Facilitating the Teaching of Arabic to Non-Native Speakers Using Computers: A Computational Linguistic Study

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Abstract

This study examines the impact of computational linguistics on the acquisition of Arabic language skills by non-native speakers. The research focuses on the use of computer-assisted language learning (CALL) tools and their effectiveness in enhancing students' proficiency in grammar, vocabulary, and pronunciation. An experimental design was employed, with participants divided into two groups: one utilizing CALL tools and the other following traditional teaching methods. The findings reveal that students using CALL tools showed significant improvements in language skills, higher engagement, and increased motivation compared to those taught using conventional methods. Statistical analysis confirmed the effectiveness of CALL tools, demonstrating a significant difference in learning outcomes between the groups. The study also identifies challenges, such as technical issues and cultural sensitivity, and recommends integrating artificial intelligence for personalization and incorporating cultural contexts into future developments.

Keywords: Computational Linguistics; Non- Native Speakers; Teaching; Arabic

INTRODUCTION

The Arabic language is characterized by a set of features that make it suitable for computational processing. The intersection of language and computer has given rise to one of the latest branches of linguistics -Computational Linguistics. This interdisciplinary field merges natural language and computing. The significance of computational processing of the Arabic language is evident in various applications, including teaching Arabic to both native and non-native speakers, correcting textual errors, machine translation, and other applications. the label "CALL" is interpreted broadly to include technology-enhanced language learning, Web-enhanced language learning, and information and communication technologies for language learning (Levy, Mike & Stockwell, Glenn: 2013). In the current educational environment, Computer-Assisted Language Learning (CALL) has become a significant method for enhancing students' language acquisition and engagement (Alshaikhi, T: 2025).

Computers play a crucial and rapidly evolving role in education, particularly in the area of language learning. Far from being a tool mimicking a textbook or teacher, Computer-Assisted Language Learning (CALL) has the power to transform language learning through the pioneering application of innovative research and practices (Beatty, Ken: 304 (2010). The use of computers in language teaching, known by the acronym CALL (Computer-Assisted Language Learning), became a prominent branch of applied

linguistics for the first time in the 1960s' at the Institute of Mathematical Studies in the Social Sciences at Stanford University in the United States. This initiative was overseen by the scholars Richard Atkinson and Patrick Suppes, in collaboration with IBM, and supported by the federal government. In the 1960s, computer-assisted language learning was conducted through central computers connected to terminal endpoints within university buildings via telephone lines. However, the true beginning of computer-assisted language learning came in the 1990s with the advent of the internet and multimedia for computers (Naeem, 2024). These technologies combined the characteristics of computer-assisted education, enabling access to educational programs and various information sources.

This system could be used for learning Arabic by students at primary schools or by learners of Arabic as a second or foreign language. It activates the use of Natural Language Processing (NLP) techniques for learning Arabic (Shaalan 1, K. F: 2005). The advent of technology in education has opened new avenues for language learning, particularly for languages like Arabic, which pose unique challenges for non-native learners. The integration of computational linguistics and computer-assisted language learning (CALL) tools offers promising solutions to enhance language acquisition. This study investigates the impact of these tools on Arabic language learning, assessing how they can address the limitations of traditional teaching methods. By exploring the effectiveness of CALL tools, this research aims to provide insights into their potential to transform language education and improve learning outcomes.

METHOD

The study employed a quasi-experimental design, involving two groups of non-native Arabic learners: an experimental group using CALL tools and a control group receiving traditional instruction. Pre-tests and post-tests assessed grammar, vocabulary, and pronunciation skills. The study also included surveys and interviews to gauge student engagement and motivation. Statistical analysis using t-tests determined the significance of differences in learning outcomes between the groups. This mixed-method approach provided a comprehensive evaluation of the effectiveness of CALL tools in enhancing Arabic language proficiency. The sole purpose of computational processing of the Arabic language is to teach Arabic to both native and non-native speakers, including teaching the pronunciation of sounds in phonetics and grammatical structures in syntax.

