LEARNER SATISFACTION WHEN APPLYING AN INSTRUCTIONAL MODEL IN E-LEARNING
An Experimental Study

Fernando Alonso, Genoveva López
Department of Languages and Systems and Software Engineering, Facultad de Informática-UPM, Madrid, Spain

José María Font, Daniel Manrique
Department of Artificial Intelligence, Facultad de Informática-UPM, Madrid, Spain

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Abstract: This paper presents the results regarding the satisfaction of learners attending a course under the following instructional conditions: traditional face-to-face classroom, distance learning without an instructional model, having only virtualized the teaching contents used in face-to-face classrooms; and distance learning with an instructional model. The courses on which the experiments were run are related to information and communications technologies. Specifically, we present in this paper the results for a Java programming course taught to information technology specialists under the above three instructional conditions. The course was originally designed for classroom attendance. Later, with the aim of reducing student travel expenses, all the course teaching content was virtualized (distance learning without an instructional model). And the course was designed to simulate face-to-face classroom teaching via web and videoconferencing. In view of the sharp drop in learner satisfaction with this second teaching mode, we adopted an instructional model to systematize the distance course design and teaching process. The results suggest that learner satisfaction in this study is slightly higher among students attending the distance course applying the instructional model than for students taking the traditional face-to-face classroom course and greater in both cases than among students enrolled in distance learning without an instructional model for the course.

1 INTRODUCTION

A good educational system should not focus exclusively on transmitting knowledge from the teacher to the learners (Govindasamy, 2002). It should concentrate on the key aspect of training: learning. Learning is the outcome of several separate cognitive processes used to assimilate facts, concepts, procedures, etc., and build new mental representations of knowledge. These representations can be applied in situations other than the settings where they were learned and used to successfully solve problems (Altenhofen and Schaper, 2002).

Learning is not just about acquiring new knowledge, but also about consolidating, restructuring or replacing what we already know. In any case, it always leads to a change in the structure of the brain, altering learners' knowledge schemata and/or cognitive structures. Learning is achieved by accessing information, communicating interpersonally with teachers or peers, and carrying out cognitive operations (Pazos, Azpiazu et al, 2002).

Learning processes are activities carried out by learners to achieve the educational objectives that they aim for. It takes place through a process of internalization where each learner accommodates new knowledge in their existing cognitive structures (Anderson, 1996). Conceptions about learning and the roles learners should play in such processes have evolved from learning being originally considered as an acquisition and reproduction of informative data transmitted by a teacher to now being viewed as a construction or mental representation of meanings.

Over the last few years, there have been major technological advances improving and easing Internet-based distance education (Arriaga, El Alami et al, 2003). This is what is known as e-learning. E-

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learning can be defined as the use of new multimedia technologies and the Internet to improve learning quality by easing access to resources and services, as well as remote exchange and collaboration (European Parliament, 2001) or the use of network technologies to create, foster, deliver and facilitate learning anytime and anywhere (Sampson and Karagiannidis, 2002). However, all this technology developed around distance learning is useless without an instructional model to drive the process of building and executing a distance course as illustrated empirically in this paper, confirming the results of earlier research (Tallent-Runnels, 2005; Alonso, López et al, 2005).

Our experience is based on teaching training courses related to information and communications technologies to information technology specialists since the late 1990s. These courses were originally designed to be taught as three- to five-hour traditional face-to-face classroom sessions, each course having a total workload of 20 to 50 hours. The results were satisfactory not only in terms of learning outcomes but also as regards learner satisfaction (Alonso, López et al, 2008). The biggest drawback for teaching these courses, though, was the high travel and maintenance expenses they generated, as the students came from all over Spain. For this reason, it was decided, in view of the glut of technological advances in the early 21st century, to virtualize all the teaching material available for the class attendance courses and give students Internet access to these contents. This moved the courses into the distance education domain. However, this option failed to include an e-learning instructional model. The learners attending the courses taught in this mode were not happy with this move, and satisfaction dropped sharply from 4.25 out of 5 on average for the class attendance courses to 3.28 for distance education with virtualized contents.

