EVALUATION METHODS OF A DISTANCE LEARNING SYSTEM IN ENGINEERING EDUCATION

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Abstract: This paper presents an educational network used for engineering education. The educational network is located in the Maghrebian countries (Morocco, Algeria, Tunisia) and is based on remote laboratories and on e-learning format courses. Development of this education system is the main objective of aproject carried out under European Commission funded Tempus framework, four European and three Maghrebian countries being involved. This paper presents the project and the proposed evaluation methods which can be applied on such kind of teaching units. The evaluation process has two main parts and it is done in two phases. This paper focuses on technical evaluation strategies.

Keywords: technical evaluation, distance learning, educational network, engineering education

Introduction

Today's engineers must deal with continual technological and organizational changes in the workplace, with the commercial realities of industrial practice in the modern world. Engineering programs are now required to demonstrate that their graduates are achieving a set of specified learning outcomes, and the means of demonstrating this is left to each university to decide and implement. There are also some requirements in each country for increased management education, design education and industry relevance of programs. Starting from these considerations, an international educational network which can assure access to high-performance measuring units, to real, but remote labs and to e-learning format teaching units, is very useful.

This paper presents an educational network dedicated for engineering education. This educational network based on remote laboratories and on e-learning format courses is located in the Maghrebian countries (Morocco, Algeria and Tunisia) and it is carried out within the framework of the European Tempus project called "eSience". In past few years, these countries showed a growing interest for engineering education, they made serious investments in every field of engineering, so the formation of specialists became an important task for them. As an example of this, Algeria adopted in 2004 the three cycle system educational model following the Bologna process, through this the Algerian higher education has made major changes related to the relationship with socio-economic environment. In these countries many measures have been taken to develop emerging technologies, resulting in a significant growth for the electric and electronics industry [4]. The development strategy of university education in the Maghrebian countries allows the creation of a new generation of well-prepared graduates able to adapt to a changing global context.

This project tries to offer a response to this challenge, through increasing the capacity to train students in institutions of higher education in these countries offering an innovative pedagogical approach, integrating eLearning and remote laboratories. This project created a network of Maghrebian universities that allow through their skills to build, maintain and disseminate new training and provide efficient complements to existing training solutions [5].

To strengthen the training of engineers and technicians with innovative and accessible pedagogy, the governments of these countries made available to academic institutions, facilities for distance education. Morocco, Tunisia and Algeria are involved in this TEMPUS framework driven project, titled eScience, with the aim to create a network of remote labs whose goal is the sharing of high performance instrumentation and the development of e-learning format teaching units which will train a larger number of technicians and engineers.

This paper is organized as follows: in the next section it describes the eSIENCE project as a partnership with its specific objectives; afterwards it presents the proposed evaluation strategy, the first results and specific steps for further work

The eSIENCE project

The eSIENCE (rESeau maghrébIn de laboratoirEs à distaNCE) project is based on a consortium formed by four European and three Maghrebian countries [2]. Four European universities (Bordeaux, Villach, Thessaloniki and "Petru-Maior" University of Tirgu-Mures) joined their competences in order to create the educational network, along with the three or four partner from each of the Maghrebian countries (universities, companies). The 16 partners are presented in the table below:

Table 1. eSCIENCE partner institutions

Nr	Partner Institution	Country
1	University Bordeaux	France
2	Fachhochschule Kärnten	Austria
3	IAOE: International Association of Online	Austria
4	Engineering	Greece
5	University Thessaloniki	Roman
6	University Petru-Maior	ia
7	University HASSAN I Settat	Moroc
8	University HASSAN II Mohammedia –	co
9	Casablanca	Moroc
10	Bureau Maghreb de l'Agence Universitaire de la	co
11	Francophonie	Moroc
12	Cluster Electronique, Mécatronique et	co
13	Mécanique du Maroc	Moroc
14	InstitutSupérieurd'Electronique et de	co
15	Communication de Sfax	Tunisia
16	University Virtuelle de Tunis	Tunisia
	InstitutSupérieur des SystèmesIndustriels de	Tunisia
	Gabès	Tunisia
	Société de gestion de la technopôle de Sfax	Algeria
	University Mentouri Constantine	Algeria

