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AI Concepts Integration in Developing E-Muhadathat Kits For Non-Arabic Speakers

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Abstract
Recent educational reforms focus on strategically integrating technology into teaching, aligning with the principles of the fourth industrial revolution (IR 4.0). Among the swiftly evolving technologies in language learning is Artificial Intelligence (AI), particularly in the form of Natural Language Processing (NLP). This technology has been applied to create the E-Muhadathat kit, an interactive Arabic conversation simulation tool designed to enhance communication skills for non-Arabic speaking students in Malaysian public universities. This study aims to investigate the role of AI in education, address the challenges in developing AI-based Arabic language learning software, and propose a model for the E-Muhadathat kit tailored for non-Arabic speakers. This literature review uses documentary methods to gather information from journals, conference proceedings, articles, dissertations, and digital books from databases such as Google Scholar, Springer Link, Science Direct, and Research Gate. The collected data undergoes descriptive analysis based on thematic categorization. The findings indicate that the concept of AI consists of three core components: machine learning, deep learning, and neural networks. Arabic linguists have recognized several challenges in developing AI-based software, such as orthographic, morphological, syntactic, anaphoric, and semantic ambiguities. Moreover, the E-Muhadathat kit's design integrates machine learning and deep learning techniques, featuring applications for both spoken and written language. The study's findings support educators and researchers aiming to create Arabic language software tailored for non-native speakers in Malaysian higher education institutions. As a result, the study advocates for further investigation into the use of AI in Arabic language education to enhance the communication abilities of non-native speakers in Malaysia.
Keywords: Artificial Intelligence; Natural Language Processing; E-Muhadathat; Arabic; Teaching and Learning; Non-Arabic Speakers

INTRODUCTION

In today's advanced digital environment, Artificial Intelligence (AI) enables machines to observe and learn from human behavior. This technology relies on software programs based on algorithms or robots that can comprehend, interpret, and react to human instructions. Its widespread use has led to the development of popular high-tech devices such as smartphones, tablets, laptops, autonomous vehicles, drones, and robots (Nawi, 2019). Moreover, popular products like Amazon Alexa, Siri-Apple, and OK Google or Hey Google are utilized to recognize human voices for tasks like playing music, finding tourist destinations, and managing home devices (Naik, 2020). AI technology, including its subset Natural Language Processing (NLP), is commonly applied in language learning. Examples include Google Translate for multilingual

translation, Chatbot and Wit.ai for interactive conversations in both spoken and written formats, Gmail's auto-mail feature, and Grammarly for automated text prediction and sentence correction. In Arabic language teaching, the use of this technology remains in its early stages and requires further investigation (Khalati & Al-Romany, 2020; Muflihah, 2023). Several factors contribute to this issue, such as a lack of scholars or experts in Arabic language computing, the variety of Arabic dialects, and a delayed recognition of using internet networks and machine-assisted translation to enhance Arabic language proficiency (Anwar & Ahyarudin, 2023; Adel, 2022). Limited research has focused on the development of media kits for Arabic communication skills utilizing AI technology (Abdelghani, 2021; Abdurrosid & Mamluatul, 2021). This article seeks to address this gap by exploring the intersection of AI and education. Its primary goal is to lay the groundwork for creating the E-Muhadathat kit model, which is designed specifically to improve Arabic communication skills for non-native speakers. This interactive conversation simulation model, accessible via smartphones, aids non-native students in mastering Arabic communication. Additionally, the article highlights and addresses the challenges in developing Arabic language software integrated with AI technology, particularly in the creation of the E-Muhadathat kit model. It also proposes a model design that follows the ADDIE Instructional Model procedure, which encompasses analysis, design, development, implementation, and evaluation. This approach is customized to benefit non-Arabic speakers in Malaysian Higher Education Institutions.

As noted by Sahrir (2016), the significance of the Arabic language goes beyond the Muslim community, extending into various professional fields and international communication avenues such as translation, business, diplomatic relations, broadcasting, and mass media. The extensive application of Arabic in science and technology contributes positively to the development of professionals on a global scale (Ramli et al., 2023; Romli et al., 2018; Atoh et al., 2014). However, Khalati and Al-Romany (2020) emphasize that efforts to strengthen the Arabic language on a global level must be expanded, given its status as the fifth most spoken language worldwide, with over 400 million speakers (Cabral, 2023; Bakar et al., 2023).

