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# *Qalam AI*: a Study on the Potential of Automatic *Ḥarakat* Detection for Arabic Sentence Learning

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## *Abstract*

*This study examines the linguistic performance and pedagogical relevance of Qalam AI as an automatic ḥarakāt detection system in Arabic sentence learning. Employing an exploratory qualitative case study design, the research involved analysis of student text samples, expert evaluation through comparison between AI-generated outputs and manual linguistic analysis, and classroom integration simulation. The analysis focused on three grammatical cases: al-asmāʾ al-marfūʿah (nominative), al-asmāʾ al-manṣūbah (accusative), and al-asmāʾ al-majrūrah (genitive). The findings indicate that Qalam AI is capable of identifying various sentence-level linguistic features, including grammatical case assignment, orthographic inconsistencies, sentence-structure variation, and punctuation-related issues, while also exhibiting systematic limitations in contexts involving morphological ambiguity and syntactic role differentiation. Rather than functioning as an error-free automation tool, Qalam AI appears to support form-focused learning by making linguistic features visible for learner reflection and instructional mediation. These findings suggest that Qalam AI may serve as a supportive pedagogical tool within AI-assisted Arabic language instruction, complementing human linguistic judgment rather than*

*replacing it. The study contributes to ongoing discussions in Computer-Assisted Language Learning and Arabic Natural Language Processing by highlighting the instructional value of automatic diacritization systems beyond technical accuracy.*

## Abstrak

Penelitian ini mengkaji kinerja linguistik dan relevansi pedagogis Qalam AI sebagai sistem deteksi ḥarakat otomatis dalam pembelajaran kalimat bahasa Arab. Penelitian ini menggunakan desain studi kasus kualitatif eksploratif dengan melibatkan analisis sampel teks peserta didik, evaluasi pakar melalui perbandingan antara hasil analisis Qalam AI dan analisis linguistik manual, serta simulasi integrasi pembelajaran di kelas. Analisis difokuskan pada tiga kategori gramatikal, yaitu *al-asmāʾ al-marfūʿah* (nominatif), *al-asmāʾ al-manṣūbah* (akusatif), dan *al-asmāʾ al-majrūrah* (genitif). Hasil penelitian menunjukkan bahwa Qalam AI mampu mengidentifikasi berbagai fitur linguistik pada tingkat kalimat, seperti penandaan *iʿrāb*, ketidaksesuaian ortografis, variasi struktur kalimat, serta aspek tanda baca, namun masih menunjukkan keterbatasan sistematis pada konteks yang melibatkan ambiguitas morfologis dan pembedaan peran sintaktis. Qalam AI tidak berfungsi sebagai sistem otomatis yang bebas kesalahan, tetapi berpotensi mendukung pembelajaran berfokus bentuk dengan menampilkan ciri-ciri linguistik secara eksplisit untuk refleksi peserta didik dan mediasi pedagogis. Temuan ini menunjukkan bahwa Qalam AI dapat dimanfaatkan sebagai alat bantu pedagogis dalam pembelajaran bahasa Arab berbasis kecerdasan buatan, dengan peran yang bersifat melengkapi, bukan menggantikan, penilaian linguistik pendidik. Penelitian ini berkontribusi pada kajian *Computer-Assisted Language Learning* dan *Arabic Natural Language Processing* dengan menyoroti nilai instruksional sistem diakritisasi otomatis di luar sekadar akurasi teknis.

**الملخص**

يهدف هذا البحث إلى دراسة الأداء اللغوي والأهمية التربوية لتطبيق Qalam AI بوصفه نظاما آليا لاكتشاف الحركات في تعلم الجمل العربية. اعتمد البحث منهج دراسة الحالة النوعية الاستكشافية، من خلال تحليل نماذج من نصوص المتعلمين، وإجراء تقييم خبراء عبر مقارنة مخرجات Qalam AI بالتحليل اللغوي اليدوي، إضافة إلى محاكاة توظيف النظام في سياق التعلم الصفي. وتركز التحليل على ثلاثة أقسام نحوية، وهي: الأسماء المرفوعة، والأسماء المنصوبة، والأسماء المجرورة. تشير نتائج الدراسة إلى أن Qalam AI قادر على تحديد عدد من السمات اللغوية على مستوى الجملة، مثل ضبط الإعراب، والكشف عن الأخطاء الإملائية، ورصد تنوع البنية التركيبية، ومعالجة بعض قضايا علامات الترقيم، مع وجود قيود منهجية في السياقات التي تتسم بالغموض الصرفي وصعوبة تمييز الوظائف النحوية. ولا يعمل Qalam AI كنظام آلي خال من الأخطاء، بل يظهر إمكانات تربوية في دعم التعلم المرتكز على الشكل اللغوي من خلال إبراز الظواهر اللغوية وإتاحتها للتأمل والتوجيه التعليمي. وتفيد هذه النتائج بأن Qalam AI يمكن توظيفه كأداة تعليمية مساندة في تعليم اللغة العربية القائم على الذكاء الاصطناعي، بوصفه مكملا للحكم اللغوي البشري لا بديلا عنه. ويسهم هذا البحث في إثراء دراسات التعلم بمساعدة الحاسوب ومعالجة اللغة العربية آليا، من خلال إبراز القيمة التعليمية لأنظمة التشكيل الآلي بما يتجاوز قياس الدقة التقنية وحدها.

