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Natural Language Processing (NLP) and EFL Learning: A Case Study Based on Deep Learning

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***Abstract*—The enhancement of artificial intelligence (AI) and related machine learning represents one of many recent technological developments, causing educators to consider the potential of AI for teaching and learning. In this case study, opinions were gathered from six mature students of English as a foreign language (EFL) in a university in Saudi Arabia. The researcher especially explored the use of a voice recognition device (Amazon's virtual assistant, Alexa) based on natural language processing (NLP) for deep learning. The participants were instructed to interact with Alexa individually for 30 minutes each, over the course of one week, including a game of 'hide-and-seek'. Structured observations were performed of this activity, and semi-structured interviews were subsequently conducted to gather the participants' opinions of the device. Main and sub-themes emerged from the results, related to deep learning through NLP. This theoretical perspective was adopted because Alexa was found to develop its voice recognition across different language structures and styles. Moreover, Alexa was very responsive to the participants, sometimes asking them to reword or modify their questions, so that it could find answers. The game also proved helpful for presenting the language, reflecting a real game of hide-and-seek. The participants mentioned that such technology could be useful in language labs, as it was fun, entertaining, convenient, and easy to use. It is therefore recommended to invest in these devices for learning activities in education. Furthermore, statistical studies are recommended to test the impact of voice recognition devices on teaching and learning for generalisable results.**

***Index Terms*—natural language processing, voice recognition device, deep learning, EFL learning, Saudi Arabia**

I. Introduction

Technology has developed phenomenally to serve a multitude of human purposes. The educational domain is no exception, especially where foreign language teaching and learning are concerned. In particular, students of English as a foreign language (EFL) face various difficulties in finding opportunities to practice their English if the language is taught in a country where it is not the main medium of daily communication – as is the case in Saudi Arabia. This is where technology can enable learners to practice their English in real communication. Voice recognition devices, like Alexa, offer such an opportunity, operating through artificial intelligence (AI) as a natural language processing (NLP) tool.

In NLP, computational techniques are deployed to understand, learn, and reproduce human language (Hirschberg & Manning, 2015). However, while NLP systems now include speech recognition, language understanding, and machine learning, they initially fell far short of human performance (Deng & Liu, 2018). Deng and Liu (2018) claim that the original shallow NLP machine learning models were incapable of absorbing a huge volume of training data. Nevertheless, these early models gave rise to a new wave of NLP, which is based on deep, structured machine learning ('deep learning'). This technology could potentially have a positive impact on learners' attitudes, especially as it adapts itself to users' needs. For example, NLP-based devices are capable of imitating human conversational language (Hirschberg & Manning, 2015). Hence, the present study attempts to answer the following questions:

1. How does natural language processing (NLP) through voice recognition technology help improve EFL learners' English language skills in respect of deep learning?
2. How can the inclusion of voice recognition technology be helpful in language labs?

II. Related Work

In this section, the concept of NLP is outlined, together with its possible application in foreign language teaching. Also explained is deep learning in NLP machines. Thus, Alexa (the NLP machine used in this investigation) is described under the methodology in section 3 ('The Study').

A. Natural Language Processing (NLP) and Foreign Language Learning

Natural language processing is not entirely new: its history spans the past 50 years or more (Litman, 2016). In brief, it may be described as the use of computers to process and understand natural human language in the performance of

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useful tasks (Deng & Liu, 2018). However, NLP is an interdisciplinary field, combining computational linguistics, cognitive sciences, computing science, and AI (Deng & Liu, 2018; Meurers, 2012). From an engineering perspective, NLP is concerned with developing new applications to facilitate the interaction between human language and computers. Typical NLP applications include speech recognition, machine translation, understanding spoken language, lexical analysis, parsing, knowledge graphs, information retrieval, answers to questions, natural language generation, and natural language summarisation (Deng & Liu, 2018). Conversely, from a scientific perspective, NLP seeks to model the cognitive mechanism that underlies the production and understanding of human language (Deng & Liu, 2018).

