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# EFFECTIVENESS OF AN AI-BASED AND FUNCTIONAL APPROACH PROGRAM IN DEVELOPING GRAMMAR SKILLS AMONG NON-ARABIC SPEAKING STUDENTS

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## ABSTRACT

*The current research aimed to measure the effectiveness of an AI-based educational program with a functional approach in developing grammar skills among non-native Arabic speakers. The research employed a quasi-experimental design with two groups (control and experimental). The sample consisted of 60 second-year students at the College of Sharia and Fundamentals of Religion at Najran University, who were learning Arabic as a second language. They were randomly divided into two groups: an experimental group (30 students) that studied using the AI-based program with a functional approach, and a control group (30 students) that studied using the traditional method. The research utilized an achievement test in grammar skills, the validity and reliability of which were verified. The program was implemented for four weeks, with three sessions per week. The results showed statistically significant differences ( $\alpha = 0.05$ ) between the mean scores of the two groups on the post-test, favoring the experimental group. This confirms the effectiveness of the AI-based program with a functional approach in developing grammar skills. The research also presented a set of recommendations and suggestions for improving grammar education for non-native Arabic speakers.*

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**KEYWORDS:** Artificial Intelligence, Functional Approach, Grammar Skills, Teaching Arabic to Non-Native Speakers.

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## 1. INTRODUCTION

The contemporary world is witnessing rapid development in artificial intelligence (AI) technologies and their diverse applications across various fields, including education, which is increasingly reliant on these technologies to enhance the quality of education and facilitate the learning process. In language teaching, AI has become an effective tool in developing methods for teaching various language skills, particularly in teaching Arabic to non-native speakers.

Arabic is one of the most widely spoken languages in the world, with over 400 million speakers. It is also the language of the Holy Quran, making its learning a religious obligation for millions of Muslims worldwide. With the growing interest in learning Arabic, the need has arisen to develop modern teaching methods that consider the specific needs of non-native speakers and the challenges they face in acquiring various language skills.

One of the most prominent challenges facing non-native Arabic learners is learning Arabic grammar, given its unique characteristics and complex rules that differ from other languages, such as the system of inflection, gender agreement, number, and verb conjugation. Salim (2024) pointed out that teaching Arabic grammar to non-native speakers faces numerous challenges that require innovative teaching approaches to overcome.

To address these challenges, various teaching approaches have emerged, aiming to facilitate grammar learning and make it more effective. Among the most prominent of these approaches is the "functional approach," which focuses on teaching the language through its functional uses in daily life, moving away from theoretical complexities that might distract learners from the primary goal of language learning: effective communication. Rashwan (2008) affirms the effectiveness of the functional approach in developing the language skills of non-native Arabic speakers.

Several studies have demonstrated the effectiveness of the functional approach in developing various language skills. For example, Al-Jwaid and Saeed's study (2022) indicated its effectiveness in developing grammatical and morphological skills. Al-Dossari's study (2021) confirmed its effectiveness in developing speaking skills among non-native Arabic speakers, while Al-Ayadhi's study (2021) found that a program based on the functional approach was effective in developing listening skills. In light of rapid technological advancements, integrating artificial intelligence (AI) with a functional approach to teaching Arabic

grammar has become essential for achieving better educational outcomes. Sultani (2025) highlighted the importance of AI and its various applications in the automatic processing of Arabic language, while Haj Madani (2025) emphasized the importance of employing AI in teaching Arabic through audiovisual programs.

AI offers tremendous potential in language teaching, including: immediate feedback, adaptation to the learner's level, automatic generation of practical examples, automatic error correction, and the provision of interactive exercises tailored to each learner's needs. Al-Qadi (2021) pointed to the vast prospects and potential of investing in AI in learning and teaching Arabic as a second language.

From this perspective, the current research aims to integrate the functional approach to teaching grammar with AI technologies, with the goal of designing a comprehensive educational program that leverages the advantages of both approaches to effectively and engagingly develop the grammar skills of non-native Arabic speakers.

### 1.1. Research Problem

Despite efforts to develop Arabic language teaching for non-native speakers, teaching Arabic grammar still faces significant challenges that affect learners' acquisition of grammatical skills. A study by Al-Fallaj (2022) confirmed the prevalence of grammatical errors among Arabic language learners, indicating shortcomings in traditional teaching methods.

The research problem lies in the weak grammar skills of non-native Arabic speakers, a fact observed by the researcher through teaching Arabic to this group. These students struggle to understand and apply grammatical rules in functional contexts. Furthermore, traditional grammar teaching methods focus on memorization without connecting rules to their functional uses, making grammar learning a burden rather than a tool for effective communication.

