



Digital Scaffolding and Linguistic Features in Arabic MALL Application: A Socio-Cultural Comparative Evaluation

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ARTICLE INFO

Article History:

Submitted/Received 02 Jun 2026

First Revised 30 Aug 2026

Accepted 12 Oct 2026

Publication Date 17 Oct 2026

Keywords:

Arabic language learning

Digital scaffolding

Linguistic features

MALL

Socio-Cultural theory

ABSTRACT

The use of Arabic language learning applications is rapidly increasing, yet the quality and depth of the linguistic features they offer remain understudied. This study presents a comparative evaluation of the linguistic content embedded in three widely used Arabic learning applications: Nemo Arabic, Drops Arabic, and Mondly Arabic – viewed through the lens of Socio-Cultural Theory (SCT). Employing a qualitative descriptive digital content analysis (application audit) supported by a literature review, this research examines six core linguistic dimensions: writing system, phonology, morphology, lexicon, syntax, and pragmatics. Findings show that each application offers distinct forms of digital scaffolding, ranging from static and multimodal to dynamic, supporting learners' progress within the zone of Proximal Development (ZPD) in different ways. Drops excels in visual mediation for early literacy, Nemo strengthens lexical and phonological retention through repetition, while Mondly provides the richest social scaffolding via dialogue simulation and voice recognition. However, none of the three applications achieves comprehensive integration across all linguistic aspects, particularly morphology and pragmatic context. These findings highlight the fragmented nature of current digital Arabic learning tools and point to the need for more holistic, theory-informed app design. The study offers practical implications for developers and educators seeking linguistically robust and pedagogically sound Arabic learning applications.

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1. INTRODUCTION

Advances in digital technology have fundamentally changed language learning, and Mobile-Assisted Language Learning (MALL) has emerged as a dominant approach to foreign language acquisition. Mobile and e-learning platforms can enhance linguistic comprehension, motivation, and academic achievement while giving learners access to materials without spatial or temporal limitations (Auliya et al., 2025; Hady et al., 2025). More recent research has moved beyond simply providing access toward interactive, adaptive, and learner-centered environments that accommodate learners' behavioral, contextual, emotional, and performance characteristics, thereby strengthening accessibility, engagement, and learning performance (El Fezazi et al., 2025). The same trend is visible in the Arabic learning market, where platforms such as Drops, Mondly Arabic, and Nemo Arabic offer diverse methodological approaches and features (Haq et al., 2024). However, this rapid growth has not been matched by the optimal application of pedagogical principles. An application's effectiveness depends not only on its technological sophistication but also on the extent to which its features support users' linguistic needs and learning processes (Gimeno-Sanz et al., 2024). This concern is particularly acute for Arabic, whose linguistic characteristics pose unique challenges for designing effective learning applications and underscore the need for tools that combine interactivity with sustained learner motivation (Firdaus & Aziz, 2024; Seyidov, 2024).

Arabic has distinctive linguistic characteristics that differentiate it from many European languages. These characteristics include a right-to-left writing system, a morphology largely based on trilateral root patterns, complex systems of grammatical inflection, and diglossia between *fushā* and *‘āmmiyyah* (Saiegh-Haddad et al., 2023). Such linguistic complexity requires pedagogical approaches that are specifically adapted to the nature of Arabic, particularly when the language is delivered through digital learning media. In this context, the complexity of phonological, morphological, syntactic, and pragmatic aspects demands a learning design that is not merely oriented toward vocabulary presentation or simple exercises but is also capable of facilitating structured and contextual language comprehension (Issa, 2023; Owens & Embarki, 2023). Although previous studies have examined the effectiveness of mobile applications in improving general Arabic language skills, research investigating how core linguistic features—such as the writing system, phonology, morphology, lexicon, syntax, and pragmatics—are systematically represented and implemented within these applications remains limited. Recent analytical evidence further indicates that existing Arabic language learning applications have attempted to provide structured materials, including *naḥw*, *i’rāb*, and features supporting letter writing and pronunciation (Ab.Rahim et al., 2024; Bousnane, 2025). Nevertheless, their implementation continues to face several technical and quality-related limitations, including intrusive and complex advertisements, insufficient coverage of specialized learning materials, limited supporting multimedia resources such as videos, and inadequate reference documentation. These limitations highlight the importance of critically evaluating Arabic language learning applications not only in terms of their technological features and pedagogical attractiveness but also in terms of their capacity to accommodate the distinctive linguistic complexity of the Arabic language.

