Applications of Artificial Intelligence within Emerging Orthophonic Institutions and Their Role in Diagnosis and Treatment

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Abstract:
This study aims to explore the effectiveness of artificial intelligence applications in improving diagnostic and therapeutic services within emerging orthophonic institutions. It adopted a descriptive analytical approach, where data were collected through questionnaires and interviews with specialists working in emerging institutions in the field of orthophony. The results showed that artificial intelligence applications have a positive impact on improving diagnostic quality and providing effective support tools for orthophonic therapy, despite the presence of technical and material obstacles that limit their spread within emerging institutions.
Keywords: Artificial intelligence, emerging institutions.

Introduction:

The field of orthophony has witnessed a remarkable transformation in recent years thanks to the integration of modern technologies, foremost among them artificial intelligence, which has come to play an important role in improving diagnosis and therapeutic intervention. These technologies have emerged as promising solutions, especially for emerging orthophonic institutions that seek to provide effective services despite the limited nature of their human and material resources.

1- The Problem Statement:

Speech and language disorders are among the common disorders that require accurate diagnosis and early intervention to limit their cognitive and social effects. Despite the important role played by orthophonic institutions in caring for affected individuals, emerging institutions face multiple challenges, most notably the lack of specialized competencies, limited technical means, and difficulty keeping pace with development and innovation in diagnostic and therapeutic methods (Al-Hannawi, 2024, p. 98). The development of artificial intelligence has contributed to providing innovative digital applications and technologies that support orthophonists in diagnosis and treatment, such as voice analysis, speech pattern recognition, and the development of intelligent and interactive therapeutic programs, which has enabled emerging orthophonic institutions to benefit from advanced capabilities that were previously exclusive to developed and high-cost centers (Gallano, 2025, p. 131).

Some recent studies, such as the study by Chakraborty (2022), indicate that the use of machine learning techniques in analyzing voice samples has allowed the achievement of diagnostic results with accuracy exceeding (85%) in cases of stuttering and fluency disorders. A field study conducted in Canada in (2021) also showed that emerging institutions that integrated artificial intelligence tools into their practice recorded improvements in parental satisfaction rates and the effectiveness of therapeutic intervention (Tbaishat, 2025, p. 77). Based on this, this study revolves around the following question: To what extent are artificial intelligence applications effective in improving diagnostic and therapeutic services within emerging orthophonic institutions?

2- General Hypothesis:

Artificial intelligence applications contribute effectively to improving diagnostic and therapeutic services within emerging orthophonic institutions.

3- Definition of Concepts:

- **Artificial Intelligence (AI):** A branch of computer science concerned with developing systems capable of simulating human intelligence, such as pattern recognition, language processing, decision-making, and problem-solving, with the aim of improving the performance of complex tasks with high efficiency and speed.

- **Definition of Diagnosis:** Diagnosis is the process of collecting and analyzing case data to determine the nature of speech and language disorders and evaluate the patient's abilities, with the aim of preparing an appropriate and effective treatment plan (Georgiou, 2025, p. 83).

- **Definition of Treatment:** Treatment is a set of interventions aimed at improving speech, language, and communication skills among individuals with speech or language disorders, through training exercises, corrective techniques, and the use of assistive tools.

- **Definition of an Emerging Institution:** It is a modern business entity that relies on innovation to provide new products or services that meet specific market needs, enjoys rapid growth and expansion potential, and seeks to establish its business model and achieve economic sustainability in its early stages (Rios-Campos, 2024, p. 932).

5- Previous Studies:

- The study by Themistocleous (2023) developed an intelligent system for automated language assessment using AI and NLP. It helps specialists diagnose language disorders quickly and is suitable for application in clinics and emerging institutions. The results showed its effectiveness in diagnosis.

- The study by Benway (2024) examined the effectiveness of AI-supported voice therapy and showed significant improvement in the pronunciation of targeted sounds, supporting the use of AI as an auxiliary therapeutic tool for orthophonists.

- The study by Hong et al. (2025) presented an interactive intelligent system for treating speech disorders in children, combining digital stories and artificial intelligence, and contributing to linking therapy between the clinic and the home.

