# Advanced Learning Space as an Asset for Students with Disabilities

**RNDr. Klára Císařová, Ph.D.**
*The Institute of Mechatronics and Computer Engineering, Technical University of Liberec, Studentská 2, 461 17 Liberec, Czech Republic*
*klara.cisarova@tul.cz*

**Ing. Marián Lamr, Ing. Jana Vitvarová, PhD.**
*The Institute of Mechatronics and Computer Engineering, Technical University of Liberec, Studentská 2, 461 17 Liberec, Czech Republic*

**ABSTRACT**
The paper describes an e-learning system called Advanced Learning Space that was developed at the Technical University of Liberec. The system provides a personalized virtual work space and promotes communication among students and their teachers. The core of the system is a module that can be used to automatically record, store and playback lectures. Recently, we extended the system by new features such as sound websites and lecture recordings with a sign language interpreter. This further enables students with disabilities to study the same courses as other students.
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Peer-review under responsibility of the Sakarya University.

## 1. INTRODUCTION
In the new conditions of a competitive labor market, only well-educated graduates prepared in the best way for the 21st century workforce can succeed. At the Technical University of Liberec (TUL), we are continuously searching for ways to ensure that our graduates reach the highest possible level and as much as possible students complete successfully their studies. We also want to give a chance to the group of students with disabilities. Additionally, we need to take into account the fact, that we are a relatively small regional university with around 9000 students. This defines the pool of students applying to study with us. Bigger and well known universities attract, as expected, top talents but we want also our students to become good even the best in what they do. In order to learn new skills and gain deeper knowledge our students often require additional time and more personal approach. Therefore, we started considering an e-learning system based on new technologies with adaptive elements that will respect our students' individual learning needs, their personality and even their handicap. Our aim was to provide students with friendly supporting tools, where they can flexibly manage their learning path, interact with the teachers and among themselves. The solution should be low-cost and especially should not require time-consuming procedures from teachers.

## 2. PROJECT ADVANCED LEARNING SPACE
An analysis of the current technologies, current educational opportunities and the situation at the university clearly showed that one of the solutions, that can support our vision of providing high quality education and producing competent and competitive graduates, should be a students and teachers friendly virtual workspace promoting a professional creative atmosphere in the campus. Having this in mind, we developed the Advanced Learning Space (ALS). In the project ALS, which was co-financed by the European Social Fund and the state budget of the Czech Republic, we have built an e-learning portal with integrated technology for automatic recording of lectures. Now ALS offers to the student standard features such as the access to pdf files, powerpoint presentations or testing modules as well as new educational opportunities. Those new mostly comprise a video recording of a lecture synchronously complemented by a data stream coming either from the teacher's laptop, a magnetic board or a visualizer. The Fig. 1. depicts an example, when a video stream is accompanied by a presentation using a visualizer. Students can replay a specific part or a whole lecture, which they found difficult as many times as necessary. Or while revising, they come back to specific topics, where they missed an important point or took inaccurate notes. The teachers, on the other hand, get valuable information from electronic data representing students' access to various educational materials on ALS. They can find out which topics are the most viewed, though probably the most difficult or interesting, how much time students spend on average watching each recording or what time of the day do they usually use the ALS. Based on this information, teachers may decide to adjust their e-learning support as well as their lectures.
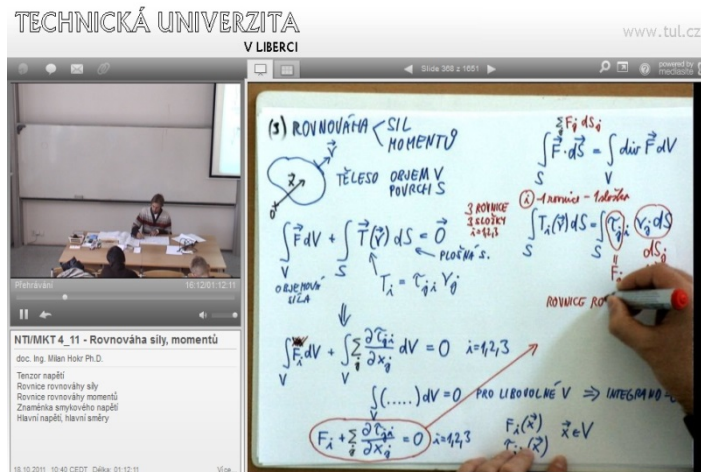
Fig. 1 Lecture recording example – video stream with a data stream from a visualize

*2.1. ALS technologies*
From the very beginning, we rejected the idea of building ALS from scratch. Modern e-learning is no longer a simple Web catalog of lectures in the form of powerpoint presentations or PDF files but a complex system. The design and development of a comprehensive e-learning solution would have cost us an excessive amount of time, money and manpower. Nor did we intend to repeat the mistakes from previous years of buying a closed commercial system with no scope for our own extensions (Císařová, Kopetschke and Hnídek, 2010).