Hashem (2022), in his analytical study of the grammar content in the "Arabic Between Your Hands" series, pointed to the necessity of developing grammatical content based on a functional approach to achieve greater teaching effectiveness. A study by Belbaji and Al-Aib (2024) also emphasized the importance of teaching functional grammar in developing reading comprehension skills.

With modern technological development, it has become necessary to invest in artificial intelligence techniques in developing grammar education. Ramadan (2024) pointed to the effectiveness of using

artificial intelligence in teaching various Arabic language skills. Al-Majayda (2025) also confirmed the impact of using artificial intelligence in improving the Arabic language skills themselves. The study by Nhan, Hoa & Quang (2025) confirmed that learning languages other than the mother tongue causes anxiety and a lack of confidence in some learners. This contributes to alleviating the anxiety of learning foreign languages by providing an environment free of prejudices and enhances the feeling of more confidence and desire to practice learning. The study emphasizes the importance of artificial intelligence in promoting self-learning by providing customized constructive feedback and adaptive learning environments. Based on the above, the research problem is defined by the following main question:

What is the effectiveness of a program based on artificial intelligence and a functional approach in developing grammar skills among non-native Arabic speakers?

### 1.2. Research Questions

This research seeks to answer the following questions:

1. What is the effectiveness of a program based on artificial intelligence and a functional approach in developing grammar skills among non-native Arabic speakers?
2. Are there statistically significant differences at the ( $\alpha = 0.05$ ) level between the mean scores of the experimental and control groups on the post-test for grammar skills?

### 1.3. Research Objectives

This research aims to:

1. Measure the effectiveness of the proposed program in developing grammar skills among non-native Arabic speakers.
2. Identify the differences between the experimental and control groups in grammar skills after the program's implementation.

### 1.4. Research Significance

The significance of this research lies in the following:

First: Theoretical Significance:

1. This research contributes to enriching the educational literature related to teaching Arabic to non-native speakers by integrating the functional approach with artificial intelligence (AI) technologies.
2. The research presents a comprehensive theoretical framework on the functional

approach to grammar teaching and the applications of AI in teaching Arabic.

3. The research highlights the importance of employing modern technologies in developing the teaching of grammatical skills.

#### Second: Practical Significance:

1. This research presents an AI-based educational program that can be utilized in teaching grammar to non-native Arabic speakers.
2. The research provides a validated test for measuring the grammar skills of non-native Arabic learners.
3. The research assists teachers of Arabic as a foreign language in employing AI technologies in their teaching.
4. The research benefits curriculum designers and developers of educational programs in the field of teaching Arabic to non-native speakers.
5. The research fulfills the educational field's need for modern teaching methods that keep pace with technological advancements.

### 1.5. Research Scope

The research is limited to the following:

1. **Subject Matter Scope:** The research focused on developing basic grammar skills (parsing, correct grammatical structures, nominal and verbal sentences and the distinction between them, and particles of negation and jussive mood) among non-native Arabic speakers.
2. **Population Scope:** The research sample consisted of (60) second-year students at the College of Sharia and Fundamentals of Religion at Najran University, who were learning Arabic as a second language.
3. **Time Scope:** The research was conducted during the first semester of the 2024/2025 academic year. The program was implemented over four weeks, with three lectures per week.
4. **Geographical Scope:** The research was conducted at one of the Colleges of Sharia and Fundamentals of Religion at Najran University for non-native Arabic speakers in the Kingdom of Saudi Arabia.

## 2. RESEARCH TERMINOLOGY

1. **Effectiveness:** The research defines effectiveness operationally as: "The degree of improvement in students' performance in grammar skills, measured by the difference between the mean scores of the experimental and control groups on the post-test of grammar skills."
2. **Artificial Intelligence:** The research defines

artificial intelligence operationally as: "A set of technologies and software that mimic human intelligence in processing Arabic, generating examples, correcting errors, and providing immediate feedback to learners."

3. **Functional Approach:** The research defines the functional approach operationally as: "An educational method that focuses on teaching grammar through its functional uses in real communicative contexts, so that the student learns grammar as a tool for communication and not as an end in itself."
4. **Grammar Skills:** The research defines grammar skills operationally as: "The learner's ability to understand grammatical rules and apply them correctly in parsing, constructing correct linguistic structures, distinguishing between nominal and verbal sentences, and using the particles of negation and jussive mood in different functional contexts."
5. **Non-Native Arabic Speakers:** The research defines this category operationally as: "Students whose first language is not Arabic and who are learning Arabic as a second or foreign language, and who have reached an intermediate level in language learning."