The application of NLP in education began during the 1960s (Litman, 2016). Its initial application was in marking students' tests and developing a grading system for text-based dialogue (Litman, 2016). This application has similarly been integrated into the teaching and learning of foreign languages. Meurers (2012) explains the possible use of NLP to teach writing, whereby two approaches are outlined:

1. The use of NLP to analyse a learner's language (words, sentences, or text produced) and develop technology-based tutoring systems in computer-assisted language learning (CALL).
2. Natural language processing can be used to analyse native language, thereby playing a potentially major role in the language-learning context. This allows authentic material to be presented to language learners. It also enables the generation of activities and tests based on authentic material – as in the case of machine translation.

In this area, a rare early study was conducted in Japan by Nagata (2002), with the creation of an application called BANZAI, a new intelligent tutoring program. The BANZAI application was programmed in Java and runs via a Web browser. It was designed to help develop learners' Japanese grammar and sentence production skills, as well as to reflect Japanese culture. Moreover, BANZAI uses Japanese characters, so that learners can produce sentences in 'kana' (phonetic Japanese script) and 'kanji' (Chinese pictograms).

The key concept behind the BANZAI application was that it would read, parse, and correct sentences typed by learners, using AI and NLP. The NLP analyser consists of a lexicon, a morphological generator, a word segmenter, a morphological parser, a syntactic parser, an error detector, and a feedback generator. The results of Nagata's (2002) study indicate that the participants became enthusiastic about learning Japanese, and the application was subsequently introduced into the curriculum of the University of San Francisco.

Natural language processing can enhance educational technology in many ways, as stated by Litman (2016). For instance, it may be used to automate the marking and grading of students' texts in linguistic dimensions such as grammatical correctness or organisational structure. Moreover, dialogue technologies are currently being used to replicate one-to-one tutoring, and learning can be personalised for individual students by processing texts from the Web. In addition, NLP can create tests automatically or semi-automatically for teachers, for example, by drawing information from an education forum.

Aside from the above, some NLP technologies are used to play games in an educational setting. To examine the positive impact of such technological enhancement, Yunanto et al. (2019) created a game application using NLP to practice various language sub-skills, like grammar. In the above study, 27 EFL participants aged 21-27 years were recruited as the sample. These participants engaged in the game and then completed questionnaires that were designed to collect their opinions. The game data consisted of 100 English language questions, drawn from the Longman TOEFL Test Books (author: Deborah Philips). A variety of question types were included, for example, multiple choice (with 2-4 options). These questions increased in difficulty with each stage, over a total of six stages. Furthermore, AI was used to create a non-player character. The questionnaire results were positive, with the learners appearing keen to learn.

Concluding their study, Yunanto et al. (2019) recommended further research in this area. Elsewhere in the literature, games and the associated fun factor have been described as among the most important and positive contributors to foreign language learning, with faster retention and lower stress compared to more traditional methods (Gafni et al., 2017; Lee, 2020; Panagiotidis et al., 2018).

Nevertheless, despite the positive impact of NLP technology, there are still limitations in the current NLP models, which should be considered in future NLP development. Some of these limitations were identified by Deng and Liu (2018), who found that while many deep-learning methods have been proven to offer accuracy that is close to or exceeds human accuracy, they require more training data, power consumption, and computing resources than humans. Moreover, even if the accuracy of the results is statistically impressive, these results are usually unreliable on an individual basis. Besides, decision-making is not part of current NLP models.

Conversely, as described in this section, the speech recognition, language understanding, and machine translation enabled by NLP systems have developed better performance than the previously more limited machine learning (Deng & Liu, 2018). This is explored in more detail below.

B. Theoretical Framework: Deep Learning – a Sub-Type of Machine Learning

In recent years, intelligent systems have been created that demonstrate the capabilities of AI. These systems rely on machine learning (Janiesch et al., 2021), which represents a system's capacity to learn from problem-specific training data. This 'learning' automates the processes of analytical models in building and resolving tasks (Janiesch et al., 2021). Out of this concept comes deep learning, which is a form of machine learning that is modelled on artificial neural networks. In many applications, deep learning outperforms shallow traditional data analysis approaches and machine learning models (Janiesch et al., 2021). Dargan et al. (2020) add that deep learning is the most effective, supervised, and

cost- and time-efficient machine-learning approach. In other words, deep learning is a sub-set of machine learning, which is itself a sub-set of AI (Oppermann, 2022).