This study adopts a layered theoretical framework in which two bodies of theory play distinct and complementary roles. Vygotsky's (1978) Socio-Cultural theory (SCT) is the primary analytical lens, whereas Computer-Assisted Language Learning (CALL) and second language acquisition (SLA) theory serve as supporting conceptual background (Idrissi et al., 2024). The SLA component, namely Krashen's (1982, 1985) Input Hypothesis and Schmidt's (1990) Noticing Hypothesis, specifies what the linguistic content of an application should offer: comprehensible input that aligns with the phonological and morphosyntactic structures of Arabic, and features that draw attention to form and help users develop metalinguistic awareness related to writing systems, pronunciation, and grammar (Alisoy & Sadiqzade, 2024). SCT, in turn, determines how this content is interpreted: through the concepts of mediation, scaffolding (Wood et al., 1976), and the Zone of Proximal Development (ZPD), each application is treated as a digital mediating tool whose feedback, language modeling, and gradual activities support linguistic development (Zakiyah & Mulyani, 2024). SLA theory therefore informs the content dimension of the evaluation (the six linguistic dimensions examined), while SCT informs the interpretation of the mediation provided across those dimensions; the two frameworks are integrated rather than applied as competing lenses.

Within the context of Arabic language learning, however, research on interactive and learner-centered mobile environments remains fragmented and lacks a comprehensive approach. Some studies have examined the effectiveness of digital applications in supporting language learning, while others have focused on specific linguistic domains or learners' perceptions (Elsayed Ahmed et al., 2023; Hidayat et al., 2024). For example, Hidayat et al. (2024) demonstrated the potential of digital platforms to facilitate the learning of Arabic morphology through the visualization of morphological concepts and reported an increase in learner engagement. Nevertheless, such research still focuses on specific linguistic components or user responses, rather than evaluating the overall quality and representation of Arabic linguistic features in mobile learning apps.

This limitation indicates an important research gap concerning the systematic evaluation of how Arabic linguistic characteristics are represented and implemented across digital learning applications. Existing studies tend to emphasize general effectiveness, motivation, engagement, or individual linguistic components, leaving less attention to the interconnected representation of writing-system, phonological, morphological, lexical, syntactic, and pragmatic features within the applications themselves. Consequently, it remains unclear to what extent popular Arabic language learning applications accommodate the structural and functional complexity of Arabic through their learning content, activities, and interactive features. Addressing this gap requires an evaluative approach that examines Arabic learning applications not only from the perspective of technological functionality and learner engagement but also from their linguistic adequacy and pedagogical alignment.

This study therefore aims to conduct a systematic comparative evaluation of three popular Arabic learning applications (Nemo Arabic, Drops Arabic, and Mondly Arabic) across six linguistic dimensions, namely the writing system, phonology, morphology, lexicon, syntax, and pragmatics, and to interpret the digital scaffolding each application provides through the lens of SCT, while identifying the strengths and weaknesses of the available linguistic features. Existing frameworks for

evaluating language learning applications, such as Chapelle's (2001) criteria for CALL tasks, Reinders and Pegrum's (2016) learning-design framework for mobile language learning resources, and Rosell-Aguilar's (2017) taxonomy and four-category framework (technology, pedagogy, user experience, and language learning), are designed for language learning in general, so linguistic coverage appears in them as a single, language-neutral criterion. To our knowledge, none of them maps the representation of one language's linguistic system dimension by dimension or interprets the resulting support through Socio-Cultural mediation. The novelty of this research therefore lies in an analytical framework that combines a six-dimension, Arabic-specific linguistic matrix (what is represented) with SCT-based categories of mediation and scaffolding (how it is supported), thereby integrating Arabic linguistic theory, MALL principles, and a socio-cultural perspective. The study's contributions include providing a foundation for further research on application effectiveness, developing quality standards for linguistic features, and offering practical guidance for educators in selecting applications that align with contemporary Arabic language learning needs.

2. METHODS

This study employs a qualitative-descriptive design based on digital artifact content analysis (an application audit), supported by a literature review, to examine linguistic features and pedagogical values in Mobile-Assisted Language Learning (MALL) applications. The primary data are the features and user interfaces of the applications themselves, which were audited directly, while the literature review provides the theoretical and comparative grounding for interpreting them. This approach was chosen to facilitate an in-depth, interpretative analysis of application features based on established literature and digital artifacts, without involving human user trials.

Research Design

An evaluative-comparative design was employed to systematically assess and contrast the internal linguistic features of multiple Arabic language learning applications. The conceptual framework integrates Vygotsky's Socio-Cultural Theory as the primary analytical lens. Within the framework, the applications are treated as digital mediating tools that provide digital scaffolding to support learners within the Zone of Proximal Development (ZPD). The study maps how digital representations- such as pronunciation models, audio synthesis, and structural visualization- facilitate the internalization of language concepts.