After considering all the criteria we chose the environment Moodle due to its considerable popularity in academia, open source code and time-tested reliability. We strictly avoid changes to the core of the Moodle in order to maintain the ability of regular updates. Extra features are added through the development of custom modules. The most significant modules are the user authentication, the integration with the university study agenda software and the integration with the storage of the recorded lectures (Císařová, Kopetschke and Hnídek, 2011).

The recording of lectures is based on the technology Mediasite from Sonic Foundry for the moment. The streams of lectures are stored in a special catalog, which is a part of the Mediasite web application. The lectures can be categorized and directly playback through the web browser with an enabled or disabled option for a download. Due to the university security requirement to limit an uncontrolled spread of the lectures outside the university, downloads are forbidden. But then the access to the streams revealed to be the stumbling block. For the above mentioned security reason, the streams were accessible only through specialized user accounts unique for each subject and teacher. However, this proved to be quite impractical. The teacher had to disclose this access information to his students and therefore had no longer control over its misuse. The storage fortunately provides a collection of Web services enabling to establish a connection to an external entity using an authentication ticket and make accessible selected streams within the ticket context, which led to the development of an extension module. This module allows adding a specialized content – a lecture recording to the course. Therefore, students need no longer special access credentials. Once they are subscribed to a course, they automatically see all the lectures published for that specific course. Although, a similar module already exists for Moodle, we developed our own, which enables a higher degree of automation in the selection of streams for a particular course. The hardware solution of the lecture recordings based on the approach "switch on, give lecture and switch off" is described in Svoboda and Vlasák (2013).

*2.2. ALS current state*
The ALS portal was launched in pilot operation at the beginning of the spring semester in 2011. By January 2014 we had 375 registered authors - teachers and guests who agreed to stream their performances, 320 registered courses and around 4000 recordings of individual lectures and university events viewed 110,550 times. In the moment, the portal is used by two faculties out of seven. More statistical information can be found in Císařová and Kopetschke (2013). The numbers would although require an interpretation. A number of specialized lectures were intended only for a small amount of students and there are as well authors, who decided not to publish their recordings or use the portal only as a simple catalog of learning materials. Nevertheless, these data together with the positive feedback from students give a sense to the work of the whole development team.

## 3. SUPPORT FOR STUDENTS WITH DISABILITIES

Support for students with disabilities is addressed within the university project "Equal Opportunities", which is co-financed by the European Social Fund and the state budget of the Czech Republic. The aim of the project is to promote various activities creating better studying opportunities and more successful assertion in the labor market for students with special needs. The ALS feature of lecture recordings gives students with disabilities a chance to attend the lectures at least virtually or adapt the playback of the recordings to their needs (Gregová, Lamr and Tyl, 2013). The first may be important in particular for students with immune system disorders especially in times of increased incidence of viral disease. On the other hand, the adaptability of the playback is crucial for visually or hearing impaired students. At the moment, we are working on three adaptation elements; websites enhanced with sound, recording with a sign language interpreter and subtitling of the recording.

### 3.1. Websites enhanced with sound

Sound websites or websites enhanced with sound target visually impaired student, which represent the largest group of students with disabilities at TUL. The access to the recordings as well as their basic format is not comfortable enough for those students as it was not originally designed for such purpose. Based on the discussions with concerned students, we created a simple intuitive web interface, which makes available recordings directly, not hidden among other e-learning materials. In order to ease the navigation, we use a small number of large elements (buttons or hyperlinks) and a sound system. When the student hovers the mouse over an element, the element's text is played. This way, the student can, for instance, search for a correct button. As there were not many elements at the beginning, our first idea was to read and record the necessary sounds for the elements ourselves. As it turns out, this solution is not very effective and produces unprofessional results. Maintaining the same volume, tone and style of the speech is in our conditions complicated and unfeasible. Another solution especially suitable for larger catalogs of lecture recordings is a use of a commercial synthesizer. The output of the synthesizer is exported into audio files that are incorporated into the site the same way as the sounds recorded by us. Visually impaired students prefer to have only a standalone audio stream. Therefore, we extracted the audio tracks from the original recordings and designed a simple audio player with regards to the students' needs. The Fig. 2. depicts the audio player. It has again large buttons enhanced with sound.

