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E-LEARNING APPROACHES FOR SUPPORTING HIGHER EDUCATION (HE) STUDENTS WITH DISABILITIES ON TRANSITION PLANNING

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Abstract: *The results of the survey that was conducted in the framework of the Trans2Work project will be the basis (a) for six e learning seminars that will be organized during the project life time in order to reach as many stakeholders as possible and (b) for the training of the teaching staff, mentors, employers, students with disabilities and mentors. The most crucial part will be the synchronous and asynchronous training that will be offered in the local language to as many stakeholders as possible and will needs to respect accessibility rules. HEIs cannot avoid the responsibility towards all students or trainees on providing accessible material. This paper presents basic issues related to accessibility focusing on deaf and hard of hearing persons and for blind and low vision persons that will be taken into account during the design and implementation of the e learning seminars as well as the training.*

Keywords: *e-learning, accessibility, higher education, students with disabilities*

1. INTRODUCTION

Due to rapid development of information-communication technology (ICT), we are witnesses of significant differences in all areas of life. In particular, these have been especially obvious in the field of education and inclusion of persons with disabilities (PwD). Consequently, in modern technologically-oriented society, PwD gained possibilities for equal inclusion in social, societal and economic environment. In this way, quality computer-based education that would be suitable for all, disregarding their abilities and motives, has become an important question in all environments, especially in developing countries. Necessities for continuous renewal of skills caused that education and content have not only been adjusted to young generations, but also PwD, who have their own needs and requirements. This leads to the need that the ways of knowledge transfer and educational content should be adjusted to the needs and requirements of PwD as well.

Current situation on the labour market, e.g. high competitiveness regarding the workforce, shows the urgency that PwD should be involved in educational environment specifically tailored for them, so that they are able to reach their professional and personal goals.

The output of merging both technology and education is e-learning as a field which allows distance learning and learning with techniques tailored to users. Concurrently, electronic media and devices are used for facilitating access to learning material [1].

The importance of ICT use in education for PwD is strongly emphasized on national and international level, so there is an increasing need for development of accessible e-learning and its inclusion into public administration and private corporations as well. However, the above-mentioned action is not sufficient, but what is needed is rather additional public awareness raising in teachers and personnel working with PwD. This is especially crucial at the moment, when UN Convention on Rights of Persons with Disabilities is ratified by most of the European countries. Hence, Higher Education Institution (HEI) staff needs to understand how the use of equipment can make their life as well as life of their disabled students, easier.

However, there are still too many open questions at HEIs about how to develop accessible e-learning material and teaching process. It is essential to be aware that it is important how the e-learning material is developed for persons with different types of disabilities, such as d/Deaf

and hard of hearing (D/HH), blind and weak-sighted and persons with other types of disabilities. The familiarity with specific needs and requirements of all relevant types of disabilities is crucial and accordingly the system should be adapted.

One of the reasons for paying attention to accessibility lies in statistics, as well. According to World Health Organisation [2], about 15% of the world's population lives with some form of disability. Out of these, 2-4% experience significant difficulties in functioning. When studying at HEIs is concerned, 18% of all Europeans go to university, while only 9% of Europeans with disabilities do so [3]. To the best of our knowledge, there is still a lack of reports on how many SwD actually study on HEIs. In 2016, there was a study conducted within the EU project Trans2Work (<http://trans2work.eu/>). A total of 170 SwD from Serbia, Montenegro and Bosnia & Herzegovina participated in this study. Out of these, 23.53% had visual impairment, 5.88% had hearing impairment, and 58.24% had physical disability or orthopaedic impairment.

Accessibility provides a specific form of social cohesion, since independence is best for users and the most efficient support for our social systems. Accessibility also makes independent and reduces social costs in care, rehabilitation, inclusive education, employment and all daily activities. Currently, there are technical and organisational regulations in use, and tools for implementing accessibility, such as the WCAG 2. Also, ITU, IEC and ISO encourage "the development of standards that take account of the widest range of characteristics and abilities of persons, including in particular those of older persons, children and PwDs" [4].