**Keywords**: Arabic NLP; automatic diacritization; computer-assisted language learning; error analysis; natural language processing

## Introduction

Technology and communication in the Industry 4.0 era have increasingly shaped various aspects of human life, including educational institutions, where digital technologies play a central role in daily activities and professional practices.[1]

[1] Restu Budiansyah Rizki, Fathur Rohman, and Abdul Ghofur, "Taṭwīr al-Wasīlah at-Ta'līmiyyah al-Iliktrūniyyah al-Mu'tamadah alā Asās

Among these technologies, artificial intelligence (AI), defined as the modeling of human intelligence applied to smart machines, has significantly transformed how individuals access information, communicate, and engage with learning environments.[2]

The integration of artificial intelligence into education has contributed to a shift from conventional instructional models toward more adaptive and personalized learning approaches. AI-based systems support educators through automated feedback, personalized learning pathways, and enhanced assessment mechanisms, thereby reshaping teaching and learning paradigms.[3] Prominent examples of AI-driven

Weblog li Da'mi Namūżaj at-Ta'līm al-Mad'ūm bi al-Web (Web Enhanced Course)," *Al Mi'yar: Jurnal Ilmiah Pembelajaran Bahasa Arab dan Kebahasaaraban* 6, no. 2 (2023): 697–728, https://doi.org/10.35931/am.v6i2.2564; Piksa Dewi Ekantiningsih and Dadang Sukirman, "Trends of Education and Training Teacher Competency in Information and Communication Technology," *Jurnal Inovasi Teknologi Pendidikan* 10, no. 1 (2023): 87–105, https://doi.org/10.21831/jitp.v10i1.52630.

[2] Luh Putu Ary Sri Tjahyanti, Putu Satya Saputra, and Made Santo Gitakarma, "Peran Artificial Intelligence (AI) untuk Mendukung Pembelajaran di Masa Pandemi Covid-19," *Jurnal Komputer dan Teknologi Sains (KOMTEK)* 1, no. 1 (2022): 15–21, https://doi.org/10.37637/komteks.v1i1.1062; Maud Chassignol et al., "Artificial Intelligence Trends in Education: A Narrative Overview," *Procedia Computer Science* 136 (2018): 16–24, https://doi.org/10.1016/j.procs.2018.08.233.

[3] Arnolus Juantri E. Oktavianus, Lamhot Naibaho, and Djoys Anneke Rantung, "Pemanfaatan Artificial Intelligence pada Pembelajaran dan Asesmen di Era Digitalisasi," *Jurnal Kridatama Sains Dan Teknologi* 05, no. 2 (2023): 473–76, https://doi.org/10.53863/kst.v5i02.975; Yoshija Walter, "Embracing the Future of Artificial Intelligence in the Classroom: The Relevance of AI Literacy, Prompt Engineering, and Critical Thinking in Modern Education," *International Journal of Educational Technology in Higher Education* 21, no. 1 (2024), https://doi.org/10.1186/s41239-024-00448-3; Abdulaziz Alzahrani, "A Systematic Review of Artificial Intelligence in Education in the Arab World," *Revista Amazonia Investiga* 11, no. 54 (August 2022): 293–305, https://doi.org/10.34069/ai/2022.54.06.28.

educational tools include generative systems such as ChatGPT, which are capable of producing multimodal content, including textual, auditory, and visual outputs.[4]

At the policy and institutional levels, the adoption of artificial intelligence in education has been widely endorsed. The U.S. Department of Education, for instance, has emphasized the strategic integration of advanced technologies to support innovation and improve learning outcomes.[5] Empirical studies further demonstrate that AI systems can enhance digital instruction through personalization, learning automation, and adaptive assessment, positioning AI as an essential component of contemporary educational transformation.[6]

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[4] Fiona Fui-Hoon Nah et al., "Generative AI and ChatGPT: Applications, Challenges, and AI-Human Collaboration," *Journal of Information Technology Case and Application Research* 25, no. 3 (2023): 277–304, https://doi.org/10.1080/15228053.2023.2233814.

[5] Office of Educational Technology U.S. Department of Education, *Artificial Intelligence and Future of Teaching and Learning: Insights and Recommendations* (Washington D.C., 2023), https://www.ed.gov/sites/ed/files/documents/ai-report/ai-report.pdf.

[6] Haoran Xie et al., "Trends and Development in Technology-Enhanced Adaptive/Personalized Learning: A Systematic Review of Journal Publications from 2007 to 2017," *Computers and Education* 140, no. May (2019): 103599, https://doi.org/10.1016/j.compedu.2019.103599; Kyoungwon Seo et al., "The Impact of Artificial Intelligence on Learner–Instructor Interaction in Online Learning," *International Journal of Educational Technology in Higher Education* 18 (2021): 1–23, https://doi.org/10.1186/s41239-021-00292-9; Valentine Joseph Owan et al., "Exploring the Potential of Artificial Intelligence Tools in Educational Measurement and Assessment," *Eurasia Journal of Mathematics, Science and Technology Education* 19, no. 8 (2023): em2307, https://doi.org/10.29333/ejmste/13428; Failasuf Fadli and Mochamad Iskarim, "Students' Perceptions of Artificial Intelligence Technology to Develop 21st Century Learning Skills," *Lentera Pendidikan: Jurnal Ilmu Tarbiyah Dan Pendidikan* 27, no. 1 (2024): 178–90, https://doi.org/10.24252/lp.2024v27n1i11; Joonhyeong Park et al., "Integrating Artificial Intelligence into Science Lessons: Teachers' Experiences and Views," *International Journal of STEM Education* 10, no. 61 (2023): 1–22, https://doi.org/10.1186/s40594-023-00454-3; Thi Ngoc Le Phan, "Students' Perceptions of the AI Technology Application in

Within language education, this technological shift has also significantly influenced the teaching and learning of foreign languages, including Arabic. One notable aspect of this technological advancement is the evolution of Arabic language learning, which now fully integrates artificial intelligence into all knowledge-transfer processes.[7] This integration can leverage multimedia platforms, computer-based systems, and internet technologies to enhance learning outcomes.[8] Among the technologies applicable to Arabic language learning in this era of digital advancement are platforms such as Zoom, Google Meet, and Kahoot, along with other interactive tools.[9] This narrative demonstrates that technological advancements have fundamentally transformed educational paradigms from conventional methods that usually focuses on grammar-translation and memorization to modern methods by using technologies.[10]

Arabic is considered a foreign language in Indonesian society. Those who wish to learn Arabic must follow foreign language acquisition principles.[11] Furthermore, in Arabic

English Writing Classes," in *Proceedings of the AsiaCALL International Conference*, vol. 4, 2023, 45–62, https://doi.org/10.54855/paic.2344.

[7] Muhammad Rehan Anwar and Herdi Aziz Ahyarudin, "AI-Powered Arabic Language Education in the Era of Society 5.0," *IAIC Transactions on Sustainable Digital Innovation (ITSDI)* 5, no. 1 (2023): 50–57, https://doi.org/10.34306/itsdi.v5i1.607.

