



The Role of Virtual Lab in Professional Training for Pre-Service Biology Teachers and Engineers Student

Asya Asenova¹, Kameliya Yotovska², Vladislav Slavov³

^{1,2} Department of Biology education, Sofia University "St. Kliment Ohridski"; ³ Department of Electrical Measurements, Technical University of Sofia (Bulgaria)

asya_asenova@yahoo.com, kami_yotovska@abv.bg, vladi_s@abv.bg

Abstract

Virtual laboratory occasionally replaces traditional classrooms due to rapid advances in computer technologies. The Virtual Lab is an interactive environment for education including creating and conducting simulated experiments for engineers: a playground for experimentation. It consists of simulation programs, experimental moduls, different tools that operate on objects. This paper presents possibilities of virtuallab in the development of professional knowledge and skills of student-pre-service biology teacher and engineers in Sofia University "St. Kliment Ohridski" and Technical University of Sofia. These article present results of the data analysis for educational potential of Virtual lab in professional university training. This paper describes an experiment conducted to compare a virtual lab application and traditional environmental in professional training in university.

1. Introduction

One of the main goals of the EU growth strategy "Europe 2020" is to use actively the opportunities that the modern technologies offer for improving the quality of learning. In response to the e-Europe initiative in recent years the number of virtual learning environments significantly increases. Some of the main task of these environments is to increasing learners' motivation and individualization of the learning process, as well as for the development of practical and professional skills.

The virtual laboratories are one of the latest developments in the modern education. A virtual laboratory can be defined as an environment in which experiments are conducted or controlled partly or wholly through computer operation, simulation, and/or animation either locally or remotely via the internet. With regard to the computer animation type of virtual laboratory, the experiment is often a graphical model of the actual experiment.

The advantages of the virtual laboratories are well known. Their development has started in the last decade of the 20th century and has increased rapidly with the production of cheaper and faster powerful computers as well as the development of the web technologies. Their main task to solve the three resource type problems related to time, space and saving money has enhanced lots of scientists to put efforts in the evolution of the basic idea – global access to laboratory equipment anytime. From simulations to real experiments the virtual laboratories has been named after remote laboratories, web-based laboratories, computer based laboratories and so on. But no matter the name one fact is indisputable - the advantages that come from their development. As far as it concerns the education the virtual laboratories can improve significantly the accessibility of the knowledge since they offer modern methods bounded by a strong platform that user orientated and aims only to facilitate.

2. Development of the virtual labs in ELFE

The implementation of the virtual laboratories concept in the professional university education is not an easy task though. The connection between the laboratory exercises and the theoretical knowledge (lectures) is very important in the both engineering and science disciplines. And as long as we can say that the transfer of theoretical knowledge using contemporary approaches as e-learning and m-learning has improved significantly in the past few years, the virtual labs' implementation in the higher



education (especially in the professional training for pre-service biology teachers and engineers student) makes small steps [1].

Under a development project ELFE decided to implement a few virtual labs into the educational process. The expectations are to facilitate the students (Pre-service Biology Teachers and Engineers Student) in accepting the educational material with extra possibilities to execute their laboratory work remotely – from their home computers instead of visiting the “real” labs. This first trial for ELFE of implementation the virtual laboratory concept in the real professional education is supposed to lead to further “stronger” and stable development of the educational process supplying the students with more options to do their duties – remote study (distant education) [4]. As it can be seen the problem is that the easiest thing does not seem to happen so easy. To translate that question it can be asked other way – how not to make the students to try something new but the new to attract them to try? The development of the virtual labs in ELFE can be divided into 6 stages (fig 1):

1. Choosing appropriate laboratory exercises to be virtualized.
- 2 Choosing appropriate software for virtualization
- 3 Virtualization of the laboratory exercise
- 4 Improving of the interface
- 5 Producing manual to lead the students through the execution
- 6 Feedback

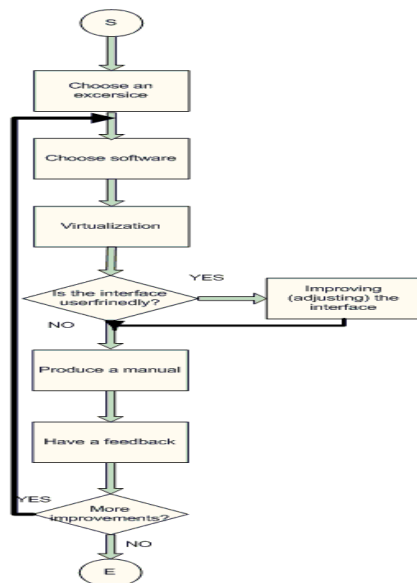


Fig 1.

From simulations to real experiments the virtual laboratories has been named after remote laboratories, web-based laboratories, computer based laboratories and so on. But no matter the name one fact is indisputable - the advantages that come from their development. As far as it concerns the education the virtual laboratories can improve significantly the accessibility of the knowledge since they offer modern methods bounded by a strong platform that user orientated and aims only to facilitate. Implementation of virtual lab in professional education is not so easy because is necessary to use cheap components to build such a laboratory together with “tuning” of the teaching staff to use this “not traditional” resource of education. The big question and the most important factor is how the students will accept the idea. Is it really easier for them or since they do not have an experience working that way they will prefer to keep on the status quo? To answer questions concerning the



advantages and disadvantages of virtual laboratories in different educational context, we conducted a survey among the target groups- pre-service biology teachers and engineers student.