Research Objects and Sampling Criteria

Unlike field studies involving human participants, this study analyzes digital learning media. Arabic learning apps on the Google Play Store were selected via purposive sampling based on literature-supported criteria: (a) average rating of at least 3+; (b) at least 100,000+ downloads; (c) structured Modern Standard Arabic (Fusha) courses for non-native learners (excluding apps with only dialects or phrasebooks); (d) at least one update within 6 months prior to data collection; and (e) a free plan or trial sufficient to evaluate beginner- to intermediate-level content. Based on these criteria, three apps were selected for evaluation: Nemo, Drops Arabic, and Mondly Arabic.

Application Specifications and Testing Protocol

To ensure replicability, the audit followed a documented testing protocol. The applications were installed and tested on smartphones running Android. The versions audited were Nemo Arabic

(1.7.1), Drops (39.18), and Mondly (10.39.5). Data were collected between April and July. All three apps were accessed using their free versions; therefore, these findings reflect the content available at that access level, while content restricted to other subscription tiers is outside the scope of this analysis.

Data Sources and Instruments

Data were collected from secondary sources and digital documentation, including (a) peer-reviewed scholarly articles and research reports on MALL, Arabic linguistics, and Socio-Cultural pedagogy, and (b) direct observation of the selected applications, documented through screen captures of representative features, together with their official digital documentation, interface specifications, and system features. The primary instrument used for measurement and analysis was a standardized structural matrix based on six core linguistic domains: writing system, phonology, morphology, lexicon, syntax, and pragmatics.

Procedure

The research procedure was conducted systematically without direct human intervention, focusing solely on content and feature auditing. The research procedure was conducted systematically without direct human intervention, focusing solely on content and feature auditing. The audit covered only beginner-level content, limited to one free level per day; content outside this scope was not examined, and these findings should be interpreted with this in mind. The operational steps were as follows: (a) *Feature Mapping* – extracting and documenting the visual, audio, and interactive components of each application; (b) *Pedagogical Alignment* – identifying how each feature functions as a form of scaffolding within the SCT framework; and (c) *Matrix Coding and Verification* – recording the findings for each application in the six-dimension matrix and checking the coding as described under Data Analysis.

Data Analysis

Data were processed using library-based content analysis techniques following the systematic framework of data reduction, data categorization, and data interpretation (Adlini et al., 2022), which corresponds to the data condensation, data display, and conclusion-drawing and verification stages described by Miles et al. (2014). The coding of application features into the six-dimension matrix followed the logic of systematic, replicable content analysis (Krippendorff, 2018). To limit subjectivity in completing the evaluation matrix, the first and second authors independently coded the features of each application. Differences in coding were resolved through discussion until consensus was reached, and the completed matrix was then reviewed by the supervisor (third author) to verify the accuracy of the linguistic categorization. The analysis proceeded in two phases: (a) *Comparative Phase* — each linguistic and pedagogical finding was cross-examined across Nemo, Drops, and Mondly; and (b) *Evaluative Phase* — the comparative data were interpreted through Vygotsky's scaffolding concept to assess the degree of gradual support, tiered input, and guided digital mediation each application provides to help learners access Arabic linguistic structures.

3. RESULTS AND DISCUSSION

3.1 Result

Comparative Summary

To systematically evaluate how mobile applications facilitate Arabic language acquisition, the functional designs of Nemo Arabic, Drops Arabic, and Mondly Arabic were analyzed through a Vygotskian Socio-Cultural framework. Table 1 presents a comparative summary of the linguistic features, scaffolding mechanisms, and socio-cultural dimensions embedded within the three applications.

Table 1. *Comparative Data of Arabic Language Application*

Analysis Aspect	Nemo Arabic	Drops Arabic	Mondly Arabic
Mediational Tools	Native speaker audio, vocabulary list, repetition.	Iconic Visuals, Animation, Arabic letters, mini-games.	Interactive dialogue, chatbot, speech recognition.
Types of scaffolding	Static scaffolding: gradual vocabulary reinforcement through repetition.	Multimodal scaffolding: visualization of letters and meaning	Dynamic scaffolding: adaptive support based on user responses.
Competency Focus	Phonology & Basic Vocabulary	Early literacy (letters, symbols), vocabulary.	Communicative skills (speaking, dialogue)
ZPD Alignment	Helping beginners build a linguistic foundation	Bridging the Initial Phase of Reading–Recognizing Symbols	Guiding users toward communication practices that emulate social interactions
Social Interaction	Minimal; more individual	Minimal; focus on visual representation	High; a simulated dialogue resembling a human tutor
Advantages in the Socio-Cultural Framework	Strengthening the internalization of vocabulary through stable mediation tools.	Reducing the initial cognitive load through visual scaffolding.	Providing social mediation that is closest to real interaction.
Limitations within the Socio-Cultural Framework	Lacks social context; does not facilitate interaction.	Not actively practicing language production.	Requires a device with microphone functionality and accurate system response.