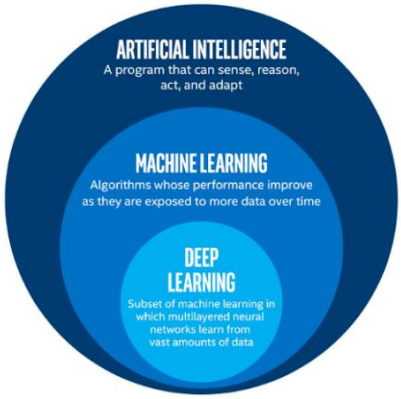

Figure 1. Artificial Intelligence (AI) vs. Machine Learning vs. Deep Learning
(Source: Oppermann, 2022)

Specifically, deep learning is a type of machine learning that is inspired by the human brain (Oppermann, 2022). When deep learning was initially being established, it was referred to as 'artificial neural networks', since some of the earliest learning algorithms were intended to be computational models of the biological learning that takes place in the brain (Bengio et al., 2017). To clarify this further, the neural aspect of deep learning is motivated by two main notions. First, the human brain provides examples to indicate that intelligence is possibly a behaviour. Thus, a reflection of this concept is built computationally to follow the brain's pathways. Second, the brain and its functions are discerned, and its patterns are followed to build the machine (Bengio et al., 2017).

Machines designed in this way are consequently an attempt to imitate the functions of the human brain by taking in huge amounts of data and attempting to learn from it. However, even though deep learning is fascinating, it still cannot replicate the human brain's ability to process and learn from the information it receives (Connected World, 2021). Figure 2 illustrates the difference between the human brain and deep learning. Meanwhile, Figure 3 compares the abilities of the human brain and the process through which a machine learns by extracting information. For instance, the human brain receives and responds to information, just as a machine receives data, extracts what is necessary, and learns from what it extracts, before generating its own data. In contrast, this requires a complex algorithm and huge volume of data, in order to be able to extract enough complex patterns – ideally, millions of labelled data points for a classification task. Thus, due to the lack of a large corpus of precisely labelled high-quality data, results can sometimes be disappointing (Koleva, 2020).

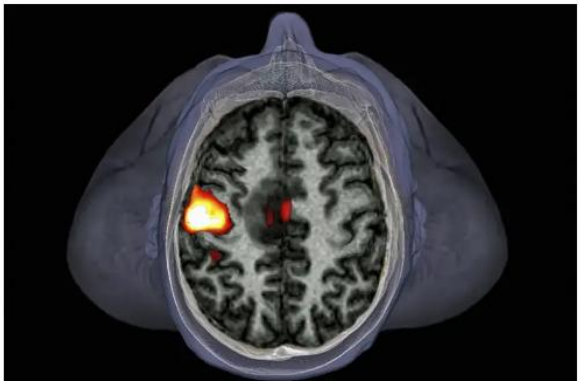

Figure 2. An MRI Scan of an Area of the Brain Lighting up During a Task (Motor Area)
(Source: Oxenham, 2016)

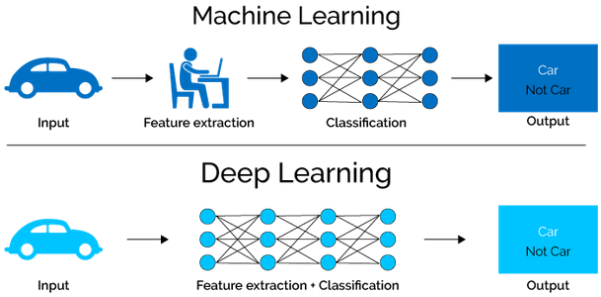

Figure 3. Machine Learning and Deep Learning
(Source: Koleva, 2020)

According to LeCun et al. (2015), the latest forms of deep learning support computational models constructed from multiple layers, in learning data representations with multiple layers of abstraction. Furthermore, these methods have considerably developed the ability of machines to recognise speech and visual objects, amongst other types of content. Meanwhile, conventional machine-learning techniques are limited purely to processing natural language in its raw form (LeCun et al., 2015). Thus, traditional machine-learning features are designed and managed by human experts, meaning that the models produced lack representative power, and cannot form levels of decomposable abstractions that are then automatically disentangled (Deng & Liu, 2018). In contrast, deep learning simplifies these features via a deep, layered model based on neural systems and the relevant learn-to-learn algorithms (Deng & Liu, 2018).

