Martina Galeković (Croatia)
Center for Education, Velika Gorica
galekovicmartina@gmail.com

ICT APPLICATIONS FOR PEOPLE WITH SPEECH AND LANGUAGE DISORDERS

Abstract

The digital technology used on smartphones and tablets provides entertainment and offers a number of additional materials and content needed in education. The possibility of using computers for educational and therapeutic purposes has enabled children and users with various health problems, motor impairments, and chronic diseases access to information, education, therapeutic work, monitoring and counselling. As part of the EU projects, the EU constituent countries have developed programmes and applications aimed at education. The project "ICT Competence Network for Innovative Services for Persons with Complex Communication Needs (ICT-AAC)" took place from March 2013 to March 2015 and was carried out by the University of Zagreb in collaboration with other stakeholders: associations and companies. The developed applications are applicable for educational and therapeutic purposes in education as a teaching method and a tool in treating speech and language disorders within speech therapy. In addition to education, there are also applications for communication purposes for people with complex communication needs. This paper briefly presents some of the ICT-AAC applications and their implementation in working with the intended users.

Keywords: assistive technology, digital technology, educational applications, m-learning, assisted communication

_____

Introduction

One of the most important areas in primary education is the acquisition of language competence, and delays in the acquisition of speech and language affect other aspects of a child's development. Language is a system consisting of a series of symbols with a certain meaning and a set of rules by which these symbols are associated (Hržica and Peretic, 2015). Speech and language development disorders are diagnosed, detected and assessed by a speech therapist who is qualified to work on the prevention, detection, diagnosis, rehabilitation and treatment of speech, language and communication disorders.

Language development is an individual process, which means that it does not flow in all children at the same speed and in the same way, i.e., the style in which children reach some milestones is not uniform (Kuvač Kraljević and Kologranić Belić, 2015). Speech therapy is usually carried out face to face, but due to the covid-19 pandemic measures, a number of speech therapists have used video conferencing tools and online exercise options. In performing therapy, the speech therapist can use various materials and aids: worksheets, puzzles, didactic toys, as well as high-tech devices and available educational applications. Given the specificity of the speech and language area, it is necessary to have an app in the mother tongue. In Croatia, ICT-AAC applications have been developed for people who need help and support in speech, language and communication development within the project "ICT Competence Network for Innovative Services for Persons with Complex Communication Needs (ICT-AAC)", which lasted from March 2013 to March 2015.

Application development in the world and Croatia

Pavlin-Bernardić et al. (2015) state that the use of computers in education can contribute to the success of not only children with a normal developmental pattern but also children with communication and developmental disorders. To this end, the project "ICT Competence Network for Innovative Services for Persons with Complex Communication Needs (ICT-AAC)" was launched. The abbreviation ICT-AAC refers to the terms "information and communication technology" and "alternatives and augmentative communication".

The project was co-financed by the European Union from the European Regional Development Fund (ERDF). Experts from four constituents of the University of Zagreb participated in the project: the faculty of Electrical Engineering and Computing, Faculty of Education and Rehabilitation Sciences,

Faculty of Graphic Arts and Faculty of Humanities and Social Sciences (Pavlin-Bernardić et al., 2015).

The development of applications within the ICT-AAC project was focused on two main areas: education and communication. When developing applications, the aim was to make the learning and communication process as attractive as possible to end-users in order to encourage them to use the application. Within The ICT-AAC project, a number of applications were developed that are used in working with young preschool children with complex communication needs, working with adults after traumatic brain injuries and cerebrovascular stroke, and also working with older preschool and young school children in acquiring skills that precede reading, writing and calculating (ICT-AAC Developed Applications, 2021). The apps were developed as Apple iOS, Android and web applications and can be used on smartphones, tablets and computers.

Applications as a tool in speech, language and communication therapy have been well accepted and recognised by educators in kindergartens, schools and other educational institutions, as well as in speech therapy practice (Ivšac Pavliša et al., 2016; Kuhar et al., 2016; Mervcich and Kutnjak, 2019; Gerstner and Sekol, 2014).