This drop in learner satisfaction was what was behind the design of a web-based instructional model for distance learning (Alonso, López et al, 2005; Alonso, Manrique et al, 2009). The instructional model was to provide guidance not only on how to prepare the educational contents to be rendered for learners but also how to teach the courses, where a blended learning solution (El-Deghaidy and Nouby, 2008) was adopted. This solution combined three ingredients: self-paced learning (Ellis, 2007), live e-learning in a virtual classroom (Stahl, 2005) and traditional classroom learning (Michell, 2001). The aim behind this teaching style, adopted in 2004 to 2005, was to bring learner satisfaction back up to the level it reached with the traditional classroom courses and keep the costs as low as they were for distance learning without the instructional model.

This paper presents the experience gained since the late 1990s in teaching courses related to information and communications technologies across three different teaching modes: traditional face-to-face classroom learning, distance learning of virtualized educational contents without an instructional model and distance learning using the outlined instructional model. The results presented here refer to learner satisfaction with each of the three teaching modes for the particular case of a Java programming course taught by the same teachers to a set of learners chosen at random and divided into three groups to receive instruction in one of the three teaching modes.

2 THE INSTRUCTIONAL MODEL

The instructional model deployed in the third teaching mode used for information and communications technology courses is based on the fact that teaching should enable learners to apply the concepts that they learn to perform their jobs and evaluate the outcomes. Learners must be motivated to learn the educational contents covered in the e-learning course with which they were previously unfamiliar and be able to apply them to carry out new tasks. Results will not always be as expected. In this case, learners will have to review the decisions taken and take corrective actions. This way, learners will be able to internalize the knowledge that they have learned.

The instructional model used is based on the systematic development of instruction and learning. It is composed of the following phases: analysis, design, development and deployment, and execution and evaluation.

2.1 Analysis

This phase defines what the course should teach. The purpose of this phase is to find out what needs future learners have in order to define appropriate resources and analyse the best suited educational contents. The results of this phase are the learning objectives and the teaching contents making up the course. The educational contents define what the student should learn by performing a specified set of tasks.

The educational contents are represented by a knowledge graph. The knowledge graph nodes

represent the learning objectives, and the directed lines connecting the nodes represent the tasks that they have to carry out to reach a particular knowledge state. This way, it is possible in this phase to establish all the possible knowledge sequences taking learners from an initial knowledge state to the target knowledge state set for the course, including all the tasks that learners have to complete to able to do this.

2.2 Design

This phase defines how the learning process should be carried out, that is, it specifies the learner's learning process, defining the learning approach, the structure and depth of the concepts to be taught, the process of executing the course and the expected learner outcomes. Based on the knowledge graph established in this last step, all the possible paths leading from the initial knowledge state to the target knowledge state are defined. This results in a roadmap describing all the possible learning processes required to achieve the course learning objectives. Additionally, this design phase defines the tasks learners have to complete to achieve each of the learning objectives, group problem solving and assessment exercises to check that learners have acquired the concepts covered by the above learning objectives.

2.3 Development and Deployment

The development of the course involves choosing the best of all possible paths defined in the roadmap developed in the last phase taking the learner from the initial knowledge state to the target knowledge state. This path includes a schedule of educational contents, tasks to be completed and assessment exercises. Additionally, deployment involves implementing the course on a learning management system platform.

2.4 Execution and Evaluation

This phase involves the learner using the learning process. This instructional model takes 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 an asynchronous learning mode available to learners anytime and anywhere. Learners use digitalized and virtualized material hosted by a LMS (learning management system), including exercises and activities set for learners. Learners complete self-assessments to evaluate what they have learned before they are allowed to access the next learning objectives. Learners are tutored and can communicate with their peers and the teacher over the Internet. Live e-learning is a collaborative learning mode implemented through videoconferencing, online chats, threaded discussions or virtual classrooms scheduled at the start of the course. Finally, face-to-face traditional classrooms enable learners to get to know each other and the teacher.

