

Research Article

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Designing a Smart Voice Assistant Based on Artificial Intelligence to Develop Listening and Speaking Skills in English for Elementary School Students

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Abstract

Background/purpose. The research aimed to develop listening and speaking skills in English as a foreign language among elementary school students by designing a smart voice assistant application based on artificial intelligence technology.

Materials/methods. The research used the experimental methodology and was applied to a sample of two groups. The first group was the experimental group, which included ten students, and the control group included twelve students. Two research tools were designed: the first tool was an observation card and the second one was an oral test. The observation card included two axes: the first to assess listening skills, and the second to assess speaking abilities.

Results. The results of the observation card showed statistically significant results between the two groups. The experimental group performed better on two indicators of assessing listening skill and four indicators of measuring speaking skill. In contrast, the findings of the research through the oral exam indicated the presence of statistically significant differences between the experimental and control groups in the listening and speaking abilities. The research attributed these differences to the positive effect of applying the smart voice assistant on developing the listening and speaking skills of the students in the experimental group.

Conclusion. The study demonstrated that smart voice assistants based on artificial intelligence significantly improved students' English listening and speaking skills. These results highlight the potential of integrating modern technology into language learning to enhance student engagement and achievement.

1. Introduction

Artificial Intelligence (AI) is a recent technology of the Fourth Industrial Revolution (Chen et al., 2020). As there are no limits to its capabilities or the extent of its rapid development and the difficulty of predicting its future potentials (Ahmed & Abdel Samad, 2020), it has occupied an important place in implementing work and accelerating its pace in various aspects of people's lives. Artificial intelligence means the process of teaching a machine to simulate human behavior, imitate its abilities in thinking, analysis and decision-making, and even surpass it in the accuracy of operations and the speed of their implementation (Ahmed & Abdel Samad, 2020). Artificial intelligence provides empowerment in managing, facilitating, and speeding up work completion (Al-Hadi, 2021), and is considered a solution to increase productivity and control the flow of data and information, processing and analyzing them (Kushmar et al., 2022). For example, its uses are prominent in translating languages and conducting conversations between machines and individuals (Al-Sharif, 2022). Artificial intelligence is an important major pillar in the process of transforming the traditional educational process into a development that is both smart and advanced (Mahmoudi, 2022). The utilization of AI in the educational process would facilitate teachers and learners alike with the support of the technology available to them (Aljohani, 2021). The emergence of the scientific term "Artificial Intelligence in Education (AIED) has contributed to building modern foundations for the education and teaching processes and improving learning among students (Miao et al., 2021; Terzopoulos & Satratzemi, 2020).

Based on the interactions of smart voice assistants with people, they have been used to improve learning of speaking and listening skills in English, building on the foundations of different learning theories. In addition, English is the first language spoken (Rao, 2019), and occupies an important position as the most widely used communication language as a second or foreign language around the world (Visaltanachoti et al., 2021; Haberman et al., 2020; Rao, 2019). English is taught as a foreign language at all levels of general education in the Kingdom of Saudi Arabia, but some studies have shown a decline in learners' practice of English, especially in the elementary stage (Ali, 2020; Dizon, 2020; Riadil, 2020; Haberman et al., 2020; Hamouda, 2020; Hou, 2021; Kushmar et al., 2022).

Some students face a number of difficulties in practicing English as a foreign language, although it is taught from the elementary stage. The aftermaths of the low level of speaking English lie in the absence of practicing it; as some students feel shy or afraid of criticism for making mistakes in pronunciation or linguistic structures. They may only practice it in specific places such as an English language lecture or with specific colleagues (Riadil, 2020). Furthermore, ineffective traditional teaching methods, limited English language practice, and weak communication between teachers and learners, as well as among learners themselves, may affect the degree of acquisition of listening and speaking skills in English (Ali, 2020; Aljohani, 2021). In addition, several studies have confirmed the weakness in communication resulting from the lack of effective practice of the English language, and the shortage of integrating listening and speaking skills alongside other language skills among students in general (Bilic, 2020; Dizon, 2020; Goneim & Elghotomy, 2021; Kushmar, 2022). Artificial intelligence and the improvement of education are requirements for Saudi Arabia's Vision 2030 (Alghamdi & Alfarani, 2020). Its use has been facilitated by the spread of smartphones and smart voice assistants, also known as virtual assistants, which rely on cloud computing in their work (Dizon & Tang, 2020).

There have been many studies and research on using smart voice assistants in teaching English and its skills around the world (Al-Muqeeti & Abu Al-Ola, 2022; Abalkheel, 2022; Kushmar et al., 2022; Huang et al., 2023). However, the review of studies and research showed that studies and research are scarce on such use in the elementary stage in Saudi Arabia in particular, as there is a heavy reliance on the secondary and university stages and on the views of university faculty members and English language teachers. Accordingly, the following research questions were formulated: (1) What

is the impact of designing a smart voice assistant based on artificial intelligence on developing listening skills in the English language subject among elementary school students?, (2) What is the impact of designing a smart voice assistant based on artificial intelligence on developing speaking skills in the English language subject among elementary school students?