[8] Ali Al Musawi et al., "Perceptions of Arabic Language Teachers toward Their Use of Technology at the Omani Basic Education Schools," *Education and Information Technologies* 21, no. 1 (2016): 5–18, https://doi.org/10.1007/s10639-013-9305-5.

[9] Muhimmatul Choiroh, "Evaluasi Pembelajaran Bahasa Arab Berbasis Media E-Learning," *Jurnal Naskhi: Jurnal Kajian Pendidikan dan Bahasa Arab* 3, no. 1 (2021): 41–47, https://doi.org/10.47435/naskhi.v3i1.554.

[10] Abdillah Mahbubi, "Conventional and Contemporary Arabic Language Teaching Methods: A Comparative Analysis," *Alsina : Journal of Arabic Studies* 6, no. 2 (2024): 205–28, https://doi.org/10.21580/alsina.6.2.23307.

[11] Restu Budiansyah Rizki, "Istirātījiyyat Qirā'at Kutub al-Turath 'ala Asās Naẓariyyat Rebecca Oxford fī Ta'allum al-Lughat al-Ajnabiyat,"

language learning, there is an important principle students should consider before immersion: "Whoever wishes to learn a foreign language must study its grammatical rules". Consequently, language acquisition must incorporate structural knowledge of the target language.[12] In structuralist linguistics, a language comprises several components including phonemes, morphemes, words, phrases, and sentences.[13] One branch of linguistic science that examines clause and sentence structures is *naḥw* (Arabic syntax).[14] *Naḥw* (Arabic syntax) examines core grammatical elements including subjects, predicates, objects, and adverbials.[15] Thus, mastery of Arabic syntax plays a vital role in comprehending, analyzing, and producing Arabic texts.[16] In the domain of morphology, the focus primarily centers on the intricacies of word structure and its syntactic relationships with other lexical elements.[17] In Arabic grammatical studies, morphology plays a fundamental role. Therefore, it is accurate to assert that mastery of Arabic syntax requires a thorough understanding of

*Alsina : Journal of Arabic Studies* 1, no. 1 (2019): 67–86, https://doi.org/10.21580/alsina.1.1.3725.

[12] Munir Munir, "Pendekatan Struktural dalam Pelajaran Bahasa Arab," *Shaut al Arabiyyah* 6, no. 1 (2018): 13–24, https://doi.org/10.24252/saa.v6i1.5644.

[13] Restu Budiansyah Rizki, "Kajian Linguistik Modern Strukturalis dalam Pembelajaran Bahasa Arab," *Alsina : Journal of Arabic Studies* 2, no. 2 (2020): 173–88, https://doi.org/10.21580/alsina.2.2.4968.

[14] Robert D Van Valin and Randy J LaPolla, *Syntax: Structure, Meaning, and Function* (Cambridge University Press, 1997).

[15] Edi Kurniawan Farid, "Sintaksis Bahasa Indonesia dan Bahasa Arab (Studi Analisis Kontrastif Frasa, Klausa, dan Kalimat)," *Jurnal Bahtsuna* 2, no. 1 (2020): 1–23, https://doi.org/10.55210/bahtsuna.v2i1.70.

[16] Aflah Tamami Rishanda et al., "Artificial Intelligence dalam Pembelajaran Nahwu Secara Mandiri," *Al Mi'yar: Jurnal Ilmiah Pembelajaran Bahasa Arab dan Kebahasaaraban* 8, no. 1 (2025): 27–39, https://doi.org/10.35931/am.v8i1.4594.

[17] Siregar Junifer, *Morfologi* (Banyumas: Pena Persada, 2021).

the Arabic morphological system.[18] Amid rapid technological advancements, artificial intelligence has made significant contributions to education, particularly in Arabic language learning, by demonstrating capabilities to analyze linguistic structures including *naḥw* (syntax) and *ṣarf* (morphology).[19]

One notable technological innovation applicable to Arabic language learning is Qalam AI. In the context of Arabic education, this AI system demonstrates significant benefits for students across vocabulary acquisition, grammatical understanding, and other core language competencies.[20] Previous research has examined the use of artificial intelligence in Arabic language learning through automatic diacritization systems. Studies by Fahraini and Almaliki show that AI-based *Tashkeel* applications are capable of assigning *ḥarakāt* to Arabic texts with relatively low error rates, thereby supporting learners' reading accuracy and fluency. These findings highlight the pedagogical value of automatic diacritization primarily as a functional aid for improving *mahārat al-qirā'ah*.[21] However, such studies tend to emphasize output accuracy and reading performance, with limited attention to how AI systems linguistically interpret Arabic

[18] Muhammad Aqil Luthfan and Syamsul Hadi, "Morfologi Bahasa Arab: Reformulasi Sistem Derivasi dan Infleksi," *Alsina : Journal of Arabic Studies* 1, no. 1 (2019): 1–22, https://doi.org/10.21580/alsina.1.1.2599.

[19] Restu Budiansyah Rizki, Muhammad Fatkhur Rizal, and Chusnia Rahmawati, "Students' Perceptions of Integrating Qalam AI and Teacher Competencies in Arabic Reading Instruction," *LISANIA: Journal of Arabic Education and Literature* 8, no. 2 (2024): 188–207, https://doi.org/10.18326/lisania.v8i2.188-207.

[20] Restu Budiansyah Rizki, Muhammad Fatkhur Rizal, and Chusnia Rahmawati, *Evaluasi Pembelajaran Bahasa Arab Berbasis Integrasi Teknologi AI dan Manusia* (Jombang: LPPM Unhasy, 2025).

[21] Sovia Fahraini and Muhammad Fikri Almaliki, "Analysis of Arabic against The Use of Artificial Intelligence (AI) through Tashkeel (Automatic Harokat) Application to Increase Maharah Qiraah," in *Proceeding International Conference on Education*, 2023, 64–77, https://jurnalfaktarbiyah.iainkediri.ac.id/index.php/proceedings/article/view/1740.

sentence structures. In contrast, the present study focuses on Qalam AI, which offers broader linguistic features beyond diacritic assignment, including grammatical analysis and sentence-level evaluation.

