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THE USE OF SPECIALIZED ICT PROGRAMMES IN THE PHONOLOGICAL DIFFERENTIATION OF SOUNDS AND THE DEVELOPMENT OF CHILDREN'S SPEECH COMMUNICATION

Using ICT in speech therapy intervention

Modern technology, now in common use in education or intervention for children of early, pre-school and school age, includes a wide range of devices we can use in diagnostics and speech therapy. We are dealing with an area of constant progress with increasing new possibilities to include new technologies in speech therapy intervention. The possibilities of using technologies are quite wide. We can divide ICT into several categories (Neubauer, Dobias, 2014):

– Desktop programs, primarily to be used on desktop computers. In this category, we may list programs such as FONO, SPEECH VIEWER III and the diagnostic program MENTIO. There is a large number of therapeutic and diagnostic desktop programs that are used in speech therapy intervention. A significant disadvantage of these programs is that they are rather old and are gradually being replaced by newer programs from a different area of ICT.

– By mobile technologies we mean a field that includes smartphones and tablets. Nowadays, this area includes a wide range of possibilities. Primarily, we are talking about using tablets and smartphones with

the iOS and Android operating systems, which offer a large selection of applications aimed at diagnostics, stimulation and motivation, not only in therapeutic programs but also education and language teaching.

– Applications to share data and use the web represent a specific field offering the possibility to gain new therapeutic materials and websites or to create and share them. Currently, this field is related to using mobile technologies. A concrete example may be using the iOS environment, specifically the iPad and its option to share data, materials or multimedia files, such as images, videos or sound recordings, through the iCloud service. There are similar possibilities with Android devices. The service Google Drive offers very similar options. The advantage of these systems is that access to them is almost unlimited. All we need is a device with iOS or Android operating system or a computer running OSX or Windows.

Communication programs include a very specific application of technologies in speech therapy intervention. Primarily, we mean programs using video, such as Skype, Viber, WhatsApp or websites with this option, such as Facebook. Communication via video is widely used in speech therapy and counselling, especially in areas with a limited access to therapists due to distance, meaning Australia or the United States. The "telepractice" phenomenon is studied at various research facilities, for instance the University of Pittsburgh is deeply involved, publishing the *International Journal of Telerehabilitation*. (www.telerehab-pitt.edu), and it is necessary to mention the current development of this approach in speech therapy. (www.asha.org).

ICT can be used in all areas of speech therapy and prevention. It is best for the treatment to start as soon as possible after the indication. The methods of therapy need to be adapted to the age, mental capacities and, primarily, the specific disorder of the child. Currently it is possible to use ICT as a preventive tool with children who have not been diagnosed with a communication disorder. ICT also helps speed up and ease the communication between teachers and students or parents (e-learning, e-mail – Zikl et al., 2011)

As for the level of primary prevention, we are mainly interested in expanding the vocabulary or attention; in secondary prevention, minimizing the manifestations of a concrete speech communication disorder. In the Czech Republic, we have been using PC programs, such as SPEECHVIEWER III, BREPTA, LOGOOMALOVÁNKY, BOARDMAKER, ALTÍK, KDYŽ CHYBÍ SLOVA, GLOBÁLNÍ SLABIKÁŘ, GRID II, SIMWRITER and

ACKEYBOARD. Even though it is not that long ago, in the last five years there has been a lot of progress, so we do not have to download and install programs on our desktop computers. The modern era offers devices that are easy to carry, fully supplying or even surpassing the PC – tablets (or smartphones – Zikl et al., 2011), Skype and similar applications – may be used by children who developed a disability in the prelingual phase, so they struggle with the written form of speech. Online dictionaries may also be used (sign language). Moreover, there have been attempts to create mobile communication applications, such as the KLÁBOSIL app.

