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Neurodidactics in Arabic Language Learning as a Foreign Language: The Integration of Arabic Linguistics and Cognitive Neuroscience

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Abstract
This study aims to examine the role of neurodidactics in Arabic language learning as a foreign language through the integration of Arabic linguistics and cognitive neuroscience. This study employs a qualitative research method using a systematic literature review approach of relevant scholarly works in the fields of cognitive neuroscience, Arabic linguistics, and foreign language pedagogy. The analysis is conducted by examining the relationship between learners' neurological processes—such as attention, memory, emotion, and brain plasticity—and effective strategies for learning Arabic. The discussion highlights how neurodidactic principles can be implemented in the teaching of phonological, morphological, syntactic, and semantic aspects of the Arabic language in order to enhance learners' comprehension and retention. The findings indicate that the application of a neurodidactic approach can create learning environments that are more adaptive to the way the brain functions, increase learning motivation, and optimize cognitive processes in the acquisition of Arabic as a foreign language. In conclusion, the integration of Arabic linguistics and cognitive neuroscience through a neurodidactic approach provides a strong theoretical and practical foundation for the development of more effective, innovative, and scientifically grounded models of Arabic language learning.

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INTRODUCTION

The learning of Arabic as a foreign language is expected to produce learners who are not only linguistically competent but also possess balanced cognitive and communicative abilities (Kamal, 2025). Ideally, the process of learning Arabic should be designed based on a profound understanding of how humans process language, including aspects of attention, memory, emotion, and learning motivation (Almelhes, 2025). With an appropriate pedagogical approach, Arabic can be learned effectively despite its high phonological, morphological, and syntactic complexity compared to many other foreign languages (Asadi et al., 2025).

However, in practice, Arabic language learning often remains oriented toward traditional approaches that emphasize rote memorization of grammatical rules and mechanical text translation (Cojanu, 2025). Such approaches often overlook learners' cognitive characteristics, resulting in low motivation, high cognitive load, and weak long-term retention. Consequently, Arabic language

learning is frequently perceived as difficult, monotonous, and insufficiently relevant to learners' communicative needs (Ghani et al., 2025).

In recent decades, advances in cognitive neuroscience have made significant contributions to understanding how the human brain learns and processes language (Halkiopoulos et al., 2025). The concept of neurodidactics has emerged as an interdisciplinary approach that integrates findings from neuroscience with learning theories and educational practices (Zhumabayeva et al., 2025). Neurodidactics emphasizes the importance of brain-based learning, which takes into account biological and cognitive factors in designing language teaching strategies (Gavilán-Martín et al., 2026).

Previous studies have shown that the application of neuroscience principles in foreign language learning can enhance instructional effectiveness (Gkintoni et al., 2025). Studies in the context of second and foreign language learning reveal that instruction involving positive emotions, multisensory engagement, and meaningful repetition can strengthen neural networks associated with language acquisition (Gkintoni et al., 2025). Other research also confirms that understanding working memory, attention, and brain plasticity contributes significantly to enhancing language proficiency.

Nonetheless, research specifically integrating neurodidactics with Arabic linguistics remains relatively limited. Most neurodidactic studies have focused on Western languages, such as English, Spanish, or German, while the unique characteristics of Arabic—such as its derivational morphological system, diglossia, and phonetic complexity—have been scarcely examined within the framework of cognitive neuroscience (Khwaileh et al., 2025). Consequently, the implementation of neurodidactics in Arabic language learning often remains adaptive in nature and has not yet been grounded in a comprehensive analysis of Arabic linguistics.

This research gap indicates the need for a study that systematically connects the principles of neurodidactics, findings from cognitive neuroscience, and the linguistic structure of the Arabic language. The solution proposed in this study is to develop a conceptual framework for teaching Arabic as a foreign language grounded in the integration of Arabic linguistics and cognitive neuroscience, thereby enabling the design of learning strategies that align with the neurological mechanisms of learners' brains.

