“Learning to research” in a Virtual Learning Environment: a case study on the effectiveness of a socio-constructivist learning design

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Abstract: Learning is the basis for research and lifelong training. The implementation of virtual environments for developing this competency requires the use of effective learning models. In this study we present an experiment in positive learning from the virtual campus of the Complutense University of Madrid (UCM). In order to carry it out we have used E-Ling, an e-learning environment that has been developed with an innovative didactic design based on a socio-constructivist learning approach. E-Ling has been used since 2006 to train future teachers and researchers in “learning to research”. Some of the result of this experiment have been statistically analysed in order to compare them with other learning models. From the results obtained results we have concluded that E-Ling is a more productive proposal for developing competences in learning to research.

Keywords: e-learning, virtual learning environments, socio-constructivism

1. Introduction

We consider “Learning to research” as a key skill not only for future teachers but also to ensure people “lifelong learning”. Learning to research means embarking on the process of systematic learning in order to increase our knowledge in a specific area. This involves: (i) the selection, organization and processing of existing information (ii), the choice of adequate analysis strategies, and (iii) the efficient management of information and time, both at individual and in group level. The question of the effectiveness of “learning to research ” competency is not new [1], but it is only recently it has been “officially” acknowledged: in 2005 the European Commission and Parliament published a Resolution recommending, for the first time, that this competence should be included in the curricula of EU countries in order to ensure “lifelong learning” [2]. In university education, “learning to research” extends to “learning to learn”. “Learning” and “researching” are consecutive inter-related stages of the same

process of acquiring and building on knowledge that is developed by every university student.

Following these premises, we have drawn up a learning design for students to learning to research. We have put it into practice within 3 different learning models: behaviourism, constructivism and socio-constructivism. The methodology is been applied in our under- and post- graduate courses since 2006 as a means of introducing students to certain areas of research during their final years. In first place, it was used in a face-to-face learning environment with satisfactory results. Then, the methodology has been transferred to a Virtual Learning Environment (VLE) in order to achieve more accessibility and effectiveness.

Regardless of the learning model, the results obtained in previous experiences confirm the fact that a VLE improves i) the student accessibility to the learning process, ii) the classroom interaction and iii) their motivation towards the learning [3]. We have also observed a relationship between learning models, learning activities and the learning environment used. For instance, the first stages in the learning process corresponding to the activities of *topic choice* and *bibliographical compilation* are usually easier and faster to perform either individually in any instructional environment or collaboratively in face-to-face environment. However, in the last stages, *construction* and *analysis of a problematic,* the results improve when students work in a virtual environment with a socio-constructivist model. These observations could indicate that the learning model in a certain activity could need to be transformed when transferred to an e-learning environment in order to improve the results.

The research question

In spite of the fact that technology is an efficient and effective support for implementing any learning model [4], there is still no answer to whether it is more efficient and effective to some pedagogical models or not. The huge range of technological possibilities [4], pedagogical proposals and learning styles [5], and the few experiments carried out within a well-defined theoretical framework, make this question difficult to answer [6].

In this work we present a case study analysing the effectiveness of using a socio-constructivist learning model along with a VLE in knowledge construction activities. Some studies deal with the influence in the students' performance. of the learning environment [7] or the influence of the Learning model [8], independently.

Our objective is to build up a theoretical framework for the relationship between learning models and learning processes in VLEs. In order to do so, we

raise the following research questions: Is a socio-constructivist VLE more effective to "learn to research" than a behaviourist or a constructivist one? Do the students build their knowledge better in socio-constructivist virtual learning scenarios than in behaviourist or constructivist ones? Is there any type of activities better perform using a virtual socio-constructivist environment than using other approaches?

To answer these questions we carry out an experiment based on statistical methodology, using *t-student* and *ANOVA* techniques [9]. We have evaluated three different learning experiences with three groups of university students, using a VLE. Each group of students has been through the same learning activities but in a different learning model: a socio-constructivist approach, a constructivist approach and a behaviourist one.