The aim of this paper is to present the essential issues which should be followed when purchasing accessible equipment, emphasizing the needs and requirements of D/HH, blind and weak sighted persons. Moreover, concrete advice for adequate purchase of equipment is provided, while recommendation for certain existing adaptive solutions for D/HH, blind and weak sighted are provided as well. These are of significant importance due to its relevance in the EU Erasmus + project Trans2Work – School-to-Work Transition for Higher education students with disabilities in Serbia, Montenegro and Bosnia & Herzegovina. In the project, training e-learning and on-site programme will be developed and implemented for teaching staff, employers and SwDs in Serbia, Montenegro and Bosnia & Herzegovina.

2. GOALS FOR USING ACCESSIBLE EQUIPMENT

The first step towards development and implementation of new systems accessible to all is familiarity with accessible equipment. It is possible to define several goals for use of accessible equipment in education, such as:

1. Technology significantly increases independence of PwDs.

D/HH persons can receive the e-learning material not only in written language, but also in sign language which can be considered as a mother tongue to many of them. Blind

persons can now read the books, using software recognizing print or buying e-books and using screen reading software.

2. Equipment allows PwDs to have the same chances during exams and in the same time it supports teachers in preparation of the exams.

D/HH persons can more easily understand the content by providing sign language interpreter video. Accordingly, if the teacher poses a question, D/HH person may understand it to a greater extent when the question is displayed in sign language as well. Moreover, additional time should be ensured, so that the D/HH may not be under time pressure. As far as blind and weak-sighted persons are concerned, technology provides a number of opportunities to reduce barriers when passing written exam. For instance, usually, blind person needs magnifying glasses for reading and it may take him/her more time than for average student. Similarly, it takes more time for teachers to read the student's answers. However, when technology is used during the exam, electronic version of exams may replace the paper-based version which may simplify the process of reading and answering.

3. Technology increases chances for good communication.

Many disabilities influence the communication between disabled student and his professor in a negative way. It implies to d/Deaf persons and people with hands disabilities not being able to write in normal way. Also, blind persons may face difficulties in written communication. Hence, use of accessible technology may reduce such barriers.

4. Technology supports people not being able to read regular books.

Deaf student should be provided by the content in language adequate for them, e.g. sign language, and in a form adjusted to their capabilities, e.g. reading capabilities. Unfortunately, not all the deaf, whose primary language is sign language, are able to capture written information in the same way as hearing people do, so it would be suggested to provide easier-to-read written learning material. When learning material is provided in sign language by using sign language interpreter video, captions should be used concurrently since results of the previous study [5] show that the comprehension of the content presented in sign language video increased by 24% among deaf viewers and 42% among hard of hearing viewers.

Likewise, for blind students is simply impossible to read printed books and for low vision is often difficult, so the technology adapter allows them to read the electronic books.

5. Accessible technology supports academic teachers to work with disabled students in their groups.

Having a d/Deaf or blind student, teacher can send all messages to him/her by e-mail or by video message. Student can prepare their homework and other assignments on his/her computer and in this way allow the teacher to read the electronic material prepared by

them. Thus, it is necessary to raise awareness of academic staff on the role of accessibility and its use during the classes. In some cases when material does not meet standards of accessibility, even the most advanced technological solutions will not be effective enough to guarantee the independent access to such material. On the other hand, producing accessible materials does not cost in comparison to adapting not accessible materials.

6. Equipment allows PwDs prepare for work.

In many cases, the use of assistive technologies enables PwDs to perform the work, and can importantly increase its effectiveness.

3. ADVICE FOR ADEQUATE PURCHASE OF EQUIPMENT

Before purchasing of the equipment is conducted, it is important to be aware of the rapid changes on the market and different way of transmitting information. Stand-alone computers were popular until recently. Currently, the use of mobile devices, such as smartphones and tablets, is at the forefront. Likewise, these devices are personalized and adapted to the user needs to a greater extent.

As a result, we face the situation where students with disabilities (SwD) are less likely to use traditional stand-alone computer devices, but rather they prefer to use personal, portable and mobile devices. On the other hand, the accessible equipment can be in most cases more expensive than standard, mostly non-accessible devices.

Another issue is the assumption that the devices are purchased only for already existing SwD. In other words – many HEIs present the attitude that purchasing of adaptive solutions in advance has no sense. However, for many SwD the information about available accessible e-learning and equipment is crucial when selecting the HEI they want to study at.