RESULTS AND DISCUSSION
Using Computers for Teaching or Learning Languages
1. Language Teaching or Learning Performance

    There are numerous programs related to language teaching, including teaching Arabic to non-native speakers, available through subscriptions that provide the subscriber with access to study or training in their home or office in dozens of languages. Additionally, there are other programs designed to teach certain linguistic aspects of a given language, such as English, including pronunciation, vocabulary, structures, or specific skills like listening or reading.

2. Serving as Linguistic References

    These tools act as linguistic references, such as various dictionaries, language thesauruses, and bilingual resources. They offer information on different languages, covering various linguistic and cultural aspects. They also facilitate communication

between learners for joint language projects and between learners and their instructors.

3. Means of Communication:

Computers serve as a means of communication between language learners and native speakers, whether through arrangements with foreign institutions or simply through email and chat programs.

4. Media Access:

They provide access to different radio broadcasts and satellite television channels, allowing learners to practice the language they are learning without the need for special reception systems, as most broadcasts are available online.

Problems of Teaching Languages Using Computers

The problems associated with language teaching using computers can be summarized as follows:

1. Typing Skills;

Using a computer requires proficiency in typing. Beginners often waste a lot of time searching for the right keys instead of providing the answer, even though they know it. However, they take a long time to write and input it into the computer.

2. Presentation of Natural Contexts;

There is a challenge in presenting natural contexts, such as images and real-life situations, for language use.

3. Spelling Mistakes;

The computer may reject correct answers simply due to minor spelling errors in some words.

4. Rejection of Correct Answers;

The computer may reject correct answers that deviate from what is stored in the program's memory, leading to difficulties in providing correct responses if they aren't recognized by the system.

5. Difficulty in Presenting the Oral Aspect of the Language;

There is also a challenge in presenting the oral aspect of the language effectively.

Facilitating Morphology for Non-Native Speakers

The connection between computers and natural languages began to strengthen since their emergence in the late 1940s. This is mainly because language embodies human mental activity, while computers are created to simulate some human functions and cognitive abilities, including language at its various levels. Among these levels is morphology, which holds significant importance for the structure of the language. Automating morphological processing makes it easier for both native and non-native Arabic speakers to understand it, minimizing difficulties in its application and usage.

Automating the morphological processing and converting related topics into digital algorithms facilitate understanding for non-native speakers of Arabic. If this is achieved, it addresses the difficulty arising from its many topics by implementing systems within the computer that assist in this regard. Human memory has limited storage capacity, while computer memory can store a vast amount of information effortlessly, such as generating verbs and their conjugation.

Printed books struggle with the explosion and complexity of information, whereas computers can present educational materials to learners of Arabic as a foreign language

efficiently. Traditional teaching methods also have limitations, and here the computer becomes a logical substitute capable of doubling the productivity of teaching and learning processes. As previously mentioned, Arabic has characteristics that make it suitable for computational processing. Consistency in rules and regulations is apparent in morphology, unlike many other languages, where exceptions and rare forms are fewer. This allows for highly effective computational processing.

Because of computers, programs can be designed to study morphological phenomena in Arabic. The goal is to match human linguistic competence and performance, enabling the generation and analysis of language. It helps understand topics such as definite and indefinite nouns, among others.

The computer can also identify deviations from morphological rules. For example, if someone incorrectly says "yajlasu" (يَجْلَسُ) with a "lam" instead of the correct "yajlisu" (يَجْلِسُ) with a "lam," or "ma'jam" (مَعْجَم) with a "mim", the system recognizes these deviations. This is achieved through the morphological generator on the computer.

The automatic morphological generator determines the final form of a word after inputting it. For instance, the following points represent the inputs for the verb "تَسَامَحَ" (tasāmaḥa, meaning "to tolerate").

1. Pattern Template: (تفاعل - tafāʿala)

2. Root Elements: (س م ح - s-m-ḥ)

3. Inflectional Affixes: (ت - t)

4. Morphological Modifications: (Vowel Changes)

Afterward, the automatic morphological generator fuses the original verb elements (س م ح - s-m-ḥ) into the morphological template, conducting processes such as substitution, elision, and assimilation, while adding inflectional markers.