The development of smartphone and tablet technology has created a need to design software applications that encompass areas for gaming, entertainment, leisure, social networking, but also education. The number of apps is constantly growing, with a total of about 1.85 million apps available in the Apple Store in early January 2022 and 2.56 million apps in the Google Play Store. Twenty thousand of them are intended for children to play, have fun and learn. Applications for children most often have a label indicating the age group to which it is intended, such as a label from the third year of life onwards, from the age of three to seven, from the age of seven to eleven or the like. Most apps are free; both Google and Apple offer more free apps than paid ones, and the Google Play Store lists a percentage of 97% of entirely free apps (Statista, 2022). Applications related to the promotion of speech and language skills are intended for persons/clients who can use them independently, as well as for professionals and family members who can guide, help and assist them in using the applications.

One of the first most famous programs was the SpeechViewer computer system developed by IBM, designed as a program that can be used by speech therapists and other experts in the field of speech and language communication while working with clients. The interactive programs were primarily intended to support the treatment of people with hearing impairment (Barry, 1994; Pratt

et al., 1993). When applied, SpeechViewer provides therapists and clients with auditory and visual feedback; it is adapted to various age groups and includes pitch, loudness, vocalisation, and (sound) pronunciation exercises. It features motivating, attention-grabbing exercises and animated graphics reminiscent of playing games. The application is easy to use and applicable to users of all ages with various speech disorders. SpeechViewer has been developed for a specific number of countries, that is, different speaking areas.

European Union projects regularly fund and encourage the development of science and technology. Hence, some of them have resulted in creating software solutions to encourage speech and language communication. These are, for example, an OLP (Ortho Logo-Paeida) project, which was implemented in 2002 and coordinated by the Institute for Language and Speech Processing founded in Greece (Athens) in cooperation with other European countries. The aim of the project was to implement the e-learning method to support speech therapy (Oster et al., 2002). Within the INCO-COPERNICUS programme, coordinated by the European Commission, the SPECO project was implemented, in which the e-learning method was developed. Also, a software solution was developed for improving the pronunciation of the persons with hearing and speech impairments, encompassing the languages of the countries involved in the programme: English, Swedish, Slovenian and Hungarian. Hardware and software solutions were also designed for hearing-impaired speech exercises - in German, French, and Spanish within the ISAEUS project, while the HARP project was implemented for English and French-speaking areas, enabling prelingual and postlingual children with hearing impairments and children with cochlear implants to be rehabilitated using high technology in schools, clinics, and homes (Vaquero et al., 2006).

In the beginning, applications for encouraging speech and language development were based on the phonological component of language, sound/letter recognition in words. However, later numerous applications were developed that include all language components and are used to develop, encourage and strengthen communication competence. An example of an application as a tool used in speech, language and communication therapy in the Spanish-speaking area is *Vocaliza (Vaquero et al., 2006), Pre-Lingua and Cuentame (Rodriguez et al., 2008).* The purpose of the applications is to support the daily speech therapy exercises and the development of language skills in persons with speech-language pathology. The *Vocaliza* application covers three language components: phonology, syntax, and semantics, and its usage is based

on automatic speech recognition, speech synthesis, and articulation verification (Vaquero et al., 2006). Although the application is focused on certain language components, it provides a wide range of possibilities for designing creative speech therapy, and computer skills are not necessary for its use. The application consists of several blocks of tasks or games that are interesting and attractive to children and can be a valuable addition to speech therapy. *Vocaliza* includes four types of games, and they are intended for: (1) pronunciation of sounds, (2) riddles related to the semantic component of language and the discovery of meaning, (3) putting words into sentences and practising syntactic structure, and (4) generally encouraging speech and verbal expression. Whether the task was successfully completed is assessed using technologies that enable the recognition and translation of spoken words into computer text or text understandable to a computer, also called Automatic Speech Recognition (ASR), using a text-to-speech system. -TTS), which is actually the computer-generated simulation of human speech, i.e., speech synthesis.

An equally important part of speech therapy is working with adults and the elderly, and applications designed for this population have been developed. Loss or disorder of speech with difficult or reduced ability to understand, as a result of impairment of the functions of speech centres in the brain, is a common clinical picture of stroke survivors. The prognosis depends on the cause and extent of the damage. There is no specific therapy, but speech therapy can significantly speed recovery.