3. Research methodology

The current study investigated pre-service biology student's and engineer student's perception and experience on the virtual laboratories in different educational context. The study was conducted at the end of the semester and academic year 2013/2014 in both Sofia University "St. Kliment Ohridski" and Technical University of Sofia. The data to inform the study were collected from 83 student: 45 were pre-service biology students and 38 engineer students. Of these 83 were third years of education in university. In this case study, a system which allows students to conduct simulated laboratory experiments with the use of laptops has been researched and developed. Students can conduct remote virtual experiments at any time by a local machine or by a remote machine via the internet. The system has been set up for students on the Laboratory Training module, as a part of the Educational management course, Applied physiology for biology teachers, Virtual instrumentation for measurement of electrical quantities course and Informational measurement system course.

The questionnaire was focused on the usability of the virtual lab, the frequency of its use, the attitude towards its use in the education process and its advantages and disadvantages with regards to education. A survey questionnaire with both closed and open-ended questions was designed and data was collected in order to investigate student perceptions of their experiences of virtual laboratories in this case study.

The data to inform this study were collected using a questionnaire of 23 items with both open and closed ended questions. The questionnaire consists of three sections:

- 1) Categorization – this section is necessary to categorize the target group on certain criteria.
- 2) Estimation - This section aims to assess the quality of training in the virtual laboratory system of signs. Responses are required.
- 3) Improvement – the section is designed based on comments and recommendations of the students to improve the quality of education in the virtual laboratory.

Part one of the questionnaire comprised of three closed ended items that inquired demographic characteristics of respondents. Part two had thirteen items that asked participants about their perception and opinion towards virtual lab. For this purpose we using a 5-point Likert scale where scores of 1–5 were used to indicate levels of agreement with the statements (ranging from 1- Totally Disagree, to 5- Strongly Agree). Part three had open ended questions generally required respondents to provide some recommendations and other comments to improving the quality of education in the virtual laboratory.

The findings from table 1 indicate that more than half of the students agreed that Virtual Lab is effective and helped them to improved their learning activity and increase there motivation for learning. In addition, in the open ended part of the questionnaire respondents were required to indicate some advantage and disadvantage of VL and also to provide opinion on the recommendations for improving the quality of education in the virtual laboratory.

Table 1: Students experience and perception towards Virtual Lab

Statements	Agree	Undecided	Disagree
	%	%	%
1. Easy to operate with tools in VL.	62	25	13
2. Easy to understand learning material and experiments in VL.	53	37	10
3. Flexible to use in relation to time and place.	70	25	5
4. Stimulating learning motivation and creativity.	87	6	7
	79	13	8



5. Satisfying of learning activities.	68	74	6
6. I learn and understand more in a virtual lab environment than a traditional lab.			
7. I can use virtual laboratory (over the Internet) instead of physically staying in a laboratory.	90	7	3
	89	7	4
8. Learning activities and virtual forms of education encourage active learning.	73	17	10
	92	5	3
9. Learning tasks and instructions to them is clearly and specifically defined.	74	11	15
10. Opportunity to use virtual laboratory at any time and anywhere.	84	6	10
11. Allows more opportunities to practice experiments.	88	3	9
12. Provides a safe workshop environment without the need for supervision.	82	11	7
13. Enhances my enthusiasm for learning through interactivity.	54	21	25
14. Increase my motivation for learning.			
15. Increase my IT literacy.	92	5	3
16. There is a permanent feedback from the teacher	58	27	15
17. Training in the virtual lab saves time and cost of laboratory equipment.	69	21	10
	92	4	4
18. Learning process is individualized and consistent with my educational needs.	85	9	6

Based on their responses we summarize some advantages of VL as follow: virtual labs allow students to repeat demonstrations that they do not understand or as a review for exams, also maximizing time and space flexibilities, enhancing students' enthusiasm for learning through interactivity, improving time efficiency, simplifying complex procedures so that more complicated workshops can be conducted, offering a safe workshop environment, and enabling a convenient platform for student assessments. Some curriculum incorporate operating instructions for lab equipment similar to what students would see in a lab manual. Students can practice using equipment in virtual realm before wasting resources with operational mistakes. Virtual Laboratory experiences reinforce critical thinking skills and understanding of the scientific method. Non-traditional, technology-based exercises enrich the laboratory learning experience and increase student interest and satisfaction.

However, virtual labs have some disadvantages indicate from student as: work in VL can be frustrating for students who lack conceptual understanding of science subject; discourage students from becoming familiar with physical instruments and real devices. In relation to the transferable skills such as team-work and communication skills which can often be found and delivered in traditional laboratory training, the remote access features in virtual laboratory training could discourage direct collaboration and interaction.

Conclusions

This article indicates the beginning of implementation of the virtual laboratories in the educational process in two very different areas. It shows that the practical implementation can cause some advantages as well some disadvantages during the education. It is indisputable, though, that the future developments will lead to more and more sustainable implementation of the virtual laboratories even in the engineering education where the practical training takes important part in the process.



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