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TOWARDS AN ACCESSIBLE SCIENCE: FACILITATING ACCESS TO SCIENTIFIC DIGITAL RESOURCES FOR VISUALLY IMPAIRED STUDENTS

D3.1 Best Practices for University Support Services: Best Practices to Support Sight Impaired Students at University

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[1] OJ L 79, 24.3.2005, p. 1.

EXECUTIVE SUMMARY

This document aims at illustrating some best practices to facilitate support to blind and partially sighted students who go through university scientific studies. This document is supposed to be used by those university support services which are not experienced in supporting blind or partially sighted students or which have been recently founded.

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1 INTRODUCTION

Higher education institutions all over Europe confess themselves to offering equal opportunities for people with disabilities. Up to now relevant progresses have been achieved. Anyway, there are still differences between study conditions, legal regulations, architectural access to university buildings and especially access to scientific courses as far as some disabilities are concerned. Above all, blind and visually impaired students have to face many barriers in going through university scientific studies. Some of these barriers concern:

- reading, writing and processing scientific documentation, in particular as far as mathematical expressions are concerned;
- exploring and creating technical drawings, diagrams, graphs, which are widely employed in scientific university courses;
- using specific programs necessary in a certain educational context, in particular, symbolic and numerical computation software and programming environments, which are often inaccessible to people with sight impairment unless these programs are properly customized in order to make them compliant with screen readers.

There exist assistive tools which help blind and partially sighted overcome successfully many of these problems (see @Science deliverables D2.1, D4.2, D4.4). Even if these tools are available, students in the early years of a university course may not know the existence of proper tools or they may not know how to use these tools. So, it is essential a service which first of all informs blind and partially sighted students about the existence of proper tools in order to enable them to go through university scientific courses. Also, specific training might be indispensable.

Further problems involve the reading process. Actually, available scientific resources, even in digital format, are generally not usable by visually impaired university students. Therefore, adaptation in alternative formats is indispensable and it usually takes long time and high expertise to come to a high quality result (see “Guidelines to Prepare Scientific Textbooks Usable by Visually Impaired”, @Science deliverable D4.2, and “Guidelines to Make Lessons and Educational Resources Accessible”, @Science deliverable D4.4). The adaptation process from not usable formats (e.g., printed material or not accessible digital formats) to usable formats has to be planned and carried on in time, so as to enable the students to attend the course and learn a certain subject according to the course work plan (i.e., scheduling of lessons, examinations, laboratory exercises, etc.).

So, a well co-ordinated service should exist in the university. Such a service should either adapt scientific educational resources or co-ordinate its activities with external institutions, which adapt the necessary learning material on time.

Nonetheless, additional issues have to be overcome successfully by visually impaired students who attend scientific university courses. In particular, attending lessons and taking examinations may turn out to be very challenging activities, which often prevent students from successfully

accomplishing university courses. Explanations of technical and scientific subjects are usually based on transparencies with text, mathematical expressions and graphics. Professors are used to write on transparencies or on the blackboard (e.g., to illustrate the solution of exercises or to clarify some concepts). The verbal explanation does not always describe what is actually printed on the transparency or what is added by writing on it. Therefore, the blind or visually impaired student often only gets the gist of the explanation, but many details are lost and have to be approached after the lesson. Because of difficulties to understand what is presented at lesson time, the learning process after the lesson usually cannot be based on notes taken throughout the explanation. Therefore, collaboration with students who attended the lesson or the possibility to have notes available in usable formats are crucial to learn the subjects presented in the course (see "Guidelines to Make Scientific Lessons and Educational Resources Accessible to Visually Impaired", in @Science deliverable D4.4).

As for taking examinations, two main problems can be outlined: the need to have the text of the examination in a format usable by the blind or visually impaired student and time expensive working procedures with assistive tools. Text, mathematical expressions and graphics in each written exercise have to be adapted in advance so as to enable the student to read and understand this kind of content during the examination. It means that a special service at university should take care of this adaptation procedure, which is a sensitive one. Indeed, the exercises in examinations have not to be known in advance by the students. Consequently, the adaptation service has to guarantee full reliability.

The second issue concerns time expensive use of assistive tools and activities which are time demanding because of a non-visual modality (e.g., exploration of tactile drawings). Certain assistive tools, especially those for the preparation or exploration of tactile images, compensate for the lack of sight, but the users can perform operations in a longer time than sighted ones. That leads to the need for a longer duration of the examination so as to enable the student to solve all of the exercises. Longer duration of written examinations as well as further special needs should be discussed and agreed in advance with the professor.