ICT in the process of intervention with children with developmental dysphasia

The area of speech communication includes a wide spectrum of disorders, each requiring a different therapeutic strategy. We may use diverse materials and tools, including ICT. Based on current findings, we may point out some possibilities to use applications in therapy for children with developmental dysphasia (SLI – specific language impairment – Mikulajová, Rafajdusová, 1993; Škodová, Jedlička, 2007).

– **Visual perception development.** In this field, we primarily focus on applications where the user distinguishes colours, shapes, details and differences, searches for a figure in the background, and matches a picture with its outline or background. It is especially important to focus on the coordination of processing different stimuli and the motor activity of the hand. Currently, the apps DRAWING WITH CARL, MYSCENE, MLUVÍDEK, TOBÍK UKLÍZÍ are in widespread use. (Krejčířová et al., 2006).

– **Auditory perception development.** In the area of hearing perception, it is important to use applications with a correct and distinctive speech model. For instance, the app MLUVÍDEK offers the POSLOUCHEJ (Listen) exercise, primarily focused on auditory perception.

– **Thinking development.** We use applications that can actively stimulate communication about new topics. For instance, we may use apps to build stories or complete images from the plot with objects. It is very important to actively encourage the child to speak.

– **Memory and attention development.** We use apps built on the principle of a simple sound memory game. We may also use applications focused only on sound, e.g. repeating a rhythm, etc.

– **Motor development.** Motor activity as such can be developed through carrying a tablet or working with a real object. Children with more severe motor disorders use applications for primary touch. By this, we mean apps allowing the user to use the entire space of the display to move a simple object around or stimulate movement. For that purpose, we may use the application Fluidity, where we can set different forms of movement. In our work with such a child we always expect general lack of coordination. It is advisable to use applications that work with imagination and motor activity at the same time – e.g. MYSCENE.

– **Orientation development.** To develop orientation, we most often use programs with tasks in a time sequence, right-left orientation, mosaics and jigsaw puzzles. A tablet is suitable, as well as moving around the room.

– **Graphomotor skills development.** To develop graphomotor skills, there are a number of drawing apps. By this, we mean any application allowing the user to create something by means of drawing or completing a picture. The excellent thing is that tablets offer the possibility of using mirror screens, so we can use various touch boards for drawing and developing motor skills.

– **Speech development.** In speech development, it is essential to respect the child's individual needs, therefore we pick especially apps that allow the user to create content. A very good application for that is BITSBOARD, where we can create a variety of our own image materials (Mikulajová, Kapalková, 2011).

It holds true for all areas of development that the use of a tablet is connected with hand motor activity. It depends on the experience of the speech therapist how they implement the tablet into the therapy program to achieve efficient motivation and stimulation of the development of the child.

Current views on using ICT in special education and speech therapy

The topic of using tablets in special education is rather new. Even so, in the past three years, some very interesting papers emerged, mapping the situation regarding ICT in special education. A very interesting one is the Investigation of Tablet Computer Use in Special Education Teachers Courses, a qualitative study of how teachers use tablets with children with special needs. The investigation follows teachers who routinely use tablets in their lessons. This

investigation employed the questionnaire method. The questionnaire was aimed at teachers working in special schools and other specialized facilities in Crete. The results of the study were meant to highlight the possibility to use tablets in special schools, but also point out the fact, that public schools do not have the option or the funds to use tablets or other ICT. A sample of 13 teachers who work at special schools in Nicosia was selected. The data was collected through 10 open questions designed by experts from the field. The questions focused on the specifications of individual students and working with them. The principal contribution of the questionnaire investigation was the focus on specific mobile applications these teachers use in their work on smartphones, tablets and computers. The conclusion showed that teachers who use tablets or other education technology are more successful at educating pupils with special education needs. This had to do especially with teachers who have children in their classroom with autistic spectrum disorders, mental deficiency, with motor disorders or combined disorders. At the very end, the study gives recommendations on using technologies in educating children (Haksiz, 2013).