Source: the author's research 2026

As illustrated in Table 1, each application operates at a distinct stage of the Socio-Cultural continuum by offering specialized mediational tools tailored to specific learner needs. Nemo Arabic emphasizes lower-level cognitive internalization through static repetition, making it suitable for establishing basic phonological foundations. Drops Arabic leverages multimodal visual scaffolding to reduce cognitive load during the initial symbol-recognition phase. In contrast, Mondly Arabic integrates dynamic scaffolding and speech recognition technology, offering interactive social mediation that simulates real-world communication. While Nemo and Drops remain limited in

facilitating active oral production, Mondly depends heavily on reliable hardware infrastructure. To provide direct empirical evidence supporting the comparative claims summarized in Table 1, screen captures illustrating a representative scaffolding feature of each application are presented in Figures 1–3.

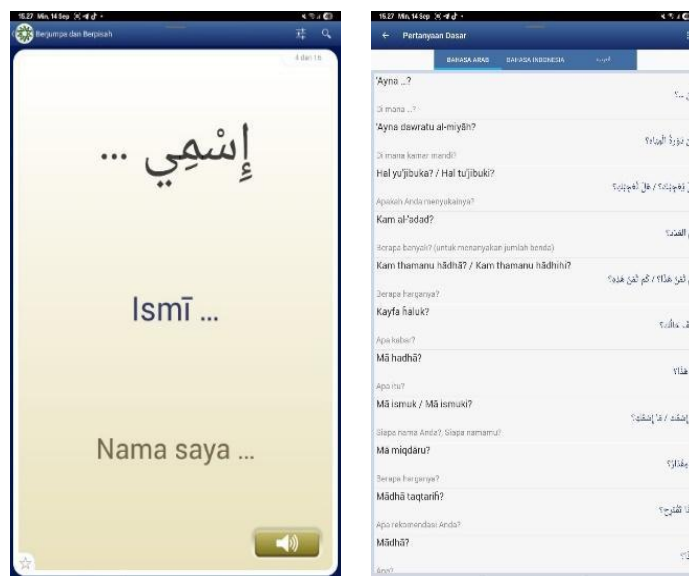


Figure 1. *Nemo Arabic flashcard interface combining Arabic script, Latin transliteration, and an audio-playback button, illustrating static scaffolding through vocabulary repetition and native-speaker pronunciation (e.g., “Ismī...” / “My name is...”).*

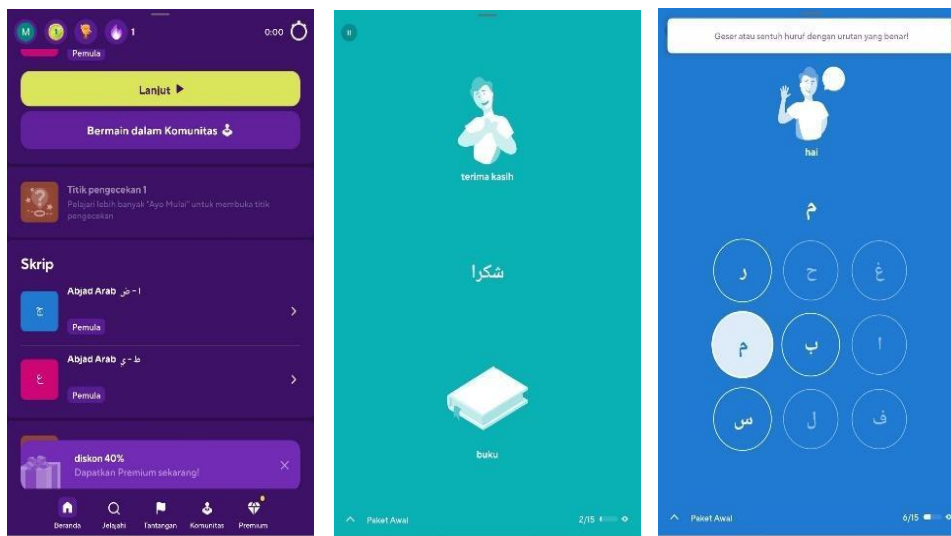


Figure 2. *Drops Arabic “Abjad Arab” (Arabic Alphabet) lesson menu, illustrating structured, visually mediated exposure to individual letters as scaffolding for early script recognition.*

