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ADAPTATION, DESIGN AND IMPLEMENTATION OF ENGINEERING EDUCATION TO LIMITED INTERNET ACCESS

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Abstract – **This paper is a description of the design and implementation of a course within the project USo+I: Universidad, Sociedad e Innovación financed by the European Union, within the ALFA III program. The course was an introduction to the handling of Learning Management Systems (LMS) first conducted at Instituto Superior Politécnico José Antonio Echeverría, Facultad de Ingeniería Eléctrica, Havana, Cuba. The course was divided as two weeks of on-campus lectures and workshops followed by distance learning for three months, altogether corresponding to ten weeks of full time studies. Pedagogically and methodically the course was planned within the concept of Problem Based Learning (PBL). All course material was open educational resources freely available on the internet. The design of the course also had to consider the problems of limited access to computers and internet, both during the course and in the lecturers´ future practice. The solution was to have the LMS "Moodle" and other software executable from USB-memories and all course material available from the same USB-memory sticks. How this design can meet the given considerations is discussed.**

Key Words – **e-learning, engineering education, Learning Management systems, Open Educational Resources.**

Resumen – **Este trabajo es una descripción del diseño y la implementación de un curso como parte del proyecto USO+i: Universidad, Sociedad e Innovación financiado por la Unión Europea, dentro del programa ALFA III. El curso fue una introducción al empleo de un Sistema de Gestión para el Aprendizaje, con las siglas LMS en inglés que se llevó a cabo en el Instituto Superior Politécnico José Antonio Echeverría, en la facultad de Ingeniería Eléctrica, La Habana, Cuba. El material del curso se dividió en dos semanas presenciales "on-campus" con lecciones y talleres, después de la etapa presencial el curso se impartió a distancia durante tres meses. Las dos etapas del curso en total corresponden a diez semanas de estudios de tiempo completo. Pedagógicamente y metodológicamente el curso estaba basado en el concepto de aprendizaje basado en problemas (PBL). Todo el material del curso estaba basado en recursos educativos abiertos libremente disponibles en Internet. En el diseño del curso también fue necesario tener en cuenta los problemas de acceso limitado a ordenadores e Internet, tanto durante el curso como para las futuras actividades de los profesores. La solución fue tener un LMS "Moodle", y otros programas ejecutables desde la memoria de USB además de todos los materiales del curso en disponibles en la misma memoria de USB. ¿En este trabajo se discute cómo el diseño de este curso pudo satisfacer las necesidades mencionadas.**

I. INTRODUCTION

Background

The University of Borås is one of the European participants in the project USo+I: *Universidad, Sociedad e Innovación. Mejora de la pertinencia de la educación en las ingenierías de Latinoamérica* (University and Society: Improving of the relevance of the engineering education in Latin America) financed by the European Union, within the ALFA III program. The aim of the project is to develop the engineering education in Latin America by transfer of educational methods between universities. When the University of Borås accepted the task of giving a course about Learning Management Systems (LMS) to lecturers I Latin America the 15 ECTS-credits course *Adaption of Engineering Education to the use of net independent software* was designed and registered at the School of Engineering, University of Borås.

At the University of Borås a lot of attention is given to the concept science for the professions. To comply with this the course was planned with special attention to the relevance for lecturers in engineering education in developing countries. It meant that all methods should be economically feasible in the long run. It was also desirable to raise the participants' awareness about free internet resources and new, flexible pedagogical methods.

II. COURSE DESIGN

The course used Problem Based Learning (PBL) [1] with the main assignment for each participant to select a course from their practice and adapt the course material to the LMS Moodle, to add new instructional material and to make plans for the appropriate use of discussion boards, grade book etc.
To enable the participants to work without internet access the material that was needed in the process was downloaded and copied to 4 GB USB-memory sticks. Instructional videos and texts, *Moodle, Sumatra PDF, VLC media player, LyX, HotPotatoes 6, AbiWord, MoWeS, Portable II* and *OpenOffice* can be downloaded from the internet and are free to use in public education.

The special method

All programs were executed directly from the USB memory, allowing everyone to try out different settings and modifications in their own copy of the LMS. Throughout the course everyone had their own USB-memory and a headset, the idea was that no one should be dependent on access to internet, or access to a particular computer. Whenever a computer was available the participant could log in and run the LMS from the USB-memory and work on the assignments or study the instructional material. Between sessions all work was saved in the USB memory.

Course aims

1. After the course the participants should understand what a LMS are and be able to use and adapt the common tools in a LMS to design and implement virtual education/courses.
2. They should have an understanding about how ICTs can be used in higher education and how access to ICTs will affect methodology and pedagogy.
3. They should understand the standards for E-learning [2].
4. Exercises and a project intended to give practical experience in the handling of a LMS should be completed.

Apart from the explicit course aims above there were some additional intentions. The participants should be prepared, in their turn, to give the course to their colleagues and act as pioneers at their workplaces in the use of Open Educational Resources (OER) [3, 4]. It means that they need a positive attitude to the use of LMS and OER, together with a confidence in their own ability to handle the LMS.

III. IMPLEMENTATION OF THE COURSE AND THE SURVEY

The course was given in two parts, an introduction with the participants gathered on campus for two weeks followed by approximately three months of distance education, in total corresponding to 15 ECTS points or ten weeks of full time studies. The first time the course started was on Cuba in Mars 2010. The participants were lecturers at the Instituto Superior Politécnico José Antonio Echeverría, Facultad de Ingeniería Eléctrica, Havana, Cuba. The second time was in May 2010 when the course was given at Centro Universitario de Occidente – Universidad de San Carlos. CUNOC-USAC. Guatemala, Quetzaltenango.

