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The contribution of information technology in the education of high school students with visual impairment

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Abstract: *This paper focuses on the identification of software and information technology programs in the education of high school students with visual impairment. The sample included 32 respondents, 17 females and 15 males, all categories of visual impairment. The aim of the research is to determine which software and programs the high school students with visual impairments commonly use, whether they prefer tactile or voice outputs, as well as the dependence of computer competencies of the schools they attend and their success at school. The obtained results will be discussed in the paper, and it would point out the possibilities of practical implication of the results through the use of information technologies in improving the participation of high school students with visual impairment in educational activities.*

Keywords: *information technology, education, student, visual impairment*

1. INTRODUCTION

This paper deals with the notion of the possibilities of application of information technologies (IT) that are increasingly present in the education of children with visual impairment. They provide the independence to these students in the educational environment and while learning, enabling them to develop and maximize their potentials.

In accordance with the current teaching and educational-rehabilitation practice, more areas could be distinguished that often require specialized instructions in teaching the students with visual impairments, in order to meet their specific educational needs [1], because certain knowledge and skills of students are expected upon completion of their studies, among which the most important ones are related to the field of information technologies.

Therefore, this research started with the assumption that the respondents would point out in the sample the basic directions of the application of information technologies in learning and secondary education. The aim of this research is concerned with the question of how the availability of information technology and curriculum based on this technology affects the ability of the high school students with visual impairments to learn.

Technology enables a blind learner to quickly access information as well as to receive feedback, whether using Braille alphabet, sound output, or any other medium, allowing them to prepare the materials for personal use in all subjects. Adaptation of computer technology, input, output, application of computer programs, interaction with computer equipment and its accessories also depends on individual psychophysical, cognitive, and sensory abilities [2]. The type and quantity of children's activities on the computer, in addition to their abilities, depend on the teaching objectives. By the evaluation of access technology, the special technological solutions for every child are determined, performed with persons who are familiar with the unique needs of blind and visually impaired pupils, but who are also well informed about the possibilities of modern technology.

Some software programs could be used in different areas of teaching, helping children of different ages and with different abilities. Some programs are designed to support certain activities, such as programs that train children in mastering cause-effect relationships, telling differences and similarities between individual images, graphic views, and so on.

Adaptation of the existing information technology for persons with visual impairment offers different possibilities: sound output, Braille hard copy, and for visually impaired persons text in capital letters, on the screen or in the printer. The input could be a device such as touch screen, joystick and keyboard. The input could be on a standard keyboard, using 6 selected points in the Braille's dots: (s, d, f - j, k, l), or by special techniques by using Perkins. The first method is cheaper, and the advantage of the second method is that a hard

copy is immediately obtained, because one is typing and the paper is in the machine.

A blind user who is conversant with typewriting can enter data on a classic keyboard, but must have a screen reader to be informed about errors, or through the Braille order (display). The screen reader could read selected images on the screen or images as a whole. The output can be done in various formats: increased printing on the screen or printer, speech synthesis, Braille printer [3]. Devices that a child would use will depend, above all, on their visual abilities, cognitive need, and all other needs they have at home, school, and community [4].

The visually impaired students, in accordance with their needs, use different software that appears on the market. Currently, the following programs are the most widely used: JAWS, Magic 9.50, Open Book Scanning Reader Software, Open Book's, Window – Eyes, et al.

JAWS is a powerful software program designed to work with a speech synthesizer to improve the productivity of visually impaired students. By streamlining keyboard functions, automating commands, and eliminating repetition, JAWS allows the student to learn faster and easier than ever before.Magic 9.50 introduce a new approach to settings files and customization. Just as Windows provides a "My Documents" folder for each user on a computer or serve, Magic now allows each user to have own profile. Open Book Scanning Reader Software allows to convert printed documents or graphic based text into an electronic text format using accurate optical character recognition and quality speech. Window - Eyes is nothing less than the most stable screen reader available on the market today. Featuring Windows 9X, Me, 2000, XP and 2003 compatibility, Window-Eyes is the most powerful screen reading software ever created.