Based on the foregoing discussion, this study aims to analyze the role of neurodidactics in teaching Arabic as a foreign language through the integration of Arabic linguistics and cognitive neuroscience, as well as to examine its implications for the development of a more effective, adaptive, and scientifically grounded model of Arabic language learning.

METHOD

This study employs a qualitative approach with a conceptual research design based on a (systematic literature review) (Schreiber & Cramer, 2024). This approach was selected to obtain a comprehensive understanding of the integration of neurodidactics, Arabic linguistics, and cognitive neuroscience in the context of teaching Arabic as a foreign language. A conceptual review enables the researchers to synthesize various relevant theoretical and empirical findings in order to construct a coherent and scientifically grounded analytical framework.

The data sources of this study consist of internationally reputable journal articles, academic books, and scientific conference proceedings related to neurodidactics, cognitive neuroscience,

foreign language learning, and Arabic linguistics. The literature was selected from indexed academic databases, such as Scopus and Web of Science, with a publication range of the last ten years to ensure the relevance and novelty of the review. The keywords used in the search process include *neurodidactics*, *brain-based learning*, *Arabic as a foreign language*, *cognitive neuroscience*, and *Arabic linguistics*.

The literature selection process was conducted through several stages, namely initial identification, screening based on titles and abstracts, and full-text review (Joos et al., 2026). The inclusion criteria comprised publications that explicitly discuss the relationship between language learning and cognitive or neurological processes. Meanwhile, the exclusion criteria included non-academic articles, publications that had not undergone a peer-review process, and studies that were not relevant to the context of foreign language learning (Granado De la Cruz et al., 2025).

Data analysis was conducted using a qualitative thematic analysis technique. Each source was examined to identify key concepts, research findings, and pedagogical implications related to neurodidactics and Arabic language learning. The main themes were then classified into several aspects of Arabic linguistics, such as phonology, morphology, syntax, and semantics, and subsequently associated with relevant cognitive processes, including attention, memory, emotion, and brain plasticity (Pearson et al., 2025).

To enhance the validity and credibility of the findings, this study employed a source triangulation technique by comparing various theoretical perspectives and research findings from different disciplines (Papavasileiou & Dimou, 2024). In addition, the analysis process was conducted in an iterative and reflective manner to minimize researcher bias and to ensure the consistency of interpretations of the data examined (Wilson, 2025).

The results of the analysis were subsequently synthesized into a conceptual framework of neurodidactics in the teaching of Arabic as a foreign language (Tuna Pusa & Dinçer, 2025). This framework is formulated by emphasizing the integration between the linguistic structure of the Arabic language and the principles of cognitive neuroscience, thereby providing a foundation for the development of a more adaptive, effective, and brain-based learning model (Candel et al., 2025).

RESULTS AND DISCUSSION

Overview of Research Findings

The results of the systematic literature review indicate that the neurodidactic approach has significant potential to enhance the effectiveness of teaching Arabic as a foreign language. The integration of Arabic linguistics and cognitive neuroscience enables the design of learning processes that are more closely aligned with the biological and cognitive mechanisms of the learner's brain. These findings suggest that the teaching of Arabic cannot be separated from an understanding of how language is processed, stored, and reproduced by the human nervous system (Bhatti, 2025). An analysis of the reviewed literature reveals that foreign language learning that takes neurological aspects into account—such as attention, memory, emotion, and brain plasticity—tends to produce more optimal learning outcomes compared to traditional approaches that focus solely on the mastery of grammatical rules (Cao et al., 2026). In the context of the Arabic language, this finding becomes particularly relevant given the complexity of its linguistic structure and its typological distance from the native languages of most learners. The main findings of this study are classified into four principal

linguistic domains—phonology, morphology, syntax, and semantics—each of which is analyzed in relation to the principles of neurodidactics and the underlying cognitive processes (Chen et al., 2025).

