PACIE Methodology Applied in Virtual Learning Environments to Support Learner Academic Performance

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Abstract: The Virtual Learning Environment (VLE) offers the students new opportunities for interaction and exchanging ideas and concepts, exploring virtual resources, fostering an active and dynamic learning, all these always supported by digital tools that allow academic improvement. This paper aims to present the experience obtained when implementing a VLE, designed according to the parameters of the PACIE methodology, as a strategy that permitted the utilization of Information and Communication Technology to increase performance in the learning process of undergraduate Engineering students at the National University of Chimborazo in Ecuador.

1 INTRODUCTION

According to The Internet Usage Statistics, the number of global Internet users estimated for June 2014 was 3,035,749,340; fact that leads to the question: Can we ignore the importance digital technologies and Internet have in our lives, especially in the educational field? The answer should be, not at all. However it is crucial to bear in mind that the main role of Information and Communication Technology (ICT), in this sense, is to improve the teaching and learning experience, not to substitute effective pedagogy (Barr, 2004).

The ICT use in the performance of University students is not exactly defined and there is not a specific conclusion about it from the last two decades, however it is possible to say that, ICT permits students to become the new center of the educational process, creating new opportunities to develop an additional academic experience. This achieved when being individually supported by the teacher, discovering the new information once they analyze the topics studied, having the chance to access the information every time they consider it necessary not being limited to face-to-face lessons in a physical class. Students can overcome the emotional barriers by being trained in online assessment, improve research skills, explore various virtual resources, and access to digital material in an asynchronous or synchronous way. Furthermore they can share experiences with other students regardless the place where each one is, explore the topics that are considered complicated, propose alternative uses of tools and/or topics (stimulating the creativity) in the virtual learning environment, and finally get involved in the globalized employment of ICT (Ben Youssef and Dahmani, 2010).

Student desertion is a major problem at University education, just to mention the alarming statistics in some countries such as Spain, United States, France and Austria where the rate of desertion ranges between 30% and 50%, while in Germany, the rate goes between 20% and 25%, Switzerland between 7% and 30 %, Finland 10% and Netherlands between 20% and 30% (Cruz Sosa et al., 2010). This phenomenon takes place mostly during the first semester of almost any major field. Due to this, many universities have determined the use of online software in order to guide the students administratively and academically (Edwards, Acosta, Santos, and García-Ruiz, 2006).

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By adopting learning virtual tools is possible to: change or enhance curriculum, work with a high quantity of students, the advantage of using online assessments and tasks, implement new strategies to improve student performance, keep a detailed record of every student's grades to eventually justify the academic student performance, direct on and offline communication with students, provide feedback of the academic process, giving less subjectivity to grade students without leaving student-teacher communication apart.

In Ecuador, particularly at the National University of Chimborazo (UNACH), it is fundamental to include methods, techniques and strategies that foster meaningful, collaborative and participative learning, encouraging students to become proactive and more involved in their own learning. In order to succeed in such purpose, it is indispensable to pose the design and implementation of a virtual learning classroom; making emphasis not only on technology to be employed, but also on transition methodologies that allow the improvement of learning techniques and methods.

Consequently, the aim of this paper is to present the experience obtained when implementing a virtual classroom, designed according to the parameters of the PACIE methodology, as a strategy that permitted the utilization of ICTs to improve student performance in the learning process. It is important to highlight that the elaboration of this project is supported by previous research and experiences shown by different authors (Gallo and Zavalía, 2012; Ruiz, 2012); as well as from our own training to become "Experts in e-learning processes" achieved at the Latin American Foundation for Technological Advancement (FATLA, 2010).

The second section briefly describes the PACIE Methodology in Virtual Learning Environment, then the third one is dedicated to the Methods. The results and discussions are reported in the fourth section; and the conclusions close the paper.