The software in education, enables access to literature through digital textbooks and online sources of knowledge, simplicity of solving tasks in educational institutions, access to global information, and equal communication with the majority of population.

Reviewing the foreign literature, a tendency could be noticed that almost all modern education systems and teaching environments for students with visual impairment are based on modern information technologies [5].

Complaints about inaccessibility were often framed in terms of unequal access for visually impaired and sighted users. The participants expressed their frustration about having to depend on assistance from sighted people [6].

A research indicated that students use various assistive technologies, computer devices and programs / applications. The students used the most laptops and "smart" phones, as much as 90%. From a program on a computer, phone, or other device, most often used is the MS Windows laptop, IOS on the tablet / phone. JAWS was the dominant screen reader on these computers, and Voiceover on the tablet / phone. E-mail is used by 80% of respondents, 70% regularly browsing the Internet, and about 70% download and upload documents [7].

The research has shown that students with visual impairments mainly use certain screen readers, which are the most convenient tools for them, they regularly search the Internet for various purposes: finding information, communication, shopping, socializing, education, listening to music and correspondence. Teacher's opinion (98.8%) also indicates the necessity of using information technology for work in schools for pupils with visual impairment, primarily for reading and writing, as well as for various applications (61.4%) of technology with blind and visually impaired students. The result of a study in which the competences and the level of computer literacy of high school students with visual impairment was examined, showed that screen readers need to have simple access to Web browsers, in terms of easy and quick reading of Web site source codes, as well as that web designers should, in addition to each animation also include a text description, instruction, so that the screen readers successfully pass the information to the blind user [8]. Some research suggests that users of screen readers should be allowed to go right to the main content, to skip peripheral or repeated content, which would save a lot of time to a blind user and would not tire and confuse them. A particular webpage should also be shared, defined, and should indicate exactly what could be found where; for example: the main part, the header, the advertisement, the contact, the announcements, so that a blind person could orient oneself faster and better, and could skip the part that is not needed [9].

The main causes of frustration could be a page layout that causes confusing feedback on the screen reader, badly designed / unmarked forms, no alt texts for images, so the blind users reported a loss of an average of 31% of time due to these frustrating situations [10].

In the study conducted at the Faculty of Special Education and Rehabilitation [11], the importance of acquiring knowledge and competencies in the field of information technologies in special education is emphasized, where almost half (41.6%) of the sample, which included 204 students of basic studies of three study programs (Speech pathology, Oligophrenology and Special Education – with several different modules), points to the importance of classes and the training they receive at the faculty about the information technologies as an adequate preparation for their future professional role,

which would certainly require the application and inclusion of technology in the broader learning and education objectives of persons with special needs.

2. METHODOLOGY

The sample included 32 respondents, 15 male and 17 female. Related to the category of visual impairment, there were 37% of blind and 63% of visually impaired students according to the International Classification of the WHO on visual impairment. The age of respondents was between 15 and 19 years for both groups of respondents, 12 visually impaired and 19 blind, the majority of blind respondents is 17, and visually impaired 16 years old. The sample covered blind and visually impaired students from the 1st to the 4th grade, the largest number of blind students is in the 3rd grade (50%), the largest number of visually impaired is in the 2nd grade (35%). In relation to school and departments, 38% of students have physiotherapists, 28% of legal-technical department students, 34% of PTT department, and out of that 37% of blind and 63% of visually impaired. In relation to the success at school, there are respondents from sufficient to excellent success in both groups of respondents, and there is the highest number of students with excellent success (58%). The level of knowledge in the context of using of the internet technology is equated through the attendance of school subjects in which internet technology is applied.