Taking these factors into consideration, during the purchase of equipment the following criteria should be respected:

1. Choose first the solutions accessible to persons with different types of disabilities, or being possible to connect with many different accessible tools.
2. Do not purchase many pieces of the same type of disability, but rather be prepared for many different situations and types of disabilities.
3. If possible, choose rather portable equipment, which can be used both as the classroom equipment as well as personal equipment.
4. Prepare clear procedures of obtaining this equipment, i.e. whether it is possible to rent it, for what period of time, in which classroom situations it can be used by students, etc.

5. ADAPTIVE SOLUTIONS FOR D/HH STUDENTS

When advising on equipment purchase for d/Deaf students, it is essential to consider two issues:

- providing written information in sign language video as an online video (e.g. video conference) or offline video (e.g. webinar);
- considering the findings of the previous study [6], we should take into account the fact that natural videos are currently more accepted by the end users than signing avatars and synthetic gestures. In line with that, lately, researchers more focused on development of e-learning materials and systems which use videos and sound amplifiers.

As far as equipment for hard of hearing students, who use hearing aids or cochlear implants, is concerned, firstly, Personal frequency modulation (FM) systems are quite popular. They function as miniature radio stations, operating on specific frequencies, and consist of transmitter microphone used by the speaker (such as the teacher in the classroom, or the speaker at a lecture) and receiver used by the listener with hearing aid.

Secondly, another useful system for hearing aids, which have a chance for using T-Coil, is "induction loop" system. It magnetically transmits sound to hearing aids and cochlear implants with telecoils (T-coils).

Thirdly, for live following the lectures by D/HH students it is advised to use a system for live subtitling, where the sound from the talking person is transmitted to the typist situated in the same room or at the distance (see Image 1).



Image 1: Live subtitling (from VerbaVoice)

Moreover, another important system is a multipoint videoconference system which enables collaborative work, telepresence, desktop video conferencing, and multipoint connections to users.

For webinars, popular systems are systems like Adobe Connect or Webex, since they allow using video, document sharing and text chatting during the live sessions.

Furthermore, an example of good practice when using the video for D/HH is the Sign language Interpreter Video Player (SLI module) for web sites, which allows multimodal composition of HTML5 video, audio and subtitles on the web page, so that video on demand is displayed over the existing web-page [7]. Accordingly, there is no need for additional implementation of static video clips which usually take much space on the website. Video is activated on demand by end-users and implementation is unobtrusive into existing websites. The ability of the system is also important in terms of including cross-browser and cross-mobile video player, and that the subtitles are displayed over the existing video

clip which simplifies inclusion of different languages (see Image 2).

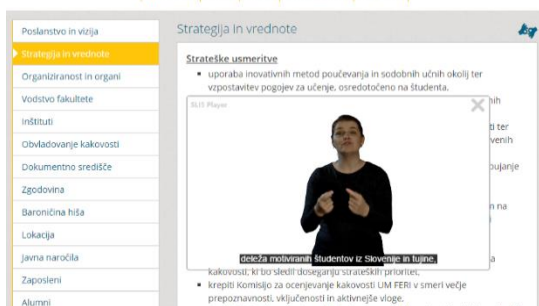


Image 2: Sign Language Interpreter 5 (SLI5) Video Player for Web Sites

At the University of Maribor, Slovenia, the e-learning portal based on a custom-modified version of Moodle has been already implemented as an e-learning system. The system comprises three parts: contextual, communicative and collaborative. The whole content is accessible in both, written and sign language. Sign language interpreter videos with translation of the written text are fixed and are positioned on the left side of a screen window. The text in written form is on the right (see Image 3). The glossary of potentially unknown words is provided with a transparent SLI module, where the words are explained in sign language and supported with captions. The video is displayed when activated by the user on the website.

The communication part of the abovementioned e-learning system is videoconference communication and collaboration tool, videoforum and chat room. Videoconference provides communication among D/HH students and sign language interpreters with live video, text messages and interactive whiteboard. Videoforum enables the posting of messages in the form of a video recording, along with text message, or just text without a video recording. In terms of collaboration, users can do exercises, quizzes and assignments.