2 PACIE METHODOLOGY IN VIRTUAL LEARNING ENVIRONMENT

2.1 Virtual Learning Environments

Virtual learning environment (VLE) means "a software system that combines a number of different tools that are used to systematically deliver content online and facilitate the learning experience around that content" (Thomas and Reinders, 2010). VLEs make communication and collaboration tools available, fostering the use of social software to enhance online interaction. These types of tools can be divided in two categories: simple environments like chat or forums, and complex virtual worlds which offer graphics, text and audio, and intercultural activities, among others (Thomas and Reinders, 2010).

It is worth pointing out that technology has made a great contribution to the shift of roles of students and teachers in learning due to the vast amount of resources that it provides, however, the success of the employ of technology will depend on both technical proficiency and pedagogical techniques that exploit technology's potential (Thomas and Reinders, 2010). On the other hand, Barr adds that no matter which approach to learning is adopted, a learning environment will facilitate it, yet the four main elements of a learning environment should be considered:

- Tools, which comprise any type of material that is utilized to aid learning.
- Resources, which are necessary to provide the learner with the material s/he needs to study, material that has to be relevant and meaningful to the specific situation.
- People, which refers to the users of the environment. Since the purpose of a learning environment is to facilitate learning, this will obviously require human participation. Since a learning environment has to do with the interaction between learners and teachers, it must be designed taking both groups into consideration, with the ultimate goal of being pedagogically beneficial to the learner.
- Environmental design, which refers to the infrastructure that will enable the distribution of information or resources if the objective is to make sure that all the aspects of the environment work together and appropriately (Barr, 2004).

It is likewise suggested that learning environments should be assessed to evaluate their effectiveness; a well-designed learning environment will provide both authentic learning and appropriate review, and one key element of reflection and analysis is student satisfaction which is related to academic fulfilment. If educators are successful in assessing the learning environment, then they will be able to search for alternatives and make accurate and effective modifications that will gradually improve education (Warger and Dobbin, 2009).

2.2 PACIE Methodology

The PACIE methodology was created by Pedro X. Camacho P., Engineer, MWA; founder and director of the Latin American Foundation for Technological Advancement (FATLA) and advisor to more than 270 institutions, educational programs and projects throughout the world, executive chairman of Virtual Group Corporation (Machado and Molina, 2014).

PACIE is a methodology that allows the use of ICT Networks, as support to the learning process and/or self-study, by enhancing the pedagogical scheme of real education. This methodology takes as key elements motivation and peer support, with the quality and human warmth, versus the quantity and indifference. In addition, communication and information exposure are supported by social processes that foster critical thinking and analysis of the data to build knowledge, through sharing previous experiences (Molina, 2012).

This methodology employs guidelines defined in a virtual campus and determined by a transition process of conventional and institutional classroom events. Moreover, the possibility of searching the Web in order to support the didactic tools utilized by the teacher is created (Molina, 2012).

PACIE comes from the Spanish acronyms that refer to the academic processes on which this methodology is based: Presence (**P**resencia), Scope (**A**lcance), Training (**C**apacitación), Interaction (**I**nteracción), and E-learning (**E**-learning).

The aspects that characterize the methodology proposed by Pedro Camacho are the following:

- Prioritize motivation, peer support, quality and human warmth, opposed to quantity and indifference.
- Include social processes to the communication and information presented to learners, which foster critical thinking and analysis of data, and permit to build knowledge from the interaction and the exchange of educational experiences.
- Go beyond presenting and exposing information; through guiding, interacting, sharing knowledge, and allowing creative learning spaces (Flores and Bravo, 2012).

The first phase of PACIE, Presence, refers to the visual impact of the Virtual Learning Environment, in which the following elements are highlighted: Corporate Image, Extension and Structure, Image and Animation and Colors.

Corporate Image: It is a definite element of differentiation and positioning of the virtual learning environment in relation to others. In the same way education must adapt to changes at a high speed, also teachers and their virtual learning environment must adapt their image in order to maintain its validity.

The corporate image is the way in which it communicates: who is it?, what is it?, what does it do? and how does it do it?.

