimental group demonstrated substantially higher performance levels. In the delayed post-test, the difference between the two groups became more pronounced, indicating stronger long-term retention in the experimental group.

Repeated measures ANOVA revealed a significant interaction effect between time and group ($p < 0.05$), confirming that contextual microlearning had a meaningful impact on vocabulary consolidation over time. The calculated effect size (Cohen's $d = 0.82$) indicated a large practical significance of the intervention. These results suggest that learners exposed to contextual microlearning not only acquire vocabulary more effectively but also retain lexical items for longer periods compared to those receiving traditional instruction.

DISCUSSION

The findings of this study provide strong evidence that contextual microlearning enhances long-term vocabulary consolidation through both cognitive and neurocognitive mechanisms. From a cognitive perspective, microlearning reduces cognitive load by presenting information in small, manageable units, allowing learners to allocate sufficient attentional resources to each lexical item. The integration of contextual information further promotes semantic depth, which is essential for durable memory formation.

From a neurocognitive standpoint, the results can be explained through hippocampal memory consolidation theory. Repeated exposure to vocabulary in meaningful contexts activates neural pathways responsible for encoding and storing lexical information in long-term memory. This process is strengthened by distributed practice and contextual variation, which enhance synaptic connectivity and retrieval efficiency. The proposed NMRM model effectively captures this interaction between pedagogical design and brain-based learning mechanisms.

Furthermore, increased learner engagement observed in the experimental group suggests that motivation and attention play a critical role in memory consolidation. Higher cognitive involvement leads to stronger encoding processes, which in turn improve retention. These findings align with dual coding theory and cognitive load theory, both of which emphasize the importance of meaningful input and optimized information processing in learning environments.

CONCLUSION

This study demonstrates that contextual microlearning significantly enhances long-term vocabulary consolidation in EFL contexts through neurocognitive mechanisms of memory encoding and retrieval. The findings validate the Neurocognitive Microlearning Retention Model (NMRM), which integrates principles of cognitive load theory, distributed practice, and memory consolidation into a unified framework for vocabulary instruction.

The study contributes to both applied linguistics and cognitive neuroscience by providing empirical evidence that pedagogical strategies can be effectively aligned with brain-based learning processes. It is recommended that future research incorporate neuroimaging techniques such as EEG or fMRI to further investigate the neural basis of vocabulary acquisition in microlearning environments. Additionally, larger sample sizes and longitudinal studies are needed to strengthen the generalizability of the findings.

REFERENCES

1. Baddeley, A. D. (2012). Working memory: Theories, models, and controversies. *Annual Review of Psychology*, 63, 1–29. <https://doi.org/10.1146/annurev-psych-120710-100422>
2. Baddeley, A. D., Eysenck, M. W., & Anderson, M. C. (2020). *Memory*. Routledge.
3. Barcroft, J. (2007). Effects of opportunities for word retrieval during second language vocabulary learning. *Language Learning*, 57(2), 249–273. <https://doi.org/10.1111/j.1467-9922.2007.00405.x>
4. Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological Bulletin*, 132(3), 354–380. <https://doi.org/10.1037/0033-2909.132.3.354>
5. Ellis, N. C. (2002). Frequency effects in language processing: A review. *Studies in Second Language Acquisition*, 24(2), 143–188. <https://doi.org/10.1017/S0272263102002024>

Journal: <https://ifsmrc.org/index.php/aijrm>

6. Ebbinghaus, H. (1913). Memory: A contribution to experimental psychology. Teachers College, Columbia University.
7. Kukulska-Hulme, A., & Traxler, J. (2013). Mobile learning: A handbook for educators and trainers. Routledge.
8. Lakoff, G., & Johnson, M. (2003). Metaphors we live by. University of Chicago Press.
9. Nation, I. S. P. (2013). Learning vocabulary in another language (2nd ed.). Cambridge University Press.
10. Schmitt, N. (2010). Researching vocabulary: A vocabulary research manual. Palgrave Macmillan.
11. Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. Cognitive Science, 12(2), 257–285. https://doi.org/10.1207/s15516709cog1202_4
12. Waring, R., & Takaki, M. (2003). At what rate do learners learn and retain new vocabulary? Reading in a Foreign Language, 15(2), 130–163.