Impairments in the area of speech production are most often the result of a stroke in the left hemisphere of the brain. In addition to stroke, these impairments can be caused by infections, head trauma, tumours, and other neurodegenerative changes. Inability to communicate makes the person isolated and frustrated; depression and loneliness are frequent. Speech therapy intervention, family counselling and direct work with the affected person should be provided as soon as possible. Sometimes this is only possible in the family home if the person is immobile. Since the beginning of the therapy often has to be waited for, applications can serve as an aid that is available to everyone. Garcia (2019) published a study that tested the patient's initial condition and the condition after conducting task-based exercises using the *Theraphasia* app for eight consecutive weeks, for 10-15 minutes a day. In monitoring patients' progress, proposals were made for further therapy and the organisation of exercises. Since the participants are mostly older, they need a tablet or device with a display larger than a mobile phone. Instructions and a tutorial for the

patient in the mother tongue (in this case, Filipino) are also necessary to make the patient aware of the purpose of the exercises and what they are expected to do. It is important to make it possible to monitor the progress in doing tasks and achieving goals in the rehabilitation of speech and language development in a visible way. Since patients with aphasia are older people, it is necessary to adjust the graphics and the volume of the games without additional distractors in solving tasks. *Teraphasia* as an application has seven categories encompassing seven elements of therapy: (1) communication and conversation; (2) language comprehension; (3) sentence comprehension; (4) appointment; (5) repetition; (6) reading aloud, and (7) pronouncing sounds (Garcia, 2019).

Therapy of speech and language disorders is focused on speech and written communication, prevention, diagnostics and treatment of deviations in speech and language development. Speech disorders include disorders in the field of oral motor skills, (sound) pronunciation and fluency disorders. Speech disorders include stuttering, which affects 1% of the population and occurs in a 4: 1 ratio in favour of the male population (Hollingshead and Heeman, 2004). Delayed Auditory Feedback is a technology often used in stuttering rehabilitation to slow down and slightly calm speech motor skills. A delay option is also present on the devices intended for hearing and speech rehabilitation, such as verbotonal acoustic devices (e.g. Suvag-LINGUA, Behringer). The signal delay option is also provided by applications available for smartphones and tablets. However, there are also desktop-only applications. As software to help speech therapists, we can mention MSTAT (Malay Speech Therapy Assistance Tools), which was developed for the diagnosis and treatment of stuttering. The method of counting errors, i.e. deviations in fluency, is often used in the assessment of stuttering. Stuttering symptoms include: (1) repetitions that may be at the beginning, in the middle and at the end of a word or sentence; (2) blockages at the beginning of the word due to airflow stoppage; (3) prolongation of sounds and (4) repetition of certain words/phrases, pausing and entanglement. The software uses speech recognition technology to count the occurrence of disfluency. It shows results in individual categories of disfluency, the number of pauses in words or sounds, the frequency of disfluency in general in speech and each category of disfluency in one recorded speech sample.

Applications adapted to the Croatian language

The development of applications within the ICT-AAC project has always been focused on two main areas: education and communication. The applications Učimo slogove (Learning Syllables), Učimo riječi (Learning Words), and Učimo čitati (Learning to Read) are intended for learning letters, words, and acquiring reading skills. They are specific in that they contain a predefined set of words intended for gradual learning by levels; each word has a corresponding symbol, and individual syllables are emphasised within the word. The applications were developed in collaboration between the Faculty of Electrical Engineering and Computing in Zagreb and the Croatian Down Syndrome Association in 2012 and refined within the ICT-AAC project.

The application *Learning Syllables* teaches the user the pronunciation of syllables and offers defined sets of syllables; it is possible to select syllables consisting of two or three letters. Syllables can be emphasised in different colours, printed in uppercase or lowercase letters in red or black, and there is the option to turn the audio record on and off.