### 3. THEORETICAL FRAMEWORK AND PREVIOUS STUDIES

**First Theme:** The Functional Approach in Grammar Teaching

The functional approach is a modern approach to language teaching, based on the idea that language is a tool for communication, not an end in itself. This approach focuses on teaching language through its social and communicative functions, enabling students to learn to use language in real-life situations. Al-Ahwal (2014) highlighted the importance of the functional approach in teaching Arabic, particularly in relation to teaching functional reading.

The functional approach is based on several principles, including: linking linguistic content to learners' functional needs, focusing on the actual use of language in real contexts, and prioritizing meaning and function over abstract form and rules. Ghwairiq (2022) emphasized the importance of the functional approach in developing Arabic language skills at the primary level, as it helps learners use language correctly in various communicative situations.

When the functional approach is applied to grammar teaching, the focus shifts from teaching abstract grammatical rules to teaching grammar as a

functional tool that serves linguistic communication. Instead of starting with a grammatical rule and then searching for examples, the teacher begins with real-life communicative situations where the learner needs to use a specific grammatical rule. The learner then infers the rule from its functional use.

Studies have proven the effectiveness of this approach in teaching grammar. A study by Al-Juwaid and Saeed (2022) found the functional approach to be highly effective in developing the grammatical and morphological skills of secondary school students. The study attributed this to the fact that the functional approach makes grammatical rules meaningful to the learner by linking them to their functional needs.

Similarly, a study by Al-Fallaj (2018) confirmed the effectiveness of a program based on the functional approach in addressing common grammatical errors among female students in the Arabic language department. The program helped the students understand grammatical rules by applying them in functional contexts, which significantly reduced grammatical errors.

The functional approach to teaching grammar is characterized by several features, including:

1. **Contextual Connection:** Grammatical rules are taught in real-life communicative contexts, which helps the learner understand the communicative function of the rule.
2. **Emphasis on Usage:** This approach focuses on the practical application of grammar rules in communication, rather than the memorization of abstract rules.
3. **Functional Sequence:** Grammar rules are taught based on learners' functional needs, not on a logical sequence of rules.
4. **Flexibility:** This approach allows for the adaptation of grammatical content to learners' needs and levels.

Sanji (2020) indicated that using the functional approach contributes to the development of written literacy, as it helps learners use grammatical rules correctly in their writing.

The functional approach is also particularly important in teaching Arabic to non-native speakers, as it meets learners' functional needs and helps them use Arabic in their daily lives. Rashwan's study (2008) confirmed the effectiveness of the functional approach in developing functional speaking skills among Spanish-speaking learners of Arabic. This approach helped learners use Arabic in real-life communicative situations. Similarly, Al-Dossari's study (2021) found that a program based on the functional approach was effective in developing

speaking skills among non-native Arabic learners at Umm Al-Qura University. The study confirmed that the program helped learners acquire speaking skills through practicing the language in diverse functional situations.

In the same vein, Al-Tamimi (2020) indicated the effectiveness of a program based on the functional approach in developing language literacy skills, thus confirming the effective role of the functional approach in developing language skills in general.

### **3.1. Second Theme: Artificial Intelligence In Arabic Language Education**

Artificial intelligence is defined as a set of technologies that enable machines to simulate human cognitive abilities such as learning, reasoning, and problem-solving. Sultani (2025) defined artificial intelligence (AI) as "the ability of a machine to mimic the human mind in thinking and decision-making." She noted that AI has numerous applications in the automatic processing of Arabic, including speech recognition, machine translation, grammatical analysis, and text generation.

In the field of language teaching, AI has become an effective tool in developing the educational process, offering tremendous potential for improving the quality of education and personalizing learning according to each learner's needs. Ramadan (2024) emphasized the importance of using AI in teaching Arabic language skills, as it helps provide an interactive learning environment that responds to the diverse needs of learners.

AI offers several benefits in teaching grammar, including:

1. Immediate feedback: AI applications can correct learners' errors instantly and provide detailed explanations for each mistake, leading to rapid performance improvement.
2. Adaptive learning: AI systems can determine the learner's level and deliver content that suits their abilities, thus achieving personalized learning.
3. Example generation: AI can automatically generate diverse grammatical examples, saving teachers significant time and providing learners with unlimited practice opportunities.
4. Continuous Interaction: Artificial intelligence applications enable learning anytime, anywhere, increasing opportunities for practice and training.

Al-Majayda (2025) indicated that the use of artificial intelligence has a positive impact on improving Arabic language skills, helping learners learn in an interactive and engaging way.