We present this case study organized in five sections: introduction; the socio-constructivist learning model; the description of the design and implementation of the VLE; the methodology and results of the experiments; and finally, the discussion and conclusions.

2. The socio-constructivist learning model

The behaviourist model is based on the knowledge transmission from the teacher to the student [10], while constructivist approaches [11] and socio-cultural approaches [12, 13 and 14]are learning theories which postulate that knowledge is not a mimetic copy of reality but rather a reconstruction of this reality; in other words, comprehension develops from the representations constructed by the subject. Two further models applied to learning were developed from this notion: the Piagetian cooperative model and the socio-cultural collaborative model.

Cooperative constructivist models consider that it is the student who should control his or her own learning process using a distributional approach. It implies the division of work amongst those participating, whereby each student resolves his or her tasks individually, and the results are finally polled with those of the rest of the group [15].

In contrast, socio-constructivist learning is collaborative. It is essentially a social process, in which the students are responsible both for their own learning and for that of the rest of the group. It implies the contribution simultaneous and integrated of each and every one of the members to carry out a task. Numerous specialists have dealt with these two types of learning [16 and 17], either to show the differences between them or to attempt to minimise these.

In our case, following Brufee [18], we consider that these are stages that may occur in the pedagogical relationship (learner/teacher/medium) [19], as both types of learning may be presented during the teaching process.

In our case study the learning activities of information selection and organization are basically the responsibility of the teacher. It is a face-to-face learning strategy structured by the teacher and directed towards the students. These activities have an essentially behaviourist and non social constructivist character. However, in the rest of the activities of the learning process, in the virtual learning environment, the learning responsibility lies in each student's commitment to the rest of the group. In this case the character is collaborative.

Our experiment, therefore, involves social and personal interactive learning. In this learning process there is a harmonious blend of "how we learn" – cooperatively and collaboratively- with "where we learn" –in the classroom or in the VLE.

3. Design and Implementation of the VLE

The influence of ICT in universities has transformed many traditional teaching environments into Virtual Learning Environments (VLE) [20]. A VLE is a Web application integrating a set of tools for on-line teaching and learning that allows both non face-to-face learning (e-learning) and blended learning (b-learning) in which offline experiences and e-learning are combined [6].

The most commonly used VLEs in universities are Learning Management Systems (LMS) such as WebCT-Blackboard, Moodle [4] or Sakai [21]. Despite criticism of the inflexibility of these systems, [4, 22 and 23], our experience at UCM shows that with an appropriate selection and combination of their functionalities, it is possible to support many different models and learning designs [24].

Virtual Learning Environments are the containers for Virtual Learning Scenarios (VLS), where the learning process takes place [25, 26 and 27]. Learning scenarios can be created either by the institution or by the teachers themselves. In both cases teachers are the managers and the ultimate responsible for VLS teaching and learning. It has been observed, however, that there is a general lack of theoretical and methodological framework when it building these scenarios [20 and 25]; this is probably due to a lack of technological competence and good-practice guidelines to provide orientation.

The socio-constructivist model previously presented has been implemented in a VLE named E-Ling. The learning design consists of three

different phases comprising eight stages. Each stage has one or more activities (Fig.1). The phases correspond to the three main steps in a scientific project [28] and the stages shows the different analytical levels which mark out the consistency and progression of the research.

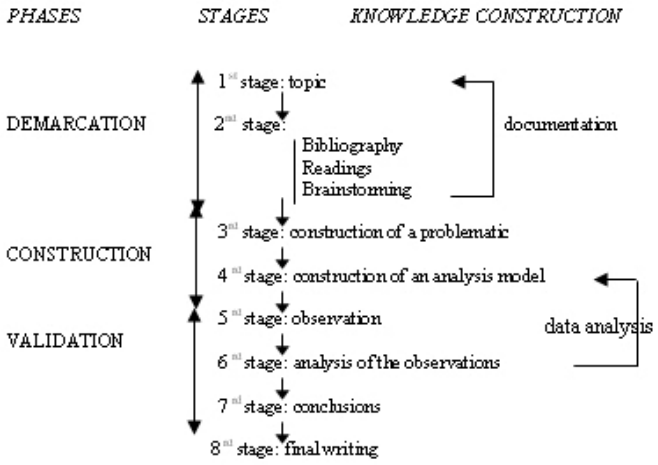

Fig. 1. Diagram of the phases and stages defining the learning to research procedure

Stage 1 corresponds to the formulation of the "topic", which is individual at first but which may lead to group discussion.

