# USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN LANGUAGE AND SPEECH DIFFICULTIES

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**Abstract:** During the last decade speech and language therapy has undergone a remarkable transformation towards the use of information communication technologies (ICT) for the diagnosis and intervention of speech and language difficulties. In most cases, while ICTs are used as auxiliary tools for speech and language therapists, they are used as an intervention tool in regions where speech and language therapists are not available. In this article, a brief summary of some applications of information communication technologies used for assessment and intervention according to the type of language and speech difficulties will be given. The lack of sufficient experts in parallel with the prevalence of language and speech difficulties suggests that information and communication technologies can be used. It has been determined that the prevalence of language and speech difficulties in school age children is 5% in the world. This rate was mostly found as voice disorders (3%) and stuttering (1%). In a study on the screening of children with language and speech problems in Turkey, the rate of 5% in the kindergarten and first grades of primary schools in Eskişehir. It has been determined that there are children with language speaking difficulties at a rate of 1. A similar study revealed that 3.5% of 16.000.000 kindergarten, primary and secondary school children have language and speech difficulties. In the research conducted by taking samples from 59 private and public institutions in 25 metropolitan cities from 7 geographical regions of Turkey, the disability groups served were listed; including stuttering, delayed speech,

***Key words:*** *Speech and Language Therapy, Speech and Language Difficulties, Assessment, Intervention, Use of Information Communication Tools.*

## I. INTRODUCTION

Language and Speech has been the most natural and frequently used agency of human communication throughout history in terms of providing information transfer between individuals (1). In this direction, the profession of speech and language therapist has developed rapidly, especially in the last 30 years, with interdisciplinary clinical training and practices, and has recently used available information and communication technologies (ICT) (2).

In speech and language therapy, ICT is used as a real clinical tool for diagnosis and intervention. These tools are: Web-based content, simulations and micro-domains, adaptive systems, smart course systems, virtual reality, hand and mobile devices, virtual learning environments and applications such as telehealth and high-budget research and development (R&D) studies for the development of ICTs. is done (2).

The literature refers to the positive effect of the use of ICT in children and adults with deficient speech and language skills. Investigating the use of ICT for the evaluation, support and rehabilitation of communication disorders has shown positive results in disorders caused by neurological disorders, autism, hearing impairment, and acquired speech and language disorders (4). Through the use of ICT, therapists use flexible and innovative assistive technology integrated into their clinical competencies, as well as individual therapy programs for participants with speech difficulties. Speech and language therapists use ICTs for measurement and evaluation purposes. (3, 4). In this study, We provide an overview of the most popular applications used for the assessment and intervention of speech and language disorders in both children and adults. We have divided assessment and intervention ICTs in speech and language therapy into two main categories: First, it includes assessment tools for adults and children, and second, to classify speech and language difficulties through ICTs.

II. Bit Use in Evaluation Procedures

Early diagnosis of speech and language difficulties in children or adults is of fundamental importance to the speech and language therapist and plays a key role in the successful outcome of the intervention of the difficulty. The rejection of language and speech difficulties by the participant causes some basic problems: He may experience difficulties in communication skills, lack of self-confidence, negative self-esteem and social withdrawal in social and academic life. Since the speech and language therapy process can be challenging and time-consuming for both the therapist and the participant, intelligent diagnosis and therapy systems have been created as a way to increase the efficiency of speech and language therapy (5).

"Telelogos" is an easy-to-use web-based tool aimed at assessing the optimal level of intervention by speech and language tarpists. The system offers an alternative approach to distance/technology supported language and speech therapists and has a feature that detects children's learning problems as well as speech and language therapy to children. In addition, it enables to communicate with participants with paralysis, language speaking difficulties, and to evaluate non-verbal written language skills, phonological awareness and level. In addition to these features, Telegos is also used as a communicator between two disabled children who have language and speech difficulties (6).

He developed a computer-based program for the evaluation and analysis of voice disorders. This tele-diagnostic software package has been named "Diagnostics of Voice Disorders (DoVd)". This computer-based program consists of two main applications: Perceptual evaluation of sound and acoustic analysis and integration with endoscopy techniques. The

first "MedivozCaptura" records the signals in speech production, the second - "WPCVox" - analyzes the sounds, objectively measuring their quality. This computer-based software requires a large sound and endoscopic image database in order to use the program(7).

A study was conducted on patients with aphasia to determine whether there was a difference in outcomes between standard face-to-face language assessment and real-time tele-rehabilitation via videoconferencing. A total of 32 patients with aphasia were examined under equal conditions by bilingual and speech pathologists in order to determine the effect of the severity of language impairment on the assessment of language impairment. The results revealed that although the severity of aphasia counteracted assessment through telerehabilitation, it did not affect the accuracy of assessment results. Some subtests may be difficult due to some difficulties such as telere rehabilitation sound and image quality deterioration. However, these can be eliminated with the use of more advanced technological tools (8).