There are numerous applications of artificial intelligence in teaching Arabic to non-native speakers, and several studies have reviewed these applications and their benefits. For example, Jahida (2021) cited Duolingo as a model for using artificial intelligence in teaching Arabic to non-native speakers, as the application provides an interactive learning environment.

Al-Qadi (2021) also pointed to the vast potential of artificial intelligence (AI) in teaching and learning Arabic as a second language, emphasizing that AI can contribute to the development of innovative educational tools that mimic the role of a human teacher in providing explanations and feedback.

In a recent study, Haj Madani (2025) highlighted the importance of employing AI in teaching Arabic through audiovisual programs, as these programs help learners acquire language skills in an interactive and engaging way.

The need for AI in teaching Arabic grammar to non-native speakers is also increasing, given the significant challenges these learners face in understanding and applying Arabic grammatical rules. Zubair (2024) pointed to the importance of using computers and modern technologies to facilitate teaching Arabic to non-native speakers, particularly through computational linguistics studies. The study by Syaikhudin and Laili (2024) also found that an AI-based learning model was effective in improving Arabic speaking skills among non-native speakers, confirming the potential for applying AI to teaching various language skills, including grammar.

The study by Negeri et al. (2025) confirmed the potential for utilizing AI in designing Arabic language teaching programs for non-native speakers, as AI can provide innovative solutions to the challenges facing Arabic language education.

Mohideen (2024) reviewed the opportunities available for applying AI technologies in teaching Arabic to non-native speakers from a theoretical perspective, indicating that AI offers significant opportunities for developing interactive educational tools that help learners acquire language skills effectively.

The study by Asfar et al. (2024) also indicated that AI contributes to redefining Arabic language teaching models by offering innovative teaching methods, and emphasized that AI can bring about a qualitative shift in Arabic language education. In the same vein, a study by Borham et al. (2022) concluded that integrating artificial intelligence (AI) is effective in designing Arabic conversation learning tools for non-native speakers, confirming the potential for

applying AI in various aspects of Arabic language teaching.

**3.2. Third Axis: Integrating the Functional Approach with Artificial Intelligence**

The integration of the functional approach with AI is based on the idea that the two approaches complement each other. The functional approach provides the educational framework that focuses on the functional use of language, while AI provides the technical tools that enable the efficient implementation of this framework. When we combine the focus on the communicative function of grammar (through the functional approach) with the immense technical capabilities of AI, we obtain a comprehensive educational program that achieves optimal results.

Integrating the functional approach with AI offers several advantages, including:

1. Personalized Functional Learning: AI can identify the functional needs of each learner and provide grammatical content that meets these needs.
2. Intensive Functional Practice: AI provides unlimited functional exercises, increasing opportunities to practice grammar rules in real-world contexts.
3. Immediate Functional Correction: Artificial intelligence can correct grammatical errors instantly while clarifying the correct communicative function of the structure.
4. Continuous Assessment: AI systems can continuously assess the learner's ability to use grammatical rules in different functional contexts.

In practice, the functional approach can be integrated with AI by designing educational programs that present grammatical content in interactive functional contexts. This allows the learner to interact with real-life communicative situations where they need to use specific grammatical rules. AI then guides the learner, corrects their errors, and provides additional examples as needed.

Belbaji and Al-Aib (2024) indicated that teaching functional grammar has a positive impact on developing reading comprehension, demonstrating the effectiveness of the functional approach in improving overall language performance. When this approach is integrated with AI technologies, even better results can be achieved by providing an interactive learning environment that focuses on the functional use of language.

**4. RESEARCH METHODOLOGY AND PROCEDURES**

This research employed a quasi-experimental design, utilizing a two-group (control and experimental) approach, to measure the effectiveness of an AI-based educational program and a functional approach in developing grammar skills among non-native Arabic speakers. This methodology is suitable for the nature of this research as it allows for measuring the impact of the independent variable (the educational program) on the dependent variable (grammar skills) through comparison between the two groups.

The research population consisted of all second-year students in the Faculty of Sharia and Fundamentals of Religion who are learning Arabic as a second language for non-native speakers. The research sample comprised 60 students, selected purposively from the intermediate level, and randomly divided into two groups:

- Experimental Group: Consisting of 30 students who studied using the AI-based program according to the functional approach.
- Control Group: Consisting of 30 students who studied using the traditional method based on direct instruction and written exercises.