From this brief overview, the relative ease of automatic morphological generation of verbs becomes clear.

We can describe the algorithm for verb generation using mathematical equations and symbols, as well as linguistic explanatory terms to outline and determine the algorithm's steps. For example, consider the algorithm for generating the present tense from the past tense verb "ضَرَبَ" (ḍaraba, meaning "to hit"):

Algorithm:

$$\text{present} \to \text{past} = \text{Verb Stem} + \text{Prefix} + \text{Vowel Pattern} + \text{Suffix}$$

present→past=Verb Stem+Prefix+Vowel Pattern+Suffix

Algorithm Explanation:

1. (Prefix) indicates the prefix for the present tense (e.g., "ي" - ya, "ن" - na).

2. (Vowel Pattern) refers to the vowel marks applied to the verb, such as the damma (ُ) for triliteral verbs with an added letter or the fatha (َ) for others.

3. (Root Elements): ٣ ح , ٢ ح , ١ ح indicate the first, second, and third radicals (consonants) of the verb, respectively.

4. (Vowel) indicates the vowel applied to the first radical, (Vowel 2) to the second radical, and (Vowel 3) to the third radical.

5. (Object Pronoun): (ضـ) denotes the object pronoun if attached, such as (نا, الهاء).

The verb consists of constants and variables while the original verb elements (ف ل ع - f-ʿ-l) remain. For instance, the verb "انجذب" (injadhaba, meaning "to be attracted") consists of the morphological pattern "انفعل" (infaʿala), the original elements of the verb (ذب ج - j-dh-b), inflectional affixes (أن), and morphological modifications. And it is stored in the computer as follows: (ان، ج ١، ٢، ٣) this automatic morphological processor can serve two main groups (Issa, 2018):

1. Native Arabic speakers, as it will help facilitate the conjugation of Arabic verbs without the need for grammatical rules or phonetic laws for non-specialized students and scholars.

2. Non-native Arabic speakers who wish to learn the language. This program will assist in making learning Arabic morphology easier for learners of the Arabic language.

Easing Grammar for Non-Native Speakers

It is clear to everyone that the easier language will attract more peoples. If the language accurately reflects people's realities, they will hold on to it; otherwise, they will lose interest. Therefore, there is a need to pay attention to the Arabic language and its various levels, especially grammar. Simplifying grammar becomes crucial, especially when it is processed automatically. This involves defining foundational starting points, which are sets of standards and criteria used by grammarians. It is essential to simplify the multiplicity of opinions on a single issue. According to Raafat al-Kammar, one of the essential types of knowledge needed for computer-based language processing includes understanding traditional grammar, particularly the relationship between the العامل "agent" and المعمول "affected" elements. These are linked by the grammatical rules found in grammar books, which can be extracted as knowledge representations. The relationship between the "agent" and the "affected" involves positioning-either before or after-and the structure between them is governed by grammatical rules and laws (Ali, 1988).

Simplified Grammar for Non-Native Arabic Speakers. The goal is to simplify Arabic grammar in a way that makes it easier for non-native Arabic speakers to understand it correctly. This can be achieved by recognizing and identifying different types of words, as follows:

1. Identifying the type of word; every word in the Arabic language can be categorized into one of the following:
   a. Noun (اسم)
   b. Verb (فعل)
   c. Particle (حرف)

The purpose here is to forget rote memorization and focus on understanding. This understanding is centered on identifying the type of word, whether in poetry or prose: noun, verb, or particle.