Extension and Structure: Refers to the balance there must exist between the structure and relationships among menus or indexes, covers and content pages or any other graphics or linked documents. The objective is to build a hierarchy of menus and pages that look natural and well-structured for the user.

Image and Animation: It becomes difficult to get students motivated to be involved in the learning objects without considering the visual impact of lines, colors and their contrasts within the pages. Dense text documents without supportive images, animations or typographical variations are difficult to read, especially in low resolution displays.

Colors: Refer to the consistency and predictability of two essential attributes of any online information system, helping users to identify the origin and relationship of classroom resources.

The second phase of PACIE, refers to the internalization of competencies to be achieved by the network participants, considering the communication, information and support interaction (Flores and Bravo, 2012), as well as promoting reflection on a large number of questions related to institutional policies, the educative mission and vision. This phase comprises the Standards, Benchmarks, and Skills (SBS) to be developed in students through the Web.

The *Standards* refer to the learning students are expected to acquire. Generally, it is possible to have several standards for each unit or learning topic. The *Benchmarks* are useful to check whether the standard has been accomplished or not. It is also possible to have one or more marks for each standard; this will depend on what is to be measured -which normally has to do with theoretical / practical knowledge and values. The *Skills* refer to the abilities of the individual which make student every time more competent to solve a task.

At this stage, it is necessary to consider the academic, experimental and tutorial scopes to fulfill the SBS (Fig. 1).

The third stage of PACIE is the Training. This has direct concordance with the previous process, due to the sequence of the 3 transversal elements that are in PACIE: technological, pedagogical and communicational (Molina, 2012).

Through VLEs, self-learning strategies, the enrichment of complex knowledge are encouraged as

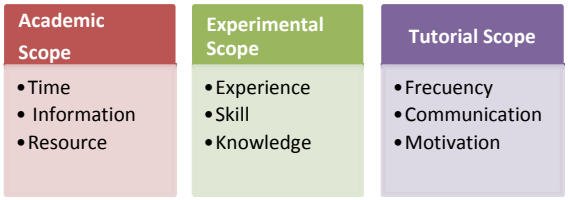

Figure 1: Expectation to be reached.

necessary to promote work and collaborative learning of the participants. Furthermore, the Cycle Design is emphasized by these stages: research, planning, creation and assessment, implementing Web 2.0 resources and tools, also stimulating the learning by doing, collaborative work, and continuous research. In addition, single and group tutorials are scheduled by using video conferences, chats, text messaging, among others (Flores and Bravo, 2012).

The fourth stage is Interaction, it is geared to produce suitable interplay processes in such a way that motivates the experiences that will generate knowledge and facilitate tutorial processes. The objectives to be pursued in this phase are: to foster constant communication within the VLE, motivate student online participation, encourage socialization among the students in the course, generate interactive VLEs by making use of resources such as videoconferencing, social bookmarking, slideshows, among others.

In this stage, the virtual classroom is divided in blocks: Zero or Informational Block, Academic block and Closing block, the same that in turn contain sections that pool the resources and/or activities in accordance with their functionality and usefulness. Each section must be varied in order to avoid monotony and boredom in the virtual classroom.

The Zero block (Fig. 2), is the most important part of the methodological process, because it is the core of the interaction within the Virtual classroom and the source of the cooperative knowledge generated as a result of a common and enriching experience for the group members.

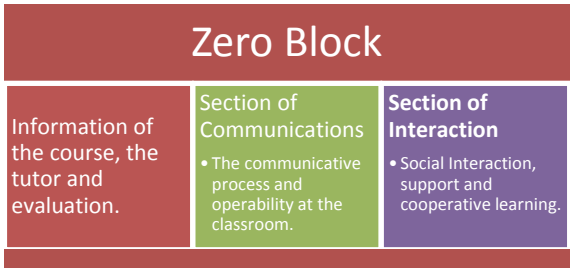

Figure 2: Informational block of virtual environment.

The Academic Block has information and subject content, documents to be shared, links and the thematic exhibition that is performed. This block contains four sections: Exposure, Bounce, Construction and Testing (Fig. 3).

