THE IMPACT OF APPLYING AN INSTRUCTIONAL MODEL IN DISTANCE LEARNING: A CASE STUDY

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ABSTRACT

This article presents the results of applying an instructional model to distance learning of subjects related to information and communications technologies within the information technology specialists training programme taught by the Spanish Public Administration. The study was conducted on a Java programming course, which has been taught presentially since 1997 and as distance education since 2001, originally by virtualizing the contents and simulating face-to-face classroom teaching through videoconferencing, and later, as of 2004, using this instructional model. The model also incorporates a blended approach to the learning process in web-based distance education, combining self-paced learning, live e-learning and face-to-face classrooms. The results of this study show the impact of applying the proposed instructional model on the time it takes students to study the course and learning objective attainment. To do this, we took into account three instructional conditions: traditional face-to-face classroom, distance learning after contents virtualization and distance learning applying the proposed instructional model.

KEYWORDS

Instructional model, distance learning, blended learning, web-based distance education.

1. INTRODUCTION

A genuine education system should not focus on the transmission of knowledge from teachers to pupils (Govindasamy, 2002). It should be concerned with the fundamental aspect of education, that is, learning. In recent years, a lot of technology has been developed around the e-learning paradigm. This is beneficial for improving the quality of learning, but the critical element in technology-enhanced instruction is the nature of the instructional model (Tuckman, 2002). There exists a serious dysfunction between the profusion of technological features that are put forward and the shortage of instructional conditions to guide the development of the educational contents of any course (Tallent-Runnels, 2005), (Alonso, 2007).

For more than 15 years now, the Spanish Public Administration has been running an information and communications technologies (ICT) training programme to refresh the knowledge of public servants working in this field. Initially, these courses were taught through eight, five-hour classroom sessions, with a final examination at the end to assess attainment. This traditional teaching/learning method provided satisfactory results in terms of both the grades attained in the final examination and the time employed by students to learn the course contents. With the aim of reducing the costs of getting students to the institution where the classes were taught, it was decided to virtualize the courses in a digital format accessible over the Internet. But this approach led to a sizeable drop in the grades attained by learners in the test taken at the end of the course.

These poor results were the reason why an instructional model was designed, including a blended learning solution (Alonso, 2005) as the best way to take into account the learner's perspective (Garrison, 2004). The blended approach mixes three ingredients: self-paced learning, live e-learning in a virtual

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classroom where learners can collaborate, and traditional classroom training to learn collaborative skills (Stahl, 2005), (Michell, 2001).

This paper presents a study of the impact of applying our instructional model in teaching technology for distance learning. The results measured the grades attained by students in the test at the end of the course and the time taken to study the Java programming language course. These results have been compared according to the different instructional/learning approaches that we have experienced: traditional classroom sessions, distance learning through contents virtualization and distance learning applying the proposed instructional model.

2. THE INSTRUCTIONAL MODEL

The proposed e-learning instructional model provides the pragmatic level of knowledge defined within Bloom's taxonomy of educational objectives (Bloom, 1956) and the performance and action defined by Schulman (Schulman, 2002). So, it is based on the fact that training should enable learners to apply the concepts learned at their workplace and evaluate the methods, processes and tools to be used. To do so, this instructional model applies the systematic development of instruction and learning and is composed of five phases: analysis, design, implementation, execution and evaluation.

2.1 Analysis

This phase defines what to teach and outputs the learning objectives with their educational contents and their interrelations. The learning objectives define the knowledge and skills to be learned and the tasks to be performed to acquire the target knowledge state. A learning objective is the specific knowledge that the learner has to acquire about a concept or skill and the tasks to be performed. A learning objective includes several learning objects. Each learning objective is defined by a set of interrelated learning objects that each deal with a very specific item of knowledge.

The learning objectives and their relationships are represented by means of a knowledge graph. This is an AND/OR graph where the arrows represent learning sequences and the nodes are the learning objectives. As Figure 1a illustrates, AND learning occurs when two or more arrows have the same target node: this indicates that all the source learning objectives have to be accomplished before starting on the target learning objective. Figure 1b shows an example of OR learning, which occurs when two or more lines are directed at a node: the target learning objective can start to be learned when any of the source learning objectives have been achieved.

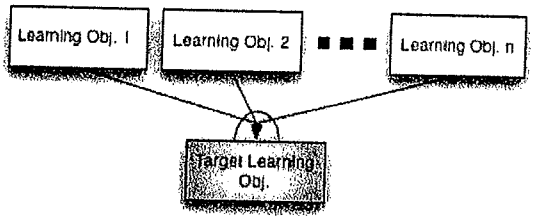

Figure 1a. AND learning route.

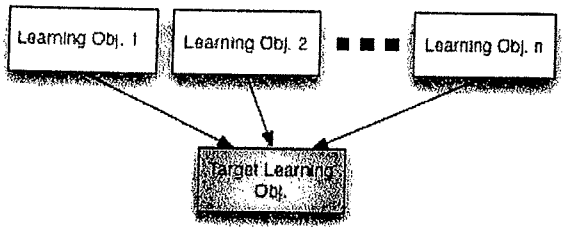

Figure 1b. OR learning route.