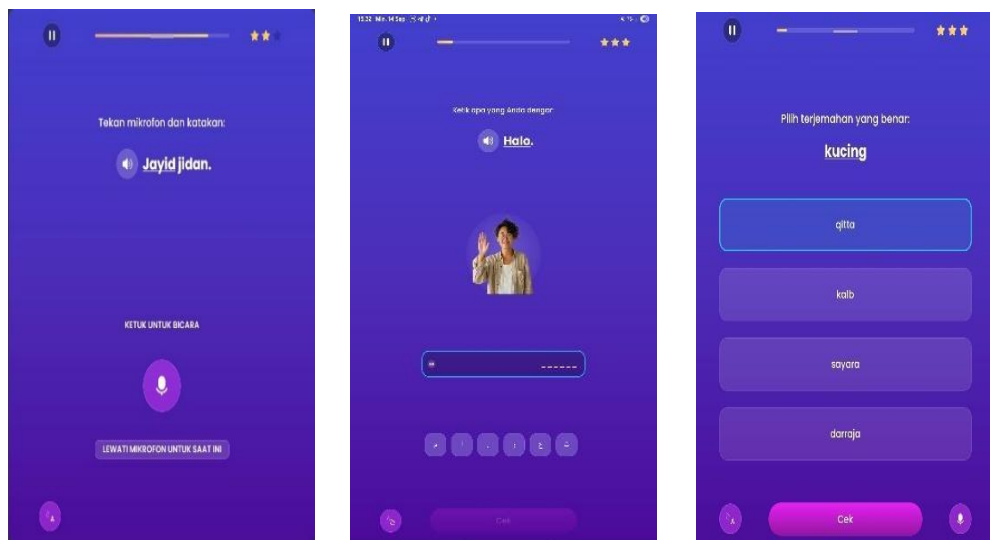


Figure 3. *Mondly Arabic speech-recognition exercise prompting the learner to pronounce the phrase “Jayid jiddan” (Very good) via microphone input, illustrating dynamic, dialogic scaffolding aligned with the Zone of Proximal Development.*

From the perspective of Socio-Cultural Theory (SCT), the three applications demonstrate significant variations in how they provide mediated learning and scaffolding to language learners. Nemo Arabic functions as a basic mediation tool that offers static scaffolding in the form of repeated vocabulary and native speaker audio, thereby aiding the internalization of language forms and sounds at the early stages of acquisition. Drops Arabic provides multimodal scaffolding through the visualization of hijaiyyah letters and animations, which facilitates the gradual construction of meaning for beginner learners, in line with the SCT principle that cultural tools can reduce cognitive load (see Figure 2).

Meanwhile, Mondly Arabic provides dynamic scaffolding that closely approximates social interaction through role-based dialogues, simulated conversations, and speech recognition technology (see Figure 3). This feature allows learners to practice within their Zone of Proximal Development (ZPD), where the application acts as a dialogue partner, offering support as needed. From an SCT perspective, Mondly offers the most complex and social form of mediation. In contrast, Nemo and Drops serve as initial scaffolding that helps build the linguistic foundation before learners advance to more communicative language use.

Linguistic Dimension Summary

To capture the pedagogical affordances and structural coverage of each platform, the features of Nemo Arabic, Drops Arabic, and Mondly Arabic were systematically evaluated across six core linguistic dimensions: writing system, phonology, morphology, lexicon, syntax, and pragmatics. Rather than relying on a quantitative rubric, the depth of coverage was qualitatively coded into four distinct categories—Absent, Limited, Moderate, and Strong—based on the authors’ comprehensive audit of the applications’ instructional content. Table 2 summarizes the presence, structural variation, and qualitative depth of these six linguistic dimensions across the three mobile applications.

Table 2. *Presence, Variation, and Depth of Linguistic Features in The Three Applications*

Linguistic Dimension	Nemo Arabic	Drops Arabic	Mondly Arabic
Writing system	Absent: no explicit alphabet instruction; vocabulary is introduced directly.	Strong: structured exercises on letter recognition, connected forms, and vowel marks (harakāt) through strong visual mediation.	Limited: written Arabic is embedded in simple sentences, without explicit scaffolding for script-level mastery.
Phonology	Moderate: authentic audio recordings, but no feedback on learner output.	Limited: basic sound examples only; minimal scaffolding for productive pronunciation.	Strong: speech recognition and automated feedback that simulate dialogic interaction.
Morphology	Absent: no structured exposure to the root-and-pattern (jidzr-wazn) system.	Absent: no structured exposure to the root-and-pattern (jidzr-wazn) system.	Absent: no structured exposure to the root-and-pattern (jidzr-wazn) system.
Lexicon	Strong: extensive thematic vocabulary organized semantically; supports independent learning but lacks socially situated contexts.	Moderate: visually grounded lexical items for beginners; perceptual rather than socio-communicative scaffolds.	Moderate: vocabulary situated within conversational exchanges, providing social mediation.
Syntax	Limited: isolated words or short phrases.	Limited: isolated words or short phrases.	Strong: full sentences and structurally accurate patterns presented through guided exposure.
Pragmatics	Absent: vocabulary presented apart from authentic communicative settings.	Absent: vocabulary presented apart from authentic communicative settings.	Moderate: situational dialogues reflecting formal and informal registers; the conventions behind register choice (e.g., politeness) are not made explicit.