This research applied the Technology Assessment Checklist For Students with Visual Impairments [12] which examines practical effectiveness through understanding and applying commands to computer access in multiple areas of use, such as input (using standard and custom keyboard) and visual output (visual, auditory and tactile), use of the Braille Letters and reading speed on printed material and the Braille displays, motivation, access to printed information through audit mode, and computer competence.

The results are presented by descriptive statistics, frequency analysis, and parametric statistics.

3. RESULTS

Screen Readers are software programs that enable visually impaired users to read text using a synthesizer that reads aloud the contents of the entire screen or the active window. New programs are constantly emerging on the market, and the objective was to determine which spoken programs are most used by high school students with visual impairment.

It could be noticed from the graphic that blind responders equally use the software for the blind – screen readers Jaws (Job Access with Speech) and NVDA (NonVisual Desktop Access) software. JAWS supports standard Windows and other popular applications; it is the most popular and most used screen reader in the world, so our students have been generally referred to this program in recent years. It gives blind and visually impaired people the ability to access information on the screens of their computers using a speech synthesizer or a Braille order at the output, an interactive voice installation allows installation and settings on an equal footing with users who see.

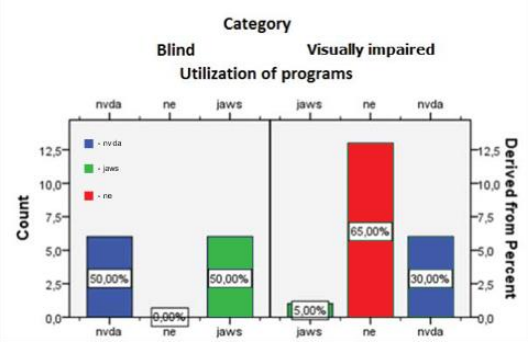

Figure 1. *Screen readers used by blind and visually impaired students*

The reason for the growing use of the NVDA is that it is a free screen reader that is increasingly used by both blind and visually impaired learners, as could be seen at the chart. The text that is read could be controlled by moving the cursor to the appropriate text area using the mouse or keyboard arrows. It also has the ability to convert text into Braille characters if the computer user has a device called Braille order or Braille display. 49% of respondents perform basic functions without instructions, and 51% of them change the basic font size / items / icons using shortcuts, with instructions. 50% of respondents understand the synthesized speech, and 40.6% move on the screen using shortcuts 41%.

A common dilemma among researchers is whether visually impaired people use sonic or tactile output, and many feel that speech requires greater attention of the user than the tactile text structure and that it provides different characteristics and "feelings" of the program [13].

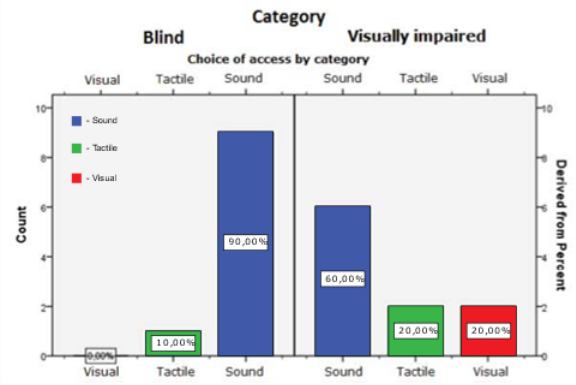

Figure 2. *Output information*

The majority of blind high school students use the sound output of information, and very few use