2.2 Design

The design defines how to teach. The tasks to be performed in each learning objective, defined during analysis, are replaced by learning objects. Problems that have to be solved through group work are designed for each learning objective as a condition for attaining the target knowledge states. Evaluation exercises must also be set to assess what knowledge has been acquired. This instructional model involves a blended learning approach to the learning process that includes three learning types: self-paced learning, live e-learning and face-to-face classrooms. Self-paced learning is the asynchronous interactive mode of learning over the

Internet that each learner accomplishes at any place and any time. Live e-learning is a mode of collaborative learning that can be implemented by means of videoconferences, threaded discussions, online chats or virtual classrooms at a scheduled time. Finally, the face-to-face or traditional classroom is the third ingredient of blended learning.

2.3 Implementation and Execution

Implementation involves deploying the course on a learning management system platform, while execution involves the learner executing the learning process. The proposed instructional model implements a blended learning process, which has been adapted to a four-week course of forty teaching hours executed as follows. The course kicks off with a one-day face-to-face session where the learners have the chance to meet each other and the e-learning tutor. There are one-hour interactions between learners and between learners and the instructor that are held every three days via chat. Computerized videoconferences are broadcast every week. There is permanent email support. Finally, a face-to-face assessment is held immediately after the course has finished.

3. DESIGN OF THE CASE OF STUDY

The aim of this study is to analyze the time taken to study and the grades attained in the test taken at the end of the Java programming language course by students taught according to each of the three teaching modes. The face-to-face classroom course was taught in eight, five-hour sessions. For distance learning all the teaching material used in the classroom was virtualized. The teacher emulated the instructional model of the face-to-face classroom, teaching the lessons via videoconferencing and answering students' questions via chat and e-mail. The third teaching mode applied the instructional model proposed in this paper to teach the educational contents of the course: nine learning objectives with about four to six learning objects each, including a group problem-solving assignment and evaluation exercises to assure that the knowledge states represented by each of the learning objectives have been attained.

This course has now been taught using the three teaching methods (the independent variable) employing the same teachers. The number of students involved in this study was 225: 75 had followed the traditional classroom method, 75 took the distance course and 75 were enrolled in the course supported by the proposed instructional model. The gender distribution of students in the sample was 60% male and 40% female, all of which were of the same ethnicity and of very similar ages, ranging from 38 to 43 years. This was designed to assure that these parameters did not affect the study results. Two dependent variables are taken into account, where criterion measures were: the test score attained at the end of the course, graded from 0 to 10, and the average learning time in hours students put into the course.

4. RESULTS

Table I shows the results for the dependent variable *test score* in terms of mean and standard deviation for each of the three teaching methods. Figure 2 is a chart illustrating the mean test scores.

Looking at this table, we find that there are sizeable differences in the grades attained by students taking the presential and distance learning courses, and also between learning with the instructional model and distance learning. On the other hand, the differences between traditional classroom and learning with the instructional model are much smaller: 6.7 and 6.5, respectively. This result corroborates the fact that the use of the proposed instructional model for distance learning improves the learning process.

Table 1. Test scores, graded from 0 to 10

Teaching method	Samples	Mean	Std. Dev.
Traditional class.	75	6.7	2.21
Distance learning	75	5.5	2.39
Instructional model	75	6.5	2.02
Total	225	6.2	2.27

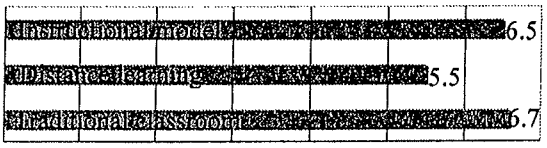

Figure 2. Averaged test scores

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Table 2. Time to study, measured in hours

Teaching method	Samples	Mean	Std. Dev.
Traditional class.	75	57.4	12.6
Distance learning	75	73.8	11.8
Instructional model	75	78.5	13.2
Total	225	69.9	15.9

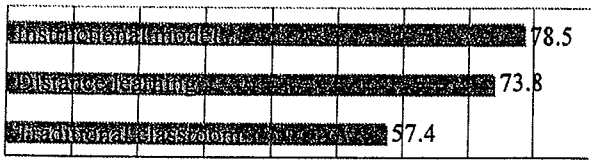

Figure 3. Averaged time to study in hours

Similarly, Table II and Figure 3 show the results for the dependent variable *time to study* analytically and graphically. From this table, we find that the distance course with the proposed instructional method calls for a bigger effort (time to study) on the part of the learner than the other two teaching methods: ~57 hours for the traditional classroom method, ~74 hours for distance learning with virtualized contents and 78.5 hours for the case of distance learning with the proposed instructional model. Distance learning with virtualized contents and with the proposed instructional model teaching modes have a higher (and similar) time to study because students have to spend much more time mastering a concept without a presential teacher to answer questions as they study the material provided. However, distance learning with the proposed instructional model takes a little bit longer (about four and a half hours on average) because the instructional method's learning process is longer and the interactions with the teacher and other learners is greater.

5. CONCLUSION

This paper presents the impact of adding an instructional model to information technology distance learning courses on learning objectives attainment and time to study. The results of applying the proposed instructional model to distance learning for the case study, a Java programming course, indicate that the average test scores taken after finishing the course are similar to the grades attained by students taught by the traditional classroom method. These are on average 1.1 and 1.4, respectively, higher than the grades of the students who took the distance learning course that emulated classroom teaching without any instructional model. On the other hand, there is found to be an increase in the effort students have to put in (time to study in hours) to achieve the proposed learning objectives using this instruction model. Specifically, it takes 20.9 more hours on average than for classroom sessions.

We are now looking into how the time to study for distance learning students can be reduced to a similar level to the time taken in face-to-face classrooms. Additionally, we are examining whether learners are as satisfied with distance education (with or without the instructional model) as they were with the presential course, which had very high acceptance levels.

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