Despite Arabic speakers comprising 5% of the global population, Arabic content online is still limited, making up only about 1% of the total. Abdurrosid and Mamluatul (2021) emphasized the need for broader use of the Arabic language across various media platforms through NLP concepts, such as websites, machine-assisted translation, smartphone applications, and social media. This wider application aims to assist both Arabic and non-Arabic speakers in mastering the language, which is crucial for professional and international communication. In Malaysia, there is a growing trend towards incorporating multimedia elements into Arabic education to foster a student-centered and interactive learning experience. This shift responds to the traditional, textbook-based, teacher-centered approach commonly used in Arabic language instruction (Ramli et al., 2019; Romli et al., 2018; Ramli et al., 2017).

Traditional methods, which primarily depend on textbooks and teacher-centered approaches, are now being complemented by innovative techniques. Incorporating educational technologies like pictures, audio, video, text, and animation as teaching tools can ignite student interest, thereby improving Arabic speaking skills. This, in turn, promotes more effective Arabic pedagogical activities (Ghani & Daud, 2023; Zakaria et al., 2019). Consequently, the creation of an E-Muhadathat kit, developed as a smartphone application, can provide students with meaningful opportunities to engage in real

conversations with Arabic speakers. These interactions help enhance their language proficiency and improve their communication skills.

METHOD

This study utilizes a literature review approach, concentrating on library resources. The research methodology is qualitative and descriptive, involving a structured analysis of the gathered data, which is presented in the format of a scientific report. The data sources include various library materials, such as books, journals, papers, and articles pertinent to the subject being explored. Data collection involved utilizing specific keywords, including "Artificial Intelligence," "Arabic Natural Language Processing (ANLP)," "Natural Language Processing (NLP)," "teaching and learning Arabic," "communication skills in Arabic," and "Arabic communication skills," to conduct searches across databases like Google Scholar, Science Direct, Springer Link, and Research Gate. The collected online data was then subjected to thematic categorization and descriptive analysis to extract insights.

RESULTS AND DISCUSSION

Concept of Artificial Intelligence (AI)

AI technology is an extraordinary domain focused on mimicking human intelligence to address a range of challenges and issues. Its three primary techniques—Fuzzy Logic (FL), Evolutionary Computing (EC), and Machine Learning (ML)—are revolutionizing industries and impacting our daily lives (Ahmad, 2017). FL techniques emulate human reasoning by taking into account all possible outcomes and interpreting values between the binary digits of 0 and 1 (Nasution, 2012). An exemplary application of FL can be seen in the automatic braking systems used in Japanese trains, which enhance passenger safety and help prevent accidents. EC revolves around computational evolution, prioritizing natural evolutionary methods to achieve optimal or nearly optimal solutions. This technique is utilized in air conditioning compressor and inverter systems, allowing for automatic adjustments to room temperature, thus aiding in electricity conservation. It significantly contributes to energy efficiency and conservation.

ML, the most prevalent technique, is fundamental to advancements in AI. It allows software to enhance prediction accuracy based on experience without the need for explicit programming. ML has a wide range of applications, including fraud detection, spam filtering, malware threat detection, and more. It serves as the backbone for many businesses, fostering growth and innovation. Additionally, AI technology relies on three core concepts: machine learning, deep learning, and neural networks. Machine learning imitates human intelligence by learning from its environment. This powerful tool has transformed numerous fields such as spacecraft engineering, medicine, and pattern recognition by utilizing Big Data (El Naqa & Murphy, 2015).

Conversely, deep learning allows computers to naturally execute intricate tasks using images, text, and voice, leading to significant innovations like driverless vehicles, image classification, voice recognition, machine-assisted translation, and more (Nawi, 2019). These advanced technologies are transforming our world, with limitless potential. This approach can achieve impressive accuracy, at times even exceeding human intelligence. Furthermore, the neural networks concept uses a reflective system inspired by how the human brain operates. This facilitates computer programs in identifying patterns and mimicking communication among biological neurons. Neural network

applications encompass rain detection, currency authentication, disease identification through X-ray scans, and depression detection, among others (Annisa et al., 2020). A summary of the three key AI concepts is illustrated in Figure 1 below:

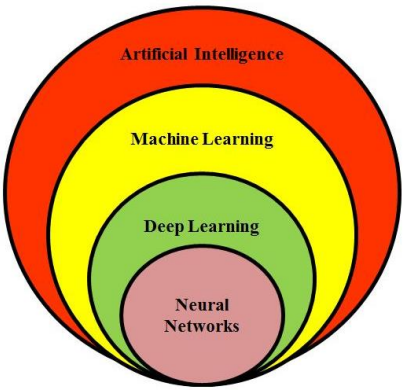

Figure 1. Main Concepts of AI in Education

Challenges and Obstacles in Developing Arabic AI Software

The swift advancement of AI has enabled computers to achieve capabilities comparable to those of humans. AI systems equipped with NLP can now interpret natural human language on the internet, including expressions in Arabic. However, the complete potential of Arabic language utilization on virtual platforms is still constrained due to several issues and challenges associated with the development of AI software. Specialists in Arabic Natural Language Processing have identified various obstacles, such as the application of Chatbots to assist teachers in the Arabic teaching and learning process (Almurayh, 2021).

Recent research shows an increasing interest in AI technology among Arabic and non-Arabic speakers, especially in the automatic detection of threatening, cyberbullying, and hateful texts in Arabic on social media (Elzayady et al., 2022). Nevertheless, challenges remain in utilizing algorithms to assist Arabic students in addressing morphological errors and ambiguities (Elayeb et al., 2022). Scholars in ANLP continue to concentrate on significant issues such as orthographic, morphological, syntactical, anaphoric, and semantic ambiguities (Shaalan et al., 2018).

1. Orthographic Ambiguity
   Arabic Orthographic Ambiguity pertains to the uncertainty surrounding orthographic symbols, commonly referred to as diacritics. These marks or symbols are employed to distinguish sounds within a letter. In Arabic, diacritics play a crucial role in clarifying the pronunciation of letters and the meanings of words, also known as tashkeel or short vowels. Examples include lines used in words such as كَتَبَ(he has written), كُتِبَ(has been written), and كُتُبٌ(books). Such ambiguous orthography can make Arabic text difficult to read and can obscure the intended meaning of a sentence. Nevertheless, this ambiguity can be alleviated by incorporating specific diacritics into ANLP processing for applications like text-to-speech or conversation (Al mekhlafi et al., 2022; Jarrar et al., 2018).
2. Morphological Ambiguity
   Arabic is well-known for its remarkably rich morphology, distinguished by its unique structure called "Mizan Sorfi." The intricate nature of Arabic morphology frequently results in ambiguity when differentiating between word and sentence structures due

to its considerable flexibility and complexity. Nonetheless, this complexity can be managed through particular derivation processes designed for various proficiency levels. Deriving Arabic words involves the use of three or four-character root words, represented in diverse patterns and enhanced with affixes. A brief summary of Arabic word derivation is presented in Table 1 below:

Table 1 Illustration of Arabic Word Derivation Levels

Words	Transliteration	Root Words	Transliteration	Pattern
حافظ	Hãfiz	حفظ	Hafaza	_ _ ا _
كاتب	Kãtib	كتب	Kataba	_ _ ا _
معلوم	Ma'lũm	علم	‘Alima	م _ _ و _
مدروس	Madrũs	درس	Darasa	م _ _ و _

Source: Shaalan et al., 2018

3. Syntax Ambiguity

Arab linguists established the foundation of Arabic grammar rules to prevent errors in Quran recitation. However, these grammar rules pose challenges for computers in automatically processing Arabic text with ANLP. Verbal and nominal sentences in Arabic have a different structure than that in English. For example, in the verbal sentence "يتعلم التلميذ" (the student is studying; yata'allamu al-Talib), the verb comes before the subject, unlike in English where all sentences begin with a subject followed by a verb. Nominal sentences in Arabic begin with a noun or pronoun and can be classified into two types: those without verbs and those with verbs. Nominal sentences without verbs imply the concept of "to be," similar to the English "verb to be," as demonstrated by phrases like "the weather is wonderful." However, in Arabic, the verb is not explicitly used, as seen in the example "الجو جميل" (beautiful weather).

4. Anaphoric Ambiguity

Utilizing anaphora resolution in Arabic involves associating a particular entity or pronoun with the corresponding noun or name to which it refers. Examples of anaphora usage in Arabic sentences as shown in Table 2 below:

Table 2 Anaphora in Arabic Sentence

Arabic Sentence	Machine Translation
رأيت القطة، فاعطيتها الطعام	I saw the cat, so I gave it food
رأيت القطة، فاعطيتها الطعام	I saw the cat, so I gave her food

Source: Shaalan et al., 2018

Referring to Table 2, the comparison between the phrases 'give it' and 'give her' illustrates the ambiguity of anaphora in Arabic. In Malay or English, the appropriate term would be 'give it.' This discrepancy arises from the classification of the noun for cats as an animal, unlike the use of 'her' for nouns referring to people. Machine translation encounters challenges in processing the anaphora for the third person pronoun or ها which refers to the noun cat in the aforementioned sentence.