In our case study, the blended learning process has been adapted to four-week courses with a total student workload of 40 hours. The course starts with a face-to-face classroom session where the professor explains the aims of the course, the teaching schedule and the exercises to be completed both as a group and individually, as well as the assessment exercises. Apart from enabling learners and teachers to get to know each other, another aim of this session is to form work groups. One-hour interactions between learners and between learners and the instructor are scheduled throughout the course. They are held every three days via chat. Computerized videoconferences are broadcast every week. There is also permanent e-mail support, and, finally, a face-to-face assessment is held immediately after the course comes to an end.

During execution, information on the problems encountered and the knowledge acquired is gathered and logged to be analysed for monitoring purposes to determine success and ascertain the learning product quality.

3 STUDY DESIGN AND RESULTS

The goal of the study is to analyse the evolution of learner satisfaction depending on each of the three implemented learning modes. The results presented in the paper are for a Java programming course. The first learning mode is composed of eight five-hour sessions taught in a face-to-face classroom. In the case of distance teaching without an instructional model, where the educational contents used in the traditional classroom course were merely virtualized, two face-to-face sessions were taught: one at the start of the course to present the course aims and teaching schedule and the other at the end to hold the assessment examination. The other distance teaching mode uses the described instructional model combined with a blended learning approach. In this case, two 45-minute face-to-face sessions were held at the start and end of the

course for the same purposes. Teachers provide support through videoconferencing, interactive chat sessions and permanent e-mail support.

To run the experiment, the same course was taught by the same teachers in the three teaching modes (independent variable) to a population of different students in each case to stop the results from being influenced by or depending on the instructor teaching the course. To prevent the outcomes being biased by the fact that the learners enrolling for different teaching modes of the course were not the same, the population was chosen to assure that all the subjects perform similar jobs with the same responsibilities and commitments. Additionally, students took a level test at the start of the course, and learners that attained a similar grade were chosen for this study. A total of 225 learners were involved in the study: 75 in each of the three teaching modes. The criterion measured for the dependent variable was the level of learner satisfaction. This measurement was taken from a questionnaire administered in the face-to-face session at the end of the course in each learning mode. This questionnaire contained three statements: A1 "The course content meets my training needs", A2 "What I learned will be applicable in my job" and A3 "The applied methodology, technical resources and teaching materials were appropriate". The participants scored their agreement or disagreement with each of the above statements on a six-point Likert scale, ranging from strongly disagree (scored as 1) to strongly agree (scored as 6).

Table 1 shows descriptive statistics for the learner satisfaction dependent variable: column 1 shows the three statements for all three executed learning modes, column 2 indicates the size of sample N and columns 3 and 4 list the mean and standard deviation for the scores of the questionnaire statements, respectively. Even though the sample size was 75 learners for each of the three course teaching modes, lower values in column N of Table 1 indicate that some learners failed to score the statement specified in the respective table row. Accordingly, 73 of the 75 learners participating in the study scored questionnaire statement A2 administered at the end of the traditional classroom course. Figure 1 plots similar information (mean and standard deviation).

Table 1: Descriptive statistics for learner satisfaction dependent variable.

Teaching method / Statement	N	Mean	Std. Dev.
Traditional face-to-face classroom:			
A1	75	4.21	1.34
A2	73	4.43	1.32
A3	72	4.12	1.32
Distance learning without instructional model:			
A1	74	3.26	1.38
A2	73	3.44	1.35
A3	71	3.15	1.32
Distance learning with instructional model:			
A1	75	4.43	1.39
A2	75	4.72	1.41
A3	74	4.68	1.31

From the results shown in Table 1 and Figure 1, it is clear that learner satisfaction effectively drops sharply from traditional teaching in a face-to-face classroom (with a mean of 4.25 out of 5 across the scores for all three statements A1, A2 and A3) to distance teaching by just virtualizing teaching contents without taking into account an instructional method (with an overall mean in this mode of 3.28). To bring satisfaction back up to the level of the face-to-face classroom, we used the instructional model described in this paper. The outcome was a mean of 4.61 across scores for all three questionnaire statements. From Table 1 and the chart in Figure 2, we find that the mean values of the responses to the three questionnaire statements are highest for the instructional model. Even so, the score for A2 is slightly higher, which means that the learning is of practical use in the world of work. Also, the score of 4.43 for the case of A1, the statement most closely related to satisfaction, indicated that teaching with the instructional model was the one that best satisfied learner needs.