tactile output. Screen readers allow students to use the computer independently in a school location, without additional equipment or adaptations, which is why they prefer to use this type of output. Along with that, using a sound card, the voice reads the contents of the entire screen or active window, and contains a set of commands that provide the ability to perform basic actions without the use of a mouse, or a similar device. Another reason why the voice output has the great advantage in relation to the tactile one is the fact that our respondents do not own the Braille order in person, but use this model exclusively at informatics classes or in a resource center, and that reflects on a weaker and slower ability to acquire computer skills. Some authors point out the advantages of speech versus tactile output due to the interaction of a user with visual impairment with a given icon or connection, then if a user types on the screen reader announces each character, and when he hears that he typed the wrong character, he has the ability to reset and delete, and correct [14]. Some other researches point out the objection that screen readers use the voice of the computer speakers, and some visually impaired users consider this extremely boring, and therefore point to the need of improving and working on voice intonation [15]. Screen readers often cannot determine whether content on the web pages is worth listening to if they do not hear at least some of them and as a result, blind users often suffer from overloading with information, but still use speech rather than tactile output. Afterwards, we were dealing with the programs most commonly used by students, as shown in the following figure.

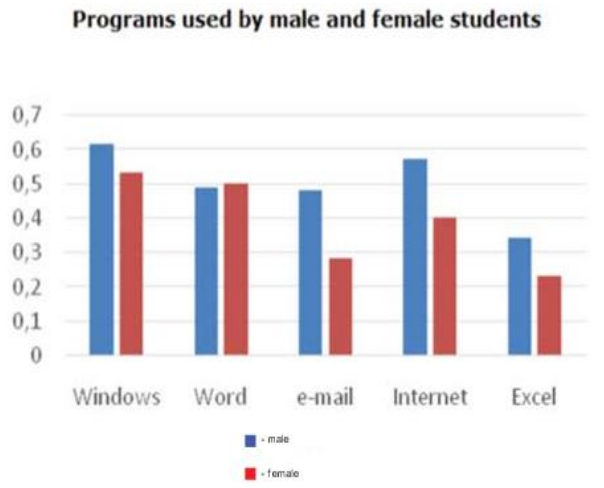

Figure 3. *Programs used by students*

The respondents (both male and female) use Windows and Word the most in everyday work. The boys use more Internet and e-mail, as well as Excel, and make better use of computers for about 8% than girls. The survey showed that on average, students use only 47% of computer capabilities, which points to the need to further improve the available programs, as well as design new ones for people with visual impairments. There is also the need to organize training of experts of different profiles, both programmers and special teachers (therapist, special-education teacher) who are well aware of the needs of students with visual impairment, and include them in this training: many commands or terms require knowledge based on visual or spatial concepts, careful verbal instruction, or Braille alphabet to use all available programs in everyday learning and free time. Our findings are similar to the results from a study in which 90 high school students with visual impairment were surveyed on the programs used. The surveyed students emphasized that they use Internet for various purposes: finding information, communication, shopping, socializing, education, listening to music and correspondence. Respondents who were better acquainted with the Internet protection were taking more care and were using Internet less than users with less knowledge in this area. Men were more frequent Internet users than females. E-mail uses 80% of respondents, 70% regularly search the Internet, and about 70% download and upload documents [16].

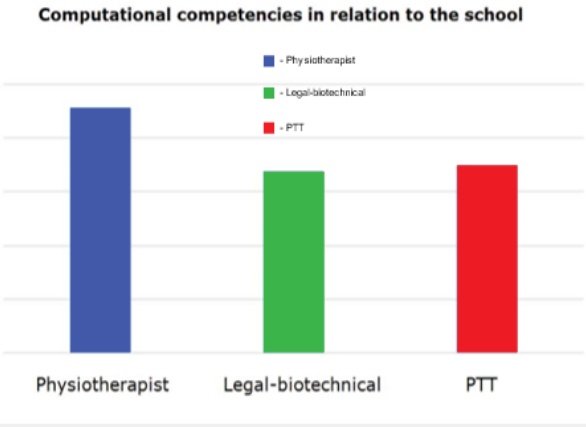

Figure 4. *Computer competencies*

There is almost no difference in the skills of using computers between students of the legal-technical and the PTT-department, who use computers only for the subject of computer science, whereas students of the medical school of physiotherapy are the most IT literate because they use computers, in addition to computer science in some subjects, such as Anatomy. Of course, this greater experience they have at work and, not only in the use of computers, but also in the organization and coordination of work materials for a larger number of cases, improves efficiency in work. It is possible to improve the teaching process by using computers, but also vice versa, incorporating internet technology into as many teaching subjects as possible would have an impact on increasing the computer competence of students.