In the context of ICT use abroad, we may interpret a very interesting investigation entitled Tablet Computers and Learners with Special Education Needs. The investigation is in the qualitative category – case studies from various EU countries were used (Austria, Belgium, Denmark, Estonia, Italy, Portugal, Turkey). The research went on for two years. It followed several children the whole time. The research tries to answer the primary question whether the tablet as an education tool improves work with children with special education needs. There are several related questions – using tablets with children with sensory disorders, using tablets in the preparation of materials to support basic reading and writing, using tablets in the inclusion of children with special education needs and also using concrete apps in the education of children with special education needs (Panzavolta, 2014).

The research has two parts. The first part focuses on the international view on educating pupils with special education needs, building on the latest research findings in this area. It also offers an overview of the theoretical findings about the education of children using tablets, but also the most frequent disorders of children with special needs, such as autism, attention disorders, dyslexia, motor disorders, visual and hearing impairments. The second part of the study analyses several case studies. The studies were followed over the course of two years, from 2012 to 2014. Each case study maps a different pupil with a different disorder. Mostly they were children between 3 and

10 years of age. The case studies process findings from the mapping of education progress with the use of a tablet. At the same, the validity and practical usage of mobile applications is verified. During these two years the progress of the children using tablets was analyzed. Each case study is complemented with video-documentation. The research also maps concrete education facilities, where the case studies in question were carried out. It sums up the kind of institution in question and the specific way education with a tablet is done there. In the conclusion, we see a comparison with the results of other existing research (Panzavolta, 2014).

In the context of the previous research, we may also mention a very similar study, Multimedia Technologies and Their Use with Students with Special Education Needs in an Inclusive School Environment, which focuses on using tablets with students with autistic spectrum disorders. This qualitative research uses the case study method. For that purpose, three students from a special school with autistic spectrum disorder or intellectual deficiency were selected. The case studies focused on students listed in a program preparing for inclusive education. The results of the research show a functional possibility to use tablets in an inclusive environment (Smith, 2012).

The statement that ICT is only a complement in basic speech communication disorders therapy, still applies. From the results of international research, we also know some negative consequences of technology use in young children and pupils. The principal point is that technology may in no case replace the teacher or therapist, their views and philosophy on the approach to the student in the lesson. The therapist himself has to find a compromise between efficient use of technology and the classic approach to intervention, especially in pre-school children. The therapist needs to find his own proven ways to work with children and incorporate ICT into the program of activities. This is related to the fact that the therapist should be well acquainted with technology beyond basic user skills and keep educating themselves in the area of using technologies in practice (Neubauer, 2015).

Phonological differentiation of sounds

For the overall development of the child, especially acquiring the spoken form of language, it is necessary that the child learn to distinguish various sounds and their combinations. The most sensitive period of this development is the part between 1 and 6 years of age, which includes the origins

of language reproduction and understanding ability. Children adopt speech models in the presence of adults. Each language also includes its own rules for combining phonemes. Phonological awareness is closely related to this, which we can call the ability to consciously work with segments of words on the phonemic level – the level of phonemes, realizing the sound structure of a word, the order of sounds, analysis and synthesis (Mikulajová, Dostálová, 2004). Phonemes are understood as phones with a distinctive function, which, as a result, means that the meaning of the word, depending on the phoneme in question (e.g. pit – bit). Children cannot pronounce all sounds since the beginning of speech acquisition, which leads to the simplification of words. Until a certain age, this phenomenon is present in the majority of children. The process of speech development is very individual. The ability of phonological awareness matures at 5–7 years of age (Dvořák, 2003).

Phonological information is of a rather implicit character for a child of preschool age, so that the child understands the content of the word, but cannot describe it by phonemes. Phonological awareness also has influence on the ability to distinguish rhythm, which is very important for children in the process of learning how to read (Vágnerová, 2012).