	University de BordjBouArreridj, ALCOMSYS	Algeria

University of Bordeaux is the coordinator of this project, the specialists from Fachhochschule Kärnten and International Association of Online Engineering has the necessary experience to build and use remote labs based educational network. The pedagogical evaluation is carried out by Aristotle University of Thessaloniki and the technical evaluation is made by "Petru Maior" University of Tg Mures, Romania. The European institutes involved in this project have already experience in the field of engineering distance education; moreover earlier they worked together on such kind of projects. Also, important efforts are made to integrate these learning units into a learning management system (LMS) in order to be accepted by the Bologna educational system [1]. The geographical positioning of the partner countries is shown on figure 1.

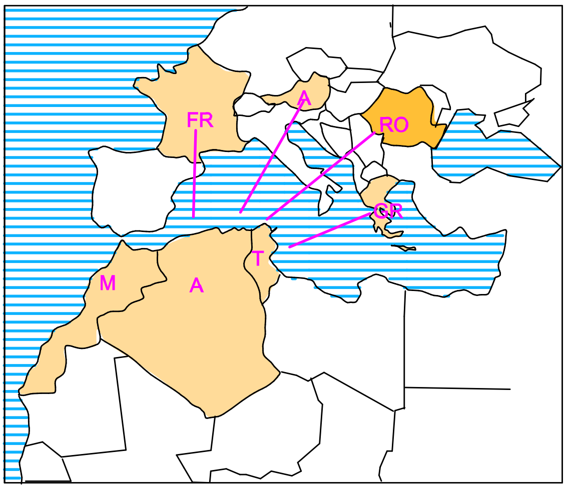

Figure 1. The geographical positioning of the partner countries

Evaluation

According to ISO/IEC 25010:2011 International Standard (System and Software Engineering-systems and Software Quality Requirements and Evaluation (SQuaRE)-System and Software Quality Models), the technical evaluation can be performed through measuring the functional suitability of remote labs [3]. This has three components, which are: functional completeness, functional correctness and functional appropriateness. These parameters can offer a global view about the technical state end function of remote labs. The proposed technical evaluation method tries to explain every one of these parameters and to express them by mathematical relationships in order to have a general purpose evaluating instrument for all remote labs.

According to SQuaRE, the functional suitability is defined as the degree to which a product or system provides functions that meet stated and implied needs when used under specified conditions. The functional suitability has three major parameters: the functional completeness, the functional correctness and the functional appropriateness.

All these can be expressed by multiple measured parameters, the proposed evaluation strategy uses the structure shown in Figure 2.