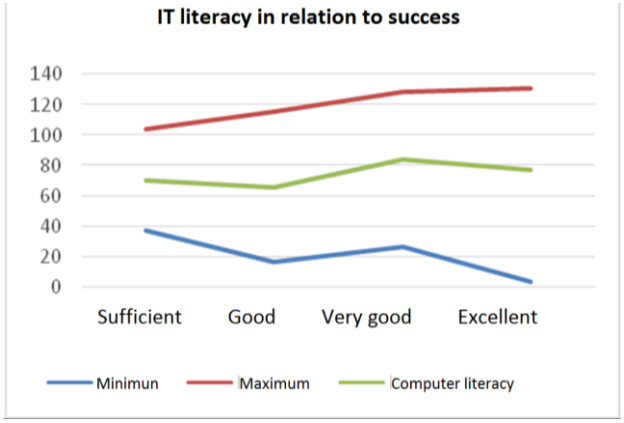

Figure 5. *Computer literacy*

IT literacy depends on the success in school. On the average, the most literate are very good students, then the top-grade ones, then the students follow, and finally good ones. Among the top-grade students are the most literate and non-literate students of the whole sample. Motivation is probably the most important factor that school teachers can target in order to improve learning and results in this area. The basic elements impacting student motivation are: student, teacher, content, method/process, and environment.98% of students expressed a positive attitude towards using computers, and as the most motivating factor they said that they are getting faster information on the availability of computer work by means of programs designed to meet their needs, finding the information they need as well as the increased ability communication and contacts with others because everyone uses the Internet and e-mail, and 86% uses Facebook and has their profile on it. On a scale of 0 to 1, the degree of computer literacy of blind students is on the average 64% (in between 37% and 90%), and for visually impaired students 57% (between 28% and 85%).

4. CONCLUSION

The preliminary results of this survey indicate the significance of the implementation of the information technology in the process of everyday learning and education of high-school students with visual impairment and the research has shown that our students generally use screen readers Jaws and NVDA, which are currently the most widely used throughout the world. The advantages of sound, compared to the tactile output of information were also established. The most commonly used programs are Windows and Word because they are the most accessible for receiving information as well as the Internet. Having access to the Internet and becoming a regular computer user are critical because of their positive impact on literacy, education, employment, and quality of life. However, further research is needed to determine the direction of the causal relationships so as to design appropriate interventions [17]. The results have also shown that the computer competences increase if the information technology is involved in as many teaching subjects, because numerous teaching contents within many teaching subjects become accessible to blind and visually impaired students exclusively through information technology, which requires the teachers to see the modern technology as important and legitimate learning tool that enables students to master a wide range of academic and practical knowledge. It is necessary to organize and improve training in the use of information technologies where technologists together with special teachers would train directly at a scholastic place. The collaboration between these experts is necessary because technology experts are best acquainted with the capabilities and performance of information technology, and professionals working with these kids know how to train persons with visual impairments. Having in mind the wider importance of information technology in other segments of life of students with visual impairments that needs to be explored, and these are directly related to education, such as orientation and movement in space, environmental control, sports, leisure and other activities, we would like to point out the need for cooperation in science in the field of social sciences, such as special education with technical and technological sciences in the development and modernization of this field on the basis of contemporary challenges of universal design and creation of innovative ideas in this field, in order to accelerate psychological and social integration of people with visual impairment, as the research indicated that still a small percentage of the possibilities of information technologies is implemented in this field. Comprehensive research of this problem is necessary in order to cover all levels and dimensions of this complex system of technology inclusion as an integral part of the education system for persons with visual impairment in our country.

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