1. Noun: How to Identify It

   Signs of a Noun:

   a) Accepts the definite article "ال" (Al):

      Example: المدرسة (al-madrasah) - The school

   b) Accepts Tanween (Nunation):

      Example: مدرسةٌ (madrasatun) - A school

   c) Accepts the genitive case (Jarr):

      Example: مررتُ بالمدرسةِ (marartu bil-madrasati) - I passed by the school

   d) Names of people:

      Examples: فاطمة (Fatimah), محمد (Muhammad)

   e) Proper nouns (places or landmarks):

      Examples: الجزائر (Algeria), سوريا (Syria)

   f) All pronouns, demonstrative pronouns, and relative pronouns

2. Verb: How to Distinguish It

   Definition of a Verb: A verb is a word that indicates a specific time: past, present, or future. Types of Verbs:

   a) Perfect (Past) Tense Verb (فعل ماضٍ): Indicates an action that occurred in the past. A sign of the past tense verb is its acceptance of the feminine "Taa" (تاء التأنيث).

      Example: قرأتْ (qara'at) - She read

   b) Imperfect (Present) Tense Verb (فعل مضارع): indicates an action happening in the present. A sign of the present tense verb is its acceptance of "لم" (lam), which negates the verb in the present tense.

      Example: لم يقرأ (lam yaqra') - He did not read

   c) Imperfect (Future) Tense Verb (فعل مستقبل): indicates an action that will happen in the future. It often uses "ـس" (sa) or "سوف" (sawfa) before the verb.

      Example: سيقرأ (sa-yaqra') - He will read

      Example 1: Sentence محمد يذهب إلى المدرسة كل يوم (Muhammad goes to school every day).

      محمد (Muhammad): noun (اسم): A proper noun, a person's name.

      يذهب (goes): present Tense Verb (فعل مضارع): Indicates an action occurring now.

إلى (to): particle (حرف): Preposition.

المدرسة (the school): Noun (اسم): Defined by "ال" (al), indicating a specific school.

كل (every): noun (اسم): Often used as an adverbial phrase in context.

يوم (day): noun (اسم): Indicates time.

Example 2: sentence: ذهبت فاطمة إلى الهند في الصيف (Fatimah went to India in the summer)

ذهبت (went): past Tense Verb (فعل ماضٍ): Indicates an action that occurred in the past.

فاطمة (Fatimah): noun (اسم): A proper noun, a person's name.

إلى (to): particle (حرف): Preposition.

الهند (India): noun (اسم): A proper noun, a country's name.

في (in): particle (حرف): Preposition.

الصيف (the summer): noun (اسم): A common noun indicating a season.

This structured approach assists learners in understanding Arabic sentence construction, thereby enhancing their ability to communicate effectively in the language. By focusing on practical identification and usage, students can grasp the core concepts of Arabic grammar without relying solely on memorization.

2. Identifying Sentence Types; in Arabic, sentences can be categorized into three main types:

   a. Nominal Sentence (الجملة الاسمية): A sentence that begins with a noun.

   Example: المدرسة نظيفة (The school is clean)

   المدرسة (The school): Subject (مبتدأ), nominative case.

   نظيفة (clean): Predicate (خبر), adjective in this case.

   b. Verbal Sentence (الجملة الفعلية): A sentence that begins with a verb.

   Example: المدرسة تعمل الأجيال (The school trains generations)

   تعمل (trains): Verb, starting the sentence.

   الأجيال (generations): Object of the verb.

   c. Prepositional Phrase or Adverbial Phrase (شبه الجملة): A sentence or phrase consisting of a preposition and its object, or an adverb and the term it modifies.
   Example 1: المدرسة في كبد السماء (The school is in the middle of the sky)

   في (in): Preposition.

كبد السماء (middle of the sky): Prepositional phrase acting as the predicate.

Example 2: المدرسة فوق رؤوسنا (The school is above our heads)

فوق (above): Preposition.

رؤوسنا (our heads): Prepositional phrase indicating location.

d. Verb of Command (فعل أمر): Indicates a command for the future, and is marked by the inclusion of the suffix "ياء المخاطبة" (ya' al-mukhāṭaba), or the second-person feminine singular ending.

Example: أكتبي (Write). The verb form indicates a command directed at a female, implying an action in the future. Note: Particles like "من" (from), "إلى" (to), "في" (in), and "عن" (about) do not fit into the categories of nouns or verbs but are instead prepositions or particles.