All of these considerations evidently remark the need for well-structured and properly co-ordinated specialized support services in universities in order to enable blind and visually impaired students to go through technical and scientific courses at university.

2 INFORMING ABOUT ASSISTIVE TECHNOLOGIES

Some information activities about assistive technologies which enable blind or partially sighted students to attend scientific courses are indispensable.

Three groups of persons should be informed:

- blind or partially sighted students who decide to go through university scientific courses;
- university teaching staff in scientific courses (i.e., professors and researchers);
- laboratory staff who usually install and configure laboratory applications.

Research and development in assistive technology has been evolving for years all over the world. Even though there are not fundamental innovations every year, many minor enhancements usually are achieved. These minor enhancements are often indispensable to give access to some classes of applications or even to one specific application, which can be extremely useful in some situations (e.g., programming environments in applied computer science laboratories).

Assistive technologies for blind and partially sighted people can be roughly divided into two categories:

- Enabling technology which makes possible access to basic software. Screen readers, Braille display and magnifiers can fall in this category. Screen readers and magnifiers enable blind and partially sighted persons to access the operating system and some basic applications, which are used for word processing, to browse the web, to communicate by e-mail and to read documents in several formats (e.g., PDF format);
- Applications which enable blind and partially sighted persons to access applications, especially used in a well-defined context. These technologies are, for example, screen reader extensions which allow access to specific applications such as programming environments, computation programs, and more. Other examples concern technologies which enable blind and partially sighted persons to make graphics for embossing and exploring by touch or self-voicing applications, which provide basic access to programs which would be otherwise inaccessible (e.g., some Java programs).

Blind or partially sighted students who apply for a university scientific course usually have basic knowledge of assistive technology, which enables them to access the operating system and basic applications. They usually do not know the existence of special solutions.

Therefore, a proper informative meeting with the student and university support service staff should be organized. It is advisable the participation at the meeting of blind or partially sighted experts in assistive technology who can evaluate the student's skills in assistive technology. The meeting can be organized according to the following steps:

- As soon as it is known a blind or partially sighted student is going to apply for a university scientific course, an informative meeting can be organized. It is useful if the meeting is held before the lessons start or in the early stage of the first academic year;
- During the meeting, at first the student is asked about which tools he/she employs to study, to make practical exercises, to take notes, etc.;

- The competencies the student has in assistive technology can be briefly assessed through really basic activities (e.g., writing a document, reading documents in different formats, browsing the web to search for some useful resource, etc.);
    - If the student is not skilled with basic assistive technology, an introductory training is advised;
    - If the student is skilled enough with basic assistive technology, no basic training will be advised, instead further information about special assistive technologies useful for the university scientific course will be introduced;
- At this stage, the student should not be provided with detailed information about special assistive technology solutions. Rather, an overview about which will be the problems and possible solutions can be enough. Instead, references to resources which can inform further about special assistive technology should be introduced (e.g., websites, document repositories, software repository, etc.). The @Science website is one of these references, since it collects in the document repository use cases, user experiences, case studies and information about how assistive technology to enable access to science is evolving.

As for informing university professors, some considerations should be taken into account:

- university teaching staff may be totally unaware of assistive technology;
- university teaching staff do not need know details about assistive technology. It is sufficient to provide university teaching staff with basic knowledge about which activities are enabled by assistive technology, which are difficult and which turn out to be impossible even if assistive technology is available;
- university teaching staff usually cannot be available for many meetings. Therefore a very short introductory meeting can be proposed or a reference to an explanatory resource about assistive technology can be made available to the teaching staff. An excellent manner to inform teaching staff about how assistive technology can be used to accomplish certain tasks is through brief screencasts or multimedia presentations.

Instead, more detailed information should be conveyed to university laboratory staff. In order to enable blind or partially sighted students to access applications in the university laboratory, some technical configurations can be indispensable or very useful. Two scenarios are described:

- the student needs use a programming environment or a computation program which is only available in the computer laboratory. To this purpose, a computer in the university laboratory should be equipped with properly configured screen reading software or screen magnifying software, in order to enable the student to use that software environment. In order to achieve these operations, the laboratory staff must be sufficiently informed about how assistive technology works;
- the student must use a specific software which can be properly configured on the student's notebook. Anyway, during the laboratory lessons the student might need to access some documents available on other computers in the laboratory or to access Internet. The

laboratory staff should enable the notebook to access Internet or other computer laboratories. Since there may be security issues, the laboratory staff should know in advance that this solution is in some situations indispensable for the student.