The present study seeks to enhance the English listening and speaking skills of upper elementary school students by designing and implementing a Smart Voice Assistant application powered by artificial intelligence. This innovative tool aims to address existing deficiencies in these language skills and offer an effective, technology-driven approach to supporting learners in acquiring English as a foreign language. The significance of this research lies in its potential to inform curriculum designers in the field of English language education, encouraging the integration of artificial intelligence technologies through the use of Smart Voice Assistant (SVA) applications. Furthermore, the study offers practical solutions for English language teachers to enhance students' listening and speaking skills, with a particular focus on elementary school learners, while also benefiting learners at all educational stages. Additionally, it may serve as a valuable resource for individuals seeking to improve their English proficiency through self-directed learning, leveraging smart voice assistants available on mobile phones and other digital devices.

2. Literature Review

Smart voice assistants (SVAs), as a practical application of artificial intelligence (AI), have gained increasing attention in the field of language education for their potential to enhance learners' speaking and listening skills in English. By integrating advanced AI capabilities such as speech recognition, natural language processing, and adaptive learning, SVAs create interactive and personalized language learning experiences. They allow learners to engage in authentic conversational exchanges, receive immediate corrective feedback, and practice pronunciation and fluency in real time. This interconnected relationship between AI, SVAs, and English oral communication skills highlights their combined role in fostering both listening and speaking abilities. While this section provides an overview of the links among these concepts, each will be discussed in greater depth in subsequent sections to provide a more detailed and focused analysis.

2.1. Artificial Intelligence (AI) and Its Applications

Artificial intelligence (AI) means simulating human behavior by replicating human capabilities in the calculation process and the speed of accurate processing of letters and numbers, enabling memorization, retrieval, and decision-making. With these capabilities, machine intelligence has been able to outperform human capabilities in terms of speed, accuracy, and the amount of targeted production (Ahmed & Abdel Samad, 2020). Artificial intelligence (AI) has undergone a number of historical developments. In 1948, Alan Turing presented the first idea about the possibility of a machine thinking like humans. Since its actual establishment in 1956 and its public appearance at Dartmouth College, a number of scientists, led by John McCarthy in 1958, were able to invent a programming language related to the field of artificial intelligence (Ahmed & Abdel Samad, 2020).

Artificial intelligence (AI) has been described as a technological revolution that has radically changed human and social life, including enhanced virtual environments and information-sharing mechanisms in known blockchain databases (Kolets, 2019). However, one of the problems that users of AI applications face is the growing concern about maintaining user privacy and security. Initially, they must be provided through advanced and effective cyber protection programs (Shih & Rivero, 2020). Artificial intelligence has been used in education (AIED) since the early twentieth century, starting in the twenties with the use of so-called teaching machines (Randhawa & Jackson, 2019). Among the solutions provided by artificial intelligence (AI) are conducting conversations, translations, and similar applications (Al-Sharif, 2022). Therefore, it has been employed in dialogue-based education to acquire speaking and listening skills, as the theoretical foundations for using artificial

intelligence (AI) in training students on skills of listening and speaking are based on a number of learning theories, such as behavioral theory, cognitive theory, and social constructivism

Artificial intelligence (AI) is used in usual language processing and its employment in this field includes the capacity to comprehend human languages and also the capacity to generate them. These are represented in instructions, commands and programming languages that make human-machine communication characterized by natural communication in human language. Natural language processing is in two parts: the first part is related to the computer's ability to understand these natural languages, and the other part is its ability to produce them, including producing correct words, phrases, and sentences in the target language (Ahmed & Abdel Samad, 2020; Miao et al., 2021). An important application based on AI technology is the smart voice assistant (SVAs) application, which have been employed in several arenas, including language education and training (Boussaid, 2022).

Terzopoulos and Satratzemi (2020) identified how to use smart voice assistants that work by speaking in the daily lives of individuals. The authors focused on whether there is a possibility of using them in the educational process. Depending on the results, the authors concluded that the use of this technology for learning increases learners' interaction towards questions and answers. However, it confirmed the existence of some obstacles, such as information security and a lack of training for teachers and learners.

El-Shazly (2020) also revealed the part of AI applications in practicing speaking the language to manage the burden of a foreign language. The findings of the study established the effective role of AI-based chatbots in clearly improving outcomes, facilitating and improving interaction and oral communication in English as a foreign language. The findings of the study also indicated providing student-centered learning. However, the study concluded that there was a continuity of fears related to speech.

Lin and Mubarak (2021) employed chatbots in classroom and extracurricular activities. The researchers aimed to facilitate students' performance in interactions and conversations within the university classroom. After the experiment, the quality of reinforcement and organization of interaction provided by the chatbots, which was supported by mind maps, in students' English-speaking performance was proven significant. These results serve teachers and researchers who want to integrate artificial intelligence into foreign language teaching using the flipped classroom. Sayed (2021) focused on the applications of artificial intelligence to automatically identify the phonetic characteristics of the language of students with speech disorders at the elementary stage.

