

## A Framework of Management System Design for Programming Virtual Laboratory

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### **Abstract:**

*Virtual Laboratories in a Virtual Learning Environment are necessary spaces for developing practical activities. In this paper a framework for designing the virtual lab management system will be presented. Technological, pedagogical and human resources are included in the Virtual Laboratories Framework. The proposed Framework has been applied to different computer areas and this paper focuses on the Virtual Programming Laboratory. Its effectiveness has been evaluated by the Teachers laboratory using a questionnaire. The results show, Teachers assess the resources were well, between 53.3 and 83.3 of Teachers considered them to be important or vital Resource. All the mean values were greater than 3.9.*

**Keywords:** Virtual Laboratory, Virtual Programming Laboratory, Virtual Learning Environment, PayameNoor

### **1- Introduction**

In the past, internet only use to search information or to access other people, but today the network technology it can be used in training and education. In this context it can be used in experiments levels testing methods for research and education applications that include virtual labs (Fatemeh Hoseini Daadmarzi, Shahnaz Bahmanyar, 2008).

Virtual Laboratories in a Virtual Learning Environment are necessary spaces for developing practical activities. Technological, pedagogical and human resources are included in the Virtual Laboratories. Therefore, Students select the experiments to do (Soheile Ganjefar, 2009; Josep Prieto-Blazquez·Ivan Garcia-Tora·Jordi Herrera-Joancomarti and Ana-Elena Guerrero-Roldan, 2009). Quick and continuous developments in information and Communication technologies, together with cultural changes, have increased the consciousness and demand for distance learning that would allow the students to access their courses at anytime and anywhere.

Virtual Distance Learning and Blended Distance Learning are two modalities of distance education that make an intensive use of information and communication technologies through Internet, where asynchronous communication is allowed in space and in time between the students

and the academic staff. Thus, students will have maximum flexibility to adapt their studies to own rhythm.

According to *computer curricula 2005*, practical laboratory activities are an essential part of any computer curriculum since they amplify the concepts of course lectures. Hence, new virtual spaces are required in a Virtual University to increase practical activities impact. Such spaces are called Virtual Laboratories (Josep Prieto-Blazquez, Ivan Garcia-Tora, Jordi Herrera-Joancomarti and Ana-Elena Guerrero-Roldan, 2008; Josep Prieto-Blazquez, Ivan Garcia-Tora, Jordi Herrera-Joancomarti and Ana-Elena Guerrero-Roldan, 2009).

The term VLab is defined in different ways in the Literature:

- - A local computer host that includes some simulation capabilities (K. Chiu, 1999).
- Virtual laboratory allow students to design and perform their own simulation experiments (Carla Martin, Rocio Muñoz, Alfonso Urquia and Sebastian Dormido, 2004).
- virtual lab each experiment is simulated by using software (e.g. Lab VIEW, MATLAB, ORCAD) (Michael E. Auer, 2002).

In this paper Virtual Laboratory (VLab) defines as:

«an interactive virtual space that incorporates the technological, pedagogic and human resources for carrying out practical activities, adapted to the needs of the students and teachers in a virtual learning environment.» (Josep Prieto-Blazquez, Ivan Garcia-Tora, Jordi Herrera-Joancomarti and Ana-Elena Guerrero-Roldan, 2008).

## **2- Virtual Laboratory features**

### **2-1. Easy accessibility**

The internet use, allow the students just with an internet connection and web browser to access virtual laboratory at anytime and anywhere. Results can be download online and used for conclusion.

### **2-2. Easy to use**

Virtual Lab allows students to be interactive experiments to do that it can be a useful way to teach. Different students can be working together. Easy communication between different sciences and geography and time constraints it would not be raised. Various scientists in different locations can work together as if in a real lab.

### **2-3. Easy to Learn**

A student without a specific programming language to learn only the knowledge of working with familiar Web (e-mail, search the Internet and search engines) can do your own experiments<sup>1</sup>. While digital guide is also intended (Aaron D'Souza, Jeff Rickel, Bruno Herreros and W. Lewis Johnson, 2001).

## **3- Virtual laboratory Resources**

Resources in a virtual laboratory can be classified in 3 categories:

- Technological Resource
- Pedagogic and Strategic Resource
- Human Resource

Each resource has some specifics that is described in next section. .

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<sup>1</sup> . [www.virtlab.com](http://www.virtlab.com)

### 3-1. Technological Resource

- Virtual Communication Environment
- Simulator
- Virtual Machine
- Automatic Assessment Tools
- Maintenance Software

#### - Virtual Communication Environment (VCE)

The virtual communication environment is a resource that allows communication between the users of the virtual laboratory: students and teachers.