The diagnostics of phonological perception can be seen as part of diagnosing hearing perception. In diagnostics, it is essential for expert speech therapists, educators, psychologists and physicians, as well as parents of the child to cooperate. There are several methods to assess phonemic hearing, including the test of hearing differentiation by Webman and Matějíček. This test comprises 25 pairs of words with no content meaning, which are read out to the child. These pairs only differ in one phone (19). There are pairs of the same word (6). The child's task is to mark pairs with the same or different pair of words. This test is primarily for children from age 5 (Krejčířová, 2006).

Another test frequently used in practice is the standard assessment of phonemic hearing by Škodová et al. This test is intended for children of preschool age starting children aged 3, using representations of word pairs that sound alike but differ in meaning. These words only differ in a single phone, a single distinctive feature. Distinctive features are assessed: voicedness +/–, continuity +/–, nasality +/–, compactness +/–. There are 60 pairs in the test, therefore 120 words. Results are compared between children of the same age with a physiological development of speech and developmental dysphasia, who are not able to distinguish between similar sounding words or words with completely different meaning (Škodová et al., 1995).

Using ICT in phonological differentiation of sounds

At the time being, there is no Czech standardized test with ICT support. Abroad, the use of modern technologies in diagnostics is on the rise. We may also find a wide range of applications aimed directly at phonological differentiation of sounds. We may include apps like PhonoPix or PhonoCentre. Among the Czech application we select those enabling the user to create content – e.g. Bitsboard, although they do not offer diagnostic assessment (Neubauer, 2015).

In the research *Development of Specific Diagnostic Material for Phonological Sound Differentiation* new diagnostic material is created, primarily using ICT, specifically mobile technology. The diagnostic material uses the conception of distinguishing distinctive features of sounds (Škodová et al., 1995). A new word bank (120 words) was created, comprising the combination of 4 basic distinctive features used in this standardized test. Currently, pilot testing is taking place, using mobile technology (tablet) with children of 3 to 6 years of age, diagnosing developmental dysphasia. This testing is primarily to be used to verify the functioning of technology and the understanding of new words. For this purpose, we selected the method of comparing a new mobile diagnostic test and the original test by Škodová from 1995 (Neubauer, 2015), and the current results support the convergent outcomes of results with the previous test materials.

Case history using a record sheet to test new diagnostic material

In the system of qualitative research, a record sheet comes into use with a group of children since the first session, connecting the subsequent progress of phonological differentiation assessment. A pilot parameter of new testing material was used in comparison with the test by Škodová (1995). The ICT tool used in research was an Apple iPad Air tablet.

- **Boy**
- – In speech therapy care at a facility in XX since 2014.
- – After examination by a speech therapist, he was initially diagnosed with delayed speech development, later suspected developmental dysphasia, currently to be confirmed by phoniatric exam, deviations of articulation in sounds L, R, Ř, both sets of sibilants (C, S, Z and Č, Š, Ž) and sounds with "softening" (dě, tě, ně).

– The boy is growing up in bilingual family environment.
– His hearing was examined in October 2015. His results show that his phonemic hearing is weakened for all distinctive features.
  70% voicedness +/–
  83% continuity +/–
  93% nasality +/–
  70% compactness +/–
– Total: 79% – 95 points/120, problem: distinguishing vocals under norm, frequent confusion of phones, multiple articulation deviations, voicedness +/– medium on medium border of the norm, long processing of information, hearing perception not good, bad hearing memory (struggles to repeat whole sentences).

Process and result of primary examination set:

The boy was shy at first, but cooperative. He liked the program on the tablet, it was obviously interesting to him and he was glad that he can point to electronic images himself. His errors were mostly in distinguishing vocals, he paused noticeably at the pair stín x stan, where he had to think for a long time and had difficulty related to understanding the meaning of the words.

In the test by Škodová (1995) he only made one mistake (míč x rýč) and it was obvious he felt more certain picking the right picture.