Stage 2, which is essentially theoretical, involves finding out about other research on the same subject and the analytical methods used.

Stage 3, "Constructing the problematic", corresponds to the theoretical approach to be adopted depending on the subject proposed, and justification of the choice.

Stage 4, "Constructing an analysis model" reflects the concepts and hypothesis that will prevail in the task of observation.

Stage 5, "Data Observation" establishes the hypotheses and the way in which data resulting from the analysis are observed.

Stage 6, "Analysis of the observations" gives the information obtained and compares the results with the hypotheses.

Stage 7, "Conclusions" is a synthesis of the research path taken, the characteristics of the analytical model, the selected field of observation, the method followed, the research results and the future prospects.

The VLE, E-Ling, has been built in WebCT using four learning scenarios: contenidos, actividades, comunicación and biblioteca de apoyo (Fig 2):

Fig. 2. The VLE four learning scenarios: contents, activities, communication and support library

The activities scenario consists of ten sequential activities: topic choice, bibliography, readings, brainstorming, construction of problematic, model of analysis, observation, analysis of the observations, conclusions and final writing. These activities have been designated as either individual and/or collaborative to implement the three learning models used. The students are supported by using the other three scenarios: contents, communication and support library. These last scenarios are essential from the sixth activity onwards, where the socio-constructivist model is applied.

Next section describes how the VLE E-Ling has been used in the experimentation of our case study.

4. Experiments: methodology and results

In order to evaluate the efficiency of our framework, a VLE with a socio-constructivist learning design, we have tested Stage 4 of Phase 2- the construction of the analysis model-(Fig.1). We have used a statistical method of evaluation. In our method we analyse the results using t-student and ANOVA techniques. These techniques, broadly used in education [9], allow the results' comparison regarding the measuring parameters. The procedure followed is the comparison between the socio-constructivist learning model and the two other models in order to verify the working hypothesis

4.1. Methodology and procedure

Our research hypothesis is that the socio-constructivist learning model implemented in a VLE enhances the students' level of learning. Therefore the null hypothesis (H0) used for testing is: "our framework does NOT influence the students' learning results". Taking H0 as a starting point, two experiments were set: Experiment 1, which contrasts ET and T1, and Experiment 2, which contrasts ET and T2, where:

ET (Experimental treatment): the socio-constructivist learning experience in the VLE.

T1 (Treatment 1): the individual constructivist learning experience in the VLE.

T2 (Treatment 2): the behaviourist learning experience in the face-to-face learning environment.

The procedure was carried out as follows [29]:

1. Selection of participants:

Experiment 1: 10 students to whom ET and T1 were applied at two different times (paired sample).

Experiment 2: 2 groups of 9 students each. The first group, Experimental Group, is made up of 9 of the 10 students[1] participating in experiment 1. The second group, the Control Group, is formed by a student selection, a priori better prepared than the experimental group[2]. This implies that any bias in the resulting data would be expected to favour the Control Group, which would mean not rejecting H0.

Due to the small size of the sample data, it is necessary to replicate these experiments in the following academic courses to validate the results [30]. However, working with real students gives us more reliable results than an artificially increased sample with volunteers non-involved in this learning process.

2. Choice of topic:

Experiment 1: The two topics proposed to the students were similar with regard to the area of knowledge and level required.

ET: Topic1, “Discourse according to F. Rastier”.

T1: Topic 2, “Discourse according to Beaugrande and Dressler”.

Experiment 2: Topic,” Rhetoric”.