Virtual communication environments can be implemented using shared mailboxes, public forums and a teacher's board from different applications, e.g.: *Blackboard*, *BSCW*, *WebCT*.

#### - Simulator (SIM)

A simulator is a tool that imitates experiments, states or processes. One of the main features of simulators is their interactive capability. Interactive simulations are quickly gaining importance to explore, comprehend and communicate complex ideas. Interactive simulators can be implemented using a combination of computers, high-resolution graphics, simulation programming languages, and Internet connection.

#### - Virtual Machine (VRM)

A virtual machine lets users create separate environments, each of which emulates the hardware of a complete physical computer. Students and teachers can run multiple operating systems at once on a single physical computer and switch between them. Virtual machines can be found implemented in different software solutions. The most important ones are *VMWARE*, *Xen virtual machine monitor*, and *Microsoft Virtual PC*.

#### - Automatic Assessments Tool (AAT)

The automatic assessment tool enables interactive processes to take place between students and the automatic assessment system that allows students to repeat and learn about iteration processes. Besides, the automatic system reduces the teacher's activities, allowing them to concentrate on other more beneficial aspects.

Essentially, the automatic assessment process consists of the compilation and execution against test data and user-specified data (benchmark). There are two different kinds of benchmarks: public and private. In the public tests, the input and output test data are known to the students, while for private benchmarks, these data are not publicly available. However, the automatic assessment tool provides to the students a report with the results of both private and public tests.

The automatic assessment tool also provides all test reports of the students.

### 3-2. Pedagogic and Strategic Resource

- Learning Methodology
- Test and Evolution
- Documentation and Maintenance Software

#### - Learning Methodology (MET)

Several changes in learning methodology have been required, moving away from a teacher-lecture-centred environment to a student-centred one. Practical activities require a specific learning methodology where the student is the central element of this educational model. Student-centred models must give students enough freedom to take advantage of the support offered, to plan their learning process and to regulate their own working rate, guaranteeing a dynamic learning experience for each student.

#### - Evolution (AVA)

The evaluation is a pedagogical resource that allows the students to achieve their learning objectives. In a VLE, it is very important to offer students a flexible model of continuous evaluation, providing activities to be completed throughout the semester.

**- Support Documentation and Other Materials Student (DOC)**

Support documentation and other materials consist of all the information and software that will help students achieve the objectives of the practical activities.

**3-3. Human Resource**

- Teacher

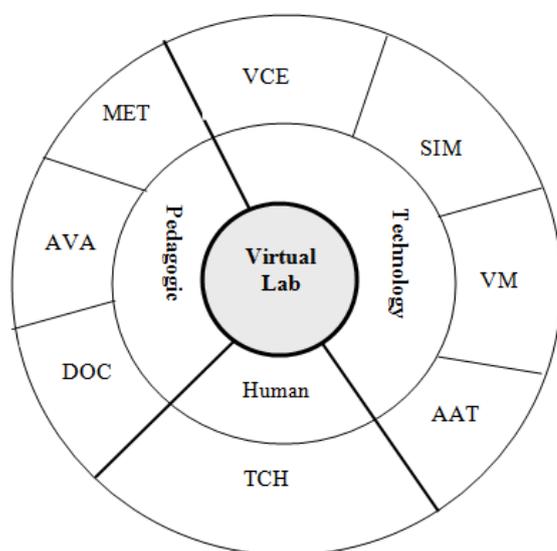
**- Teacher (TCH)**

“Virtual teachers” in a VLab are members of the academic staff who help students reach their individual objectives, offering each student personalized attention.

VLab teachers need specific skills. The most important is technological skill related to the tools used in the laboratory. Another aspect that impacts on the role of the teacher is the fact that the students are usually isolated in a VLE. Usually, they are alone at their homes. This means that education and guidance must be reinforced to guide, motivate, plan and be more proactive. On the other hand, VLabs need a team of teachers composed of at least two members of staff, each with different skill sets: one of them will need in-depth knowledge of the content related to the subject (the “Theory Teacher”), while the other will need more technical skills (“Lab Teacher”).

In the special case, “Teacher Lab” must be an expert in C programming language, who prepares the installation instructions and the C compiler FAQs. The “Theory Teacher” prepares the practical activities and the automatic assessments, and also resolves any questions related to programming contents in the virtual communication area.

In figure 1, the proposed Framework of virtual laboratory has been showed.



**Fig1.** The proposed Framework of Virtual Laboratory

**4- Evaluation the Proposal Framework**

A survey has performed with teacher of laboratories courses to evaluate the proposal framework. Statistical sample count is 30 which were selected randomly.