Related research by Rizki et al. further illustrates the integration of Qalam AI into Arabic language assessment through a collaborative framework that combines AI-generated outputs with teachers' linguistic competencies.[22] This line of research underscores the complementary roles of artificial intelligence and human judgment in evaluating learners' reading proficiency. Building on these studies, the present research advances the discussion by shifting the analytical focus from functional application toward a linguistically informed examination of how Qalam AI processes Arabic grammatical structures and where systematic detection errors emerge.

Despite the growing body of research on automatic diacritization and AI-assisted Arabic language learning, most existing studies focus on functional effectiveness, learner perceptions, or reading performance, while paying limited attention to how such systems interpret Arabic grammatical structures at the sentence level. In particular, the linguistic behavior of automatic diacritization systems, especially their error patterns related to *iʿrāb* and morphological ambiguity, remains underexplored, despite the central role of diacritics in determining meaning and grammatical function in Arabic. This gap highlights both pedagogical and theoretical challenges within Arabic NLP and CALL research.

[22] Restu Budiansyah Rizki, Muhammad Fatkhur Rizal, and Chusnia Rahmawati, "Design of Integrating Qalam AI and Language Teacher Competencies in Evaluating Arabic Reading Skill," *Tanwir Arabiyyah: Arabic As Foreign Language Journal* 4, no. 2 (2024): 257–66, https://doi.org/10.31869/aflj.v4i2.5930.

Accordingly, this study examines the linguistic performance of Qalam AI in Arabic sentence learning by analyzing its handling of syntactic structures (*naḥw*), morphological patterns (*ṣarf*), and grammatical case assignment. Rather than projecting future applications, the study prioritizes identifying how Qalam AI processes Arabic grammatical structures and where systematic detection errors occur.

This study contributes to Arabic language education and Arabic Natural Language Processing (NLP) in three ways. First, it provides an empirical error-based analysis of automatic *ḥarakāt* detection across three grammatical cases (*al-asmāʾ al-marfūʿah*, *al-asmāʾ al-manṣūbah*, and *al-asmāʾ al-majrūrah*), offering a linguistically grounded assessment beyond surface-level accuracy evaluation. Second, it extends Computer-Assisted Language Learning (CALL) research by conceptualizing automatic diacritization as a multi-functional pedagogical scaffold that supports grammar awareness, sentence restructuring, vocabulary refinement, and punctuation use, rather than merely a reading aid. Third, the findings propose a pedagogically informed framework for integrating AI-based linguistic analysis into Arabic language classrooms, emphasizing the complementary roles of artificial intelligence and human linguistic judgment.

Accordingly, this study critically examines the linguistic performance of Qalam AI as an automatic *ḥarakāt* detection system by identifying recurrent grammatical error patterns and evaluating its pedagogical relevance through an analytical lens grounded in Computer-Assisted Language Learning (CALL) and Arabic Natural Language Processing (NLP).[23]

[23] Xie et al., "Trends and Development in Technology-Enhanced Adaptive/Personalized Learning: A Systematic Review of Journal Publications from 2007 to 2017"; Seo et al., "The Impact of Artificial Intelligence on Learner–Instructor Interaction in Online Learning."

To address the research objectives and questions, this study adopted an exploratory qualitative design. This design is appropriate for examining emerging phenomena and understanding how technological systems operate within specific educational contexts.[24] The study focused on exploring Qalam AI's potential in Arabic language education through systematic observation, expert evaluation, and classroom-oriented simulation.

Methodologically, the investigation comprised three interrelated components. First, expert review evaluation was conducted to assess Qalam AI's performance in detecting *ḥarakāt* (diacritical marks) in Arabic sentences through linguistically grounded analysis by Arabic language specialists. Second, a case study simulation examined the application of Qalam AI in classroom-related assessment scenarios, with particular attention to AI–human interaction dynamics. Third, participant engagement involved students analyzing Arabic text samples using Qalam AI, followed by educators evaluating the AI outputs for pedagogical validity and providing structured feedback.

Data collection proceeded in three stages. The first stage involved analyzing student text samples by providing Arabic sentences without *ḥarakāt*, processing them through Qalam AI, and identifying grammatical detection errors. The second stage consisted of expert evaluation through systematic comparison between Qalam AI's outputs and manual linguistic analysis, supplemented by interviews addressing the system's suitability for formative and summative assessment. The third stage involved classroom integration simulation, incorporating student feedback and response surveys regarding the system's instructional usefulness.

[24] Thomas W. Edgar and David O. Manz, "Exploratory Study," in *Research Methods for Cyber Security* (Elsevier, 2017), 95–130, https://doi.org/10.1016/B978-0-12-805349-2.00004-2.

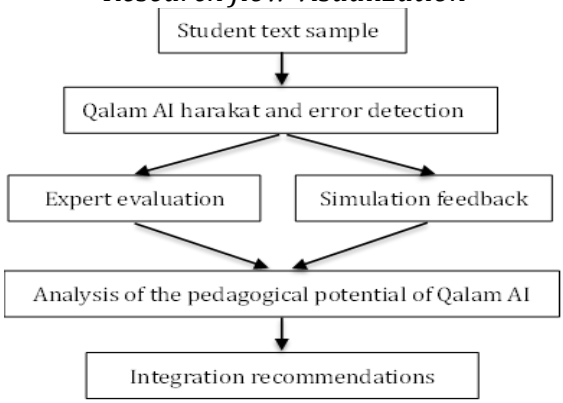
Expert validation was carried out by three Arabic language specialists with formal academic training in Arabic linguistics or Arabic language education, professional experience in teaching *naḥw* and *ṣarf* at the tertiary level, and prior engagement in Arabic text analysis or assessment practices. Their evaluation focused on grammatical case assignment (*iʿrāb*), morphological interpretation, and syntactic function by comparing AI-generated outputs with linguistically valid manual analysis.