*Table 1: Distribution Of The Research Sample.*

Group	Number of Students	Teaching Method
Experimental	30	Artificial Intelligence-Based Program and Functional Approach
Control	30	Traditional Method
Total		60

**4.1. Research Tools**

- **First: Grammar Skills Test**

An achievement test was developed to measure the grammar skills of non-native Arabic speakers. The test was developed through the following steps:

1. Defining the Test Objective: The test aims to measure basic grammar skills (inflection, syntax, subject-predicate agreement, and particles of negation and jussive mood) among intermediate-level students.
2. Preparing the Test Specifications Table: A test specifications table was prepared, outlining the grammar skills to be measured and the number of questions allocated to each skill.

*Table 2: Specifications Table for the Grammar Skills Test.*

Grammatical Skill	Number of Items	Relative Weight	Item Type

syntax	8	26.7%	Multiple Choice
Syntactic Structures	8	26.7%	Multiple Choice and Fill-in-the-Blank
Nominal and Verbal Sentences	7	23.3%	Fill-in-the-Blank and Multiple Choice
Nasb and Jazm tools	7	23.3%	Multiple Choice
Total	30	100%	

3. Formulation of Test Items: (30) objective items were formulated, varying between multiple choice and fill-in-the-blank questions, to cover the grammatical skills specified in the specifications table.
4. Test Validity: To verify the test's validity, it was presented to a panel of seven experts specializing in teaching Arabic to non-native speakers. They were asked to provide feedback on:
  - The suitability of the items to the skills being measured
  - The clarity of the wording of the items
  - The suitability of the items to the students' level
  - The linguistic and grammatical accuracy of the items.

The experts' comments were taken into account, and the necessary modifications were made. This included revising the wording of some items, deleting two items, and replacing two others. Over 85% of the experts agreed on the test's validity, confirming its content and face validity.

5. Test Reliability: To calculate the test's reliability, it was administered to a pilot sample of 25 students outside the main research sample. The reliability coefficient was calculated using Cronbach's Alpha.

**Table 3: Reliability Coefficients For The Dimensions Of The Grammar Skills Test.**

Dimension	Number of Items	Cronbach's Alpha Coefficient
syntax	8	0.84
Syntactic Structures	8	0.82
Nominal and Verbal Sentences	7	0.81
Nasb and Jazm tools	7	0.83
Test as a Whole	30	0.89

The results in Table (3) indicate that the overall reliability coefficient of the test is (0.89), a high reliability coefficient indicating a high degree of

internal consistency, making it suitable for application to the research sample.

6. Difficulty and Discrimination Coefficients: The difficulty and discrimination coefficients for each item of the test were calculated based on the results of the pilot application.

**Table 4: Summary Of Difficulty And Discrimination Indices For Test Items.**

Index	Minimum	Maximum	Average
Difficulty Indices	0.32	0.71	0.51
Discrimination Indices	0.28	0.68	0.47

The results indicate that the difficulty indices ranged from (0.32 - 0.71) with an average of (0.51), which are acceptable indices indicating the diversity of the test items, ranging from easy to medium to difficult. The discrimination indices also ranged from (0.28 - 0.68) with an average of (0.47), which are good indices indicating the items' ability to differentiate between students of varying abilities.

7. Final Form of the Test: After confirming the test's validity and reliability, the final version of the test consists of (30) objective items distributed across four basic grammatical skills. The total score for the test is (30) points, with one point awarded for each correct answer.

- Second: The AI-Based and Functional Approach Educational Program

An integrated educational program was designed that combines artificial intelligence techniques with the principles of the functional approach to develop grammar skills. The program's development involved the following steps:

1. Defining the Program's Foundations: The program was based on the following foundations:
  - Linguistic Foundation: Focusing on the basic grammatical rules needed by intermediate-level learners
  - Pedagogical Foundation: Relying on the principles of the functional approach in presenting grammatical content
  - Technical Foundation: Using artificial intelligence techniques to enhance learning
  - Psychological Foundation: Considering the characteristics of non-native Arabic speakers
2. Program Content: The program included four main learning units:
  - Unit One: Inflection and its Signs
  - Unit Two: Basic Grammatical Structures
  - Unit Three: Agreement between the Subject and Predicate

- Unit Four: Subjunctive and Jussive Particles
- 3. Teaching Strategies in the Program: The program adopted diverse teaching strategies that align with the functional approach, including:
  - Presenting grammatical rules in real-life communicative contexts
  - Using functional examples from everyday life
  - Focus on practical application and functional implementation
  - Employing cooperative and interactive learning
- 4. Artificial Intelligence Tools Used in the Program The program included several AI-based tools, such as:
  - Automatic correction: A system that automatically corrects students' mistakes, clarifies the error, and provides an explanation.
  - Automatic example generation: The program generates diverse grammatical examples according to each student's needs.
  - Immediate feedback: Students receive immediate feedback after each activity.
  - Adaptive learning: The program adapts to each student's level and provides appropriate content.
  - Continuous assessment: The program continuously evaluates student performance and identifies strengths and weaknesses.
- 5. Program duration and implementation: The program was implemented over four weeks, with three sessions per week. Each session lasted 60 minutes, for a total of 12 sessions. • Research Implementation Procedures