3. Independent variable:

Treatment type (ET, T1 and T2).

4. Dependent variable:

The pooled mark obtained by the students in a post-test held after the learning experiment. The evaluation criteria for each question and the corresponding mark were set a priori.

5. Selection of data analysis techniques.

In experiment 1 a t-test hypothesis contrast method for paired samples was used. In experiment 2 the sample is formed by two independent groups, so an ANOVA is used. The confidence interval for hypothesis testing was set at the standard 95% ($p \leq 0.05$) (for discussion see [31]).

6. Research procedure

[1] One of the students did not attend to the experimental session.

[2] Students in this group were in the last year of their degree

Experiment 1: The students draw up a synthesis file from bibliographic material that they themselves selected and classified. In the ET there was one single file for the group, produced collaboratively and supported by the VLE "Virtual Blackboard" tool. In T1, each student compiles an individual file.

Experiment 2: In the group learning with ET, the students made up a collaborative file on the research topic using the VLE "Virtual Blackboard". There was therefore only one file for all the students. In the group learning with T2, each student compiled a file individually from material provided and explained by the teacher.

Once the experiment was finished, the students took part in a post-test on the knowledge acquired.

4.2. Analysis of Results

Figures 3 and 4 show the statistical analysis of the post-test results for experiment 1 and 2 respectively.

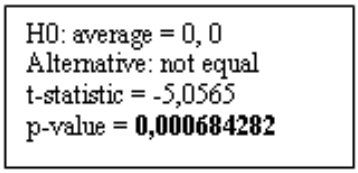

Fig. 3. t-Student hypothesis testing for Post-test ET-Post-Test T1

Sources	+ squares	Gl	M. Square	F- quotient	P-Value
Btwn group	39,0139	1	39,0139	6,05	**0,0256**
Intra-group	103,111	16	6,44444		
Total	142,125	17			

Fig. 4. ANOVA table for Total by Treatment (Post-Test ET- Post-Test T2)

The mean values of post-test evaluation marks in experiment 1 differ by 2,5 points, being higher in collaborative than in individual constructivist learning ($\bar{x}_{col}$=6,85 and $\bar{x}_{ind}$=4,35). In experiment 2 the mean results of cooperative behaviourist and collaborative constructivist treatments also differ significantly ($\bar{x}_{col}$=6,05 and $\bar{x}_{bhv}$=3,11). Both experiments rendered a p-value indicating that the differences between means are statistically significant (with the significance level for hypothesis testing set at a standard $p \leq 0.05$).

5. Discussion and Conclusions

From the statistical point of view the analysis of the results shows that the activities perform in the socio-constructivist model in a VLE are more effective than the behaviourist and cooperative constructivist ones either in virtual or face to face environments.

In particular, these results point out; firstly, learning in a VLE is more successful if it involves a social process of collaborative knowledge construction than if cooperative behaviourist or constructivist strategies are used. Secondly, learning activities for knowledge building can be more effectively developed in VLEs than in face-to-face environments. We draw a certain dependency among the learning model –socio-constructivist-, learning activities –knowledge construction- and the learning environment –VLE- that improves student learning.

Nevertheless, these results should be considered cautiously. Firstly, because although a double process of experimentation and analysis was carried out, the sample was small. The small number of doctorate students and undergraduates in their final years means that the results will have to be confirmed by repeating the experiments over successive years.

Secondly, the experiments have taken place, only, in one of the phases within a whole learning design that combines other learning models and environments. However, taking into account that the combination of models and methods is a common practice in real teaching situations [23], establishing the individual usefulness of each model does not seem viable. Therefore, we consider that studies about models, activities and/or environments efficiency must always refer to a particular learning context, that in real practices it is a blended context.

Whatever the case, we consider that inductive experimentations – as the case-study presented- are essential for being able to build a theoretical framework that helps teachers to implement their VLEs. This framework can be established formally analysing the relationships among models, learning activities and VLEs from case studies. These good-practice guidelines are basic tools to guarantee not only lifelong learning but effective lifelong learning.

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