The *Learning Words* application teaches the user new words, displaying images of objects, actions, people and concepts from the ARASAAC symbol gallery in random order. ARASAAC Gallery offers numerous symbols and the possibility of creating one's own gallery of concepts for communication and educational purposes (Paolieri and Marful, 2018), and they are free and available in Croatian. Users can select one or more categories from the main menu, words can be written in red and black letters, lowercase and uppercase letters, syllables can be highlighted, and there is the option to turn the audio record on and off.

In the *Learning to Read* application, symbols that represent objects, actions, people, and various concepts are displayed to the user in random order. The displayed symbol is accompanied by an audio record (pronunciation of the symbol name) and a text record of the symbol name in which the syllables are highlighted in different colours. In addition to learning to read, the app also helps to learn syllables, new terms and words. Besides the predefined set of words, additionally, the application allows adding and categorising new words. When adding a word, a symbol or a photo (images from the gallery on the device or the camera of the device) and the audio record (sound recorded on the device) are assigned to the term.

Applications developed within the ICT-AAC Competence Network are intended to encourage speech and language development and functional

communication. *The Communicator* and *Communicator+* apps are used to express needs, desires, and feelings and stimulate functional communication. *E-Gallery* and *e-Gallery Senior* are applications to encourage independent expression, track the sequence of events and understand causal relationships, and are intended for children and adults. The applications *Mathematical Playground*, *Domino Counter* and *Mathematical Carousel*, develop mathematical skills and contribute to the mathematical literacy of the youngest. In addition to the above, other applications have been developed for speech and language development.

The *Letters* application contains all letters of the Croatian alphabet and the offered images that show the term on the displayed initial letter. The *Vocals* and *Little Vocals* applications break down each word into sounds or letters, which can be auditorily and visually monitored on the screen. Each letter is named and is intended to develop phonological awareness through practising word segmenting and word blending. The *Memory* application is a memory game in which the number of pairs to guess and three types of pairs can be selected in the settings, i.e., the same symbols can be paired; the same letters, or a symbol and the initial letter of the term displayed by the symbol.

The *Writing* app is designed for practising the right moves necessary to learn uppercase and lowercase writing, and if dragging a line is not in the right direction or goes beyond the letter frame, it is considered an incorrect answer. Also, the application *Language-Speech Exercise* (Cro. *Jezično-govorna vježbalica*) has been published, which can serve adults with brain damage. In this application, the components, morphology and syntax are represented through solving tasks by choosing the correct gender and number of nouns and the correct form of the verb.

Implementation of digital technology in education

The use of technology itself is not new in the field of speech therapy since the use of electroacoustic devices in the rehabilitation of hearing impaired children came to life in the 1970s. With the advancement of technology, the development of computers, and Internet availability, digital technology has become a part of everyday life and a tool in the workplace. There has been much discussion about the availability of information, media, and digital literacy in the last ten years. In accordance with the National Framework Curriculum (2011), among other competencies, the development of digital competencies necessary for lifelong learning is highlighted. The development of digital

competencies refers to training for the critical and safe use of Information and Communication Technology (ICT) for work, both in personal and social life and communication. Its key elements are basic information and communication skills and abilities such as using computers to find, evaluate, store, create, display and share information and develop collaborative networks over the Internet. In education, digital technology is becoming an integral part of teaching. The curricular approach puts the student at the centre of the teaching process, emphasising constructive learning and developing independence in learning as an active process. Research has shown that the implementation of digital technology contributes to the learning system that helps the student, as well as the effectiveness of mobile learning (Chiang et al .; Hwang and Wu, 2014; Crompton et al., 2017). So, integrating technology into education arose as a need to move away from traditional teaching models. Different contemporary teaching models apply technology in various ways to support the realisation of the teaching process (Pažanin and Rosić, 2020).

Computer-assisted learning maintains a child's motivation and increases learning outcomes. Through interactive classes, it is possible to develop overall skills, like creativity, focus and cognitive skills. As emphasised, the use of computers is not limited to education; they are also used in different areas of upbringing. Appropriate computer software also enables their use for diagnostic, preventive and therapeutic purposes (Đuran et al., 2018).