The research was conducted according to the following steps:

**1. Preparation and Setup:**

- Preparing the research instruments (test and instructional program)
- Verifying the validity and reliability of the instruments
- Selecting the research sample and randomly dividing it into two groups

**2. Pre-test:**

- Administering the pre-test to both groups (experimental and control)
- Recording and analyzing the scores to ensure the equivalence of the two groups

*Table 5: Results Of The T-Test For The Significance Of Differences Between The Two Groups In The Pre-Test.*

Group	Number	arithmetic mean	standard deviation	Value (t)	degrees of freedom	Level of significance
Experimental	30	14.73	3.21	0.42	58	0.68 (Not significant)
Control	30	14.47	3.18			

The results in Table (5) indicate that there are no statistically significant differences at the ( $\alpha = 0.05$ ) level between the mean scores of the two groups in the pre-test, as the calculated t-value was (0.42), which is not statistically significant. The significance level (0.68) indicates the equivalence of the two groups before the program's implementation.

**3. Experiment Implementation:**

• The experimental group was taught using the AI-based program and the functional approach for four weeks.

• The control group was taught the same content and duration using the traditional method.

• The program's implementation was monitored to ensure adherence to the timeline.

**4. Post-Test:**

• The post-test was administered to both groups after the program's completion.

• The scores were recorded and statistically analyzed.

**5. Statistical Analysis: The following statistical methods were used:**

- Means and standard deviations
- Independent Samples t-test
- Cronbach's alpha coefficient for reliability
- Effect size calculation using eta-squared ( $\eta^2$ )

**Research Findings and Discussion**

**Findings Related to Question 1**

To answer the first question, which reads: "What is the effectiveness of an AI-based functional approach program in developing grammar skills among non-native Arabic speakers?", the means and standard deviations of the two groups' scores on the post-test were calculated.

*Table 6: Means And Standard Deviations Of The Two Groups' Scores On The Post-Test.*

Group	Number	arithmetic mean	standard deviation	lowest grade	highest grade
Experimental	30	24.87	2.34	20	29
Control	30	18.23	3.12	13	24

Table (6) shows that the mean score of the experimental group on the post-test was (24.87) with a standard deviation of (2.34), while the mean score of the control group was (18.23) with a standard deviation of (3.12), indicating a statistically significant difference in favor of the experimental group. To confirm the significance of this difference, a t-test was used.

**4.2. Results Related To Question 2**

To answer the second question, which reads: "Are there statistically significant differences at the ( $\alpha = 0.05$ ) level between the mean scores of the students in the experimental and control groups on the post-test

for grammar skills?", an independent samples t-test was used to measure the significance of the differences between them.

**Table 7: Results Of The T-Test For The Significance Of The Differences Between The Two Groups On The Post-Test.**

Group	Number	arithmetic mean	standard deviation	Value (t)	degrees of freedom	Level of significance	Trace size ( $\eta^2$ )
Experimental	30	24.87	2.34	9.68	58	0.000 (Significant)	0.62
Control	30	18.23	3.12				

The results in Table (7) indicate statistically significant differences at the ( $\alpha = 0.05$ ) level between the mean scores of the experimental and control groups in the post-test for grammar skills. The calculated t-value was (9.68), which is statistically significant at the (0.000) level. These differences favor the experimental group, which studied using the AI-based program and the functional approach. As shown in the table, the effect size ( $\eta^2$ ) was (0.62), a very large effect size according to Cohen's criteria, confirming the program's significant effectiveness in developing grammar skills among non-native Arabic speakers.

To obtain a more detailed picture of the program's effectiveness, the means and standard deviations were calculated for each of the grammar sub-skills, and a t-test was administered for each skill individually.