All instructional material and software at both these occasions were the same and the same assignments were given to the participants. In Guatemala the internet access was good and all participants had laptop computers. It would have been possible to access all instructional material directly on the internet, only providing links, but during this course the material was accessed from the USB memory. By the end of the two weeks introduction a similar anonymously filled out questionnaire was used as a part of the course evaluation process. Some of the responses are shown in table 1. The group on Cuba also answered one questionnaire about LMS and one about OER. In Guatemala a single questionnaire with statements about LMS and OER was used, the responses are shown in table 1, in this document. Two statements about the method of running programs directly from the USB memory was added for the group in Guatemala, responses are shown in table 1. In all questionnaires the participants responded to statements on a five grade scale: 1= I fully agree, 2= I agree, 3= Neutral, 4= I disagree, 5= I strongly disagree. All questionnaires were in Spanish, the translations of the tables are made by the authors. In addition to the responses to the statements in the questionnaires the participants answered a few open ended questions and participated in discussions with the first author of this paper.

IV. RESULTS AND OBSERVATIONS

The participants' opinions about the course and the use of LMS and OER were investigated with questionnaires and discussions with the first author of this paper. In the questionnaires a number of statements were assessed on a five grade scale; 1= I fully agree, 2= I agree, 3= Neutral, 4= I disagree, 5= I strongly disagree. When the course was given in Guatemala two statements about the use of USB memories in the course were added to the questionnaires. The responses are shown in table 1.

Table 1. Responses to statements

Statements about the course	1	2	3	4	5
1.The course fulfilled my expectations					
Cuba (N=15)	15				
Guatemala (N=21)	12	9			
2.Videos and other materials were well suited to the course objectives					
Cuba (N=15)	15				
Guatemala (N=21)	16	4	1		
3.There was a high level of cooperation and interaction amongst the participants					
Cuba (N=15)	14	1			
Guatemala (N=21)	6	14	1		

Statements about the course	1	2	3	4	5
4.The course objectives agree with the material covered in class					
Cuba (N=15)	15				
Guatemala (N=21)	16	5			
Statements about OER	**1**	**2**	**3**	**4**	**5**
5. I believe the use of the free course material on the Internet (freeware) offers great opportunities for increasing the quality of higher education.					
Cuba (N=15)	12	3			
Guatemala (N=21)	14	6	1		
6. I am willing to make lot of my course material available as freeware on the Internet.					
Cuba (N=15)	13	2			
Guatemala (N=21)	11	9	1		
Statements about LMS	**1**	**2**	**3**	**4**	**5**
7. A LMS can facilitate the work of the lecturers to a large extent.					
Cuba (N=15)	12	3			
Guatemala (N=21)	10	11			
8. A LMS can increase the performance of the students at my institution.					
Cuba (N=15)	9	6			
Guatemala (N=21)	16	5			
Statements about the use of USB memory	**1**	**2**	**3**	**4**	**5**
9. The ability to run programs from a flash memory significantly improved the learning experience.					
Guatemala (N=21)	17	4			
10. The use of a USB memory to emulate the resources of the Internet makes it much more feasible to use open educational resources (OER).					
Guatemala (N=21)	14	7			

1= I fully agree, 2= I agree, 3= Neutral, 4= I disagree,

5= I strongly disagree

Summation

Most participants were very positive about the pedagogical and methodological approach used in the course. They agree that a LMS can be very useful in their future practice and that the use of OER can be highly beneficial to the education process. The participants' high appreciation of the course together with their positive attitudes about OER and the use of LMS strongly indicates that they are well prepared to increase the use of ICT in their work. They appear to be ready to use OER by the same method that was used in this course, with a USB memory and a LMS to organise the material. The method of running the LMS from a USB memory was highly appreciated. Altogether the methodological and pedagogical approach was successful and served well as an example of PBL.

V. DISCUSSION

The positive assessments for the course probably were due to the close connection between design and content. The course structure immediately demonstrated how to use a LMS to utilize OER in a way lecturers should be able to integrate in their work.

There is plenty of high quality educational material available on the internet and the use of OER can contribute to make education available for more people [5, 6]. To use OER in education means a change in the educators´ practice. It takes an effort to change practice, and the attitude of the involved people is very important for a change to be successful [7].

We concur to the view of knowledge as something constructed from information, experience and reflection, known as constructivism or constructionism [8, 9]. From that perspective it is desirable that courses about computer programs is facilitated by the opportunity to try out the programs with as little restrictions as possible. Even if people will only have limited access when the programs are in use at an institution, it is desirable to have full access to copies of the programs during the education. Executing copies of programs from an USB memory allows a lot of experimentation and testing that is otherwise prohibited by restricted access to servers and network. It means that the method described in this paper can contribute significantly to the learning process, not only in developing countries with limited access to computers and internet, but also when the students have free access to computers and internet.

VI. CONCLUSIONS

To use USB memories and OER is a highly feasible alternative to the use of textbooks in many courses. The use of USB memories give a lot of flexibility, it is possible to work at any time on any available computer. With a LMS it is easy to organize instructional material from the internet and for teachers it is a very convenient way to utilize OER. In courses about computer programs, the possibility to work on copies of programs can add significantly to the learning experience.

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