Table 1
Results of primary examination set

	Phonological pairs	Distinctive feature	First session
1.	sází x házi	Voicedness +/–	x
2.	most x kost	Voicedness +/–	√
3.	hrát x prát	Voicedness +/–	√
4.	stín x stan	Compactness +/–	x
5.	pásek x písek	Compactness +/–	x
6.	maminka x miminka	Compactness +/–	√
7.	boty x noty	Nasality +/–	√
8.	malíř x talíř	Nasality +/–	√
9.	kuře x more	Nasality +/–	√
			6/9

Source: own source.

Comparison of diagnostic criteria in a group of children with developmental dysphasia

Results were obtained by comparing diagnostic materials from 6 children included. For the purpose of the comparison basic phonemic pairs were selected, with matching distinctive features, which were compared to a standardized test – Škodová (1995).

Table 2
Comparison of diagnostic criteria

New diagnostic set	Number of errors	Success rate in %	Old diagnostic set	Number of errors	Success rate in %
sází x hází	16	64.4	pálí x balí	8	82.2
most x kost	2	95.5	pere x bere	7	88.8
hrát x prát	1	97.7	zeď x seď	5	84.4
stín x stan	14	68.8	táta x teta	2	95.5
pásek x písek	4	91.1	míček x máček	6	86.6
maminka x miminka	0	100	miska x maska	1	97.7
boty x noty	3	93.3	nohy x rohy	0	100
malíř x talíř	2	95.5	míč x rýč	11	75.5
kuře x more	2	95.5	muška x tužka	0	100
Total number of errors	44			40	

Source: own source.

Results of the testing continually point to a similar diagnostic value of both materials. The biggest problem is verifiably the phonological pair sází x hází and stín x stan. The error rate is similar in both tests. We also need to take into account the fact that with children who struggle with fine motor skills or have zero experience using a tablet, we need to offer assistance in direct proportion. In case the child is not able to use a tablet, we can only use the traditional test by Škodová.

The new diagnostic material revealed 44 mistakes, while the standardized test revealed 40 mistakes. In general, the children responded positively to

the tablet and the graphical form of images. Considering the fact that using tablets and other ICP technologies in education and speech therapy intervention is becoming part of mainstream usage, it is appropriate to integrate them among diagnostic tools. Assessment in the diagnostic process can become easier, as well as the diagnostics itself.

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WYKORZYSTANIE SPECJALISTYCZNYCH TECHNOLOGII INFORMACYJNO‑ ‑KOMUNIKACYJNYCH W ZAKRESIE FONOLOGICZNEGO RÓŻNICOWANIA DŹWIĘKÓW ORAZ ROZWOJU MOWY U DZIECI

Streszczenie: Artykuł dotyczy obszaru wykorzystania technologii informacyjno-komunikacyjnych w procesie edukacji dzieci w wieku przedszkolnym, wczesnoszkolnym oraz szkolnym. Koncentruje się on głównie na fonologicznym różnicowaniu dźwięków, dysfazji rozwojowej u dzieci, a także na tworzeniu materiałów diagnostycznych związanych z technologiami teleinformatycznymi, wykorzystywaniem tabletów, iPadów i innych urządzeń przenośnych.

Słowa kluczowe: ICT (technologie informacyjno-komunikacyjne), logopedia, diagnostyka, interwencja, dysfazja rozwojowa, fonologiczne różnicowanie dźwięków

THE USE OF SPECIALIZED ICT PROGRAMMES IN THE PHONOLOGICAL DIFFERENTIATION OF SOUNDS AND THE DEVELOPMENT OF CHILDREN'S SPEECH COMMUNICATION

Summary: The article addresses the area of ICT use in education or intervention for children of early, pre-school and school age, focusing on phonological differentiation of sounds, developmental dysphasia in children and the creation of diagnostic materials in this field, connected to ICT, especially the use of tablets, iPads and mobile devices.

Keywords: ICT, education, speech therapy, diagnostics, intervention, developmental dysphasia, phonological differentiation of sounds