Huang et al. (2023) used plyometric analysis of 516 studies between 2019 and 2000 to investigate trends and issues related to language education and focus on integrating AI into language learning. The results revealed an increase in studies on language education through AI applications. Research studies confirmed the influence of such applications on improving interaction, practice, and active participation of the learner, facilitating the educational process for both the teacher and the learner. Moreover, using technology safely, in a way, preserves students' acquisition of human communication skills with their teachers and colleagues. Therefore, the focus of this research is on smart voice assistants and their design for optimal use in the educational process.

2.2. Smart Voice Assistant (SVA)

The Smart Voice Assistant (SVA) is known as a computer program that has a qualitative leap in communication between computer technology and humans. It designed to provide support to users by answering their questions and inquiries and performing some of the tasks that it responds to (Shih & Rivero, 2020). It is also known as an application that allows users to interact with computers in a way that is closer to nature and development than was previously possible; examples of which include

Amazon's Alexa and Google Assistant (Winkler et al., 2021). The use of the smart voice assistant in the educational process is backed by philosophical foundations derived from several theories such as Connectivism Theory, Behaviorism Theory, and Social Constructivism Theory. In the communication theory, the learning process takes place through networks and their multiple applications. This theory pushes for the continuous acquisition of information and understanding, distinguishes the important from the unimportant and determines change and development over time (Siemens, 2005). In the behavioral theory, educational content is sequenced and learner behavior is monitored to ensure learning (Skinner, 1965). In the social constructivist theory, learning occurs within a framework of interaction with technology and information in the form of a dialogue that represents learning in the social context (Bandura, 1986; Vygotsky, 1978). An example of this is applications based on the principle of dialogue (Ouyang & Jiao, 2021).

Some studies have investigated smart voice assistants and chatbots as models of AI technology. For example, Seeber's (2019) study on the effectiveness of using chatbots and comparing them to traditional teaching methods, which were applied to students aged 14 to 18 years. The study concluded that students were motivated better to use chatbots in the learning process compared to traditional learning methods. Bilic et al. (2020) developed an educational application based on smart assistants called "Austria and Europe Game" based on Amazon's smart assistant "Alexa", and the target audience was those who could speak German and English. They found that participants were satisfied with the use of smart assistants. A study by Dizon (2020) also tested the use of smart personal assistants via Alexa, as a virtual assistant based on cloud services, with the aim of developing listening comprehension skills and fluency in speaking a second language. It included two groups: the first experimental group, which included 13 students, and the second control group, which included 15 students. The results confirmed the ability of the experimental group to achieve mastery of speaking a second language. However, Dizon's (2020) results did not reach significant differences in improving listening skills in second language learning. In general, it also confirmed the work of a lot of research on this technology and its utilizations in language teaching, which showed positive results in enhancing the learners' abilities in the skills of listening and speaking.

2.3. English Listening and Speaking Skills

Language is communication, and it is a medium for expressing thoughts and feelings with others (Haberman et al., 2020). By learning language, people can communicate, as they obtain and share information through their interaction, and language plays an important role in human life (Riadil, 2020). Learners' abilities differ in their mastery of language skills due to their readiness, self-confidence, and mental abilities (Haberman et al., 2020). In general, learning a language requires a number of skills that are divided into two core sections: productive skills, such as speaking and writing skills, and receptive skills, such as listening and reading skills (Bailey, 2020).

It is difficult for some students to practice English as a foreign language due to the presence of a number of difficulties. Although English is taught as a foreign language from the elementary stage in the Kingdom of Saudi Arabia, students have difficulties in master speaking skills in particular. Some of the dilemmas of weak English speaking lie in the lack of practice, as some students feel shy or afraid of being criticized for making mistakes in pronunciation or grammatical structures. They may only practice it in specific settings such as an English lecture or with specific colleagues (Riadil, 2020).

Listening is a reception skill in the spoken oral situation. It is also known as the process of receiving and constructing meaning from a source and responding to speech or verbal message. It has been the major medium for language acquisition since the preparation of the linguistic environment (Benouareth & Kaouache, 2021). Listening focuses on the process of translating the spoken speech into ideas (Tantawy, 2021). Listening plays an important role in language acquisition (Al-khaza'aleh, 2021), and also provides development for learners in the aspects of sound,

pronunciation, grammatical structures, phonemic awareness, and linguistic comprehension (Mart, 2020). Listening skill combines the stages of language acquisition, as learners provide understandable inputs, and it is considered a complex process that includes effective mental behaviors including perception, knowledge, and memory, and is described as the first skill for learning a language (Benouareth & Kaouache, 2021). Students still suffer from weaknesses in mastering this skill and its utilization in the educational environment needs further improvement. In away, it is considered the first skill that must be taught as a basic process for linguistic construction and raising levels of attainment (Al-khaza'aleh, 2021).