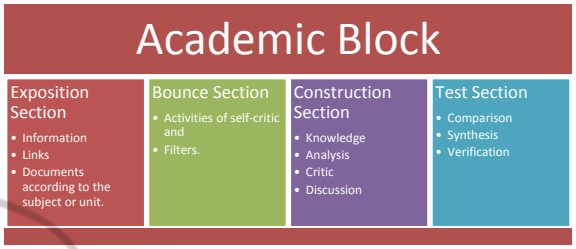

Figure 3: Academic block sections.

The Closing Block (block of closure) is intended to give assistance to conclude unfinished activities and processes, to negotiate disagreements in assessments, students' feedback not only for the content and structure of the classroom in itself, but for the tutorial part. It contains the negotiation and feedback section (Fig. 4).

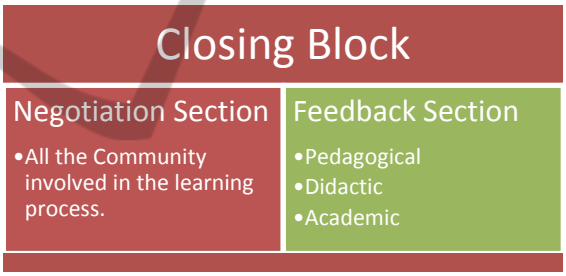

Figure 4: Closing block elements.

E-learning is the final stage of the methodology, this phase is more of the macro-curricular type than micro-curricular, that is something inherent to the Virtual Campus unlike the previous phases that are clearly associated to the virtual learning environment but also to the Campus on its organizational part.

The E-learning phase, allows to: become acquainted on assessment criteria on Internet, blended evaluations (virtual and face-to-face/traditional), encourage critical thinking, automate testing processes and combined online tutoring.

3 METHODS

3.1 Operative Model

The VLE was designed using the PACIE

Methodology, which is described in section 2.2.

For this study the VLE was composed by 3 blocks: Informational, Academic and Closing. The Information Block had three sections: Information, Communication and Interaction.

The Information section included: Home Guide, Course Presentation, Micro-curricular Syllabus and Evaluation Rubric; in the Communication section an Informational Forum (online Bulletin Board) was included; in the last section Interaction, there were a Social Forum and a Help Forum. These three sections were constantly activated and updated during the course. The tutor was responsible for creating and managing the block.

The Academic block comprised the participants' information and learning activities, consisting of five sub-blocks, each one composed by one unit previously designed in the micro-curricular syllabus of Computing sciences and Language Programming subject (Table 1).

Table 1: Micro-curricular Syllabus Units and the required time to execute them.

Units	Time
First Quarter	
Unit 1: User – Computer interaction	1 month
Unit 2: Internet and its services	2 months
Unit 3: Electronic Spreadsheet	2 months
Second Quarter	
Unit 4: Logical Programing	3 months
Unit 5: Mathlab	2 months

Each sub-block comprised three sections: Important Information, Activities to carry out and Interesting links and readings. The other sub-blocks were designed exactly in the same way with each corresponding unit.

Finally, the Closing Block showed a scenario were the participants could say good bye to their peers. Moreover this block displayed a survey to get feedback in order to improve the VLE experience and at last, the list of approved students was provided. Fig. 5 shows the structural diagram of the VLE design.

3.2 Subjects

This research was carried out at the Faculty of Engineering at the National University of Chimborazo. In the analysis process, first year students (first academic period), enrolled either in the subject of Computing Sciences and Programming Languages of Environmental Engineering (EE) or Industrial Engineering (IE) of the academic year 2010 – 2011. The students were divided in two groups, the first one called the experimental group, and the second one the control group.