Moreover, Bengio et al. (2017) clarify that deep learning in its modern form goes beyond the current neuroscientific perspective of how machine learning can be generated. This is because it relates to learning multiple levels of composition, for use in machine learning that is not necessarily neurally inspired. Marr (2023) specifies that "machine learning is the reason for the rapid improvement in the capabilities of voice-activated user interface". This is discussed further in the following section, with specific reference to Alexa, a recently developed speech recognition device.

III. The Study

This section begins with a description of the NLP tool, before proceeding to outline the study design, the tools used, and the procedures adopted to analyse the results.

A. Natural Language Processing (NLP) Tool: Alexa

Alexa is an interactive voice assistant, developed by the online retail giant, Amazon. It can perform numerous tasks, ranging from checking a user's calendar to playing tracks from a playlist (Bizaco et al., 2022). Thus, it can facilitate and enhance everyday life in diverse ways (Bizaco, 2022). Marr (2023) clarifies that Alexa was created by Amazon as a cloud service that could respond in conversational form to voice commands. The list of commands that a single Alexa device can understand grows daily through use. Amazon refers to this repertoire of commands as 'skills' (Marr, 2023).

Data and machine learning form the foundation of Alexa's power, and this power increases as more data is gathered (Marr, 2023). Furthermore, each time Alexa makes a mistake in interpreting a request, the data is used to make the system smarter for the next request (Marr, 2023). On one hand, NLP refers to the consumption of language that is created through the generation of natural language (Marr, 2023), while on the other, natural language generation (NLG) consists of the ability to process written and verbal language. Despite the complexity of human language, NLG has the capacity to become very sophisticated over time (Marr, 2023).

Amazon is also seeking to improve Alexa's capabilities by creating valuable technology (Bizaco et al., 2022). For example, the company is now working on frustration detection features, so that Alexa can understand from a speaker's tone if they are becoming frustrated with the device. Moreover, discovering Alexa's latest features merely requires asking the device: 'Alexa, what's new with you?'. Based on this description, it would seem that the technology could be used in language labs. Several studies have shown the possible impact of an AI chatbot on developing different language skills among EFL students (Wang & Petrina, 2013). Accordingly, this current research is one of the rare studies conducted in the Saudi context to investigate the opinions of EFL learners, regarding the use of AI and NLP technology. In addition, recommendations are presented, based on the research results.

B. Study Design

A qualitative approach was adopted in this study to gather the participants' opinions of using voice recognition technology and the possibilities offered by this technological enhancement in real education, for example, in language labs.

The case study was conducted during January 2023, collecting data over the course of one week via semi-structured interviews and structured observations. The interviews were conducted in English, as the participants were mature students, meaning that their level of English was sufficiently high for them to engage in conversation. In any case, the researcher asked the participants whether they would prefer to be interviewed in English or Arabic and which language they would rather use for the structured observation of their interaction with Alexa. However, the interview protocol did

not exceed seven questions. Out of these, introductory questions were put to the interviewees, asking them which English language skill they wished to improve, and what previous experience they had of using voice recognition devices, whereupon the participants mentioned Siri.