A study was conducted on the intelligibility of speech of participants with dysarthria speech disorder. In this research, the development of a model that provides reliable phoneme scores calculated from three different types of speech intelligibility models is presented. These are models with phonemic features, phonological features, or a combination of both, resulting from syntax between speech and typical phonetic transcription. As a result of the examinations on 10550 sound recordings consisting of 10550 consonant and consonant words expressed by one hundred and sixty participants, it has been shown that the findings obtained in the study can be used as a clinical tool in terms of reliability and validity (9).

They developed a screening system to detect decline in cognitive abilities. The system determined the speech characteristics from the conversations of the participants recorded over a phone. These speech features were compared with recordings made in a controlled environment. The results showed that remotely recorded speech characteristics, small algorithmic changes, may be reliable enough to be used in monitoring incipients and intervening in cognitive decline in aging subjects (10).

An internet-based program has been developed to determine speech pathology in children aged four to seven years (SPDES). In this system based on developmental methodology, they benefited from the neurology database. The database evaluates the participant's answers and presents the difficulties identified in speaking language to speech and language therapy in a list. The speech and language therapist can create a preliminary outline of the individual training program based on the pathologies in this list. Researchers especially emphasized that the program can be used for preliminary evaluation and should be considered as an auxiliary tool for speech and language therapy (11).

III. Use of Lice in Intervention Procedures

ICTs have been observed to have a significant effect on intervention in people with speech and language difficulties, neurological disorders - genetic or acquired hearing impairment and autism spectrum disorder. ICTs contribute to the improvement of the cognitive level of

the participant with speech difficulties, as well as to optimize the speech level. The program should be designed in an easy and understandable way according to disability (12, 139).

A. Autism Spectrum Disorder

A study was conducted on adding a sensory/emotional dimension to computer assisted learning or teaching methods (CAL/CAI systems) in autism intervention. The method of operation in the computer assisted learning program is considered as an assistant program that aims to develop various interaction forms suitable for the teacher-child education process and the disability level of the autistic person. The system is composed of an instruction emotional symbol, synthesized speech (Greek), written on the screen, or a combination of all three. Sign language and real images are presented together for a better understanding of the system. Icons respond to the child's situation by expressing appropriate emotions for each situation, imitating teachers in similar situations. The system also

The implementation of the ACALPA educational platform for children with autism has been evaluated. The platform uses emotional icons, synthesized speech and multimedia content (videos, images and sounds) aimed at supporting and facilitating teacher-child interaction. The platform used more and less complex modules according to the child's capacities, each focusing on a specific learning area. Evaluation results showed that the symbols contributed positively and significantly to the educational process of the participant (15).

The prototype designed program developed for students aged 6-10 is a facial expression recognition, facial expression recognition program called "Facial Expression Wonderland" (FEW) with autism spectrum disorder. The training is based on a computer game based on the movie "Alice in Wonderland", consisting of three different training levels with voice instructions. In order for the participant to move on to the next level, the children must complete all the tasks at each level (16).

The computer-based program reports, through a long-term study, the benefits of using the TROCAS platform, a customized message board designed to support visual, audio and contextual information. Very simply, this platform allows autistic children to share their ideas with others using the "Like" and "Dislike" buttons, see other children's opinions and messages of change. The results of the study showed that there were significant and consistent changes in students' communication patterns (17).

They developed a virtual reality application in the treatment of autism by using 3D virtual pink dolphins in a 3D dolphinarium. This learning activity system (LAS) enables children to meet their learning and behavioral needs and works as an external stimulus by incorporating various distracting symbols into the system. Therapists teach children how to interact with 3D dolphins, using simple hand gestures they want the dolphin to respond to. After a while, with this reinforcement, the child with ASD advances and acquires other movements, learns to respond to dolphin sounds and even dialogues with virtual dolphins, so that their communication skills improve in the process (18).

B. Hearing Impairment

It has developed an e-learning tool designed to help deaf children learn and practice vocabulary in Thai more accurately. This Tool uses language and speech technologies, eg. they developed a three-dimensional speech strategy with computer-assisted animation by going beyond the limits of traditional face-to-face speech and language therapy (19).