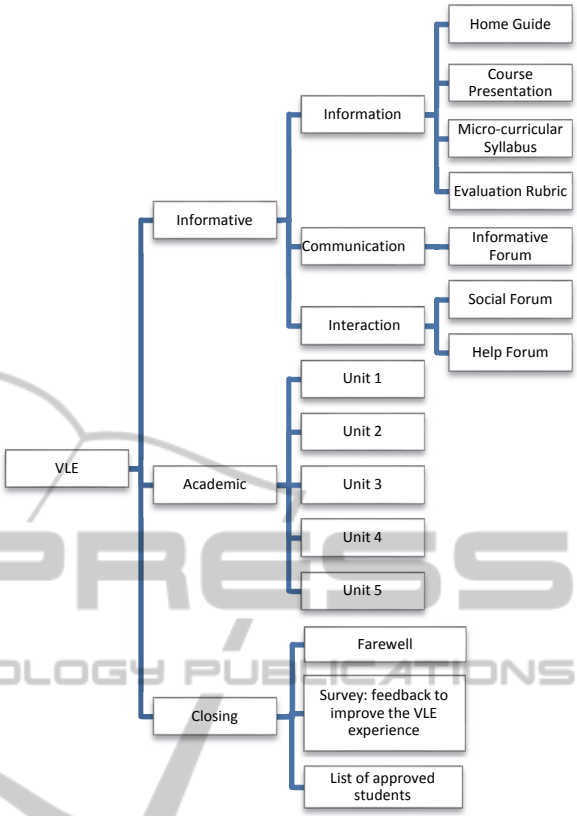

Figure 5: Schema of the VLE design.

The programmatic academic contents, the time invested in each unit, the assignments, and the evaluations were exactly the same for both groups. However the experimental group always made use of the VLE for all the academic activities, while the control group developed their activities using physical or digital tools (but without the VLE).

The population (the sample in this was of 70 students (35 of EE, and 35 of IE).

3.3 Instruments

The final grade was basically obtained from the average of the partial assessment (at the end of each academic unit), assignments, and tasks developed in class. The fully academic activity was constructed by forums, chats, blogs, wikis, and video conferences.

Additionally, in the Closing Block, a questionnaire was employed to evaluate the usefulness of VLE as an academic tool.

3.4 Procedure

The lessons were developed in face-to-face modality taking in to consideration the academic performance of both groups. The respective units were covered by providing feedback of the subject contents through different types of academic elements, such as activities carried out in and outside the classroom. Nevertheless, the difference in the academic process of both groups lies in how the VLE is employed. In the experimental group it allowed interactivity, communication, knowledge application, assessment, classroom management from any computer device and the on/offline teacher support. The variation with the control group lied in the use of physical and digital tools, with teacher support in face-to-face lessons or through e-mails.

4 RESULTS AND DISCUSSIONS

With the application of the instruments detailed in section 3.3, the following results were obtained:

As seen in Fig. 6, 13 students from the experimental group, which represent the 37.14% , achieved a high average, 21 students (60%) had an average middle grades, and 1 student (2.86%) had an average low grade. In contrast, as shown in the same figure, the high and low average of the control group correspond to 10 (28.57%), 20 (57.14%) and 5 (14.29%) respectively.

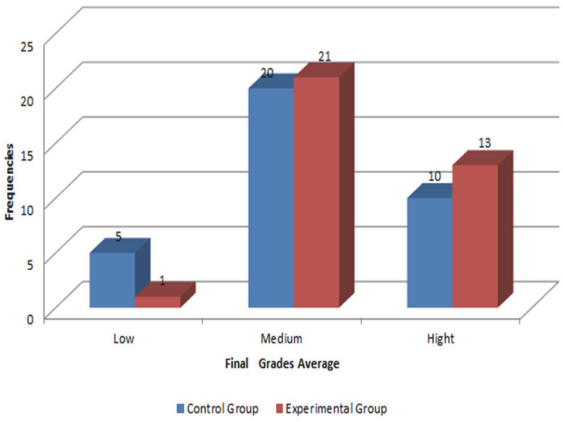

Figure 6: Frequency of averages of the final grades in both groups.