Speaking is a productive and expressive skill in the oral setting and an important part of the learning process. It is also defined as the ability to express feelings and emotions through speech. It is an action through spoken language (Arihant Experts, 2021). It is also defined as the ability to pronounce words, use language, and express them, in other words, achieve effective communication by performing linguistic knowledge (Hamouda, 2020; Rao, 2019). The ability to communicate in a different language is one of the goals of individuals. Thus, the trend towards learning and mastering other foreign languages and trying to master the four skills of communicating with others around the world has increased (Hamouda, 2020). Foreign or second language students need teaching and learning methods, techniques and methodologies that help teachers teach this skill appropriately (Yunus, 2021 & Rajendran). A comparison was made between regular and virtual learning environments for teaching speaking skills. Virtual environments proved the development of students' level and the positive impact on their learning behavior (Hamouda, 2020). Hamouda (2020) stated that students in Saudi Arabia lack some skills that help strengthen speaking skills, and avoid trying to speak a language other than their own in the classroom. A lack of interactive input causes their inability to use the target language and their poor academic achievement. The problem included the lack of an environment for practicing the language or the ineffectiveness of feedback. Namaziandost and Imani (2020) recommended the necessity of changing educational practices through the use of technologies, including virtual ones.

Several studies have addressed the employment and use of artificial intelligence and smart voice assistants in the procedure of treating weakness in acquiring and teaching English. Keezhatta (2019) aimed to investigate the association between normal language processing and artificial intelligence applications for linguistic tasks connected to morphology, analysis, and semantics through selected models from the perspective of English as a foreign language. The findings of the study indicate the possibility of using artificial intelligence to support natural language processing tasks, especially applications related to deep learning that contribute to inferring and analyzing meaning. If artificial intelligence technology is rich in the required knowledge, it will result in significant progress and capacity for these applications in linguistics and the basic principles of morphology, analysis, and semantics.

Ali (2020) also aimed to identify the efficiency of utilizing an artificial intelligence application to develop oral language skills. This included using listening and speaking skills among sixth-grade elementary school students via the Google Assistant voice program. The research findings demonstrated the efficiency of utilizing the artificial intelligence application "Google Assistant" to develop listening and speaking skills among the research sample. A study by Ghoneim and Elghotmy (2021) aimed to verify the effect of an artificial intelligence-based program to raise listening skills in English for sixth-grade elementary school students. The study comprised of a pre-test for listening skills and a post-test, and the results of the study indicated a positive change among students in the experimental group due to the use of artificial intelligence.

Hou's study (2021) also analyzed the significance of AI technology and its basic principles in understanding natural language, showing the advantages of using AI in education. It presented the procedures for adopting AI in the input and output stages of learning English. The findings

demonstrated a significant development in the effectiveness of students' learning of English due to the development of deep learning algorithms and their processing of natural languages.

Aljohani's study (2021) also aimed to verify the perception of English as a foreign language teachers and their students in the Kingdom of Saudi Arabia towards the using AI technology to develop the language learning process. The study sample included 5 female teachers and 16 female students from Yanbu University, who participated in providing their responses to the study questionnaire. The study reached positive results supporting the use of AI in learning English in the Kingdom of Saudi Arabia.

Kushmar et al.'s study (2022) indicated the role and effectiveness of artificial intelligence in teaching the English language. They included fears of losing natural communication through real human emotions, creativity, and the automatic work of learners using artificial intelligence to learn the language was evaluated to a very high degree. The study recommended the need for appropriate and wise inclusion of artificial intelligence by experts and educators. Tang and Foley (2022) also studied the improvement of AI knowledge for EFL learners and recommendations for teaching English with it in China. The results presented above confirm the positive interaction and enable students to practice the target language, which is English, through smart voice assistant applications based on AI. Given the lack of research in the field of teaching English as a foreign language through AI applications for elementary school students in the Kingdom of Saudi Arabia, the current research aims to design a smart voice assistant to advance listening and speaking skills among elementary school students.

3. Methodology

The research used the experimental approach, as it is suitable for conducting the research experiment on two groups: an experimental group and a control group. The aim of the experimental method is to study the effect of the independent variable represented by the smart voice assistant SVA on the dependent variables: listening and speaking skills in English among the members of the experimental group.

3.1. Research Sample

The research population represented all elementary school students in the Education Office in Belqarn Governorate, affiliated with the Education Department in Bisha Governorate, in Asir Region. A sample of elementary school students was selected from Al-Hassan Al-Basri Elementary School. The sample students were randomly distributed into two experimental and control groups. The sample included 22 students, with 10 in the experimental group who were taught English using the smart voice assistant designed by the researchers during the English practice process, and 12 in the control group who were taught using traditional methods.