They have developed a software system for hearing-impaired children in Iran. The multimedia-enabled program has a creative and entertaining combination. The program offers 300 different articulation videos, digital touch diagrams of 26 different language positions that facilitate interaction and synchronization of language speaking activities at home. Speech and language therapy centers have shown that it is integrated with the program developed with the results of the pre-tests for hearing-impaired children aged 2-6 (20)

C. Language Disorders

Language disorders affect the ability to read and write as well as language. Therefore, traditional language therapy and ICTs aim to optimize the participant's language development by improving existing language skills and by intervention for language difficulties. Speech and language therapist aims to maximize the communication skills of the participant (21).

Computer-based aphasia therapy program based on distance education was applied to patients with aphasia for six months. In the evaluation made as a result of the research, it was observed that there was a positive improvement in patients with aphasia. The researchers stated that the positive improvement was also related to the patient's increased autonomy and increased self-perception. Conversely, it was the amount of time spent in practice deprived of other activities. On the other hand, participants with aphasia were deprived of other activities during the computer-assisted aphasia program (22).

Computer-based aphasia therapy program (CVA) based on distance education developed by Mortley, Wade, and Enderby was applied. This therapy program was applied to participants with verbal aphasia. The therapy is based on 3-6 therapy sessions per week for twenty-seven weeks in the participant's home environment. The computer-based program was created from various therapy methods and feedback. The comparison of the pre-intervention and post-intervention (pre-post-test) language assessment test results with the data obtained as a result of participant interviews has proven that the program is acceptable and effective (23).

Interactive Reminiscence Conversation (CIRCA) is a computer-based multimedia program that provides verbal and nonverbal communication skills in participants with dementia, thanks to the use of interactive multimedia that stimulates long-term memory. After a study on a group of patients with dementia and their caregivers, it was observed that the speech autonomy of the participants with dementia increased. They stated that after the

implementation of the CIRCA program, participants with dementia activated memories that they had never heard before, and a comfortable interaction environment and more natural speech were formed (24).

It is a computer aided vocabulary acquisition program using MossTalk Words' Cued Naming exercises. The therapy system is a hierarchical, multimodal marking protocol under clinician-guided and self-directed instructions. Their review showed that computer-assisted therapy benefits not only clinical determination therapy, but also one-on-one speech therapy, and this benefit is also effective in individuals with chronic aphasia with phonetically significant defects (25).

It is a multimedia desktop program developed to support participants with aphasia. The program is based on the use of video and audio on a PC, with the ability to be later downloaded to a mobile device and used by patients to support communication outside the home (26).

Raymer, Kohen, and Saffell investigated the effects of the Talk Words Multi-Mode matching exercises module in aphasic participants. Five patients with semantic and phonological anomie were matched to verbal expression with MossTalk Multi-Mode matching exercises (verbal and written word/picture matching) via computer. One month after training, picture naming performance proved that computerized lexical training exercises could lead to increases in word comprehension and production (27). The work on updating the program continues.

An Online Multimedia Language Assistant (W2ANE) program has been developed for individuals with aphasia. The program has two main components: First, it consists of OMLA, an online multimedia library and an adaptive vocabulary of VIVA. The difference between W2ANE and similar systems is that W2ANE has more multimedia data modalities, including video and non-speech audio. It provides users with flexible language rehabilitation by searching for unknown words, accessing pronunciation and content (28).

It is the "Tele Rehabilitation" program that will contribute to telehealth by using information technologies. The aim of the program is to contribute to the provision of direct service through the use of information technologies. By using a virtual desktop, the participant is in real-time communication with the therapist and works together using screen materials such as scanned worksheets and documents or computer applications. After six weeks of treatment, all stroke survivors demonstrated improvement in cognitive and communication skills equivalent to similar face-to-face therapy (29).

The effectiveness of MossTalk Words was examined on two participants with anomaly. The study proved that the Moss Talk intervention program helped both participants improve their language skills, maintain some of the therapeutic gains on the trained materials, and generalize to a sentence generation task one month after treatment (30).

Lee, Kaye, and Cherney A computer-based speech-language training program called Aphasia Scripts TM was applied to 17 participants aged 31-70 with chronic nonfluent aphasia and apraxia of speech. The program was nine weeks long. The aim of the program was to investigate the relationship between treatment duration and speech-writing performance and the effect of this relationship on the severity of language impairment in patients with nonfluent aphasia. As a result, it was shown that the duration of treatment was significantly correlated with improvement in terms of both content and rate, especially in participants with severe aphasia (31).

MossTalk Words computer aided program was used in order to regain the lost words in patients with semantic dementia who experienced word loss. A computer-based intervention program designed for anomaly was applied to another group of participants with anomaly who had semantic dementia. Four months after the intervention, the results of participants with semantic dementia treated with different methods were compared with the results of the MossTalk Words computer-assisted program. As a result, it was observed that the results were in favor of the MossTalk Words computer aided program(32).