Neurodidactics and the Learning of Arabic Phonology

The findings of the study indicate that Arabic phonology constitutes one of the most challenging aspects for foreign language learners, particularly in relation to emphatic, uvular, and pharyngeal consonant sounds that are absent in many other languages. The neurolinguistic studies reviewed reveal that the processing of speech sounds involves the activation of the primary and secondary auditory areas, as well as the involvement of phonological memory within working memory (Sidqi & Qushwa, 2026). The neurodidactic approach emphasizes the importance of phonological learning that is gradual, multisensory, and contextual. The findings indicate that the use of audiovisual stimuli, articulatory exercises based on phonetic awareness, and meaningful repetition can strengthen the neural pathways associated with sound discrimination and the production of Arabic phonemes. This is consistent with findings from previous research in foreign language learning, which demonstrate that phonological instruction aligned with the brain's learning mechanisms enhances both pronunciation accuracy and auditory perception. Compared with traditional approaches that often rely on mechanical imitation, neurodidactics offers a more adaptive and scientifically grounded framework. Accordingly, these findings reinforce the argument that the integration of cognitive neuroscience into the teaching of Arabic phonology can reduce cognitive load and enhance the success of speech sound acquisition (Hwang et al., 2025).

The Integration of Neurodidactics in Arabic Morphology Learning

Arabic morphology is known for its complex derivational system based on root-based morphology. The results of the analysis indicate that this complexity often becomes a source of difficulty for learners, particularly in understanding morphological patterns (*wazan*) and the semantic changes they generate. From a neurodidactic perspective, morphological processing involves the simultaneous operation of declarative and procedural memory systems (Idrissi et al., 2025). The research findings indicate that morphology instruction designed based on the principles of pattern grouping, meaning association, and structural visualization is more effective than memorization-based approaches. This strategy enables the brain to construct stable cognitive schemas and strengthens interneuronal connections associated with the recognition of linguistic patterns (Gkintoni et al., 2026). These findings are consistent with previous research emphasizing that pattern-based learning and semantic association can enhance long-term retention. In the context of Arabic, neurodidactics provides a pedagogical solution by linking the Arabic morphological system with both implicit and explicit learning mechanisms in the human brain (Hoferichter & Raufelder, 2025).

Arabic Syntax in the Perspective of Cognitive Neuroscience

The findings of the study indicate that the syntactic structure of Arabic, which allows variations in word order and the use of *iʿrāb* (inflectional case marking), requires a high level of cognitive capacity from learners. Syntactic processing involves a complex neural network, including the Broca's area and cortical connections that support the comprehension of sentence structure (Erbaba et al., 2025).

The neurodidactic approach emphasizes the importance of presenting syntactic structures in a contextual and meaningful manner, rather than relying solely on the analysis of grammatical rules (Soriano-Sánchez, 2025). The research findings indicate that the use of authentic examples, visual

mapping of sentence structures, and the gradual practice of sentence production can optimize syntactic processing in the learners' brains.

Compared with previous studies in foreign language learning, these findings are consistent with the view that syntactic instruction which activates implicit understanding is more effective than purely analytical approaches (Uzun & Güvendir, 2026). Therefore, the integration of neurodidactics into the teaching of Arabic syntax has the potential to enhance both linguistic fluency and accuracy.

Semantic Processing and the Role of Emotion in Arabic Language Learning

The findings of the study indicate that the comprehension of meaning (semantics) in Arabic is strongly influenced by cultural and pragmatic contexts. Cognitive neuroscience further emphasizes that semantic processing involves not only linguistic regions of the brain but also the limbic system, which is associated with emotional processing (Zharova et al., 2025). The research findings indicate that semantic instruction involving positive emotions, narratives, and authentic contexts can enhance cognitive engagement and improve memory retention (Montgomery et al., n.d.). This finding is consistent with the principles of neurodidactics, which emphasize that emotion is a key factor in effective learning. Compared with previous studies, these results reinforce the finding that language learning which is emotionally meaningful is more easily processed and retained by the brain. In the context of Arabic, this approach is highly relevant for addressing negative perceptions and learning anxiety that are often experienced by learners.