Noteworthy, finally, is the fact that the standard deviations across all the scores for statements A1, A2 and A3 of the questionnaires range from 1.31 and 1.41. This means that there is a more or less equal and low variance across the responses for each statement regarding each of the three teaching methods that we examined. This feature makes it easier to compare the means statistically, and we can say, without having to conduct an ANOVA, that the mean scores for the statements on traditional teaching and distance teaching with the instructional model are statistically similar to each other and are both greater than for distance teaching with virtualized educational contents.

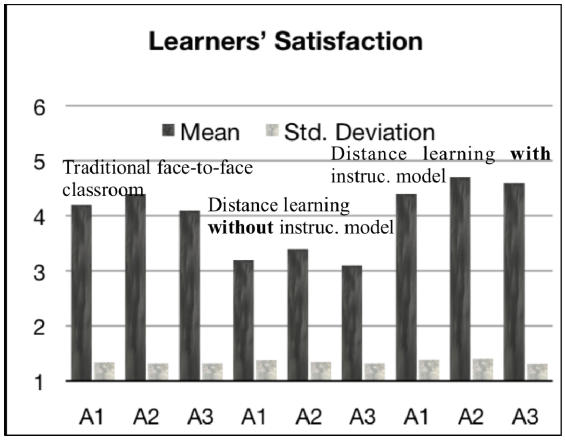

Figure 1: Mean and standard deviations for questionnaire statement scores in each of the teaching modes.

We believe that these results can be explained as follows. After years of teaching the Java programming course in a face-to-face classroom, experience was such as to achieve satisfactory results in terms of learner satisfaction. Teaching this course by merely digitalizing or virtualizing the educational contents that were used in the face-to-face classroom proved disastrous because it failed to take into account even the most elementary psychopedagogical prescriptions enabling the adaptation of the teaching-learning process to the Internet. Also a web-based instructional model is required to guide the design and development of both the contents to be taught and the actual teaching/learning process. When these ingredients were added to the distance education recipe, we found that learner satisfaction again reached and even rose above levels comparable to satisfaction with face-to-face classroom teaching. We find then that it is not practicable to migrate from traditional education in the classroom to a new e-learning paradigm by merely digitalizing and placing the contents in a web server to make the resources accessible anytime and anywhere.

4 CONCLUSIONS

This paper presents a study of satisfaction among learners attending a Java programming course. Three different teaching/learning modes have been used to teach this course over recent years. First we used traditional classroom sessions. Then, with the aim of cutting costs, it was taught as distance learning. For this purpose all the teaching contents were virtualized. Finally, we included the described instructional model. This model provides guidance on course development, educational contents and instruction. From the viewpoint of learning, a blended learning solution was adopted combining self-paced learning, live e-learning and face-to-face classrooms.

The results of the study suggest that there is a drop in learner satisfaction between learners participating in face-to-face classroom sessions and learners taking the web-based distance education course with virtualized contents without an instructional model. For this reason, we added the instructional model described in this paper to distance learning, and satisfaction moved back up to what it had been originally. The study shows then how the use of a proper distance teaching/learning model leads to similar or better satisfaction levels than traditional classroom sessions and has the plus of cutting travel expenses. This is precisely why the distance learning mode was introduced in the information and communications technologies courses. Note also that the effort and workload required of teachers in this distance teaching mode is much greater than in traditional classroom teaching, which is to the benefit of learners. For this reason, we have launched a pilot experiment deploying a blended learning approach, similar to the one described in this paper, in the learning process to teach undergraduate students a subject that is part of the undergraduate engineering degree in computing. The goal of this experiment is to find out whether the use of the innovative educational techniques suited for distance education is able to reduce underachievement in higher education or, at least, increase the percentage of students that sit the final subject examinations, that is, improve motivation.

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