In adults with aphasia and apraxia of speech, the effectiveness of the intervention with mixed paper -digital interface (mixed interface digital paper) and multimodal digital pens prototype was investigated. Especially in speech and language therapy, mixed paper -digital interface (mixed interface digital paper) and multimodal digital tools were used as an auxiliary tool. discussed the effectiveness of the pen prototype. The Livescribe Pulse Smartpen is a new type of digital pen that captures and recognizes paper-based handwriting with audio recording and playback, while also allowing custom applications to be placed directly on the pen. Besides being cost-effective, this technology is also thought to be useful for supportive care (33).

D. Speech Disorders

While speech disorders are defined as voice quality problems, dysfunctional states and phonological disorders, it can also be a combination of speech difficulties resulting from another dysfunctional condition. In many cases, ICTs can be used as an aid in the intervention process for therapists and people with speech difficulties and their caregivers (13-34).

Dysarthria and Dyspraxia

In an EU funded research project called "Ortho-Logo-Paedia" (OLP), a technology-supported program was developed to improve the quality of life of people with speech disorders. By integrating the project speech training with speech identification technology, this program has been made available over the Internet. The system has three main components: 1. OPTACIA, which provides real-time visual feedback on the participant's speaking level, 2. GRIFOS, which is an automatic speech recognition system, and the vocabulary appropriate for the participant's speech level, and 3. TELEMACHOS, Web database technology to

provide the system's remote lecture and monitoring capability. based distance education (35).

The research examined the multimedia system-based "SpeechKit" to aid intervention in participants with motor impairments. Therapists have made therapy more effective and easier by using the SpeechKit by assisting the voice-based commands they use in the traditional intervention method. Asymetrix Toolbook was used to develop the system, and a more advanced system is currently being studied, especially targeting people with motor speech disorders (34).

It has been determined that the STARDUST (Technology to Support Speech Education Through Distance Education) program, ASR (Automatically Identifying Speech), has a positive effect on the speech levels of patients with dysarthria (35). As a part of the STARDUST (Technology to Support Speech Education Through Distance Education) project, it is aimed to increase the speaking level of participants with dysatrical speech through the STRAPTK program. STRAPTK users work with a console whose software allows instructors and participants to work in a high-end graphical environment. The software allows the participant to speak and then receives visual feedback, and also gives the therapist an opportunity to review the participant's performance by reviewing the recorded speech material.

Lee Silverman Voice Training (LSVT) in Research is a program that improves voice and speech for people with Parkinson's. In addition to improving the speech level caused by different types of disabilities in LSVT applications, it also improved the voice disorder levels of the patients positively. This article presents the research and development of virtual LSVT and also identifies the disadvantages of the project and focuses mainly on the lack of clinical assessment of participant's performance (37).

Cheng, Huo, Ghovanloo et al. (21) presented the results of the use of three different algorithms -DIRECT, Powell and Nelder-Mead optimization algorithms- in their research, with a new magnetic localization system that aims to monitor tongue movement in the 3-D oral cavity. A magnet attached to the tongue signaled an array of 3-D magneto-inductive sensors outside the mouth to monitor movements in the oral cavity. It has been determined that the Owell algorithm is an adequate application that provides real-time monitoring of tongue movement.

It is an "E-learning-based Speech Therapy" (EST) tool used in the Netherlands, which aims to provide remote, personalized, yet cost-effective Speech Therapy to dysatrical patients. A central server hosts two types of audio files: target files in MP3 format and recorded speech files uploaded by participants in wav format that can be accessed by a desktop computer or laptop with an internet connection. The therapists prepare a personalized speech training program for patients from audio samples of the target speech, which is stored on the server that the participant downloads, listens, and imitates as accurately as possible. Finally, the expressions are compared with the samples and uploaded to the server. The disadvantage

of this method is that there is no visual feedback to increase auditory discrimination abilities; This,

ii. Voice Disorders

Mashima (39) investigated the distance learning-based voice therapy program developed for participants with voice disorders. The effectiveness of the program and customer satisfaction were also examined in the research. A telehealth vocal rehabilitation protocol was developed for this research. In the study, twelve participants with voice disorders received traditional voice therapy, while nineteen participants were intervened via video teleconference. As a result, it has been observed that the intervention through telehealth provides the same level of success as the traditional voice disorder intervention. However, success in administrative and technical matters has not been at the desired level.

Åkerlund, Hulting, and Petersson (40) presented one of 16 MedCal e-learning projects on DYSPHONIA voice disorder, especially for Medical or Speech Therapy students. The program includes images and video clips of various pathological conditions, as well as audio samples and analysis. It offers students the opportunity to witness exam techniques, therapeutic sessions and surgical interventions.