Image 3: E-learning Portal for Deaf and Hard of Hearing “How to get a job?” with fixed and transparent video (SLI module)

6. ADAPTIVE SOLUTIONS FOR BLIND AND WEAK SIGHTED STUDENTS

When advising on the adaptive equipment purchase for blind and weak-sighted persons, the following goals are to be respected:

1. Allow for independent reading.
2. Allow for independent writing in the way which can be read by sighted persons.

3. Access to information resources.
4. Communication with sighted people.

It is necessary to remember that blind persons do not need special tools to write on computers. They memorize regular keyboard and use it without extra adjustments. However, these persons who know Braille, can take advantage of it, using note takers with Braille keyboards, which consist only 7 keys and are much smaller. Using Braille keyboard in electronic devices does not change the standard of files, so they still can be read in regular computers.

In reading, there are two methods available:

- Reading with speech.
- Reading with Braille displays.

These two ways would not be treated as alternative, because Braille gives much more possibilities and for some tasks speech will never be as effective tool as Braille is i.e. programing, proofreading texts etc.

In order to use Braille displays which will allow the use of a PC or tablet, it is still necessary to bear in mind the software connecting such device with computer. It is usually done by screen reading software, which is also used to allow for access to the computer with voice.

Another important option for independent reading is scanning and recognizing printed materials. Even if nowadays more and more books are available in electronic version which does not require further adapting to become accessible for blind readers, there are still many books available only in print version. Such books can be also read by blind students by scanning them on regular scanner, and then by recognizing scanned images with the OCR software (optical character recognition) which converts the images to text files such as word documents.

Taking these conditions into consideration, HEIs will definitely need the following equipment:

- a. Standard laptop(s) or tablet.
- b. Screen reading software.
- c. Braille display.
- d. Scanner with OCR software.

Ad a. You should remember that on one hand the computers or tablets can be just standard ones. On the other hand, speech solution will always take some part of computer’s capacities, so it is recommended to buy medium or higher speed computers.

If laptops with Windows operating systems are taken into consideration, in the next step you will need to purchase screen readers. A very good alternative for it, will be to purchase the products of Apple Inc. Apple products do not need any further adjustments because they have adaptive solutions (not only for blind persons, but also for some other disabilities implemented in operational system. By purchasing this you will receive high equipment which can be easily available for blind

persons, but in the periods when there are not such students, it can be also used for other purposes.

Ad b. It is not necessary now to purchase expensive Screen reading software. There are two options mentioned already above:

- use NVDA free software, which is very efficient and good enough for most University tasks; It is dedicated to computers with Windows systems. Window-Eyes for MS Office User (ver. 10 and up) is also free;
- use Apple products which have screen readers implemented in their operational systems.

Recommendation is to make at least two standard Windows base sets. They will include laptop with screen reader (free software is usually enough); additionally you can add local language speech synthesizer. Depending on number of students with disabilities, you need to keep at least one for University use (organizing tests, exams etc.), and at least one or more which will be given to students for their personal use.

Two tablets or iPads for portable use. They can be used as personal devices allowing students to read electronic materials, to record lectures, use mail, Facebook etc.

They also have the advantage of being used for persons with different disabilities – i.e. for low vision students; if we talk about tablets, we definitely recommend iPads – at least for the group of totally blind students. iPads have also many functions supporting partially sighted students.

It is necessary to remember that for writing purposes tablets without standard keyboard are not as useful as regular laptops. However in case of totally blind students you can connect tablet (iPad) with Braille display and in this way you provide students with tools allowing for reading (in this way student can read during class, being able for example to have speech).

Ad. c. Braille display is one of the most expensive tools, but it is necessary for really independent studies and doing more requiring task such as programming, note-taking with simultaneous possibility of checking/reading them, giving speeches/lectures/presentations.

Currently there are two types of such devices available:

- Braille displays working exclusively as output devices to standard computers or tablets. They need software to be installed on such computer to be a manager for such display. Since they have its own Braille keyboard, they give much more flexibility when working with tablets or iPhones. Unfortunately, they are useless as independent pieces of equipment.
- Second type are Braille display with note takers built-in. They have all functions described above, but when disconnected from laptop or tablet, they can work as independent note taker allowing also for reading files saved in the memory of the display. For that reason we recommend this solution.