The linguistic data analyzed in this study covered three grammatical categories: *al-asmāʾ al-marfūʿah* (nominative), *al-asmāʾ al-manṣūbah* (accusative), and *al-asmāʾ al-majrūrah* (genitive). Qualitative analysis was employed to identify and interpret emergent patterns within the dataset.[25] This analysis followed a structured interpretative procedure: (1) identifying accurate and inaccurate *ḥarakāt* assignment, (2) categorizing errors based on syntactic misidentification, morphological ambiguity, and contextual misinterpretation, (3) validating these categorizations through expert review, and (4) interpreting the findings in relation to their pedagogical implications for AI-assisted Arabic sentence learning.

A schematic representation of the research flow is presented in Figure 1. As illustrated, Arabic text samples were processed through Qalam AI for automatic *ḥarakāt* detection, after which the outputs were evaluated through expert comparison and simulation feedback. This comparative procedure enabled the identification of Qalam AI's pedagogical potential and informed evidence-based recommendations for its integration into Arabic language instruction.

[25] Helaluddin and Hengki Wijaya, *Analisis Data Kualitatif* (Makassar: Sekolah Tinggi Theologia Jaffray, 2019).

*Figure 1*
*Research flow visualization*




**Result**

In this study, the researcher explored the potential of *Qalam AI* in Arabic language learning, especially in mastering Arabic grammar, by providing Arabic text scripts covering three main topics, namely: 1) nouns in the nominative case (*raf*ʿ), 2) nouns in the accusative case (*naṣb*), and 3) nouns in the genitive case (*jar*). For each of these main topics, the researcher created 20 Arabic sentences to be analyzed or detected by *Qalam AI* as on Appendix.

***Result on Al-asmāʾ al-Marfūʿah***

After the researcher inputted the 20 sentences into the *Qalam AI* system, the researcher then instructed *Qalam AI* to analyze and provide *ḥarakat* (diacritical marks) for the entire sentences. The analysis and *ḥarakat* detection are one of the main features of *Qalam AI* that could be utilized to determine the *ḥarakat* of an Arabic sentence. The results of *Qalam AI*'s automatic *ḥarakat* analysis could be presented in the Figure 2.

*Figure 2*
*Results of Qalam AI's automatic ḥarakat detection on al-asmā' al-marfūʿah sentences*


Regarding the automatic *ḥarakat* detection in Figure 2 above, *Qalam AI* assigned a *fathah ḥarakat* at the end of the word in sentence number 2, "الدرسَ," as if the word was a *maf'ūl bih* (object). However, this word was actually the *nāib al-fāʿil* (agent) of the passive verb "قُرِئَ" (is read). Therefore, the word "الدرس" should has a *ḍammah ḥarakat* at the end, becoming "الدرسُ." This could actually be seen from the word "اللُّغَوِيُّ" which has a *ḍammah ḥarakat* at the end because it functions as a *naʿat* (adjective) modifying the word "الدرس." From this detection result, it could be concluded that *Qalam AI* detected one word with an inaccurate *ḥarakat* assignment. The results of Qalam AI's errors in word analysis are summarized in Table 1.

*Table 1*
*Summary of Qalam AI's detection errors*

| No | Error Analysis | Correct | Clarification |
|---|---|---|---|
| 1 | اَلدَّرْسَ | اَلدَّرْسُ | *nāib al-fāʿil (agent) of* قُرِئَ |

Besides detecting automatic *ḥarakat* in Arabic sentences, *Qalam AI* also identifies several words that require special attention in the form of corrections (*taṣḥīh*). The visual identification of these terms is presented in Figure 3.

*Figure 3*
*Qalam AI detection on the aspect of spelling rules (qawā'id al-imlā)*


According Figure 3 above, the words are marked with underlines and different colors. Each word with an underline and color has its own explanation according to the type of detection that requires correction. For example, the word "فى" (with an underline and a red highlight) when clicked will show a suggestion to "review the spelling error" and display the correct word to be used, which is "في." Therefore, *Qalam AI* can recommend the correct spelling rules (*qawā'id al-imlā*) that should be applied in an Arabic sentence.

Qalam AI also identifies common Arabic word structure formal. The visual identification of these terms is presented in Figure 4.

*Figure 4*
*Qalam AI detection on the aspect of sentence structure*


According to Figure 4 above, the example is the phrase "لجميع الطلاب" (with an underline and an orange highlight), which when clicked will display the suggestion: "*tawkīd*

*ma'nawī* is originally placed after the *muakkad* and connected with a pronoun referring to the *muakkad*," and the correct phrase to be used is "للطلاب جميعهم" or "للطلاب جميعها." Therefore, Qalam AI can recommend the "sentence structure" that should be used in an Arabic sentence. Meanwhile, Qalam AI's analysis can be summarized in the following table:

*Table 2*
*Summary of Qalam AI detection on al-asmā' al-marfū'ah*

| No | Word | Types of Analysis | Qalam AI's suggestions |
|---|---|---|---|
| 1 | فِى | الأخطاء الإملائية | review the spelling error |
| 2 | قُرِئَ | الأخطاء الإملائية | review the spelling error |
| 3 | لِجَمِيْعِ الطُّلَّابِ | الصياغة | لِلطُّلَّابِ جَمِيْعِهِمْ\ لِلطُّلَّابِ جَمِيْعِهَا |

However, Qalam AI's detection results occasionally require reevaluation, as previously explained.

***Result on Al-asmā' al-Manṣūbah***

In addition, the researcher also gave commands to determine the *ḥarakat* of Arabic sentences in the form of *al-asmā al-manṣūbah* (nouns in the accusative case). The results of *Qalam AI*'s automatic *ḥarakat* analysis could be presented in the Figure 5.

Regarding Figure 5, in sentence number 2, the word "يعلم" was detected with the *ḥarakat* "يَعْلَمُ" which means "to know." However, this word should be detected as "يُعَلِّمُ" which means "to teach." This could actually be inferred from the following word "تَعْلِيْمًا," which is a verbal noun (*ism al-maṣdar*) serving as the absolute object (*maf'ūl muṭlaq*) of the verb "يُعَلِّمُ".