The participants were learning English as a second language within a consistent educational environment, following the same curriculum and at similar proficiency levels. They had not received additional English instruction outside the school, which minimized variability in prior learning experiences, aptitude, and motivation. This homogeneity supported maintaining control over participant characteristics necessary for a true experimental design. Random assignment to groups further enhanced the internal validity of the study.

3.2. Research Materials

The current research included designing a smart voice assistant application through the Voiceflow website. This allows the design of smart voice assistants without the need for programming languages. The PIE model was used in the design process of the smart voice assistant developed by Newby et al. (1996). Its letters refer to the first letters of its three basic stages: Planning, Implementation and Evaluation. This model focuses on the use of technology and media, which play

a central role in boosting students' learning in individual and group settings within the classroom. It aims to focus on what students and teachers can do to influence the learning process.

This model provides general rules that allow the designer to adapt to educational situations without being obligated to follow a specific pattern. The model also allows the teacher to modify the design in general, ensuring interaction with learners (Gutierrez, 2013). Under these three basic stages are a number of questions that discuss the roles of the learner, the teacher, and educational technology in the learning and teaching process, divided into the stages of the model (Branch, 2015, & Dousay). The research reviewed a number of questions for the PIE model (Gutierrez, 2013; Dousay & Branch, 2015). To ensure the best design for the model stages, the most important questions that are appropriate for the current research, its sample and variables were selected (Gutierrez, 2013; Dousay & Branch, 2015).

Building upon the stages of the PIE model previously discussed, the smart voice assistant was designed using artificial intelligence to target the improvement of elementary students' English listening and speaking skills. To ensure its quality and effectiveness, the product was pilot tested and reviewed by experts specialized in educational technology and English language teaching. This validation process confirmed the assistant's suitability for the intended learners and its alignment with the pedagogical principles outlined in the PIE model.

3.3. Research Tools

The current research included two research tools: the observation card and the oral test. The aim of the observation card was to track the students' abilities and compare the members of the experimental and control groups in the listening and speaking skills of English. As for the oral test, its aim was the final evaluation and obtaining the students' grades in the experimental and control groups to obtain the results of the research experiment.

The observation card was designed on two main dimensions: the first dimension is related to the English listening skill scale. The second dimension is related to the English-speaking skill scale. Each of the two previous dimensions included five indicators to measure the student's skill. The "WE CAN" series for teaching English, approved by the Ministry of Education in the Kingdom of Saudi Arabia for the elementary stage, was relied upon, and a set of behavioral indicators was extracted. Each set of these indicators is directly related to two dimensions of two scales for listening and speaking skills in English to ensure guaranteed measurement of students' behavior towards the phenomenon under study. The validity of the observation card and the extent of the relationship of these indicators to its two dimensions were calculated, as shown in Table 1 for the validity of the internal consistency of the listening skill and Table 2 for the validity of the internal consistency of the speaking skill in the observation card. The results obtained by measuring the Pearson correlation coefficient of the observation card with its dimensions and indicators indicate the validity of the observation card and its measurement of what it was designed to measure. The observation card was also presented to a number of arbitrators specialized in educational techniques. Their opinions agreed on the quality of the observation card, with some amendments that included some formulas for skill measurement indicators, which were discussed, and what needed to be amended. The stability of the observation card was also calculated using Cronbach's Alpha coefficient. The stability result of the first dimension of the English listening skill scale was (.951), and the stability result of the second dimension of the English speaking skill scale was (.972), which indicates that the stability degree of the observation card is very strong.

Table 1. Pearson's Correlation Coefficient for the Indicators of Listening Skill Scale in the Observation Card

No.	Indicator Of Listening Skill Scale	Person Correlation	Sig. (2-Tailed)
1	The student's ability to prepare for spoken language.	.913**	.000
2	The student's ability to differentiate the sounds he hears.	.898**	.000
3	The student's ability to differentiate the spoken vocabulary.	.897**	.000
4	The student's ability to clarify the spoken language.	.949**	.000
5	The student's ability to answer the spoken questions.	.933**	.000

**Correlation is significant at the 0.01 level (2-tailed).

Table 2. Pearson's Correlation Coefficient for the Indicators of Speaking Skill Scale in the Observation Card

No.	Indicator Of Speaking Skill Scale	Person Correlation	Sig. (2-Tailed)
1	The student's ability to pronounce words correctly.	.955**	.000
2	The student's ability to use appropriate vocabulary.	.902**	.000
3	The student's ability to use grammar correctly.	.968**	.000
4	The student's ability to speak fluently.	.959**	.000
5	The student's ability to speak sentences with correct grammatical structure.	.964**	.000

**Correlation is significant at the 0.01 level (2-tailed).

The oral test was designed based on a set of behavioral objectives from the English language book for elementary school (WE CAN). The test included fifteen paragraphs in the listening and speaking skills in English. The internal consistency validity of the oral test was calculated using Pearson's correlation coefficient. The results indicated a correlation between the paragraphs of the oral test. Table 3 shows the internal consistency validity of the listening skill scale paragraphs in the oral test. Table 4 shows the internal consistency validity of the speaking skill scale paragraphs in the oral test. The oral test was judged by a number of arbitrators in educational technology and specialists in teaching English, whose opinions agreed on the quality of the test, with some modifications to some of the words and terms used, which were discussed, and what needed to be modified. To calculate the reliability of the oral test, Cronbach's Alpha was used. The reliability result of the first section of the test, which measured listening skills in English, was .945. The reliability result of the second section of the oral test, which measured speaking skills in English, was .921, indicating that the reliability of the observation card is very strong.