Once formulated, the interview protocol was piloted to check its level of difficulty. The pilot sample comprised three participants with the same level of English as the main participants. These participants checked the content validity of the interview protocol for answering the research questions and sought to identify any difficulties or ambiguities in the sentence structure. Necessary modifications were made accordingly. Each interview was then voice-recorded and transcribed, permission to do so having been granted by the participants and the department, with respect to the research ethics. The participants' identities were concealed, and the data was scheduled to be destroyed some time after finalising the research. Each interview lasted around 15 minutes, with prompts from the researcher to gain more understanding of the case. The data was analysed thematically, with two main themes emerging: NLP and deep learning, and adapting voice recognition devices for use in language labs

In contrast, for the structured observation, a list of items was compiled, derived from information related to NLP and deep learning. This list corresponded to the information sought through the interview questions. Moreover, in order to increase the reliability of the research results, these elements were carefully considered in relation to the research questions, theoretical framework, and the existing literature. Observations were subsequently carried out during the 30 minutes of conversation between Alexa and each participant, which included the game of 'hide-and-seek' with the device. The following elements were considered during the observation:

1. Alexa is able to recognise different human voices
2. Alexa is able to understand different sentence structures, even if they are not grammatically correct
3. Alexa is able to reply to different tones of voice
4. Alexa is able to understand informal language
5. Alexa is able to respond to users by resolving any difficulties that arise
6. Alexa responds in the same way as humans do in real interaction
7. Alexa uses the same vocal expressions as humans do in real communication.

C. Study Sample

The researcher was granted permission to conduct this study by the Dean of the College of Languages and Translation at a university in Saudi Arabia, whereupon a convenience sample was selected to enable easier accessibility. Six female participants, specialising in English Language, were thereby sampled. These were all mature students (aged 23-24 years) in their final year before graduation (Level 9 undergraduates). Their English language level was consequently high. Moreover, data was only collected from female students, due to the religious restrictions on interaction between the genders in the research context. Once data saturation was reached, the researcher stopped collecting data.

After obtaining oral informed consent from the participants, the researcher provided them with Alexa and asked them to interact with the device on any real-life topic for a total of 30 minutes. This included playing a game of hide-and-seek for five minutes. The conversation took place individually in the instructor's office, as this would allow the researcher, who was also the instructor, to undertake the observation. The duration of the observation was identified by the researcher as suitable for the participants' timetable. Each participant interacted with Alexa just once, on a day and at a time of their choosing. All the interactions took place during the participants' break times. Although the researcher was also the participants' instructor, it was emphasised that participation in the study would have no influence on their grades, and the topics chosen for the interaction with Alexa bore no relation to the syllabus of their actual course. Furthermore, it was emphasised that participation in this study was completely voluntary, based on the students' interest. A total of 14 students were invited by the researcher, all within the same course cohort, but only six consented to take part. However, the researcher found that the data reached saturation with the sample of six respondents (Saunders et al., 2018).

IV. Results and Discussion

A. Results of the Semi-Structured Interviews

Two main themes, each with sub-themes, emerged from the data. These themes related to the concept of deep learning in NLP and are described in this sub-section. The first theme, 'NLP in deep learning', refers to the relationship between NLP and deep learning. It included the following sub-themes: 'Imitating human behaviours', 'Answering questions', 'Responding to commands', 'Adjusting speech speed', 'Clear voice', and 'Repeating information'. Therefore, this first theme helped to answer the first research question: 'How does natural language processing (NLP) through voice recognition technology help improve EFL learners' English language skills in respect of deep learning?'.

With regard to 'Imitating human behaviours', Alexa appeared to be able to replicate human conversation in its responses, even using vocal fillers like 'Hmm'. In the literature, this is described as NLP providing dialogue technologies to achieve human one-to-one tutoring (Litman, 2016). In this regard, Participant 5 stated: "Based on my experience, Alexa can have a conversation with me where I can practice my English… I tried to trick Alexa during the hide-and-seek [game] by asking whether she was hiding in the toaster. She responded: 'Not in the toaster, obviously".

In addition, since Alexa is based on NLP and AI, the data illustrates the machine's attempts to formulate responses in the same way as the human brain. This is one of the main features of modern NLP, which relies on deep learning (Oppermann, 2022). For example, the device answered the participants' questions appropriately, as exemplified in an interaction with Participant 6, wherein a short but complete answer was given. Meanwhile, Alexa provided information in response to an enquiry from Participant 2. Similarly, when Participant 5 asked a question about the *Mona Lisa*, Alexa gave a full description of the painting. Participant 1 likewise received detailed information from Alexa in response to her questions.