Laboratory staff can be informed in many different manners. In particular, due to laboratory staff technical skills, no special training is necessary, but some references to explanatory web resources can be enough. To this purpose, the @Science website can be useful to provide up-to-date documents which can guide the reader to find further resources on the Web.

3 SPECIAL TRAINING

Special training can become indispensable, in particular, for students who do not have basic knowledge about assistive technologies, or who need special solutions to go through scientific studies.

3.1 Basic Training on Assistive Technology

Basic training on assistive technology should be made available to those students who actually do not know how to use basic assistive technology, namely screen readers and/or screen magnifiers. Such a course would be useless for those students who have some basic skills and who are able to learn by themselves how to use new applications or interaction paradigms. Basic competencies are supposed to be assessed in the first meeting with students. There are basically three ways to train about basic assistive technology:

- the university support service makes available an introductory course about assistive technology. This approach has proven to be extremely effective especially if the trainer is a blind expert user of assistive technology;
- the university support service collaborates with local associations for blind and partially sighted which make available courses on assistive technology. This approach can be very effective. Nonetheless, it is essential to check in advance if the training about assistive technology does not focus on applications which will not be used in the university course;
- the student is informed about some self-training course (for example an online self-training course on assistive technology). This approach is generally not advisable for introductory courses on assistive technology. In order to successfully undertake an online course, some basic skills in assistive technology are assumed to be mastered by the student.

3.2 Training on Special Solutions for Science Learning

There exist many special solutions which facilitate blind or partially sighted students to go through science learning. Training about these special solutions cannot be done in one course. Since most of the topics are concerned with different stages of the university course, independent modules should be accomplished. There is a close relation between how university courses are held (e.g., which presentation methods are used by teachers to explain topics, which applications are supposed to be used by students in the laboratory, etc.) and which topics should be introduced in special training courses. Therefore, it is advisable that special training on accessibility solutions for scientific courses is conducted inside the university, preferably by qualified staff of the university support services for students with disability, in case in conjunction with university staff (e.g., laboratory staff). Some topics to be introduced by special training are illustrated.

Training about LaTeX

LaTeX is widely used in the scientific community to produce scientific documentation (e.g. research papers, lecture notes, books, etc.). LaTeX can be very accessible for blind students because mathematical expressions are represented in a linear manner through sequences of characters. A partially sighted student can produce a PDF document from a LaTeX source file and read it by using a magnifier. Sooner or later a blind or partially sighted student will need LaTeX either to read scientific documentation or to produce a scientific work (e.g. a technical report, the graduation or PhD thesis, etc.). LaTeX can be learnt from a step-by-step tutorial. There are many tutorials available on the Web about LaTeX. They use to introduce LaTeX source commands in source file examples and to display the visual rendering of the source file. Blind people cannot check the visual rendering of a LaTeX source file, once transformed into a PDF file. Therefore, special training which verbally describes how each LaTeX example is displayed would be of great help especially in early stages of the university scientific course. The @Science website makes available LaTeX examples and it will make available tutorials in the document repository.

Training about converters

Being able to convert documents from inaccessible formats to more accessible formats is an important skill a blind student should learn since the early stages of the university course. Some examples of converters which can be successfully used are those which turn a PDF file into an XHTML structure page (e.g., to use together with CSS for better contrast, colours and magnification), which convert files produced through Open Office into XHTML or PDF structured files, which extract text from PostScript files, and more. Basic information about the existence of these tools and how to use them would help the student find the right solution when some inaccessible documents are met.

Training about computation programs

Symbolic and numerical computation programs (e.g., MathWorks MatLab, Wolfram Research Mathematica, Octave, SciLab, etc.) are essential in many scientific courses. These programs apparently seem inaccessible because of the inaccessibility of the front-end. There exist alternative approaches to access these programs, which are often based on alternative command-line front-ends or which employ alternative editors to be used in conjunction with the computation program. Students should be trained about these alternative solutions. These solutions should not be introduced in the early stage of the university course, but as soon as a computation program is needed to accomplish a certain class.

Training about programming environments

Some laboratory courses are focused on programming in specific programming environments (e.g., Eclipse, Microsoft Visual Studio, etc.). Most of the programming work introduced in these courses can usually be achieved without using a certain programming environment. In some circumstances, the programming environment is indispensable. Many programming environments can become

accessible if some specific settings are enabled and if some specific access strategies are employed. These accessibility solutions for programming environments should be introduced as soon as these tools are used in laboratory courses. Much documentation is available online. It can be retrieved also through the @Science website.