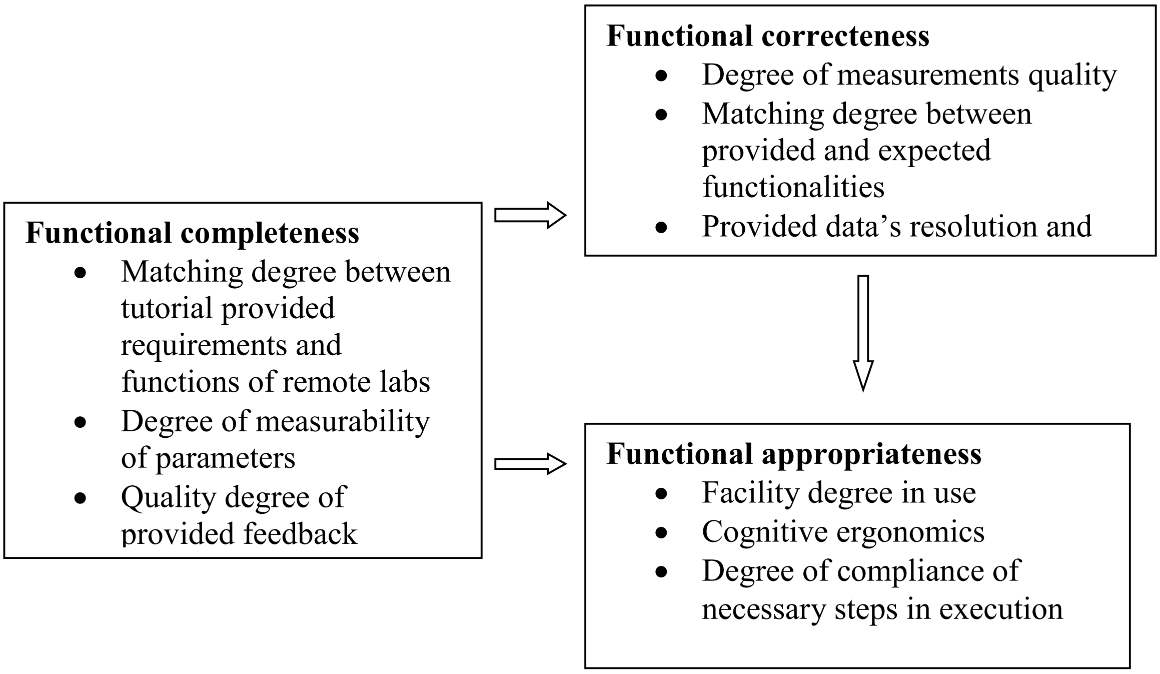

Figure 2. Evaluation strategy

The functional completeness is defined as the degree to which the set of functions covers all the specified tasks and user objectives and is expressed through three parameters. One of these is the matching degree between tutorial provided requirements/specifications and functions of remote lab, meaning how the remote labs satisfy the tutorial provided requirements, the second is the degree of measurability of parameters (tools and instruments), meaning how the parameters can be measured on user interface (UI) and compared with the digital instruments' values and the third is the quality degree of data visualization and audio and video feedback.

The functional correctness is defined as the degree to which a product or system provides the correct results with the needed degree of precision. To evaluate this three parameters are used, the degree of measurement accuracy, meaning the resolution of displayed (on UI) and measured (measuring instruments) values, graphics and other parameters, expressed in percentage as the difference between UI and measuring devices related to the resolution of measurements, the quality and resolution of graphics, the matching degree between provided and expected functionalities, and the provided data's resolution and format, expressed in percentage of provided data's resolution and format.

The functional appropriateness is the degree to which the functions facilitate the accomplishment of specified tasks and objectives and is carried through by facility degree in use, meaning usability, user-interaction, expressed by degree in percentage of message's clarity, of provided tutorials correspondence , by cognitive ergonomics (autonomy), meaning if the tutorial and user interface can cover the created topics, quantified in percentage of cognitive ergonomics and by degree of compliance of/with necessary steps in execution, meaning the pragmatism of execution (avoiding unnecessary steps).

Table 2. Evaluation parameters template

	Technical evaluation report (synthesis table)		[%]
	title		
functional completeness			
1	matching degree between tutorial provided requirements and functions of remote lab	***NPRS*100/NPF***	
2	degree of measurability of parameters	***DMP=mean(DMPUI, DMPDI)***	
3	quality degree of provided feedback	***QD (Quality Degree) = mean(QD_{AF}, QD_{VF}, mean(QD_{DVF_UI}, QD_{DVF_DI}))***	
	audio feedback		
	video feedback		
	data visualization feedbacks		
	Total functional completeness [%]		
functional correctness			
	degree of measurement accuracy	***percentage***	
	matching degree between provided and expected functionalities	***[(1-(nr of missfunctionalities/nr of total functionalities)]*100***	
	provided data's resolution and format	***percentage***	
	Total functional correctness [%]		
functional appropriateness			
	facility degree in use	***percentage***	
	cognitive ergonomics (autonomy)	***percentage***	
	degree of compliance of/with necessary steps in execution	***[(1-(nr of unnecessary steps/ total nr of steps)]*100 [%]***	
	Total functional appropriateness [%]		
	Functional suitability *[%]*		

After the technical evaluation which is a small scale supervising over functional suitability, a large scale pedagogical evaluation will be performed. This will focus on usability of remote labs; learners' attitude towards remote labs; evaluation of the e-learning content; and assessment learning outcome [2].

Conclusions

The implemented educational network can enrich the teaching and learning strategies or culture in engineering education programs and helps them to become more student-centred, encouraging individual work, offering solutions for both, problem-based and project-based learning. The presented evaluation methods can emphasize the most important tasks from technical and pedagogical point of view, offering a general but measurable view of the present situation. The project is still under development, other important results are expected to emerge until the end of projects period.

Acknowledgements

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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