*Figure 5*
*Results of qalam ai's automatic ḥarakat detection on al-asmā' al-manṣūbah sentences*


Similarly, in sentence number 4, *Qalam AI* detects the word "يعلم" with the *ḥarakat* "يَعْلَمُ" meaning "to know." It should instead be detected as "يُعَلِّمُ" meaning "to teach." This was understood from the presence of the word "اَلْمُدَرِّسُ" (meaning "teacher") and the word "اَلطَّالِبُ" (meaning "student"), which was preceded by "يَتَعَلَّمُ" (meaning "to learn"). The assumption was that the teacher teaches and the student learns. In addition, *Qalam AI* also detected the word "كلها" with a *ḍammah* diacritic on the word "كل", whereas the word should has been detected with a *fatḥah* diacritic on the letter lam (ل), functioning as the object of the word "يَتَعَلَّمُ" with the pronoun "ها" referring back to the word "اَلْمَوَادَّ".

Then, in sentence number 5, *Qalam AI* detects the *ḥarakat* of the word "اشترى" as "اِشْتَرِيْ," which means "buy it!" in the imperative form (*fi'il amr*). It should be detected as "اِشْتَرَى," the past tense verb (*fi'il māḍi*) meaning "bought."

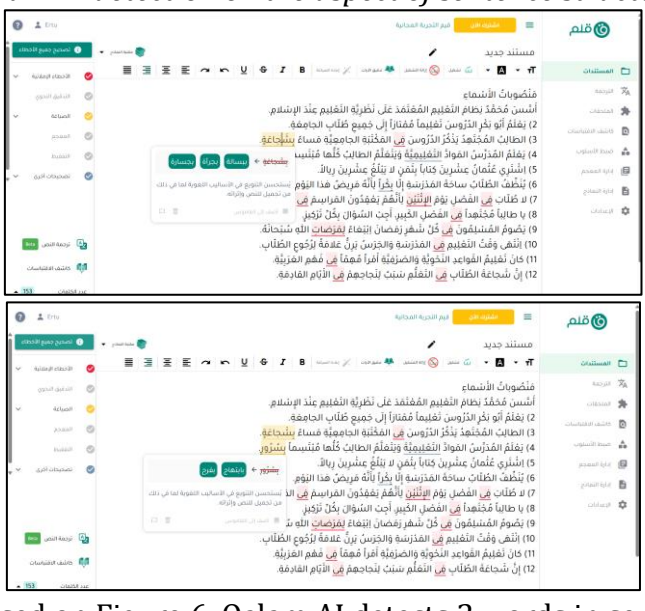
From these detection results, it appears that *Qalam AI* was unable to distinguish between words that are identical in letters but differ only in *ḥarakat*, such as "يَعْلَمُ" and "يُعَلِّمُ," which share the same letters but differ in diacritics, a distinction that was part of the study of *wazan* (morphological patterns) in the field of *ṣarf* (morphology). The results of Qalam AI's errors in word analysis are summarized in table 3.

*Table 3*
*Summary of Qalam AI's detection errors*

| No | Error Analysis | Correct | Clarification |
|---|---|---|---|
| 1 | يَعْلَمُ أَبُوْ بَكْرٍ | يُعَلِّمُ أَبُوْ بَكْرٍ | The word تَعْلِيْمًا is the verbal noun (*maṣdar*) of يُعَلِّمُ ('to teach') |
| 2 | يَعْلَمُ الْمُدَرِّسُ | يُعَلِّمُ الْمُدَرِّسُ | The assumption was that the teacher teaches and the student learns |
| 3 | اِشْتَرِى | اِشْتَرَى | past tense verb from عُثْمَانُ |

Besides detecting automatic *ḥarakat* in Arabic sentences, *Qalam AI* also detects several other words that require special attention in the form of corrections (*taṣhīh*). The visual identification of these terms is presented in Figure 6.

*Figure 6*
*Qalam AI detection on the aspect of sentence structure*



Based on Figure 6, Qalam AI detects 2 words in sentences number 3 and 4 that can be enhanced in form, such as the word "بشجاعة" which could be refined by using the words

"بسالة/جرأة/جسارة" and also the word "بسرور" which could be improved using the word patterns "ابتهاج/فرح". These word structure suggestions are intended to beautify and enrich the language, including vocabulary.

Therefore, Qalam AI can recommend the "punctuation" that should be used in an Arabic sentence. The visual detection of this word could be seen in the following Figure 7.

*Figure 7*
*Qalam AI detection on the aspect of punctuation*


Based on Figure 7, the word "التعليمية" (in sentence number 4 and "بكرا" (in sentence number 6) – with an underline and a purple highlight – when clicked, will display a suggestion to "add a comma (,) to separate parts of the sentence" and show the correct form to be used as "التعليمية،" and "بكرا،". Therefore, Qalam AI can recommend the "punctuation" that should be used in an Arabic sentence. Qalam AI's analysis can be summarized in the Table 4.

*Table 4*
*Summary of Qalam AI detection on al-asmā' al-manṣūbah*

| No | Word | Types of Analysis | Qalam AI's suggestions |
|---|---|---|---|
| 1 | في | الأخطاء الإملائية | review the spelling error |
| 2 | بشجاعة | الصياغة | بسالة\جرأة\جسارة |
| 3 | بسرور | الصياغة | ابتهاج\فرح |
| 4 | التعليمية | علامة الترقيم | التعليمية، |
| 5 | بكرا | علامة الترقيم | بكرا، |

### *Result on al-Asmāʾ al-Majrūrāh*

In addition, the researcher also gave commands to determine the *ḥarakat* of Arabic sentences in the form of *al-asmāʾ al-majrūrah* (nouns in the genitive case). The results of *Qalam AI*'s automatic *ḥarakat* analysis could be presented in the following Figure 8.

*Figure 8*
*Results of Qalam AI's automatic ḥarakat detection on al-asmāʾ al-majrūrah sentences*


Based on figure 8, besides providing automatic *ḥarakat* detection results, *Qalam AI* also detects two words that require further review, namely the words "فى" (with an underline and red highlight) and "المدرسة" (with an underline and purple highlight). These two words involve review of spelling rules (*qawāʿid al-imlā*) and punctuation, consistent with findings in previous words. Meanwhile, Qalam AI's analysis can be summarized in the Table 5.