Source: the author's research 2026

Taken together, Table 2 shows where the applications succeed and where they fall short. The areas they facilitate most successfully are early literacy (script recognition in Drops Arabic), vocabulary retention (thematic, repetition-based word lists in Nemo Arabic), and, in Mondly Arabic, pronunciation practice and sentence-level exposure through dialogue. By contrast, the triliteral (tsulathi) root-and-pattern morphology of Arabic is not addressed by any of the three applications; syntax beyond isolated words and short phrases is covered only by Mondly Arabic, and pragmatic competence, including the sociolinguistic conventions of politeness and register choice, appears only in Mondly Arabic's situational dialogues and is absent from Nemo Arabic and Drops Arabic.

3.2 Discussion

General Overview of the Applications

When considered as a whole, the patterns summarised in Tables 1 and 2 and illustrated in Figures 1–3 indicate that the three applications occupy different positions along a continuum of mediation, ranging from individual and static forms of support to interactive, socially situated ones. Rather than reflecting simple differences in features, these positions correspond to distinct pedagogical philosophies embedded in each platform's design. It is evident that *Nemo Arabic* privileges repeated individual exposure as its primary mediational strategy; *Drops Arabic* privileges perceptual, visually grounded mediation suited to early-stage learners; and *Mondly Arabic* privileges socially oriented mediation that approximates authentic communicative exchange. This distinction aligns with Vygotsky's proposition that scaffolding is not a fixed construct but varies according to the cultural tools and forms of guided participation available to the learner (Firmansyah et al., 2022; Newman & Latifi, 2021). Viewed cumulatively, the three applications demonstrate a wider range of mediation, spanning from technical and individual assistance to more social and dialogic forms. This distinction becomes especially relevant when examined across the six specific linguistic dimensions that will be discussed subsequently.

A further implication concerns how these features operate when no human tutor is present. In Vygotskian terms, the more knowledgeable other is replaced by a designed sequence of models, prompts, and feedback, so that learners move through the ZPD by means of the application's own mediational tools (Newman & Latifi, 2021). *Nemo Arabic*'s native-speaker audio and repetition cycles act as fixed models that learners can retrieve at will, which supports self-regulation but offers no response to what the learner actually does. *Drops Arabic*'s visually cued letter exercises keep each task within what a novice can complete, reducing cognitive load as learners progress independently. *Mondly Arabic*'s speech recognition and role-based dialogues respond to learner output and therefore come closest to the contingent, gradually withdrawn support that scaffolding implies (Wood et al., 1976). Even so, all three applications rely on pre-programmed pathways, so support is only partly adaptive: the audited features did not diagnose why a learner misunderstands a morphological pattern or a pragmatic choice, which limits independent progress beyond the introductory level.

Linguistic Features Analysis in the Framework of Socio-Cultural Theory

An in-depth evaluation of six linguistic dimensions writing system, phonology, morphology, lexicon, syntax, and pragmatics- shows diverse results across the three Arabic learning applications

(Alawfi, 2024). From a Socio-Cultural perspective, these differences illustrate the varying degrees of *mediation, scaffolding*, and opportunities for *socially situated learning* that learners receive (Kapoor, 2026; Säljö, 2022). In the writing system domain, Drops Arabic performs best by presenting structured exercises on letter recognition, connected forms, and vowel marks (*harakāt*) through strong visual mediation. Such visual scaffolding supports initial internalization but remains limited to perceptual learning without social interaction. Nemo Arabic does not provide explicit alphabet instruction, directly introducing vocabulary instead, while Mondly Arabic embeds written Arabic within simple sentence structures. Although this integration offers contextual mediation, it lacks explicit scaffolding for script-level mastery.

Phonologically, Mondly Arabic stands out through its speech recognition and automated feedback, which simulates dialogic interaction and aligns more closely with Socio-Cultural Theory's emphasis on learning through guided participation (Mohmad Mohmiddin & Abu Bakar, 2025). Nemo Arabic also performs well with authentic audio recordings, but the absence of feedback limits its mediational value. Drops Arabic provides only basic sound examples, offering minimal scaffolding for productive pronunciation. Morphology remains the weakest feature across applications (Ahmad et al., 2025). None of the platforms offer structured exposure to Arabic's root-and-pattern (*jidzr-wazn*) system, meaning learners receive little mediation for understanding Arabic morphology as a meaningful cognitive and cultural system, a core aspect in SCT that highlights the link between linguistic form, meaning, and social use.