Articulation and Phonological Disorders

In the research, the first web-based program for technology-assisted speech and language therapy, called "Telelogos", was developed, which was tested in Greece and the United Kingdom. The program allows therapists to assess the child's phonological level and analyze their phonological system, and then make recommendations on what would be the best intervention for each child. The program also includes tests to detect speech disorders (41).

In the study, three speech therapy tools called "Pre-Lingua", "Vocaliza" and "Cu´entame" were presented, which aim to help people improve their phonology, articulation and communication skills as a descriptive and comprehensive language, respectively. Although designed as a program focused on Spain and Latin America, it also has the ability to create an easy interface for speech therapy in any language. In this respect, it has the feature of encouraging developments regarding the functionality and robustness of computing applications (42).

The TERAPERS project was developed as a tool to assist therapists in the intervention process for dyslalia in pre-school schools in Romania (43). The system includes a wide range of research areas such as artificial intelligence, virtual reality, digital signal processing and digital electronics and psychology. The main advantage of this system is that the therapist saves time from exercising and can concentrate more on the treatment.

Greece has developed an e-learning system to improve pronunciation levels in preschool children. The software, which can be downloaded from the Internet, is an updated version of the game "You are Talented", which regulates the child's polyphony and provides feedback

on this regulation. According to the results of the research conducted on this software, it was revealed that children not only improved their pronunciation levels, but also developed their vocabulary (44).

Schipor, Pentiuc and Schipor have introduced an improved CBST system called LOGOMON (Logopedics Monitor), which includes a 3D Articulator Model and Homework Manager, loaded on a PC to improve the pronunciation levels of preschool children. The system offers children the advantage of having fun and longer exercises over the PC. The program also provides predictability, feedback, and the establishment of a close relationship between the speech language therapist and the child (45).

In Turkey (46) the study of therapy for stuttering and the creation of community-based self-help support groups on the internet (e- ÖZYARDEP) was developed as a project. 83 individuals with stuttering participated in the project. In the second study of the project, the effect of individual and group speech therapy on changing the severity of stuttering and negative attitudes was determined by using the experimental repeated measures time series model. examined. Internet-based self-help support program applications were analyzed qualitatively with the group technique. The findings showed that individual and group speech therapies were effective in changing the stuttering severity of the participants;

Within the scope of the "Increasing the Learning Opportunities of Children with Autism through Technology", which was supported by the Istanbul Development Agency in 2012 within the scope of the Information and Communication Technologies Focused Economic Development Financial Support Program for Non-Profit Organizations, which lasted for 9 months, children with autism who are in a disadvantaged position can use them in communication, academic and daily life. A new website has been prepared so that they can learn the concepts more effectively, easily, and entertainingly in every environment with the help of technology (47). Within the scope of the project, by the trainers of Tohum Autism Foundation Special Education School, children with autism or mental disability who have learning difficulties, A total of 300 different concepts have been developed within the scope of 50 educational program sets that they can use in daily life for the concept teaching sets that are aimed to be taught to children aged 0-8 with typical development. With 50 training programs developed including 20 object matching, 20 object discrimination and 10 object classification, the target group's shape, color, fruit, vegetable, beverage, etc. It helps them learn concepts such as With the aim and dissemination of the concept software, introductory seminars were given to the trainers and families in the districts of Bağcılar, Kadıköy, Şişli, Zeytinburnu and Beylikdüzü in Istanbul, so that children were informed about the access and use of the related software. During the two months following the development of the software, a total of 525 people, including families and trainers, were reached and 1,050 hours of training were provided. The concept software designed as a game is available at www.tohumegitim.com; It can be accessed free of charge on iOS and Android-based tablets.

IV. CONCLUSION

In this study, the best examples of the last ten years of using ICT in speech and language therapy, therapists, caregivers and other assistants that will facilitate the life of patients, in the intervention process of language and speech difficulties are summarized. In our country, no study has been found that measures the attitudes of speech and language therapists towards the use of technology in speech and language difficulties. Although experienced speech and language therapists abroad were reluctant to use ICTs in their fields, it is seen that their attitudes have changed significantly in the last ten years. ICTs are now recognized as a tool to help achieve faster and more efficient results when traditional intervention fails. We tried to present ICTs by classifying them according to their usage types in speech and language therapy. Although the ICTs we offer are used efficiently, they still need to be developed. The field of speech and language therapy continues to develop in our country. Considering that there are not enough experts, it is thought that the development and use of ICTs will contribute to the field.

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