*Table 5*
*Analysis summary of Qalam AI detection on al-asmāʾ al-majrūrah*

| No | Word | Types of Analysis | Qalam AI's suggestions |
|---|---|---|---|
| 1 | في | الأخطاء الإملائية | review the spelling error |
| 2 | المدرسة | علامة الترقيم | المدرسة، |

## Discussion

Building on the error patterns summarized in Tables 2 and 3, the findings of this study indicate that Qalam AI is capable of performing automatic *ḥarakāt* detection across Arabic sentences representing different grammatical cases, while also exhibiting systematic limitations in specific linguistic contexts. Rather than demonstrating uniform accuracy, the results reveal patterned successes and recurrent errors, particularly in cases involving morphological ambiguity and syntactic role differentiation. Similar tendencies have been reported in previous studies on Arabic diacritization systems, which highlight the difficulty of sentence-level grammatical interpretation in morphologically rich languages.[26]

From a Computer-Assisted Language Learning (CALL) perspective, these findings suggest that Qalam AI functions not merely as an automated correction tool, but as a mediating artifact that externalizes linguistic form for learner attention. CALL research has emphasized that form-focused feedback can promote grammatical noticing and metalinguistic awareness when learners are encouraged to reflect on deviations rather than passively receive correct forms.[27] This mediating role is

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[26] Abdulmohsen Al-Thubaity et al., "Arabic Diacritization Using Bidirectional Long Short-Term Memory Neural Networks With Conditional Random Fields," *IEEE Access* 8 (2020): 154984–96, https://doi.org/10.1109/ACCESS.2020.3018885; Aya S. Metwally, Mohsen A. Rashwan, and Amir F. Atiya, "A Multi-Layered Approach for Arabic Text Diacritization," in *2016 IEEE International Conference on Cloud Computing and Big Data Analysis (ICCCBDA)* (IEEE, 2016), 389–93, https://doi.org/10.1109/ICCCBDA.2016.7529589; Rehab Duwairi and Ftoon Abushaqra, "Syntactic- and Morphology-Based Text Augmentation Framework for Arabic Sentiment Analysis," *PeerJ Computer Science* 7 (2021): e469, https://doi.org/10.7717/peerj-cs.469.

[27] Jianwu Gao and Shuang Ma, "Instructor Feedback on Free Writing and Automated Corrective Feedback in Drills: Intensity and Efficacy," *Language Teaching Research* 26, no. 5 (2022): 986–1009, https://doi.org/10.1177/1362168820915337; Jessie S. Barrot, "Using Automated Written Corrective Feedback in the Writing Classrooms: Effects on L2 Writing Accuracy," *Computer Assisted Language Learning* 36,

reflected in the system's ability to highlight orthographic inconsistencies and grammatical deviations, thereby potentially supporting learners' engagement with Arabic sentence-level grammar within guided instructional contexts.

Viewed through the lens of Arabic Natural Language Processing, the error patterns identified in this study align with broader computational challenges in processing Arabic morphology and syntax. In particular, limitations in morphological disambiguation are evident in cases reported in Table 3, where Qalam AI failed to distinguish between verb forms sharing identical consonantal structures but differing in diacritics, such as يَعْلَمُ (*yaʿlamu*) and يُعَلِّمُ (*yuʿallimu*). This pattern reflects well-documented challenges in Arabic NLP related to *ṣarf*-based ambiguity and contextual interpretation, especially when sentence-level cues are insufficient for reliable disambiguation.[28]

At the sentence-structure level, the system's detection outputs further illustrate its pedagogical affordances. As summarized in Table 2, Qalam AI proposed alternative syntactic constructions such as reformulating لِجَمِيْعِ الطُّلَّابِ as لِلطُّلَّابِ جَمِيْعِهِمْ. Rather than altering semantic meaning, such suggestions reflect commonly attested Arabic syntactic patterns and may support learners' awareness of acceptable structural variation. Research on AI-supported grammar and writing feedback suggests that exposure to alternative syntactic formulations can facilitate syntactic flexibility and

no. 4 (2023): 584–607, https://doi.org/10.1080/09588221.2021.1936071.

[28] Marwah Alian, Arafat Awajan, and Akram Al-Kouz, "Arabic Word Sense Disambiguation - Survey," in *2017 International Conference on New Trends in Computing Sciences (ICTCS)* (IEEE, 2017), 236–40, https://doi.org/10.1109/ICTCS.2017.23; Ilhem Boulesnam and Rabah Boucetti, "Arabic Language Characteristics That Make Its Automatic Processing Challenging," *The International Arab Journal of Information Technology* 22, no. 4 (2025): 814–31, https://doi.org/10.34028/iajit/22/4/14.

revision skills, provided that such feedback is pedagogically mediated and not mechanically adopted.[29]

Beyond diacritization and syntactic reformulation, the system also generated detections related to orthographic conventions and punctuation use, as reflected in Tables 4 and 5. Although these features represent secondary aspects of the analysis, they may contribute to learners' broader textual awareness by drawing attention to spelling conventions (*imlāʾ*) and clause-level organization. From a pedagogical standpoint, such feedback may function as a trigger for learner reflection on textual cohesion and sentence organization, rather than as definitive correction.

Nevertheless, these pedagogical potentials should be interpreted with caution. Consistent with prior CALL research, the findings do not suggest that AI-based systems can function as autonomous evaluators of linguistic competence.[30] Instead, they reinforce the importance of integrating AI-generated feedback with human linguistic judgment and instructional mediation. Previous studies similarly indicate that Arabic diacritics and AI-based automatic *tashkīl* can facilitate reading accuracy and comprehension;[31] however, learners are

[29] Thi Thanh Thao Tran, "Enhancing EFL Writing Revision Practices: The Impact of AI- and Teacher-Generated Feedback and Their Sequences," *Education Sciences* 15, no. 2 (2025): 232, https://doi.org/10.3390/educsci15020232; Mohamed Mekheimer, "Generative AI-Assisted Feedback and EFL Writing: A Study on Proficiency, Revision Frequency and Writing Quality," *Discover Education* 4, no. 1 (2025): 170, https://doi.org/10.1007/s44217-025-00602-7; Yang Yang, Supyan Hussin, and Harwati Hashim, "Revising with Intelligence: ChatGPT Feedback and Its Impact on EFL Students' Revision and Self-Efficacy," *Forum for Linguistic Studies* 7, no. 7 (2025): 352–67, https://doi.org/10.30564/fls.v7i7.9845.