**Table 8: Means And Standard Deviations Of The Two Groups' Scores In Grammar Sub-Skills In The Post-Test.**

Grammatical Skill	Group	Number	arithmetic mean	standard deviation	Total grade
syntax	Experimental	30	6.83	0.79	8
	Control	30	4.97	1.12	8
Syntactic Structures	Experimental	30	6.70	0.84	8
	Control	30	4.83	1.18	8
Nominal and Verbal Sentences	Experimental	30	5.80	0.89	7
	Control	30	4.20	1.03	7
Nasb and Jazm tools	Experimental	30	5.54	0.94	7
	Control	30	4.23	0.97	7

**Table 9: Results Of The (T) Test For The Significance Of Differences Between The Two Groups In The Sub-Skills Of Grammar**

Grammatical Skill	Value (t)	degrees of freedom	Level of significance	Trace size ( $\eta^2$ )	Interpretation
syntax	7.35	58	0.000	0.48	Large
Syntactic Structures	7.12	58	0.000	0.47	Large
Nominal and Verbal Sentences	6.54	58	0.000	0.42	Large

Nasb and Jazm tools	5.29	58	0.000	0.33	Medium
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The results in Tables (8) and (9) indicate statistically significant differences at the ( $\alpha = 0.05$ ) level between the mean scores of the two groups in all sub-skills of grammar, favoring the experimental group. The calculated (t) values were statistically significant for all skills. The effect size was large for the skills of parsing, syntactic structures, and subject-predicate agreement, while it was moderate for the skill of the accusative and jussive particles.

### 4.3. Discussion And Interpretation Of Results

The research results demonstrated the significant effectiveness of the AI-based program and the functional approach in developing grammar skills among non-native Arabic speakers. The experimental group clearly outperformed the control group in the post-test. These results can be interpreted in light of several factors:

#### First: The Role of the Functional Approach

The functional approach contributed to making grammar learning more meaningful for students by linking grammatical rules to their functional uses in daily life, rather than learning them as abstract rules. This aligns with the findings of Al-Jwaid and Saeed (2022), who indicated the effectiveness of the functional approach in developing grammatical skills, as it helps learners understand the purpose of grammatical rules and apply them in real-life contexts.

Furthermore, focusing on the functional aspect of grammar reduced the perceived difficulty of Arabic grammar among non-native speakers. This is consistent with the results of Al-Dossari's (2021) study, which confirmed the effectiveness of the functional approach in improving the linguistic performance of non-native Arabic language learners.

Belbaji and Al-Aib (2024) indicated that teaching functional grammar has a positive impact on developing reading comprehension, supporting the idea that the functional approach not only contributes to improving grammatical skills but also extends its impact to other language skills.

#### Second: The Role of Artificial Intelligence

The artificial intelligence technologies used in the program provided several advantages that contributed to improving grammar learning, including:

1. Immediate Feedback: Artificial intelligence enabled students to receive immediate correction of their errors with detailed explanations, which helped reinforce learning and prevent the entrenchment of errors. This

aligns with what Al-Majayda (2025) indicated regarding the positive impact of using artificial intelligence in improving Arabic language skills.

2. Adaptive Learning: The program was able to adapt the content according to each student's level, providing a personalized learning experience for each learner. The study by Syaikhudin and Laili (2024) confirmed the effectiveness of AI-based educational models in improving language skills.
3. Example Generation: The program provided an unlimited number of diverse grammatical examples, allowing students to practice grammar rules extensively. This aligns with Ramadan's (2024) observations regarding the benefits of using artificial intelligence (AI) in teaching Arabic language skills.
4. Interactivity and Motivation: AI technologies have made the learning process more interactive and engaging, increasing student motivation and participation. Haj Madani (2025) highlighted the importance of employing AI in providing an attractive learning environment.

### Third: Integration of the Two Approaches

The program's success is largely attributed to the integration of the functional approach and AI. The functional approach provided the educational framework focused on the practical use of the language, while AI provided the technical tools that enabled the efficient application of this framework. Asfar et al. (2024) indicated that AI contributes to redefining Arabic language teaching models in innovative ways.

Furthermore, combining a functional focus with modern technologies has helped overcome many challenges in teaching grammar to non-native speakers. This aligns with Salim's (2024) observations on the necessity of using new educational innovations to overcome the challenges of teaching Arabic grammar.

### Fourth: Interpreting Differences in Sub-Skills

The results showed that the effect size was large for parsing skills, syntactic structures, and subject-predicate agreement, while it was moderate for the skill of using accusative and jussive particles. This can be explained as follows:

1. Parsing Skills: This skill benefited greatly from the immediate feedback provided by artificial intelligence, as students received immediate correction of their parsing errors along with explanations of the reasons.
2. Syntactic Structures: The automated

generation of examples helped provide diverse exercises on different structures, allowing students to practice extensively.

3. Using Accusative and Jussive Particles: Despite the noticeable improvement, the effect size was relatively small. This may be because this skill requires more memorization of the particles and their uses, which takes longer to master.