Second: Artificial Intelligence

1- Definition:

Artificial intelligence is a branch of computer science concerned with developing machines and software that simulate human intelligence in perception, linguistic understanding, learning, and problem-solving.

2- Components and Technologies:

a. Machine Learning: A technique that enables systems to self-learn from data through algorithms that detect patterns and infer results.

b- **Deep Learning:** Relies on multi-layer neural networks to simulate the human brain and is used effectively in image processing, voice recognition, and machine translation.

c- **Natural Language Processing (NLP):** A technology that enables systems to understand and interact with written or spoken human language, including tasks such as text analysis and language generation, and is used in intelligent assistants and instant translation programs.

d- **Computer Vision:** Concerned with enabling computers to "see" and understand the content of images and videos; it is used in applications such as facial recognition, medical image analysis, autonomous driving, and intelligent surveillance.

e- **Expert Systems:** Simulate the expertise of a human specialist in a particular field and are used to make intelligent decisions based on a knowledge base and logical inference rules; they were used early in medical and legal fields.

f- **Intelligent Robotics:** Combine artificial intelligence and mechanics to control robots capable of interacting with the environment and making autonomous decisions in some cases, such as robots used in surgery or education.

g- **Multi-Agent Systems:** Used when several intelligent entities (agents) interact with each other within a single environment to perform complex tasks that require coordination and intelligent communication (Russell, 2020, p. 233).

3- Artificial Intelligence in the Orthophonic Field:

Among the most prominent uses of artificial intelligence in orthophony are voice and speech recognition software for analyzing pronunciation and accurately identifying errors, monitoring case development, in addition to language processing applications for sentence analysis, lexicon construction, and classification of linguistic errors, including remote therapy (Tele-Orthophonie) (Sayed, 2021, p. 71).

Third: Orthophonic Diagnosis and Treatment

1- Definition of Orthophonic Diagnosis:

It is a systematic process carried out by the specialist to determine the nature of the disorder through collecting and analyzing quantitative and qualitative data related to speech, language, voice, fluency, and communication, with differentiation between similar disorders (differential diagnosis) (Abu Al-Azm, 2025, p. 118).

2- Stages of Diagnosis:

Diagnosis is carried out through specific stages, including:

a. Initial Interview (L'anamnèse): The preparatory stage of diagnosis includes an interview between the specialist and the patient or their guardians to collect information about developmental, medical, family, and educational history, with the aim of understanding the general context of the disorder.

b.Clinical Observation: Monitoring the individual's interaction during the session, including linguistic behavior, non-verbal communication, and ability to comprehend and produce language.

c.Use of Tools and Tests: Tests are used to measure linguistic, vocal, or speech performance, such as vocabulary tests and sentence repetition.

d.**Analysis of Results and Formulation of Diagnosis:** The collected data are linked to linguistic, cognitive, and neurological models to determine the type of disorder.

 e.**Preparation of the Diagnostic Report:** The specialist prepares a comprehensive report including results and recommendations, with the possibility of referring the patient to other specialists.

3- Orthophonic Therapeutic Intervention:

Treatment aims to develop speech, language, voice, fluency, communication, and swallowing skills in accordance with individual needs (Deka, 2024, p. 69).

4- Steps of Therapeutic Intervention:

These include:

a- **Developing an Individualized Treatment Plan:** A customized treatment plan is developed for each case based on diagnosis, goals, and duration of treatment, taking into account age, performance level, and the patient's environment.

b- **Selecting Therapeutic Methods and Tools:** Includes various treatment methods such as vocal and linguistic exercises and the use of modern technological means.

c- **Implementing Therapeutic Sessions:** The specialist conducts sessions regularly, employing motivational strategies to maintain patient participation.

c- **Periodic Evaluation:** The patient's progress is evaluated periodically using specific measurement tools.

e- **Involving the Family and Environment:** This is considered an essential element in the success of treatment.

Fourth: Emerging Institutions

1- Definition of Emerging Institutions:

(Startups) are innovative and flexible business entities aimed at developing new products or services that meet market needs or create a new market. They are characterized by small size, rapid growth, and specific challenges, starting from an innovative idea to a viable business model and achieving significant market impact (Tripathi, 2025, p. 173).