The possibility of using computers for educational and therapeutic purposes has enabled children and users with various health problems, motor impairments, and chronic diseases access to information, education, therapy, monitoring and counselling. The digital technology used on smartphones and tablets provides entertainment and offers a number of additional materials and content needed in education. Since children spend much time in their homes passively watching the content offered by the intelligent devices, it is necessary to work on enabling children access to as much helpful, educational, and at the same time, attractive and motivating content in their everyday life.

In the research which collected the views and suggestions of parents and educators on the use of computers in preschool education, taking into account all four aspects of the impact of information technology on preschool children (pedagogical, psychological, social and health), the authors (Anđelić et al., 2014) concluded that new technologies bring significant benefits if used appropriately, targeted and as an additional tool.

Đuran et al. (2019) state that teachers, educators and parents, as the most influential people in the children›s environment, must be ready for lifelong learning. It should, among other things, include the acquisition of digital competencies as a key educational factor in the global world. Moreover, it is necessary to stress the importance of creating a coherent system that could lead to the formation of key competencies in preschools to ensure a successful schooling start and lifelong learning.

The technology is present and used not only in the business world, faster database management, entertainment and play but also in therapy and the lives of people with disabilities. The very fact that a student can use a computer in any other subject and that it allows them to calm down, focus, learn diversely and open up all knowledge maps, as well as self-improvement and self-esteem, makes the world of ICT technology an endless, almost omnipotent assistant. Also, an e-learning method is being developed that opens up numerous opportunities for both students and adults with disabilities (Čop and Topolovec, 2009).

Mobile devices have experienced progress and presence in all spheres of social life. Thanks to smartphones, the m-learning service was provided as an opportunity and a source of education. Mobile learning is still new territory for designers and developers, and it is also necessary to develop new technologies and pedagogical approaches adapted to diversity in education (Paulins et al., 2015).

Advantages and disadvantages of digital technology in the therapy of persons with speech and language disorders

Anđelić et al. (2014) observe the implementation of information technology from four aspects: pedagogical, psychological, social and health. The authors mention the use of e-books- a tool that can develop creativity and achievements and provide individual and team learning opportunities. The Internet is a network that can serve even the youngest to communicate in real-time and access information. According to the same research (Anđelić et al., 2014), most parents agree that children should be supervised in computer use. A computer is a medium that offers communication, and thus the opportunity for virtual socialising and maintaining relationships with peers, but also making questionable and false friendships. Students can spend many hours playing video games, but this attention is reserved for the virtual world, while in performing concrete, real-life tasks, there are consequences of lack of attention

and short-term attention. Using computers can provide and develop self-esteem in children, as well as perseverance and persistence in solving obstacles in video games. From the health aspect, the authors state that the positive side of using computers in a child's development would undoubtedly be the speed of reactions (quick reflexes). However, there are significantly more negative consequences for health: fatigue, vision problems, lack of movement, psychological stress, depression, poor and inappropriate sitting position and many others.

Information technology has become an integrated part of everyday life and available to the average person, thus in speech therapists' rehabilitation procedures and educational and rehabilitation professionals. Great attention is paid to the advantages of technology, and research papers on the presence of ICT in therapeutic procedures mainly focus on the positive effect over a certain period of time. Introducing a computer, smartphone, or tablet in the education processes, teaching (Plantak et al., 2018), and therapeutic work with clients (Ivšac Pavliša et al., 2016) contributes to maintaining motivation and improving attention. The use of technology in therapies has resulted in an increase in the number and frequency of therapy sessions. Moreover, it enabled the therapy for people who are unable to come and are willing to conduct exercises at home with family members. Using the applications themselves is financially profitable since, in most applications, tasks can be repeated an unlimited number of times and with an unlimited number of users. The use of information technology contributes to the active role of users, increasing self-confidence, sense of competence and independence in everyday life (Kearns et al., 2021). In exercises at home, it is possible to adjust and determine the intensity of exercise depending on obligations, free time, mood and fatigue, thus particularly benefiting people with short-term attention, the elderly and people with multiple impairments. Most software solutions intended for therapeutic purposes require only basic computer skills and offer multimodality and a number of language components within a single application.