Ad. d. To allow students to read written materials you need one set made of a computer (laptop or regular PC), scanner and OCR software.

Currently, the quality and speed of scanners is so good that we do not recommend any particular model. In the field of OCR still the best option is Abby Finer Reader.

Having such a set of equipment available, for example, in the library, not only students but also teachers can easily convert written materials to electronic version.

7. IMPLEMENTATION OF E-LEARNING APPROACHES IN THE TRAIN-THE-TRAINERS PROGRAMME

Based on abovementioned solutions, we will develop the training programme within the Erasmus + project Trans2Work – School-to-Work Transition for Higher education students with disabilities in Serbia, Montenegro and Bosnia & Herzegovina. The aims of the project are (<http://trans2work.eu/>):

“(a) Upgrade and prepare HEIs services to support SwD to their transition from HE to Work following the EU policies,

(b) Link Higher Education to “disability friendly” work environments,

(c) Assimilate transition opportunities and skills with EU practices and policies and

(d) To prepare employers on understanding the needs of employees with disabilities in order to offer new job.”

Accordingly, there are recognised two crucial moments within the project:

1. for six e learning seminars that will be organized during the project life time in order to reach as many stakeholders (teaching staff, employers and SwDs) as possible, and
2. for the training of the trainers and mentors that will take place in EU countries.

In order to assure sustainability and exploitation results in the region, six e-Learning seminars will be organized, students with disabilities, environment, university teachers, staff, and university established services, career centers, employers and potential networks. The e-Learning sessions will be open to everyone and class invitations will be sent to all identified from indexed organizations related, announcements for the e-sessions will be included in newsletters and uploaded to websites. The e-Learning informational sessions are aiming to raise awareness of respective groups inside partner countries within region and will present the accessible data base and its use as well as the web based tool that will help (a) employers to identify suitable people to fill specific positions and it will be designed to account for special requirements needed by employers and (b) SwD to identify their interests and educational needs.

An important milestone of the project activities is the training that aims at providing high quality training at Partner University and public associations working on education and support of students with disability. All stakeholders will be acquainted with necessary knowledge for improving the quality of transition from School to Work of students with disabilities. The content of the

training will be based on the guidelines and transition curriculum that will be developed in previous WPs taking into account the results from the basic research. Training material will be available in the project website and in the data base and of course it will be used for the e learning seminars.

8. CONCLUSION

In this paper, we provided a technical overview of adaptive technical solutions for D/HH, blind and weak sighted persons along with lessons learned from several existing systems.

The discussed systems present a combination of multimodal information, including video, audio and captions, and offer the option of prioritizing the sign language on the Web for D/HH users. The interaction is mainly managed with transparent and movable videos of a sign language interpreter. For instance, the videoforum for deaf people presents an asynchronous communication tool for the exchange of ideas among students and tutors in two languages: sign language and written text. The tools presented could have a stimulating effect for the D/HH since they can choose their own preferred communication method.

We believe that the systems presented will thoroughly change the method of information transmission for the D/HH on the Web. These systems have already been accepted at a large scale national level in Slovenia and tend to be positively accepted in countries where sign language is recognized as an official language for the D/HH. In Slovenia, official websites are meanwhile supported with sign language translations. Moreover, a majority of television programmes and movies are captioned. Amongst the weaknesses, one cause of indignation for the deaf is the absence of captions in live television programmes and in sign language interpreter videos on the Web. Thus, our future research will be aimed at proving that the captions integrated into sign language interpreter videos are required.

With the expansion of the discussed technologies, we could contribute to literacy improvement, rising education levels and improvement of competitiveness in labour market. This will also enable them to get better opportunities for easier social integration and, at the same time, it will preserve their identity and self-esteem.

While designing and implementing the e learning seminars and the training during the Trans2Work project some recommendations from Wegner's theory will be taken into account [8]. The e learning seminars will help HEIs to make links with the employment sector and the wider community. Thus, HEIs will finally be able to identify their needs and the needs of other communities so that HEIs can improve the focus and the nature of the theory and practice related to e-learning. Combining the e learning seminars with the training hopefully at the end the project can shift the focus from the "product of accessibility towards the process of accessibility [8].

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