5. Semantic Ambiguity

The semantic ambiguity inherent in the Arabic language encompasses sentences or phrases that require contextual adaptation to convey the correct meaning. For instance, consider the verse "يحب علي أحمد أكثرمن إبراهيم" (Ali loves Ahmad more than Ibrahim). This raises the question: does it imply that Ali loves Ahmad more than Ibrahim does, or that Ali loves Ahmad more than he loves Ibrahim? Consequently, the semantic ambiguity of Arabic poses a significant challenge in developing ANLP

Arabic language software capable of discerning sentence meanings across various contexts.

Model Design of E-Muhadathat AI Kit

The development of an E-Muhadathat kit, which is an AI-powered interactive Arabic conversation simulation model for smartphones, requires a well-structured framework that can serve as a reference for researchers. This study follows the ADDIE Instructional Model procedure (Branch, 2014), which delineates five key stages: analysis, design, development, implementation, and evaluation as Figure 2 below.

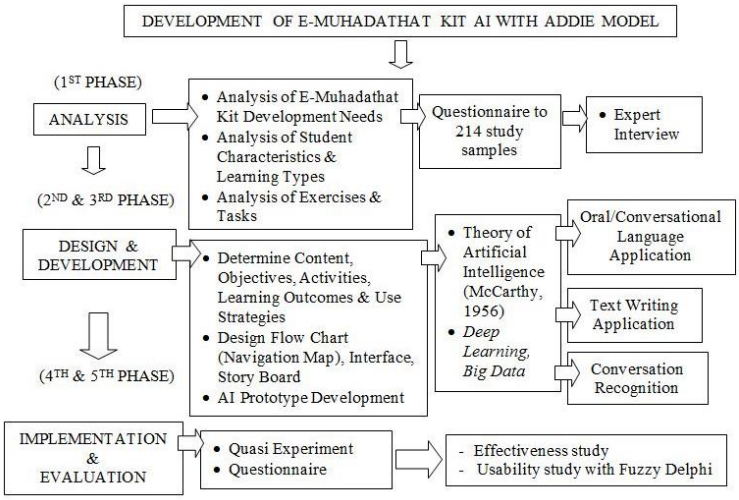

Figure 2. Overview of the E-Muhadathat AI Kit Model

Based on Figure 2, this study employs the ADDIE Model procedure in the development of E-Muhadathat kits for non-Arabic speakers. This iterative model ensures thorough and systematic development, with comprehensive evaluations conducted at each phase (Abu et al., 2020; Alwi & Kamis, 2021). The study encompasses five key stages aimed at developing the E-Muhadathat kits effectively. The first stage involves analysis. Here, the focus lies on analyzing the development needs of the E-Muhadathat kits, analyzing student characteristics and learning preferences, and assessing exercises and tasks related to Arabic communication and speaking skills. This phase incorporates a questionnaire administered to 214 study participants and expert interviews to identify the specific requirements for kit development.

The 2nd and 3rd phase emphasize the design and development process which consist of determination of content, objectives, activities, learning outcome and strategies use in teaching and learning. It comprises the design of flow chart (navigation map), interface, story board and the development of AI kits prototype. This phase also adapts theory of artificial intelligence by McCarthy (1956) and incorporates key AI concepts such as machine learning and deep learning. It enables the processing of written text, spoken conversation, and text-to-speech functionality with a spoken conversation recognition system. Moreover, the 4th and 5th phase focuses on implementation and evaluation which uses usability test to experts with Fuzzy Delphi Method (FDM) and quasi experiment to non-Arabic students in public universities.

Referring to the literature review, it is evident that AI technology significantly contributes to the enhancement of the Arabic language presence online. This advancement facilitates the dissemination of Arabic content across the internet, catering

to diverse age groups ranging from children to adults. Furthermore, the utility of the Arabic language extends beyond religious boundaries, finding relevance in professional spheres and international discourse (Sahrir, 2016). Addressing the challenges inherent in Arabic AI software development, particularly about linguistic ambiguities, such as orthographic, morphological, syntactic, anaphoric, and semantic ambiguities, is paramount. A notable solution lies in the integration of specific diacritics or tashkeel to clarify letter pronunciation and word meanings (Almekhlafi et.al, 2022).