[30] Watcharapol Wiboolyasarin et al., "AI-Driven Chatbots in Second Language Education: A Systematic Review of Their Efficacy and Pedagogical Implications," *Ampersand* 14 (2025): 100224, https://doi.org/10.1016/j.amper.2025.100224.

[31] Ali Al Midhwah and Mohammad T. Alhawary, "Arabic Diacritics and Their Role in Facilitating Reading Speed, Accuracy, and Comprehension

expected to engage critically with the output, and the role of teachers as learning facilitators remains essential rather than being replaced by automated systems.[32]

Taken together, the discussion suggests that Qalam AI's contribution to Arabic language learning lies not in error-free automation, but in its capacity to surface linguistic features that prompt learner reflection and pedagogical intervention. By making grammatical patterns, ambiguities, and deviations visible at the sentence level, the system may support both learners and instructors in engaging more critically with Arabic syntax and morphology. This perspective aligns with recent calls in CALL and Arabic NLP research to evaluate AI tools not solely on technical performance, but on their instructional value and linguistic transparency.[33]

## Conclusion

This study has examined the linguistic performance and pedagogical relevance of Qalam AI as an automatic *ḥarakāt* detection system in Arabic sentence learning. Drawing on an exploratory qualitative analysis, the findings indicate that Qalam AI is capable of identifying various linguistic features at

by English L2 Learners of Arabic," *The Modern Language Journal* 104, no. 2 (2020): 418–38, https://doi.org/10.1111/modl.12642.

[32] Chakam Failasuf et al., "Analysis of the Use of Artificial Intelligence-Based Applications in Arabic Text Automatic Diacritization," in *Proceedings of the International Conference on Environmental Learning Educational Technologies (ICELET 2023)* (Atlantis Press, 2024), 129–39, https://doi.org/10.2991/978-2-38476-240-8_12.

[33] Angxuan Chen et al., "A Systematic Review and Meta-Analysis of AI-Enabled Assessment in Language Learning: Design, Implementation, and Effectiveness," *Journal of Computer Assisted Learning* 41, no. 1 (2024): e13064, https://doi.org/10.1111/jcal.13064; Roxana Rebolledo Font de la Vall and Fabián González Araya, "Exploring the Benefits and Challenges of AI-Language Learning Tools," *International Journal of Social Sciences and Humanities Invention* 10, no. 1 (2023): 7569–76, https://doi.org/10.18535/ijsshi/v10i01.02; Shamini Shetye, "An Evaluation of Khanmigo, a Generative AI Tool, as a Computer-Assisted Language Learning App," *Studies in Applied Linguistics and TESOL* 24, no. 1 (2024): 38–53, https://doi.org/10.52214/salt.v24i1.12869.

the sentence level, including grammatical case assignment, orthographic inconsistencies, sentence-structure variation, and punctuation-related issues. At the same time, the analysis reveals systematic limitations, particularly in contexts involving morphological ambiguity and syntactic role differentiation.

Taken together, these findings suggest that Qalam AI's primary contribution lies not in error-free automation, but in its capacity to externalize linguistic features that support learner noticing and instructional mediation. When viewed through the lenses of Computer-Assisted Language Learning and Arabic Natural Language Processing, the system may function as a supportive pedagogical tool that complements, rather than replaces, human linguistic judgment in Arabic language instruction.

As an exploratory study, this research does not aim to generalize system performance or quantify accuracy statistically. Future research may build on these findings by examining Qalam AI's performance using larger datasets, incorporating quantitative evaluation measures, or investigating its effectiveness within different instructional settings and learner proficiency levels. Further studies may also explore how AI-assisted diacritization tools can be integrated more systematically into form-focused Arabic language pedagogy.

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*Appendix A: 20 Arabic sentences analyzed by Qalam AI*

**الأسماء المرفوعة**

١. يقرأ الطالب المجتهد الكتاب الجديد فى المكتبة الكبيرة بكل تركيز.
٢. قرئ الدرس اللغوي فى الفصل الكبير من قبل الطلاب المجتهدين.
٣. الكتاب الجديد فى المكتبة المدرسية مفيد جدا لجميع الطلاب.
٤. المعلم الماهر فى هذه المدرسة ذو خبرة واسعة فى التدريس.
٥. كان الطالب المجتهد فى الصف الكبير متفوقا فى درس اللغة.
٦. إن اللغة العربية لغة يتكلم بها المسلمون وغير المسلمين جيدا.

**الأسماء المنصوبة**

١. أسس محمد نظام التعليم المعتمد على نظرية التعليم عند الإسلام.
٢. يعلم أبو بكر الدروس تعليما ممتازا إلى جميع طلاب الجامعة.
٣. الطالب المجتهد يذكر الدروس فى المكتبة الجامعية مساء بشجاعة.
٤. يعلم المدرس المواد التعليمية ويتعلم الطالب كلها مبتسما بسرور.
٥. اشتري عثمان عشرين كتابا بثمن لا يبلغ عشرين ريالا.
٦. ينظف الطلاب ساحة المدرسة إلا بكرا لأنه مريض هذا اليوم.
٧. لا طلاب فى الفصل يوم الإثنين لأنهم يعقدون المراسم فى الملعب.
٨. يا طالبا مجتهدا فى الفصل الكبير، أجب السؤال بكل تركيز.
٩. يصوم المسلمون فى كل شهر رمضان ابتغاء لمرضات الله سبحانه.
١٠. انتهى وقت التعليم فى المدرسة والجرس يرن علامة لرجوع الطلاب.
١١. كان تعليم القواعد النحوية والصرفية أمرا مهما فى فهم العربية.
١٢. إن شجاعة الطلاب فى التعلم سبب لنجاحهم فى الأيام القادمة.

**الأسماء المجرورة**

١. يتعلم الناس العلوم الدينية فى المعاهد الإسلامية كل يوم وليلة.
٢. يرى بعض الطلاب مناظر المدرسة وهم يتلون الكتاب بأحسن التلاوة.