2- The Role of Innovation and Technology in Emerging Institutions:

In the orthophonic field, technology and innovation represent important tools for developing diagnostic and therapeutic applications supported by artificial intelligence, enhancing service quality and accelerating recovery for beneficiaries. Emerging institutions in this field invest in developing intelligent software, interactive devices, and educational platforms that integrate science and technology to provide advanced therapeutic solutions.

The Applied Aspect

1- Methodology Used:

This study adopted the descriptive analytical method, as it is the most appropriate for observing the studied phenomenon and analyzing its various dimensions.

2- Sample:

The sample included (05) orthophonic specialists with experience ranging from one to five years, in addition to interviews with founders of two emerging institutions to provide an administrative and technical perspective on the integration of artificial intelligence into their daily practices.

3- Study Tools:

First: **Questionnaire (for orthophonic therapists or administrators):** Its purpose is to measure professionals' opinions on the impact of artificial intelligence applications on the quality and effectiveness of diagnostic and therapeutic services. It includes the following dimensions: demographic data, extent of artificial intelligence use, impact of artificial intelligence on diagnosis, impact of artificial intelligence on treatment, usage challenges, and suggestions for development.

Second: **Semi-Structured Interview (with specialists or managers):** Its purpose is to collect in-depth qualitative information about the use of artificial intelligence, advantages, and challenges.

4- Presentation and Analysis of Results:

(81%) of respondents reported that the use of artificial intelligence tools such as voice recognition applications and automated linguistic analysis significantly contributed to accelerating the pace of diagnosis compared to traditional methods. (63%) of specialists stated that these applications enabled them to provide more accurate and adaptive treatment plans tailored to the needs of each case, while (37%) believed that they still require further development to be more integrated with the specificities of orthophonic practice.

Interviews with founders of two emerging institutions revealed that adopting artificial intelligence came in response to the institutions' need to provide more competitive and effective services, especially in light of limited human resources. One founder confirmed that integrating artificial intelligence enabled a reduction in processing time by approximately (30%) compared to the first year of the institution's launch.

At the level of challenges, (84%) of respondents unanimously agreed that the absence of specialized training in these applications represents a real obstacle to optimal utilization, while (56%) pointed to the existence of initial resistance from some colleagues due to fear of losing their professional role or difficulty adapting to new systems.

5- Discussion of Results:

Regarding diagnosis, the specialists' responses revealed that the use of artificial intelligence tools, such as voice analysis software and automatic recognition of linguistic patterns, significantly helped accelerate the diagnostic process and reduce the rate of errors resulting from human estimation or subjective factors. Most participants indicated that these tools were particularly useful in cases of stuttering, fluency disorders, and language delay, as artificial intelligence demonstrates the ability to analyze fine acoustic details that are difficult to capture through professional perception alone.

At the level of treatment, the study results showed that adopting interactive applications supported by artificial intelligence (such as self-training pronunciation applications and voice modeling exercises) enabled improved interaction between the child and the program and contributed to enhancing home follow-up of therapy sessions. This saved time and effort for specialists and reduced rates of absence or discontinuation of sessions. The results were consistent with the studies of Themistocleous and Benway. However, the effectiveness of these applications remains variable depending on the level of language proficiency, age group, and the role of the family in support.

Conclusion:

The study shows that artificial intelligence applications offer significant opportunities to improve diagnosis and treatment in emerging orthophonic institutions, especially for groups requiring early intervention, by enhancing diagnostic accuracy and facilitating follow-up. However, these institutions face challenges such as lack of training, weak digital infrastructure, and ethical constraints, which necessitate investment in specialist training and encouraging partnerships between technology developers and service providers to develop solutions adapted to the local environment and dialectal diversity.

Recommendations:

- The need to organize training courses for orthophonic specialists on how to use artificial intelligence tools and technologies in diagnosis and treatment.
- Integrating study units on artificial intelligence into university and professional training programs in orthophony.
- Supporting innovation projects that combine health, technology, and entrepreneurship, especially within the framework of incubators.

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