Al-Fallaj's study (2022) indicated the prevalence of certain grammatical errors among Arabic language learners, suggesting that some grammatical skills require more time and practice to master. The findings of the current research align with those of several previous studies that have confirmed the effectiveness of the functional approach and artificial intelligence (AI) in teaching Arabic. For example, Al-Ayadi's (2021) study demonstrated the effectiveness of a functional-based program in developing listening skills, while Al-Qadi's (2021) study highlighted the vast potential for investing in AI in teaching Arabic as a second language.

The results also corroborate those of Negeri et al. (2025), which affirmed the feasibility of utilizing AI in designing Arabic language programs for non-native speakers, and Mohideen's (2024) study, which explored the opportunities for applying AI in Arabic language teaching.

The current study distinguishes itself from previous research by integrating the functional approach and AI into a comprehensive educational program, whereas most previous studies focused on one approach over the other. Sultani's (2025) study emphasized the importance of natural language processing for Arabic, which was implemented in the current program through the use of AI-based language processing techniques.

The results also align with Hashim's (2022) study, which recommended developing grammar content based on a functional approach. The current research demonstrated the effectiveness of this approach when integrated with artificial intelligence (AI) techniques. Al-Tamimi's (2020) study confirmed the effectiveness of the functional approach in developing linguistic literacy, which supports the findings of the current research. Zubair's (2024) study highlighted the importance of using computers to facilitate Arabic language teaching for non-native speakers, a goal achieved in the current program through the use of modern technologies. Borham et al. (2022) also confirmed the effectiveness of integrating AI into the design of educational tools, a method implemented in the current research.

Finally, the results are consistent with Ghwairq's

(2022) study, which emphasized the importance of the functional approach in developing Arabic language skills, and Sanji's (2020) study, which concluded that the functional approach is effective in developing written literacy.

#### 4.4. Recommendations And Suggestions

In light of the research findings, the following recommendations and suggestions can be made:

First: Recommendations

##### 1. For Teachers:

- Employ artificial intelligence (AI) technologies in teaching Arabic grammar to non-native speakers
- Adopt a functional approach in presenting grammatical rules
- Train students to use grammatical rules in real communicative contexts
- Utilize AI-based applications and programs in teaching

##### 2. For Curriculum Designers:

- Incorporate the functional approach into Arabic language curricula for non-native speakers
- Integrate AI technologies into curricula and courses
  - Focus on the functional use of grammatical rules rather than rote memorization
  - Develop textbooks that integrate the functional approach with modern technologies

##### 3. For Educational Institutions:

- Provide the necessary technological infrastructure for implementing AI programs
- Conduct training courses for teachers on using AI technologies in teaching
- Encourage research and development in the field of AI applications in Arabic language teaching
- Support projects that integrate modern technologies with effective educational approaches

##### 4. For Decision-Makers:

- Develop policies that encourage the use of modern technologies in teaching Arabic to non-native speakers Other measures include:
  - Allocating sufficient budgets for developing AI-based educational programs
  - Establishing specialized research centers focused on AI applications in Arabic language teaching
  - Supporting collaboration between educational institutions and technology companies to develop innovative educational solutions

#### Second: Recommendations

The research suggests conducting the following studies:

1. Studying the program's effectiveness in developing other grammatical skills among different levels of Arabic language learners
2. Investigating the impact of integrating AI with the functional approach on developing other language skills (listening, speaking, reading, and writing)
3. Studying learner and teacher attitudes towards using AI programs in grammar teaching
4. Investigating the effectiveness of different types of AI technologies in teaching grammar to non-native Arabic speakers
5. A comparative study between the functional approach and other approaches when integrated with AI.

## 5. CONCLUSION

The current research has yielded significant results confirming the effectiveness of integrating artificial intelligence with a functional approach in developing grammar skills among non-native Arabic speakers. The results clearly demonstrated the superiority of the experimental group, which studied using the proposed program, over the control group, which studied using the traditional method. The effect size reached 0.62, a very large effect size that confirms the program's high effectiveness.

This research represents a valuable addition to the educational literature in the field of teaching Arabic to non-native speakers. It presents a practical model for integrating modern technologies with effective educational approaches to achieve outstanding learning outcomes. Furthermore, the research opens up broad horizons for further studies and applications in this vital field.

In light of rapid technological advancements, it has become essential to employ artificial intelligence techniques in developing the educational process, especially in teaching languages that face significant challenges, such as teaching Arabic to non-native speakers. The researcher hopes that this research will contribute to encouraging further studies and applications that leverage the immense potential of artificial intelligence to serve the teaching and dissemination of Arabic worldwide.

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