In the lexical domain, Nemo Arabic excels by providing extensive thematic vocabulary organized semantically, supporting independent learning but lacking socially situated contexts. Drops Arabic offers visually grounded lexical items suitable for beginners, functioning as perceptual scaffolds rather than socio-communicative tools. Mondly Arabic, however, situates vocabulary within conversational exchanges, thus providing social mediation and approximating real communicative activity. In syntax, Mondly Arabic again leads by presenting full sentences and structurally accurate patterns. This guided exposure supports internalization through contextualized language use, a key mechanism in SCT. Meanwhile, Nemo Arabic and Drops remain limited to isolated words or short phrases, offering minimal scaffolding for syntactic development.

Finally, in pragmatics, Mondly Arabic performs best by incorporating situational dialogues reflecting formal and informal registers. These features provide rich Socio-Cultural mediation, enabling learners to experience language as social action. Nemo and Drops, by contrast, lack explicit Socio-Cultural contextualization, offering vocabulary divorced from authentic communicative settings. The comparative analysis illustrates how each application provides different forms and levels of mediation. Mondly Arabic supplies the strongest Socio-Culturally grounded scaffolding through dialogic tasks and contextualized language use, while Nemo and Drops primarily support cognitive and perceptual aspects of linguistic learning. This underscores the value of integrating Socio-Cultural Theory principles into digital language learning design to ensure that learners engage with language not only as structure but also as social practice.

Synthesis of findings

The comparative analysis reveals that each Arabic learning application demonstrates distinct linguistic strengths: Drops Arabic excels in visualizing the writing system, Nemo Arabic focuses on vocabulary and basic phonetics, and Mondly Arabic provides wider coverage in phonology, syntax, and pragmatics. However, none of the applications achieve a balanced integration of all linguistic components, as most remain oriented toward introductory-level skills rather than the development of comprehensive language competence. These findings confirm Alghazali & Alzyoudi (2025) and Chou (2012), who states that many digital language-learning platforms prioritize lexical and phonetic elements while underrepresenting syntactic and pragmatic dimensions. In the context of Arabic language education, this pattern suggests that digital platforms generally function to build foundational linguistic awareness rather than facilitate systemic mastery. Therefore, while these applications serve as useful tools for initial exposure to the Arabic language, they often fall short of providing a comprehensive linguistic education (Alsaied, 2024; Syafri et al., 2026).

Several theoretical and technical factors may explain why the audited applications remain fragmented, concentrating on lexical and phonological aspects while remaining weak in morphosyntax and pragmatics. Technically, vocabulary lists, audio playback, and speech-recognition prompts are modular and easy to scale, whereas root-and-pattern morphology and grammatical inflection call for explicit, sequenced metalinguistic explanation that is difficult to deliver through short, game-like exercises (Alawfi, 2024; Issa, 2023). Arabic-specific constraints add to this: automated assessment of Arabic pronunciation is still being developed and validated (Ahmad et al., 2025), and diglossia between fusha and ammiyyah complicates the choice of authentic situational input (Saiegh-Haddad et al., 2023). Theoretically, morphosyntactic and pragmatic competence is the kind of knowledge that, from an SCT perspective, develops through socially situated and contingent interaction, which is precisely the form of mediation that pre-scripted application design reproduces least readily. Design priorities such as short sessions and templates shared across languages may further favor surface-level content over Arabic-specific linguistic depth, in line with the limitations reported in earlier analyses of Arabic applications (Ab.Rahim et al., 2024; Haq et al., 2024; Bousnane, 2025).

These findings extend previous MALL and CALL evaluation research in two ways. General frameworks have examined technology, pedagogy, user experience, and language learning (Rosell-Aguilar, 2017), the learning design of mobile resources (Reinders & Pegrum, 2016), and the language-learning potential of CALL tasks (Chapelle, 2001). However, they treat linguistic coverage as one language-neutral criterion. The present study shows that, for Arabic, such a single criterion conceals marked unevenness across the writing system, phonology, morphology, lexicon, syntax, and pragmatics. Likewise, Arabic-focused studies have mostly examined effectiveness, motivation, or a single linguistic domain (Elsayed Ahmed et al., 2023; Hidayat et al., 2024), or have reviewed vocabulary applications and technology integration (Ab.Rahim et al., 2024; Haq et al., 2024), without mapping all six dimensions to the type of scaffolding provided. Consistent with Alghazali and Alzyoudi (2025), the results show that lexical and phonetic content is prioritized; the SCT-based reading adds that this is also a gap in mediation, which is why a holistic linguistic evaluation of the

kind proposed here is needed.