Table 3. Pearson's Correlation Coefficient for the Questions of Listening Skill Scale in the Oral Test

Question No.	Person Correlation	Question No.	Person Correlation	Question No.	Person Correlation
1	.657**	6	.787**	11	.634**
2	.781**	7	.806**	12	.682**
3	.742**	8	.884**	13	.552**
4	.809**	9	.871**	14	.785**
5	.746**	10	.837**	15	.687**

**Correlation is significant at the 0.01 level (2-tailed).

Table 4. Pearson's Correlation Coefficient for the Questions of Speaking Skill Scale in the Oral Test

Question No.	Person Correlation	Question No.	Person Correlation	Question No.	Person Correlation
1	.652**	6	.675**	11	.579**
2	.757**	7	.793**	12	.598**
3	.738**	8	.743**	13	.624**
4	.842**	9	.789**	14	.793**
5	.809**	10	.873**	15	.725**

**Correlation is significant at the 0.01 level (2-tailed).

3.4. Data Collection Procedures

The research experiment was implemented over eight class sessions. In the first session, students in the experimental group received training on how to use the smart voice assistant. Instruction and learning activities were then conducted from the second to the seventh session, during which students' performance was systematically monitored using an observation card to record their progress in the target skills. In the eighth and final session, an oral test was administered to both groups. The experimental group's learning process integrated the smart voice assistant to provide continuous and interactive practice in listening and speaking, whereas the control group received instruction through traditional teaching methods.

4. Results

The text of the first research question was "What is the effect of designing a smart voice assistant based on artificial intelligence on developing the English listening skill of elementary school students?" To answer the question, the following hypothesis was formulated: "There is a statistically significant difference at the level of 0.05 between the average scores of students in the experimental group and the control group in the English listening skill of elementary school students." The arithmetic averages of the students' scores in the experimental group were higher than those in the

control group for all indicators of the listening skill scale. The results of the t-test for two independent samples were calculated using the SPSS program for the listening skill scale, based on the observation card, as in Table 5. It was shown that in the first three indicators of the observation card for the listening skill, the null hypothesis was accepted, which indicates that there are no statistically significant differences between the average scores of students in the experimental and control groups, as the significance value was equal to 0.27, 0.193, and 0.491, respectively. This is therefore greater than the significance level 0.05. Whereas, the statistical significance was achieved by the presence of statistically significant differences at the significance level of 0.05 in favor of the experimental group in the fourth and fifth indicators of the listening skill scale in the observation card. Their values were (0.047, 0.031) respectively, which represents a value less than the specified significance level.

Table 5. Results of Statistical Analysis of the Listening Skill Measurement via the Observation Card

No.	Indicators of the listening skill scale	Group	n	Mean	Std. Dev.	t	df	Sig. (2-tailed)	η^2
1	The student's ability to prepare for spoken language.	EG	10	2.90	.994	1.134	20	.270	.060
		CG	12	2.42	.996				
2	The student's ability to distinguish the sounds he hears	EG	10	3.00	.816	1.348	20	.193	.083
		CG	12	2.50	.905				
3	The student's ability to distinguish the spoken vocabulary.	EG	10	2.40	.843	.702	20	.491	.024
		CG	12	2.17	.718				
4	The student's ability to clarify the spoken language.	EG	10	2.90	1.101	2.162	20	.043	.189
		CG	12	2.00	.853				
5	The student's ability to answer the spoken questions.	EG	10	3.00	.816	2.328	20	.031	.213
		CG	12	2.08	.996				

Note. EG = Experimental Group, CG = Control Group.

The results of measuring listening skill through the oral test also indicated that the arithmetic mean of the experimental group's scores was 18.6, while the mean of the control group's scores was 11.083. It is clear that the mean of the experimental group's scores is higher than the mean of the control group. The results of the t-test for two independent samples were calculated through the SPSS program to measure listening skill through the oral test, as shown in Table 6. It was also concluded that there were apparent differences between the mean scores of students in the experimental and control groups at the significance level 0.05 in favor of the experimental group. The significance value for the oral test of listening skill was (0.031), which is smaller than the specified significance level, and the effect size was large at .212 as in Table 6.