Overall, the findings of this study are consistent with previous research in the fields of neurodidactics and foreign language learning. However, the primary contribution of this study lies in its focus on Arabic as a foreign language, which possesses unique linguistic characteristics and has not been extensively examined within the framework of cognitive neuroscience. Previous studies have generally positioned neurodidactics as a general pedagogical approach without sufficiently considering typological differences among languages. This study demonstrates that the effectiveness of neurodidactics increases when it is specifically integrated with the linguistic structures of Arabic. Accordingly, this research expands the scope of neurodidactic theory and provides a new conceptual contribution to the field of Arabic language learning. From a theoretical perspective, the findings of this study reinforce the argument that language learning should be understood as a complex neurocognitive process (Iacono & Feltis, 2025). The integration of Arabic linguistics and cognitive neuroscience provides a more holistic theoretical foundation for understanding the acquisition of Arabic as a foreign language.

From a pedagogical perspective, these findings imply the need for a paradigm shift in Arabic language teaching from traditional approaches toward a neurodidactic-based approach. Teachers and curriculum developers need to consider how the brain functions when designing instructional materials, teaching methods, and learning assessments (Zeivots et al., 2025). Based on the results and discussion above, it can be concluded that neurodidactics provides a comprehensive framework for addressing various challenges in learning Arabic as a foreign language. The integration of Arabic linguistics and cognitive neuroscience enables a learning process that is more effective, adaptive, and learner-centered. The findings of this study not only reinforce the results of previous research but also offer a new perspective that is more specific and contextual. Therefore, this study makes a significant contribution to the development of both theory and practice in Arabic language learning at the global level.

CONCLUSION

This study aims to analyze the role of neurodidactics in learning Arabic as a foreign language through the integration of Arabic linguistics and cognitive neuroscience. The findings indicate that the neurodidactic approach provides an effective theoretical and pedagogical framework for understanding the process of Arabic language acquisition, particularly by considering aspects of attention, memory, emotion, and brain plasticity. This integration enables Arabic language instruction to be designed in closer alignment with learners' cognitive mechanisms, thereby reducing cognitive load and enhancing learning effectiveness across various linguistic aspects.

The findings of the study confirm that the application of neurodidactic principles contributes significantly to improving the comprehension and retention of Arabic phonology, morphology, syntax, and semantics. This approach not only addresses the limitations of traditional teaching methods but also expands the application of neurodidactic studies to languages with complex linguistic characteristics such as Arabic. Therefore, neurodidactics has the potential to serve as an innovative and scientifically grounded learning paradigm in the development of Arabic language learning models as a foreign language, while also opening opportunities for further empirical research in the future.

Although this study provides a robust theoretical framework regarding the integration of neurodidactics in Arabic language learning, it possesses a primary limitation in its nature as a systematic literature review, which necessitates further empirical validation through experimental studies in real-world classroom settings. Furthermore, the scope of this research has not deeply examined the influence of learner demographic variables, such as age and native language background, on the effectiveness of this neuroscience approach. Therefore, future research is strongly recommended to conduct clinical trials or field experiments utilizing neuroimaging instruments (such as EEG or fMRI) to monitor the neural activity of Arabic language learners in real-time. Future studies should also explore the development of neurodidactic-based instructional modules that are adaptive to various language competency levels to create a pedagogical formula that is more applicable and measurable for Arabic language education practitioners at a global level.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

In the preparation of this manuscript, the author utilized AI tools, specifically ChatGPT and Gemini, solely to assist with improving the readability, linguistic structure, and grammatical accuracy of the text. All outputs were subsequently reviewed and revised by the author, who assumes full responsibility for the final content of the publication. The author confirms that these AI tools were used only as supporting instruments for language refinement and not for generating original research ideas, data analysis, or substantive scientific conclusions.

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