Although we can highlight many advantages, digital technology is most often intended for the average user. However, people with speech and language disorders are a very heterogeneous group, so it is not suitable for every individual. Therefore, some users will refuse this therapy method. In addition to the possibility of clients' rejection, there are difficulties in understanding tasks and using programs or devices in people with cognitive deficits. Furthermore, there are still therapists and other educators who prefer applying only traditional methods. In direct work with clients, 78.8% of respondents use a computer,

laptop and tablet, and the same percentage are familiar with ICT applications intended for education and communication. However, although familiar with the above applications, a slightly smaller percentage of 51.6% use them in their work with clients (Galeković, 2021). The most commonly used are the following applications: *the Vocals*, which is intended for the development of phonological awareness and the reading and writing pre-skills, followed by *the Writing*, which encourages the correct direction of writing uppercase and lowercase letters; and *the Letters*, application intended for acquiring the initial letter/sound in words and understanding the connection between the sound and the letter with learning to recognise letters

Disadvantages highlighted for some apps are a poor visual representation of lip movements and blurred lip and mouth movements in the articulation (Goncalves et al., 2017). Furthermore, the same authors emphasise the need for feedback when practising sound pronunciation and simple and accessible interaction between users and interfaces. Of course, the disadvantage is if the application is only a web application, and there is no version for smartphones and tablets, or there is only a version for a particular operating system.

Some applications cover only selected areas of speech and language development and are not comprehensive. In the information technology intended to foster communication development, the communication situations offered in the application can be restrictive and more difficult to generalise in an authentic context.

As a disadvantage, we can also highlight the price of devices and software to be paid, which is high for average users. Device implementation, service and maintenance sometimes require time and money, and user customisation and transportation of aids can be difficult.

Conclusion

With the advancement of technology, the development of computers, and Internet availability, digital technology has become a part of everyday life and a tool in the workplace. Applications as a tool in speech, language and communication therapy have been well accepted and recognised by educators in kindergartens, schools and other educational institutions. Applications developed within the ICT-AAC Competence Network for users who speak Croatian are intended to encourage speech and language development and functional communication. The possibility of using computers for educational and therapeutic purposes has

enabled children and users with various health problems, motor impairments, and chronic diseases access to information, education, therapy, monitoring and counselling. The digital technology present on smartphones and tablets provides entertainment and offers a number of additional materials and content intended for education and communication.

It is always necessary to emphasise that the success and progress achieved when using the application do not diminish the irreplaceable role of the therapist in the therapy procedures. The application is a helpful tool that therapists can use in their work, and it can help in independent use and exercise with other family members. If the speech therapist uses technology to achieve therapeutic goals, it is important to be aware that such an approach does not preclude combining with traditional therapeutic procedures. Each application is, of course, a helpful tool that assists the therapist in their work. In the therapy itself, the most important is the therapist as the coordinator and leader of the session.

Finally, it is necessary for therapists to continuously upgrade their knowledge and adapt to social changes, such as the spread of digital technology in all spheres of society. However, despite the diversity of offers, there is no appropriate digital technology for some health problems.

References

1. Anđelić, S., Čekerevac, Z., Dragović, N. (2014) Utjecaj informacijskih tehnologija na razvoj predškolske djece. *Croatian Journal of Education*, vol. 16, no. 1, p. 259-287. URL: https://hrcak.srce.hr/120167.

2. Archibald, L. M., Orange, J. B., Jamieson, D. J. (2009) Implementation of computer based language therapy in aphasia. *Therapeutic advances in neurological disorders,* vol. 2, no. 5, p. 299-311.

3. Barry, S. (1994) Speech viewer 2. *Child Language Teaching and Therapy*, vol. 10, no. 2, p. 206-213.

4. Chiang, F.-K., Zhu, G., Wang, Q., Cui, Z., Cai, S., Yu, S. (2016) Research and trends in mobile learning from 1976 to 2013: A content analysis of patents in selected databases. *British Journal of Educational Technology*, vol. 47, p. 1006–1019.

5. Crompton, H., Burke, D., Gregory, K. H. (2017) The use of mobile learning in PK-12 education: A systematic review. *Computers & Education*, vol. 110, p. 51-63.