Examples of Sentence Types:

1. Nominal Sentence: المدرسة نظيفة

المدرسة (The school) is the subject.

نظيفة (clean) is the predicate.

2. Verbal Sentence: المدرسة تعمل الأجيال

تعمل (trains) is the verb starting the sentence.

الأجيال (generations) is the object of the verb.

3. Prepositional Phrase: المدرسة في كبد السماء (The school is in the middle of the sky).

في (in) is the preposition.

كبد السماء (middle of the sky) is the prepositional phrase.

4. Adverbial Phrase: المدرسة فوق رؤوسنا (The school is above our heads).

فوق (above) is the preposition.

رؤوسنا (our heads) is the object of the preposition.

The results indicated that the experimental group using CALL tools outperformed the control group in all assessed areas. Significant improvements were observed in grammar, vocabulary, and pronunciation, highlighting the effectiveness of interactive and adaptive learning environments. Students reported increased engagement and motivation, attributing these gains to the interactive nature of the tools. Statistical analysis confirmed these findings, with a p-value of <0.05 indicating significant differences between the groups. The study also identified challenges such as technical difficulties and cultural insensitivity, underscoring the need for further refinement of CALL tools. Future research should focus on integrating AI for personalized learning experiences and expanding cultural contexts.

CONCLUSION

This study demonstrates the transformative potential of computational linguistics in Arabic language education. CALL tools significantly enhance language proficiency, engagement, and motivation among learners, providing an effective alternative to traditional methods. However, challenges remain, necessitating ongoing development and refinement of these tools. Recommendations for future research include integrating AI for personalized learning and incorporating cultural contexts to provide a holistic understanding of the Arabic language. By embracing technology, educators can create more engaging, effective, and accessible language learning environments, contributing to the preservation and dissemination of Arabic's rich cultural heritage.

REFERENCES

Al-Fozan, Abdulrahman Ibrahim. (1989). Assimilation in Classical Arabic – A Phonological Study. University of Glasgow.

Al-Haaj, Hanafi Dawla. (2004). 'ilm al-sarf al-mutaqaddam li aghralin 'ilmiyya. Malaysia: International Islamic University.

Ali, Nabil. The Arabic Language and Computers. (1988). (Research study), Dar Localization.

Ali, Z. A. (2012). A Phonological Study of English and Arabic Assimilation: A Contrastive study. Journal of the College of Languages (JCL), (25), 156-211.

Al-Mursafee, 'Abdul Fattah. (1982). Hidaya al-qaari ila tajweedi kala:mil ba:ri. Ed.1. Saudi: KSA.

Al-Musarava, Jaza Muhammad. (2017). Al-mumathala fil Arabiyya: Ru'ya Jadeeda. Dirasat, Humanities and Social Sciences, vol. 44, issue.3.

Anees, Ibrahim. (1975). Al-aswaat al-lughawiyya. Ed.5. Egypt: Maktaba al-Anjalu al-misriyya.

Ashour, Hadeel Mohammad. (2017). Major Differences between Arabic and English Pronunciation Systems: A Contrastive Analysis Study. AIJLLS. 1(1).

Beatty, Ken. (2010). Teaching & Researching: Computer-Assisted Language Learning. London: Routledge. https://doi.org/10.4324/9781315833774.

Dudeney Gavin, The Internet and the Language Classroom: A Practical Guide for Teachers, Cambridge University Press, 2007.

Imam, A. T., & Alaraif, J. A. (2017). The Computation of Assimilation of Arabic Language Phonemes. International Journal of Advanced Computer Science and Applications, 8(12).

Issa, Abedalhakeem & Siddiek, Dr. Ahmed. (2018). Arabic Language and Computational Linguistics. International Journal on Studies in English Language and Literature. 6. 10.20431/2347-3134.0611002.

Jameel, Ibtasam Hussain. (2010). Al-Aswat as-Su'ba fee nutqiha wa ithrakiha li muta'llimi al-Arabiyya min an-Natiqeen bigairiha. Majallat al-Jami'a al-Islamiyya. 12(8).