Training about making tactile graphics

The ability to explore and also draw tactile graphics is often not indispensable, but very useful for blind students in scientific courses. Special training about exploring and drawing tactile graphics should be proposed to blind students who are not familiar with tactile graphics, especially in the early stages of a scientific university course. To this purpose there are at least two modalities:

- the trainer is a qualified member of the university support service. To this purpose, qualified sighted trainers can often achieve better results because they are able to see which wrong actions are done by the student while sketching the tactile drawing. Based on the wrong actions, precise corrections can be specified;
- associations for blind and partially sighted usually make available these courses. It is essential to propose a course which actually focuses on technical drawings which are used in science learning (e.g. function diagrams, graphs, circuits, etc.).

4 MAKING LEARNING MATERIAL AVAILABLE IN ACCESSIBLE FORMATS

Making available learning material in accessible formats to sight impaired students on time for attending lessons and preparing examinations is essential. In order to learn about how to produce accessible educational material, the @Science website makes available procedure (e.g., through deliverable D4.4), examples and screencasts. In order to facilitate the preparation of educational resources in accessible formats, or to make them available to the students, it is advisable to:

- collaborate with university teaching staff. University professors or researchers often prepare their own teaching material. If they are aware of procedures to make it accessible, the documents they produce will be either completely accessible to students with sight impairment or it will be easier for qualified personnel to adapt these documents so as to comply with accessibility characteristics;
- contact publishers in order to ask for scientific learning resources already available in digital format. The availability in digital format does not imply accessibility for blind or partially sighted students (e.g. an unstructured PDF file could be totally inaccessible). Nonetheless, it may turn out to be easier for qualified members of university support services to produce an accessible digital document if a document is already available in digital format;
- search for an equivalent document in accessible format. Educational resources used by university teaching staff should never be replaced by different learning resources supposed to be equivalent. Nonetheless, in some situations it may take too long to adapt a scientific document in accessible format to be useful in due time, therefore an alternative learning resource, already available in accessible format may be successfully employed. Before making available such a learning resource to the student, the professors should be asked to assess the suitability of such a learning resource. Learning objects in accessible format can be found all over the Web, in particular on the @Science website and in the repository of the Joining Educational Mathematics network (http://www.jem-thematic.net).

5 SPECIAL ASSISTANCE

Students with sight impairment may need special assistance in some activities. A special assistant is advised:

- to be present in written examinations in order to make accessible some inaccessible parts of the examination (e.g. some drawings which were not prepared in advance in accessible format, to read the text if the examination is not in accessible format, to provide alternative verbal descriptions of some elements which are hardly accessible such as tables or flowcharts, etc.). The assistant will not suggest anything about the solution of the exercises. It is advisable the assistant informs the professor in advance about the modalities to interact with the student;
- to be present in some lessons which introduce visual topics or which are especially interactive (e.g. practical lessons which introduce how to solve exercises). The assistant will be asked by the student about inaccessible elements introduced (e.g. about something being written but orally referred by the teacher only about visual context dependent statements). The assistant will inform the student about some visual representation not addressed by speech which turns out to be useful for understanding;
- to be present in early laboratory lessons to help the blind or partially student arrange the laboratory equipment.

In some circumstances, special assistants may be of no help or they may negatively affect the learning process. That happens in particular when they interfere with the educational method employed by the teaching staff. Therefore it is essential to choose special assistants who are well qualified in assistive tools and support activities, who know enough about the subjects being taught (e.g., who are able to read context specific notations), but who do not mean to teach themselves to the student with visual impairment.

6 COMMUNICATION OF EXPERIENCES

Each university support service develops special skills based on the experiences acquired with students and university staff. These experiences should be communicated as far as possible in order both to inform students about the possibility to find good assistance in a certain university about some courses and to facilitate reuse of knowledge by students or other university support services. That can be achieved in many ways. In particular, some experiences can be made available through the @Science website. Effective forms to make available experiences are:

- audio descriptions. Students, members of the university support service and university teaching staff can talk about their experience about some specific issue or solution. Audio files can be delivered through podcasts or can be downloaded through the @science website repository;
- screen casts. Experiences in supporting, training or using some applications can be made available through screen casts. Screen casts are especially effective because they display how certain actions can be actually undertaken and they describe by speech which operations can be done;
- documents. Documents can describe success experiences through text. Text descriptions are usually less effective because it takes longer to read and understand. Anyway, text descriptions can be more easily understood in a transnational context if they are written in simple English.