Another example of interaction with Alexa consisted of commands from the participants, which Alexa duly executed as instructed. If a command was unclear, Alexa offered other options to the interlocutor. Over the course of the practice session, Alexa began to 'understand' more and more commands, offering suitable help. In reference to this, Participant 4 acknowledged: "It's a smart device that can talk about anything in life. Based on my experience today, it is incredible how it can tell you about the latest news, movies, and books".

Participant 4 also mentioned: "I asked Alexa to tell me about the latest movies that are available in Riyadh's cinema, and it gave a full answer about all the new movies".

Adjusting the speed of speech to enable a listener to understand is a further feature of human conversation that Alexa can replicate. Some of the participants found the speed of Alexa's speech difficult to follow. However, the device offers many options to adjust the speed and style of its speaking. Participant 3 therefore commented: "The speed of speech can be adjusted and there are accent options".

Participant 2 also stated: "…her speech speed was neither too fast nor too slow and could be easily understood… Alexa's speech is clear".

This was supported by most of the participants, who found Alexa's 'voice' to be 'clear'.

One way of using Alexa in teaching and learning is to play games and increase the fun factor. This relates to Alexa being established as a cloud service, which enables it to improve its conversational abilities over time (Bizaco et al., 2022). Games enable learning to take place in a stress-free environment. In the current case, the learners played hide-and-seek, and each time a participant gave a wrong answer, the device repeated its description of the setting. This repetition of information prompted the players to engage with the game. For instance, Participant 2 stated: "[Alexa] repeated itself sometimes just in case we forgot what had been said".

The second main theme extracted was 'Adapting voice recognition devices for language labs'. This theme emerged from the data as a way of providing technology to enhance educational practice, given the potential advantages of implementing NLP in EFL language learning. This theme also contained the following sub-themes: 'A fun way to learn', 'Easy and convenient to use', and 'Facilitates learning'. Each sub-theme is described below. This helped in answering the second research question: 'How can the inclusion of voice recognition technology be helpful in language labs?'.

Alexa's realistic responses could play a key role in the adoption of voice recognition devices as a fun way to learn. In this regard, Participant 1 declared: "I believe that Alexa is very helpful and entertaining".

Meanwhile, Participant 2 stated: "It is a fun new way to improve my English".

Furthermore, Alexa and other devices of this nature are easy and convenient to use. They can be carried from one room to another and implemented anywhere at any time, with the proviso that an Internet connection is available. Participant 3 therefore observed: "Alexa can function as a speaking Google, which is very convenient".

By offering a natural setting and providing the information requested by the participants, devices like Alexa can facilitate learning. To illustrate this, Participant 4 affirmed: "Alexa can have a conversation with me, which means I can practice the English language with it".

Meanwhile, Participant 5 added that Alexa was able to explain the target language in many ways, depending on the question. In the process, Alexa found definitions and origins of words, thereby helping learners to acquire the target language.

Participant 6 likewise remarked that Alexa could offer multiple ways of practicing a language: "[Alexa] can help the learner to practice the language with a device that won't laugh if the learner pronounces a word incorrectly, which makes the learner comfortable with practicing the language".

Finally, Participant 5 commented that Alexa would be a very useful device for learning English.

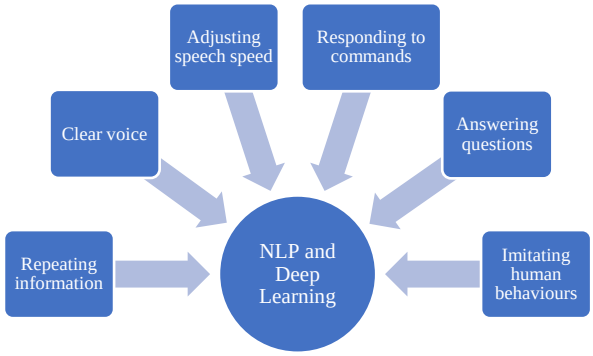

Figure 4. Themes Related to NLP and Deep Learning, Extracted From Semi-Structured Interviews

Nevertheless, Alexa appeared to have certain limitations, such as being unable to understand every request or command in the first instance, thereby responding inappropriately at times. This was mentioned by Participant 5. Deng and Liu (2018) similarly describe this as a major limitation in current language-processing systems, since the accuracy of these machines is somewhat limited on an individual basis, even though they can participate in decision-making.