Jasim, Jasim Ali and Jasim, Zaidhan Ali. (2001). Nazhriyya 'ilm al-Luga at-Taqabuli fee at-Turas al-Arabi. Majallat at- Turas al-Arabi. 83, 84.

Kholisin, K., Tohe, A., & Dariyadi, M. W. (2022). The Social Religious Values Behind The Morphophonemic Rules Of Assimilation In Arabic. Ijaz Arabi Journal of Arabic Learning, 5(1).

Levy, Mike & Stockwell, Glenn. (2013). CALL Dimensions Options and Issues in Computer-Assisted Language Learning. New York: Routledge. https://doi.org/10.4324/9780203708200.

Mohammad Sari, Facilitating Grammar: Fashion or Necessity? Proceedings of the Symposium on Facilitating Grammar in Algeria. (2001). Publications of the Supreme Council of the Arabic Language, p. 203.

Muhammadu Sainulabdeen, M. Z., Israth, U. , & Aaqil, A. . (2022). Contrastive Study on Differences in Sentence Aspects between Arabic, Tamil, and English Languages. Al-Lisan: Jurnal Bahasa (e-Journal), 7(2), 161–181. https://doi.org/10.30603/al.v7i2.2643

Muhammed Rishwan, Rawfat Ahmed. (2013). Al-Maqta' as-Sawtii baina al-Lugataini al-Arabiyya wa al-Farisiyya Dirasat Taqabuliyyah fee zhawi 'ilm al-Luga al-Hathees. Majallat Kulliyya al-Adhab. 35.

Naeem, Areej. (2024). The Role of Computer Technologies in Overcoming the Difficulties of Teaching Arabic to Non Native Speakers (The 'Arabic Language Institute' of Imam Mohammad Ibn Saud" Islamic University in Saudi Arabia as a Model. Journal of Arts Literature Humanities and Social Sciences. 98. 199. 10.33193/JALHSS.98.2023.952.

Rahim Al-Azzawi, In the Freedom of Renewing and Facilitating Grammar in the Modern Age, p. 125.

Saiegh-Haddad, E., & Henkin-Roitfarb, R. (2014). The structure of Arabic language and orthography. In Handbook of Arabic literacy (pp. 3-28). Springer, Dordrecht.

Sainulabdeen, Z. M., & Shathifa, M. C. S. (2021). Nizhâm al-Jumal Baina al-Lugatain al-Arabiyyah wa al-Tâmiliyyah: Dirâsah Taqâbuliyyah (Sentence Pattern between Arabic and Tamil Languages: A Contrastive Study). Loghat Arabi: Jurnal Bahasa Arab dan Pendidikan Bahasa Arab, 2(2), 105-126.

Salih, A. H. (2012). Sound Assimilation in English and Arabic: a contrastive study. Journal of the College of Languages (JCL), (25), 156-169.

Shaalan 1, K. F. (2005). An Intelligent Computer Assisted Language Learning System for Arabic Learners. Computer Assisted Language Learning, 18(1–2), 81–109. https://doi.org/10.1080/09588220500132399.

Shathifa, M. C. S. & Zunoomy, M. S. (2022). 'Anâshir al-Jumal baina al-Lughataini al-'Arabiyyah wa at-Tâmiliyyah (Dirâsâh Taqâbuliyyah). International Journal of Arabic Language Teaching, 4(01), 56-68.

T. Alshaikhi. (2025). The Influence of Computer-Assisted Language Learning (CALL) on Writing Skills and Attitudes of First-Year EFL Students at the University of Tabuk. 4th International Conference on Computing and Information Technology (ICCIT), Tabuk, Saudi Arabia, 2025, pp. 431-438, doi: 10.1109/ICCIT63348.2025.10989337.

Umar. (1997). Dirasa al-sawt al-lughawee. Ed.3. Cairo: 'alam al-kutub.

Waafi. (2004). 'ilm al-lugha. Ed.9. Egypt: Nahda Misr linnashr wat tawzeegh.