A Questionnaire included eight questions were designed to gather information. The aim of the review was:

- The amount of attention and use of resources by teachers;
- show the different Priority Resources in lab courses;

- Prioritize virtual laboratories resources;

Teachers were asked to score from 1 to 5 the relevance of each of the different resources of the programming virtual laboratories, as follows:

- 1- It is not a necessary resource
- 2- It is not an important resource
- 3- It is an interesting resource
- 4- It is an important resource
- 5- It is an indispensable or vital resource

The number of responders, the frequency of each value, the percentage of 4 or 5 value, the mean value, the standard deviation of the eight resources are summarized in Table 1.

A first analysis of the survey the results show that the teachers have been well evaluation of the resources. ., between 53.3% to 83.3% of teachers considered them to be important or vital Resource. All the mean values were greater than 3.9.

Secondly, in the descriptive and frequency analysis of the survey, results show a significant difference between a numbers of resources that can be classified, in order of relevance, in three groups:

• **Human factor:** the majority of teachers (83.3%) considered the *Teacher* as very important (option 4 or 5) in a VLE.

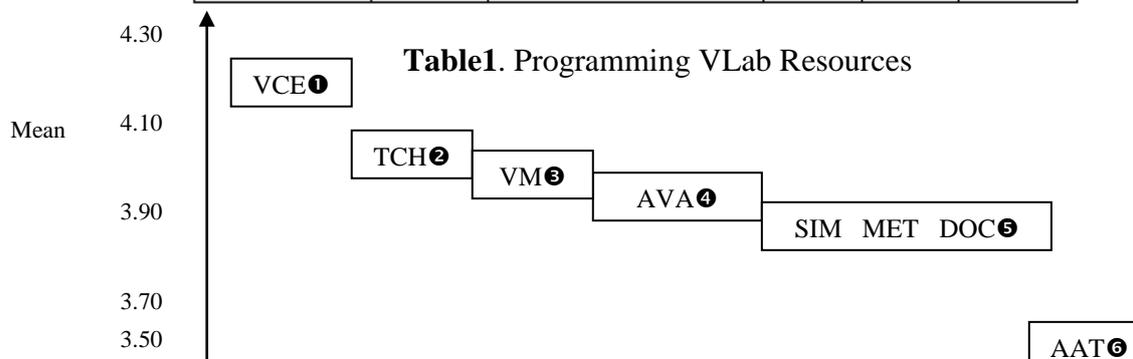
• **Pedagogic factor:** the *Evaluation* and the *Learning Methodology* were rated highly by teachers. These two resources are very important in the learning process of the students. Also, the results show that *Support Documentation and Other Materials* are a little less important in the learning process. This result is logical because the documentation and other materials are sometimes complementary.

• **Technological factor:** there is a group of tools connected to the technological resources – *Virtual Communication Environment, Automatic Assessment Tool, Simulator* and the *Virtual Machine* - that also achieved a very high score (figure 2).

It is important to note that the VCE is the highest technological resource graded. Although the VCE is classified as a technological resource, it is closely related to academic staff. In a VLE, the VCE is absolutely necessary to create a real feeling of university community and is the only way which the teachers can reach to students.

On conclusion, in order to learn programming in a VLE it is essential to have a VPLab composed of at least these eight resources and for these to be correctly integrated. Although technological resources were rated highly by the students, they appeared to place more important on pedagogical and human factors.

Resource	Number	1	2	3	4	5	4-5	Mean	S.d
VCE	30	1	2	4	7	16	76.6%	4.17	1.117
SIM	30	1	3	4	12	10	73.3%	3.90	1.094
VM	30	0	1	8	12	9	53.3%	3.97	0.850
AAT	30	2	7	9	4	8	56.6%	3.47	1.306
MET	30	0	2	7	13	8	70%	3.90	0.885
AVA	30	3	2	5	4	16	66.6%	3.93	1.388
DOC	30	0	1	9	12	8	66.6%	3.90	0.845
TCH	30	0	3	2	16	9	83.3%	4.03	0.890



## 5- Conclusion

Virtual Labs in Virtual University has special place. The results show, Teachers assess the resources were well.

This means that the proposed framework is suitable for programming courses. However, the results can classify resources as sources of technology, human and pedagogic was provided. Although technological factors are “enabling tools” for a virtual lab, teachers grant more importance to human factors and pedagogical factors.

These results may conclude that even in virtual lab, the teacher and their interaction with students through the communication environment is an essential resource to ensure the success of the learning process in a VLE.

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