### 3.2. Recording with sign language interpreter

Another software solution we are currently testing is a recording with a sign language interpreter designated for the hearing impaired students. There are two options; either the online or the on-demand mode. The first option is suitable, when the interpreter's recording can takes place at the same time as the teacher's lecture. The two video inputs, one from the camera recording the speaker and one from the camera recording the interpreter come simultaneously into a hardware device a videomix, where they are in real time layered together and can be broadcast live. In the case of the on-demand mode, the lecture can be taken using the classic one video input device and the recording of the interpreter can take place separately later on. Then, both streams need to be exported and composed using appropriate software tool such as Pinnacle Studio. By using visual effects and various techniques of keying we create an image of the interpreter in the teacher's image. Fig. 3. a) depicts the green-screen composing, where the green background behind the interpreter is filtered and made transparent. Fig. 3. b) depicts, on the other hand, the case, when the background is left.
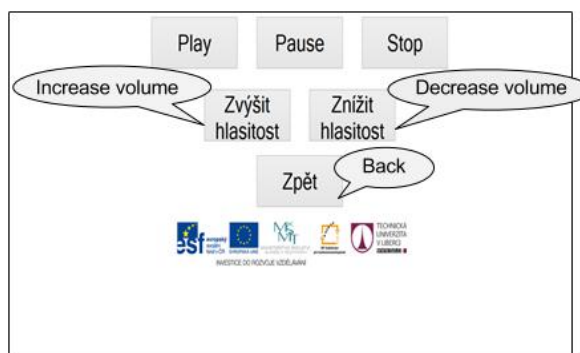


Fig. 2. Audio player for visually impaired

a            b



Fig. 3. Examples of (a) a composition with background filtering; (b) a composition without background filtering

*3.3. Subtitling*

Subtitling or captioning of the recordings is a further enhancement aimed at students with hearing impairments. Again there are several ways of doing it. Individual methods differ in quality and time requirements. Mediasite itself provide support for automatic as well as manual methods. Automatic captioning here means that the stream is sent   to a caption provider, who creates the subtitles and sent them back. As there are no caption providers for the Czech language and their services would be presumably quite expensive, this method is in our circumstances not applicable. As mentioned, Mediasite allows manual upload of subtitles created and specified in separate SAMI files.  In this case, it is necessary to create subtitles manually using special software. In collaboration with our colleagues from the speech recognition group, we test the possibility to generated SAMI files automatically from the recordings. These automatically generated captions are still not hundred percent accurate. However, they can serve well for searching. As they already contain the right timing - when what text should appear, only the inaccuracies should be corrected manually. Fig. 4. depicts an example of the subtitling.
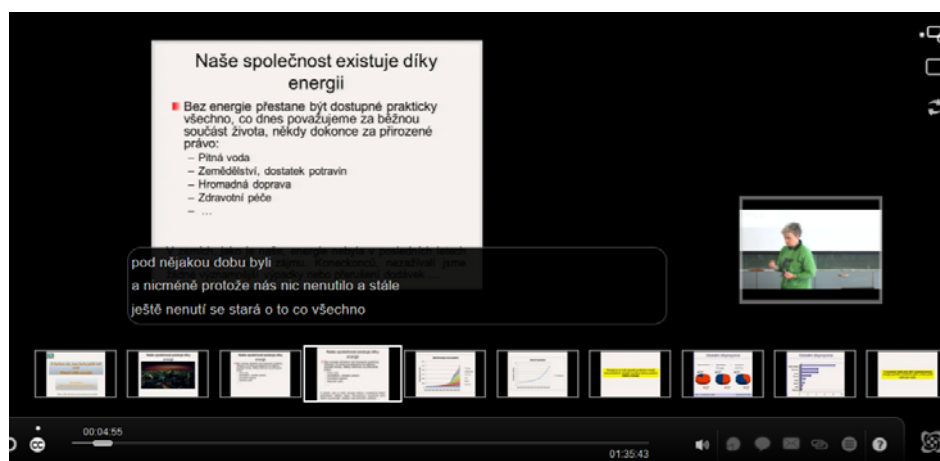


Fig. 4. Example of subtitling

**4. CONCLUSION**

New elements of e-learning together with wheelchair access, Braille translations or electronic orientation landmarks at the university premises can cause a real revolution in studying for disabled people. This academic year a student with severe disabilities was able to fully study the Information Technology (IT) specialization at the Faculty of Mechatronics. There was only one first year IT course missing in ALS and around 90% of all the first year IT lectures were recorded and made available to the student. The coverage in higher classes is lower, although continuously increasing.

In the next stage of the ALS development, we plan to provide support for mobile devices (already in progress) and include a virtual shop for electronic university textbooks in the EPUB format. In addition, we would like to implement a module for preventing plagiarism. As described earlier, we are continuously working to make

maximum of the ALS features accessible and usable by disabled students as well. Following asset will be an intelligent magnifier for visually impaired.

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