From a pedagogical perspective grounded in Socio-Cultural Theory, the diversity of these applications suggests that each can serve as a complementary mediational tool within a larger ecosystem of digital Arabic learning. Drops can function as a scaffold for script acquisition; Nemo can support lexical expansion suited to individual regulation; and Mondly can facilitate socially oriented communication practice. When strategically combined, these applications mediate learning across multiple zones of proximal development (ZPD), balancing cognitive, social, and communicative dimensions of Arabic language acquisition. Overall, this comparative study underscores the need for future Arabic learning applications to integrate linguistic and SCT-based pedagogical principles more holistically. Embedding morphological and syntactic features into dialogic interfaces, enhancing opportunities for socially mediated tasks, and incorporating realistic pragmatic contexts may significantly deepen learner engagement and internalization processes. Collaborative development involving linguists, Arabic educators, and software designers is essential to create learning platforms that are visually appealing, pedagogically grounded, and aligned with Socio-Cultural principles of effective second language learning (John, 2026; Otamurodova & Dadaxonova, 2025; Zhang & Zou, 2022).

4. CONCLUSION

This study emphasizes that the quality of Arabic language learning based on digital applications is determined not only by the variety of features but primarily by the extent to which these features can mediate the language acquisition process according to the principles of Socio-Cultural Theory (SCT). In response to the research objective, the findings show that each application mediates a different part of Arabic: Drops Arabic is strongest in visualizing the writing system for early literacy, Nemo Arabic in repetition-based lexical and phonological retention, and Mondly Arabic in dialogic, speech-recognition-based scaffolding that is closest to real communication. Their shared limitations are the absence of root-and-pattern morphology and the narrow coverage of pragmatics. These differences suggest that the development of Arabic language applications is still in a fragmented phase and, therefore, has not yet fully provided a holistic learning experience aligned with advanced linguistic needs. In general, the analysis of the results shows that the applications under review are only able to provide learning support at basic to intermediate levels. At the same time, key aspects such as root-based morphology, advanced syntax, and pragmatic contextualization are still given limited attention. This indicates that digital learning design still requires an interdisciplinary approach that integrates Arabic linguistics, instructional design, and learning technology to produce a platform that can genuinely develop communicative competence progressively. Thus, the theoretical contribution of this study lies in integrating SCT into the evaluation of Arabic MALL: the evaluative framework links six linguistic dimensions to forms of mediation and scaffolding, and it can serve as a basis for assessing the quality of linguistic features in SCT-oriented Arabic language learning applications.

Practically, application developers should embed root-and-pattern morphology and contextualized pragmatic dialogues in interactive interfaces that give feedback, rather than limiting

these features to vocabulary lists or isolated phrases. Educators selecting digital media for Arabic courses can use the applications as complementary tools, with Drops Arabic for script acquisition, Nemo Arabic for lexical expansion, and Mondly Arabic for communicative practice, while supplementing them with explicit instruction in morphology and pragmatics. This research opens up opportunities for more comprehensive follow-up studies, particularly by involving experimental or quasi-experimental user testing and empirically measuring learner retention and language development levels based on real interactions with the application. Future research is expected to be able to develop integrated models that combine writing-system, phonological, morphological, lexical, syntactic, and pragmatic features into tiered learning scenarios connected to the Zone of Proximal Development (ZPD). In addition, upcoming studies could explore the utilization of artificial intelligence, adaptive learning, and large language model-based chatbots to design learning experiences that are more personalized, responsive, and tailored to the needs of Arabic language learners at various levels.

ACKNOWLEDMENT

The authors want to thank all the individuals and writing teams who have provided support during the completion of this study.

DECLARATION OF AI-ASSISTED TECHNOLOGIES

The authors used GPT, Claude AI, and Grammarly to check spelling errors, translate writing, and facilitate the authors in creating research frameworks. Consensus, Scopus AI, and SciSpace were used to assist in reference searches. All authors are fully responsible for all content of the manuscript.

FUNDING INFORMATION

The authors declare that no funding was received for this study.

AUTHOR CONTRIBUTIONS STATEMENT *(mandatory)*

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Linura Tuada		✓	✓							✓		✓		
Muzakki Abdurrahman					✓			✓						
C : C onceptualization	I : I nterpretation					Vi : V isualization								
M : M ethodology	R : R esources					Su : S upervision								
So : S oftware	D : D ata Curation					P : P roject administration								
Va : V alidation	O : Writing - O riginal Draft					Fu : F unding acquisition								
Fo : F ormal analysis	E : Writing - Review & E diting													

CONFLICT OF INTEREST STATEMENT

The authors state no conflict of interest.

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