The statistical support that allowed to quantitatively check the results embodied in Fig. 6, became effective by using equation (1) representing the value of T-Student applied in the research.

The T distribution-Individual was employed, to compare the grades of the two groups of the research. The value obtained from t_c is 2.29.

$$t_c = \frac{\overline{x}_E - \overline{x}_C}{\sqrt{\frac{(n_E-1)s_E^2 + (n_C-1)s_C^2}{n_E+n_C-2}\left(\frac{1}{n_E}+\frac{1}{n_C}\right)}} \quad (1)$$

Where the parameters relating to E and C represent statistical information of the experimental and control groups correspondingly, in which: $\overline{x}_E = 6.0857$, $s_E = 1.4425$, $n_E = 35$, $\overline{x}_C = 5.400$, $s_C = 1.7690$, $n_C = 35$.

The value of t_c, was compared with the theoretical value of t with 68 degrees of freedom and the value of the level of Significance was α=0.05 (testing of queues), t_t =1.66 , as $t_c > t_t$, hence it could be proved that the use of a VLE implemented with the PACIE methodology improves the learners' academic performance; this was reflected in the learning process and in the final results.

The opinion survey results were analyzed (Closing block) to determine the operability of the VLE. An average of 75% of the students who ranked

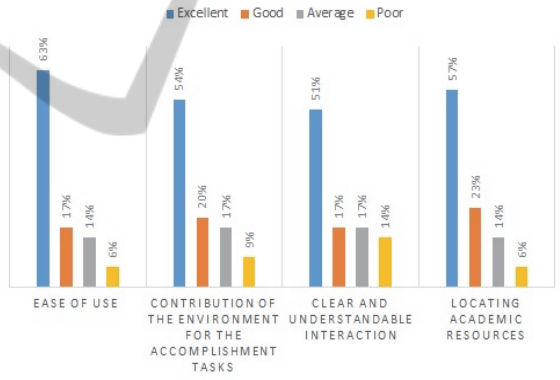

Figure 7: Level of students' satisfaction in terms of operability.

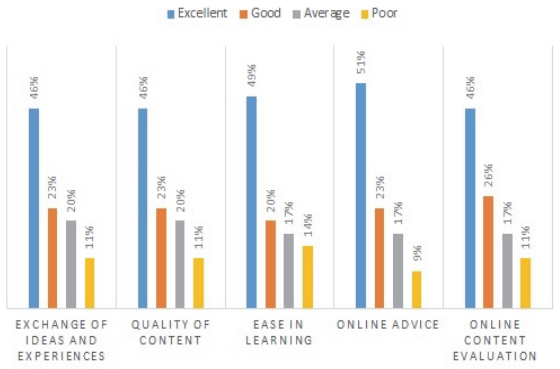

Figure 8: Level of students' satisfaction in Academic terms.

it as Excellent and Good was obtained (Fig. 7). The 71% of students pointed out that the VLE contributed academically in the learning process (Fig. 8). Finally in Fig. 9 it is highlighted that barely 11% of the students were not satisfied with the use of the VLE.

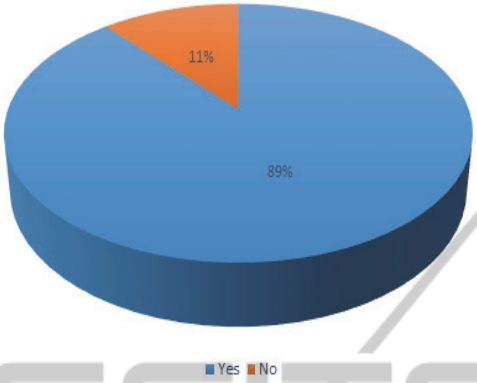

Figure 9: Satisfaction of the use of the Virtual Learning Environment.

5 CONCLUSIONS

The students from the experimental group demonstrated a higher academic performance after using the VLE as shown by the quantitative results when applying the T-Student statistical method. The same was ratified by the high acceptance percentages collected in operability and academic support surveys employed.

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