This also supports Nazih and Hifny's (2022) study that has been developed Arabic BERT Models that represents a significant stride toward mitigating orthographic ambiguity in ANLP processing. These models provide a robust framework for enhancing the accuracy and efficacy of AI-driven language processing systems tailored for Arabic, thereby addressing crucial linguistic challenges in the digital realm (Obied et al., 2022). Furthermore, Arabic morphological ambiguity can be effectively addressed through a staged derivation process, as outlined in the Mizan Sorfi template.

This methodology aligns with the Camelira system to mitigate morphological ambiguity across various dialects (Elayeb et al., 2022). This morphological ambiguity can be solved by investigating strategies to tackle morphological ambiguity encompassing word combination, derived word, and text ambiguity, without resorting to symbols or lines. Their work culminated in the development of a machine learning algorithm tailored to aid non-Arabic speakers in navigating morphological ambiguity within hadith texts.

Moreover, syntactic ambiguity, including the complexities inherent in verbal and nominal sentences, poses another challenge. Arabic syntactic ambiguity can be resolved through the application of matching formulas for rationality, gender, and number between the inchoative or المبتدأ in nominal sentences. Similarly, in verbal sentences, syntactic ambiguity can be alleviated by employing verb-subject and verb-agent matching formulas (Othman et al., 2004). This supports the study of Almanna and Jamoussi (2022) who have developed the Neural Machine Translation (NMT) system to facilitate precise translations between English and Arabic sentences, thereby aiding in the comprehension and resolution of syntactic ambiguity.

One of the challenges of Arabic language processing is anaphora ambiguity, which can be overcome by matching entities' specific pronouns or referred names (Shaalan et al., 2018). To address this issue, a set of computational and linguistic features have been developed that use machine learning algorithms (Abolohom et al., 2021). Another challenge is the semantic ambiguity of the Arabic language, which requires matching sentences or phrases with different contexts to produce the correct meaning. To overcome this, semantic marking can be used to relate text data elements to a well-formed ontology or lexicon (Rayson et.al, 2004).

A lexicon is a component of an NLP system that contains semantic or grammatical information about single words or sets of words. Thus, semantic ambiguity can also be overcome with semantic marking. This supports the study El-Haj et.al (2022) has developed Arabic semantic marking system (AraSAS) with Python 3 has been developed to convert raw data (Arabic text) to semantic marking, enabling the appropriateness of a sentence or phrase to fit its meaning in different contexts to be determined. Although developing Arabic language software with AI technology, especially ANLP, presents various challenges, these hurdles must be addressed through collaborative efforts.

It is crucial to engage experts in AI, computer-assisted language learning (CALL), innovation in language education technology, and other related fields to find effective

solutions for Arabic software development based on AI technology. Furthermore, there is a critical need to improve the integration of AI concepts into the development of educational software, such as the E-Muhadathat development kit. Taking inspiration from research endeavors, we must further develop this exploration to encompass other Arabic language skills. These skills include Maharat al-Istima' (listening skills), Maharat al-Qira'ah (reading skills), and Maharat al-Kitabah (writing skills). By leveraging AI advancements in these areas, educational software can offer more comprehensive and effective learning experiences for Arabic language learners.

CONCLUSION

In Malaysia, there is a need to incorporate more AI concepts into the development of software for teaching the Arabic language. The key concepts include machine learning, deep learning, and neural networks, which are crucial in creating educational software with AI technology, such as websites, robotics, smartphone applications, and other mobile devices. However, developing AI-based Arabic language software comes with its challenges, such as orthographic, morphological, syntactic, anaphora, and semantic ambiguity. Therefore, AI and Arabic language experts must investigate these issues thoroughly, particularly in the design and development phases of Arabic language education software. The study emphasizes the importance of the E-Muhadathat AI kit model, which applies machine learning and deep learning concepts to improve spoken language comprehension, written text analysis, and conversational recognition. This model can provide valuable insights into the development of Arabic language content modules and online learning models tailored for non-native speakers in Malaysian Higher Education Institutions (HEIs). Furthermore, by embracing student-centered interactive Arabic learning approaches, educators can better support learners in their language acquisition journey. Finally, the study advocates for the ongoing exploration and development of AI in Arabic language teaching and learning. This exploration is crucial in enabling students to communicate effectively with non-Arabic speakers in Malaysian universities. By embracing AI technologies, educators can create an enriched and inclusive learning environment conducive to cross-cultural communication and understanding.

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