Table 6. Results of Statistical Analysis of the Listening Skill Measurement Via the Oral Test

Listening Skill Scale	Group	n	MS	St. Dev.	t	df	Sig. (2-tailed)	η^2
Oral test	EG	10	18.6000	7.61869	2.320	20	.031	.212
	CG	12	11.0833	7.52521				

Note. EG = Experimental Group, CG = Control Group.

The text of the second question is "What is the effect of designing a smart voice assistant based on artificial intelligence on developing the English-speaking skills of elementary school students?" To answer the question, the following hypothesis was formulated: "There is a statistically significant difference at the level (0.05) between the average scores of students in the experimental group and the control group in the English-speaking skill of elementary school students." The results of measuring the speaking skill were calculated via the observation card. The results showed that the arithmetic averages of the students' scores in the experimental group are higher than those in the control group for all indicators of the speaking skill scale. The results of the t-test for two independent samples were calculated using the SPSS program for the speaking skill scale, based on the observation card, as shown in Table 7. It was found that in the first, third, fourth and fifth indicators of the speaking skill scale in the observation card. The hypothesis was rejected and the alternative hypothesis was accepted, which indicates the existence of statistically significant differences between the averages of the students' scores in the experimental and control groups, as the significance value was equal to 0.040, 0.032, 0.048, 0.040, respectively, which is therefore smaller than the significance level 0.05. As for the second indicator of the observation card for speaking skill, the null hypothesis was accepted due to the absence of statistically significant differences, as the significance value in the second indicator of the speaking skill scale in the observation card was .123, which is greater than the specified significance level.

Table 7. Results of Statistical Analysis of the Speaking Skill Measurement Via the Observation Card

No.	Indicators of the listening skill scale	Group	n	Mean	Std. Dev.	t	df	Sig. (2-tailed)	η^2
1	The student's ability to pronounce words correctly	EG	10	3.60	1.350	2.195	20	.040	.194
		CG	12	2.50	1.000				
2	The student's ability to use appropriate vocabulary.	EG	10	3.20	1.033	1.611	20	.123	.115
		CG	12	2.50	1.000				
3	The student's ability to use grammar correctly.	EG	10	2.90	1.101	2.307	20	.032	.210
		CG	12	1.92	.900				
4	The student's ability to speak fluently.	EG	10	2.90	1.197	2.105	20	.048	.181
		CG	12	1.92	.996				
5	The student's ability to speak sentences with correct grammatical structure.	EG	10	2.70	1.252	2.200	20	.040	.195
		CG	12	1.75	.754				

Note. EG = Experimental Group, CG = Control Group.

The results of the oral speaking skill measurement were calculated. The findings indicated that the arithmetic mean of the students' scores in the experimental group in the oral test was 18.5, higher than the arithmetic mean of the students' scores in the control group (11.33). The results of the t-test for two independent samples were calculated via the SPSS program to measure the speaking skill through the oral test, as shown in Table 8. At the significance level of 0.05, it was discovered that the average scores of the students in the experimental and control groups differed statistically significantly in favor of the experimental group. The significance value for the oral test of the English-speaking skill was 0.046, which is smaller than the specified significance level, and the effect size was large at a degree of .19, as in Table 8.

Table 8. Results of Statistical Analysis of the Speaking Skill Measurement Via the Oral Test.

Listening Scale	Skill	Group	n	MS	St. Dev.	t	df	Sig. (2-tailed)	η^2
Oral test		EG	10	18.5000	8.24958	2.128	20	.046	.185
		CG	12	11.3333	7.53577				

Note. EG = Experimental Group, CG = Control Group.

5. Discussion

The current study concentrated on elementary school pupils' deficiencies in speaking and listening to English as a foreign language. In an effort to help these children acquire these two abilities, care was made to use contemporary technology, which is represented by artificial intelligence technology, namely smart voice assistants.

The research results showed that there were differences between the average scores of students in the experimental and control groups. The differences were in favor of the experimental group on all indicators of the two dimensions of the observation card in the listening skill scale and the English-speaking skill scale. It was also in favor of the experimental group in the oral test for both skills, and the size of the effect measured by calculating the Eta square for the observation card. The T-test findings for the observation card indicators also differed on whether there were statistically significant differences between the experimental and control groups favoring the experimental group, and the oral test showed mild, medium, and large impacts. Other differences were not statistically significant on their presence between the two groups. The results of the oral test showed statistically significant differences between the two groups in favor of the experimental group.

The results of the listening skill scale in the observation card partially agreed with a study by Ali (2020), a study by Goneim and Elghotomy (2021), and a study by Kushmar et al. (2022) in proving the presence of statistically significant differences in favor of the experimental group in two indicators. The research results partially agreed with Dizon's (2020) findings that there were no statistically significant differences in three indicators, and partially differed in the existence of statistically significant differences for the remaining two indicators. This is due to the difference in the statistical research tools used between the observation card and the oral achievement tests, as well as the difference in the sub-skills that were relied upon to assess the student's skill or lack thereof.