6. Chop, M., Topolovets, V. (2009) Upotreba informacijske i komunikacijske tehnologije (ICT) u obrazovanju djece s posebnim potrebama. *Informatologia,* vol. 42, no. 4, p. 304-313. URL: https://hrcak.srce.hr/42352

7. Đuran, A., Koprivnjak, D., Maček, N. (2019) Utjecaj medija i uloga odraslih na odgoj i obrazovanje djece predškolske i rane školske dobi. *Communication Management Review,* vol. 4, no. 1, p. 270-283. DOI: https://doi.org/10.22522/cmr20190151

8. Fernandes, B. (2011) iTherapy: The revolution of mobile devices within the field of speech therapy. *Perspectives on School-Based Issues*, vol. 12, no. 2, p. 35-40.

9. Galeković, M. (2021) Upotreba digitalnih tehnologija u edukacijskoj rehabilitaciji. In: *Proceedings of the 15th Symposium of the Croatian Society for Medical Informatics*, Rijeka, November 25 and 26, 2021.

10. Gerstner, T., Sekol, I. (2014) Metodologija rada logopeda s ICT-AAC aplikacijama. In: Pavlin-Bernardić, N. (ed.) *To this end, the project "ICT Competence Network for Innovative Services for Persons with Complex Communication Needs (ICT-AAC)" was launched.* Zagreb: Sveučilište u Zagrebu, Fakultet elektronike i računarstva.

11. Golashesky, C. (2008) Technology applications at the Adler aphasia center. *Topics in stroke rehabilitation,* vol. 15, no. 6, p. 580-585.

12. Hollingshead, K., Heeman, P. (2004) *Using a uniform-weight grammar to model disfluencies in stuttered read speech: a pilot study*.

13. URL: https://www.researchgate.net/publication/228745521_Using_a_uniform-weight_grammar_to_model_disfluencies_in_stuttered_read_speech_A_pilot_study

14. Hwang, G.-J., Wu, P.-H. (2014) Applications, impacts and trends of mobile technology-enhanced learning: A review of 2008– 2012 publications in selected SSCI journals. *International Journal Mobile Learning and organization*, vol 8, no. 2, p. 82-95.

15. Ivšac Pavliša, J., Peretić, M., Bohaček, A. M., Talian, K . (2016) IKT u vrtiću – od istraživanja do primjene. *Dijete, vrtić, obitelj,* vol. 21, no. 80-81, p. 16-20. URL: https://hrcak.srce.hr/219947

16. Kearns, Á., Kelly, H., Pitt, I. (2021) Self-reported feedback in ICT-delivered aphasia rehabilitation: a literature review. *Disability and Rehabilitation*, vol. 43, 9, p. 1193-1207. DOI: 10.1080/09638288.2019.1655803

17. Kompetencijska mreža ICT-AAC (2021) *ICT-AAC Razvijene aplikacije.* URL: http://www.ict-aac.hr/index.php/hr/aplikacije/razvijene-aplikacije (Accessed on June 17, 2021)

18. Kompetencijska mreža ICT-AAC (2021) *ICT-AAC Razvijene aplikacije.* URL: http://www.ict-aac.hr/projekt/index.php/hr/novosti-hr/380-kompetencijska-mreza-ict-aac (Accessed on June 17, 2021)

19. Kuhar, I., Jakovac, T. P., Pavliša, J. I. (2016) Primjena informacijsko-komunikacijske tehnologije u logopedskom radu u osoba s afazijom-prikaz dva slučaja. *Croatian Review of Rehabilitation Research/Hrvatska Revija za Rehabilitacijska Istrazivanja*, vol. 52, no. 2.

20. Lazor, M., Isakov, M., Ivković, N. (2012) *Asistivna tehnologija u školi*. Novi Sad: Škola za osnovno i srednje obrazovanje "Milan Petrović" sa domom učenika.

21. Mervcich, S., Kutnjak, V. (2019) ŠARENI, KREATIVNI, USPJEŠNI. *Poučak: časopis za metodiku i nastavu matematike*, vol. 20, no. 79, p. 57-65.