B. Results of the Observation

The observation depended on elements drawn from the literature as being described previously. The game of hide-and-seek involved Alexa 'hiding' itself somewhere and asking the players to 'find' it. The device therefore pretended to be in an actual setting, describing elements of its location. For example, the setting might be a bedroom, whereupon Alexa would ask: "Where do you think I could hide, under the bed?", "In a drawer?", etc. The players were given three chances to make a correct guess before losing the game. Alexa even asked the players to close their eyes while it hid, which is exactly how a human would play the game. Likewise, it used natural language in its responses, such as 'Obviously, I am not hiding there' if a place was unsuitable, for example, in a toaster or oven. Hide-and-seek is a useful game for learning vocabulary and becoming more proficient in describing places. In addition, during the conversation, one of the participants presented Alexa with a riddle, which it successfully solved, indicating that the device is able to 'think' like the human brain. Playing games like this, which involve a 'non-player' character, can increase human interest, as mentioned in the experiment conducted by Yunanto et al. (2019), similarly based on NLP and AI.

As mentioned previously, Alexa can even modify the speed of its speech, making it easier for learners to understand. Moreover, diverse accents are available for the device's English language mode. Besides, Alexa can respond to any type of command, whereupon it improves its understanding by asking the interlocuter if it has understood the question or command correctly. Alternatively, Alexa may ask the interlocuter to rephrase a command or question. For example, one of the participants in this study asked Alexa to translate a sentence into Japanese, whereupon Alexa replied: 'You should say, "How would I say… in Japanese"?'.

In some instances, Alexa offered to provide information through Wikipedia. Furthermore, two participants asked for instructions on how to bake a cake. The first time this question was asked, Alexa did not have an answer. However, the second time, Alexa responded by recommending a wiki and formulating a description based on the participants' questions. Thus, it would seem that Alexa attempts to improve its cognition and functions in the same way as the human brain, where neurons send signals to trigger reactions. This is supported by the literature on NLP and deep learning (Bengio et al., 2017; Oppermann, 2022).

In addition to asking for clarity by rewording a sentence or suggesting an available option to provide assistance and answers, Alexa can propose various options, such as, "It seems that you want to shop with me. Why don't you go to Amazon to find the stuff you need?". Again, this resembles reading the human mind and reacting accordingly, due to the fact that Alexa was built on NLG. Hence, its ability to respond to verbal and textual language becomes more sophisticated over time (Marr, 2023).

From the observations, the researcher noted the participants' reactions, with Alexa appearing to elicit feelings of happiness and satisfaction. For instance, the learners were laughing, and gave the impression that they were talking to an actual native speaker in a real conversation. Therefore, the interactions reflected real-life scenarios, except that the participants were unafraid of trying to produce English language, in the knowledge that even if they made mistakes, their answers would be satisfactory. Alexa also develops its cognition to process natural language. Consequently, even when the participants spoke poor English or displayed inconsistent pronunciation, they still had a positive experience. This impacted positively on them through the autonomous and stress-free environment created, specifically in the context of EFL learning.

V. Conclusion

This study revealed the positive views of its participants, regarding the use of voice recognition devices as a possible means of promoting the development of English language skills among EFL learners. The benefits gained especially related to students discussing real-life topics without the fear of making linguistic errors. Nevertheless, there is still only limited use of these AI- and NLP-based voice recognition machines in education. This is despite the rapid rate of progress in information technology, with new programming languages and huge servers that can store and transmit as much data as is necessary. From this perspective, more attention should be given to making this technology more affordable for use in the education sector, so that it can benefit humanity as a whole, rather than directing it purely toward personal use without exploiting its full potential.

VI. Recommendations for Further Research

Based on the results of this research, the following recommendations may be made to stakeholders in the Saudi education sector and internationally:

1. Voice recognition devices could be introduced into the EFL sector.
2. Statistical studies should be conducted to investigate the real impact of such devices in EFL and other educational fields and specialties.
3. The opinions of male learners could be examined, regarding the use of such devices in education.

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