The results of the oral listening skill test agreed with Ali (2020), Goneim and Elghotomy (2021), and Kushmar et al. (2022) in proving the presence of significant differences in favor of the experimental group. However, the results in this research differed from what was shown by Dizon (2020), who concluded that there were no significant differences in improving listening skills among students. The researchers attribute the reason for the difference between the results of the research

and that study to the mechanism and method used in data collection and how to choose the content and specific objectives. This difference can also be considered a result of the different cultural and spatial dimensions between the samples used in each of the research. The results of the English-speaking skill scale in the observation card agreed almost completely with Ali (2020), Dizon (2020), and Kushmar et al. (2022) in proving the existence of significant differences in favor of the experimental group. In this research the results of the observation card reached the existence of statistically significant differences in four of the five indicators of the speaking skill scale in favor of the experimental group. Furthermore, it differed slightly from those studies represented in reaching the absence of statistically significant differences in one indicator. The researchers attribute this to the difference in statistical methods used between the studies. The possibility of difference became clear due to the objectives, indicators and sub-skills around which the research tools were built to measure the skill among students.

The results of the oral test of English-speaking skills agreed with Ali (2020), Dizon (2020), and Kushmar et al. (2022) in proving the existence of statistically significant differences indicating improvement and progress in the level of students in speaking skills using smart voice assistants based on artificial intelligence. Whereas, there were no studies that differed or conflicted with the results of improvement and progress in the level of students in speaking skills in English. The research results generally indicated that there is a positive effect of using artificial intelligence technology in developing the listening and speaking skills in English as a foreign language among students. This had also been previously confirmed by a number of studies such as Ali (2020), Dizon (2020), and Kushmar et al. (2022). Also, some other studies; for example, Seeber, 2019; Shin et al., 2021; Bilic et al., 2020; Terzopoulos & Satratzemi, 2020; El-Shazly, 2020; Hou, 2021; Lin & Mubarak, 2021; Aljohani, 2021; Ghoneim & Elghotmy, 2021, Abalkheel, 2022; Huang et al., 2023, which aimed to investigate the topic of employing artificial intelligence applications represented by smart voice assistants and the so-called chatbots in teaching English as a foreign or second language, and which reached positive results in favor of including this technology.

The research results indicate the students' ability to deal with modern technology and learn it quickly. Such technology has become an integral part of the lives of many of them, which confirms the importance of keeping pace with technological changes and modern trends that have become an element in the lives of these students outside school. This requires reaching a technology savvy that represents an important basis in learning and teaching the modern generation; to ensure saving time and effort and achieving the desired goal. The problems and dilemmas discussed by some of these studies on information security for students and teachers were also avoided. It is what the current research was careful to consider since the early design stages of the smart voice assistant application by avoiding the use of any data or tools specific to the participants in the research experiment.

6. Conclusion

The findings of this study clearly demonstrate the significant positive impact of designing a smart voice assistant based on artificial intelligence on developing listening and speaking skills in the English language among elementary school students. The observation card results revealed that the experimental group outperformed the control group on two indicators of listening skills and four indicators of speaking skills. Additionally, the oral exam results showed statistically significant differences between the experimental and control groups in both listening and speaking abilities.

These differences are attributed to the effective application of the smart voice assistant, which enriched the learning environment by providing interactive and realistic language practice. This facilitated students' improvement in active listening and confident, fluent oral expression. Consequently, this study provides valuable evidence supporting the integration of AI-based smart voice assistants into English language curricula at the elementary level.

7. Suggestion

Based on the findings of the previous research, several recommendations can be proposed to enhance educational practices through the integration of artificial intelligence. It is essential to enable students to engage with artificial intelligence technologies not only within digital skills courses but also across various academic subjects, thereby broadening their exposure and understanding of these tools. Furthermore, introducing learners to smart voice assistants can significantly support and improve the process of self-directed learning. The application of artificial intelligence in educational contexts should be guided by sound theoretical principles rooted in established learning philosophies. Additionally, it is important to assess and monitor the digital skills that students possess in order to align educational efforts within schools, ensuring that these technologies are used both effectively and safely in accordance with recognized educational standards.

Further research is recommended on the integration of smart voice assistants in developing English language skills among students and trainees. Such studies should aim to provide a more accurate and comprehensive understanding of the learning process. It is important that this research encompasses a range of educational contexts, including geographical diversity and various types of institutions such as governmental, private, and international schools, to allow for comparative analyses that reveal both commonalities and differences in outcomes. Additionally, there is a need for studies focused on the use of smart voice assistants in teaching English or other languages to students of all genders. Research should also explore ways to enhance the use of artificial intelligence in developing speaking skills across multiple languages, contributing to broader linguistic competence.

Declarations

Author Contributions. A.A₁: Introduction, Literature review, conceptualization, methodology. A.A₂: data analysis, discussion, review-editing, and writing, original manuscript preparation. Both authors have read and approved the final version of the article.

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