22. Nauris Paulins, Signe Balina, Irina Arkhipova (2015) Learning Content Development Methodology for Mobile Devices. *Procedia Computer Science*, vol. 43, p. 147-153. DOI: https://doi.org/10.1016/j.procs.2014.12.020

23. Öster, A. M., House, D., Protopapas, A., Hatzis, A. (2002) Presentation of a new EU project for speech therapy: OLP (Ortho-Logo-Paedia). In: *Proceedings of the XV Swedish Phonetics Conference (Fonetik 2002)*, p. 29-31.

24. Paolieri, D., Marful, A. (2018) Norms for a pictographic system: the Aragonese portal of augmentative/alternative communication (ARASAAC) system. *Frontiers in psychology*. DOI: https://doi.org/10.3389/fpsyg.2018.02538

25. Pažanin, J. and Rosić, M. (2020). Mobilne aplikacije u obrazovnom okruženju. URL: http://docs.mipro-proceedings.com/ce/79_CE_5826.pdf (Accessed on June 27, 2021)

26. Plantak Vukovac, D., Škara, M., Hajdin, G. (2018) Korištenje i stavovi nastavnika o igrifikaciji u osnovnim i srednjim školama. *Zbornik Veleučilišta u Rijeci*, vol. 6, no. 1, p. 181-196. DOI: https://doi.org/10.31784/zvr.6.1.14

27. Pratt, S. R., Heintzelman, A. T., Deming, S. E. (1993) The efficacy of using the IBM Speech Viewer vowel accuracy module to treat young children with hearing impairment. *Journal of Speech, Language, and Hearing Research*, vol. 36, no. 5, p. 1063-1074.

28. Statista (2022) *Android & iOS free and paid apps share 2021*. URL: https://www.statista.com/statistics/263797/number-of-applications-for-mobile-phones (Accessed on 16 January 2022)

29. Vaquero, C., Saz, O., Lleida, E., Marcos, J., Canalís, C., De Educación, C. P. (2006) VOCALIZA: An application for computer-aided speech therapy in Spanish language. *IV Jornadas en Tecnología del Habla*, p. 321-326. URL: https://www.researchgate.net/publication/228664464_VOCALIZA_An_application_for_computer-aided_speech_therapy_in_Spanish_language

Martina Galeković (Hrvatska)
Centar za odgoj i obrazovanje Velika Gorica
galekovicmartina@gmail.com

UPOTREBA ICT APLIKACIJA KOD KORISNIKA S JEZIČNIM TEŠKOĆAMA

Sažetak

Digitalna tehnologija prisutna na pametnim telefonima i tabletima omogućuje zabavu i pruža brojne dodatne materijale i sadržaje potrebne u obrazovanju. Mogućnost korištenja računala u odgojne, obrazovne i terapijske svrhe omogućila je djeci i korisnicima s različitim zdravstvenim teškoćama, motoričkim oštećenjima i kroničnim bolestima pristup informacijama, edukaciji, terapeutskom radu, praćenju i savjetovanju. U okviru EU projekata zemlje sastavnice Europske Unije razvijale su programe i aplikacije usmjerene edukaciji. Projekt "Kompetencijska mreža zasnovana na informacijsko-komunikacijskim tehnologijama za inovativne usluge namijenjene osobama sa složenim komunikacijskim potrebama (ICT-AAC)" trajao je od ožujka 2013. do ožujka 2015. u realizaciji sastavnica Sveučilišta u Zagrebu i drugih suradnika: udruga i poduzeća. Razvijene aplikacije primjenjive su u odgojne, obrazovne i terapeutske svrhe u odgoju i obrazovanju kao metoda poučavanja u nastavi i alat u terapiji govorno-jezičnih teškoća i u okviru logopedskog rada. Osim edukacije, prisutne su i aplikacije u komunikacijske svrhe za osobe sa složenim komunikacijskim potrebama. U ovom radu predstavljene su ukratko neke od ICT-AAC aplikacija i njihova primjena u radu s korisnicima kojima su namijenjene.

Ključne riječi: asistivna tehnologija, digitalna tehnologija, edukativne aplikacije, m-učenje, potpomognuta komunikacija