p-ISSN: 2184-044X e-ISSN: 2184-1489 ISBN: 978-989-53614-3-4 © 2022
https://doi.org/10.36315/2022v1end067

# DEVELOPMENT OF A COURSE FOR E-LEARNING TO THE TEACHING OF THE SUBJECT ANALYSIS OF VARIANCE

**Miguel Pineda[1], Omar García[1], Armando Aguilar[1], & Frida León[2]**
[1]*Departmento de Matematicas, Facultad de Estudios Superiores Cuautitlán, UNAM (Mexico)*
[2]*Departmento de Química, Facultad de Estudios Superiores Cuautitlán, UNAM (Mexico)*

## Abstract

The random design is the simplest of all the designs that are used to compare two or more treatments. The analysis of variance is the central technique in the analysis of experimental data, the general idea of this technique is to separate the total variation in the parts which contributes each source of variation in the experiment. In the case of the random design, separates the variability of treatment. To facilitate education students, it focused on interpreting the results and not developing. It is important to use new technologies as a support to the teaching of the subject, in this document we propose different forms of feedback to the subject as statistical software, specialized web pages, applets, and virtual labs.
In this work an E-Learning course was developed on the platform Dokeos as support for the traditional kinds of design of experiments. In which, the subject of analysis of variance explains in a simple way what is the random design. The Dokeos platform was used because it is a free software based online learning suite and provides all the features that an online learning application needs, from the authorship of courses up to reports.
The objective was to adapt the above mentioned subject to an E-learning model in order (a) optimize the contribution of content, skills, and competencies that students must have, (b) the integration of statistical software in courses to emphasize applications to the real problems as contexts, concepts and methods, (c) the development of interactive materials that facilitate updating and learning by experimentation, (d) the use of a model of continuous assessment that guide and prepare the students in their formation, (e) the participation of the collaborative learning online by assigning projects and activities to be carried out in working groups.
E-learning course helps students for three things. First, to save time, since they have different tools that help to solve real problems. Second, they make use of computer science to understand the themes of the platform and at the same time are at the forefront of technology. On the other hand, it is also transmitted to the students the idea that learning is a continuous process and that it should be done. Third, show students that these tools offered the platform is not important memorizing formulas or perform arithmetic calculations, if not who can concentrate on results more quickly. The third, show that students with these tools offered by the platform is not as important memorizing formulas or perform arithmetic calculations, if not who can concentrate on results more quickly.

***Keywords:*** *E-Learning, analysis of variance, Dokeos.*

## 1. Introduction

An experimental design is a schematic of how to conduct an experiment. The fundamental objective of the experimental designs is to determine if there is a significant difference between the different treatments of the experiment and if the answer is affirmative, what would be the magnitude of this difference. A second goal of the experimental designs is to verify the existence of a trend derived from the analysis of the data of the experiment. The main difference between experimental designs lies in the way the experimental units are grouped or classified.

The design of experiments began theoretically in 1935 by Sir Ronald A. Fisher, who gave the bases of the theory of Experimental Design and is currently quite developed and amplified. Currently the applications are multiple, especially in research in the natural sciences, engineering, laboratories and almost all areas of the social sciences.

In the course developed, a single factor is considered, the experimental designs used when the objective is compared with more than two treatments than are presented. It may be of interest to compare

three or more machines, several suppliers, four processes, three materials, five doses of a drug, and so on. Many of the comparisons are made based on the completely random design, which is the simplest of all the designs used to compare two or more treatments, since they only consider two sources of variability: the treatments and the random error. The course was conducted for a totally randomized design.

## 2. Development

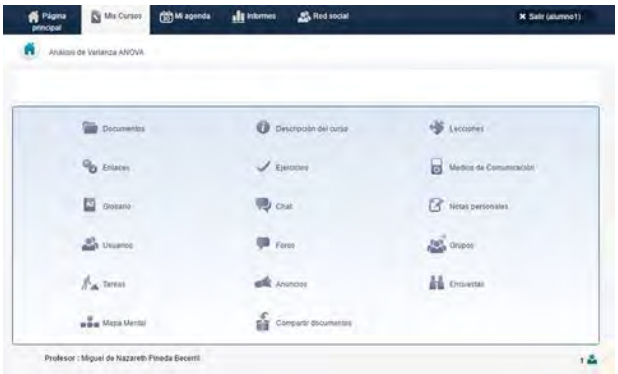
The subject of design of experiments is taught in the food engineering degree, the purpose of this course is for students to obtain a better understanding of the subjects of analysis of variance of the subject. This course was developed on the Dokeos platform, under the E-learning methodology, which contains the following sections in each of these topics: Documents, Link, Tasks, Exercises, Chat, Forum and Task mailbox.

In the platform that was created, there is an Analysis of Variance section and in this, in turn, there are each of the aforementioned sections, Figure 1 shows us the main access to the E-learning course.

*Figure 1. Course E-Learning.*


When accessing the E-learning course, students will find the menu of available courses, where the topic of Analysis of Variance appears as shown in Figure 2.

*Figure 2. E-learning course menu for analysis of variance topic.*



In the E-learning course of Analysis of Variance, the theoretical part of the topics completely randomized design and the tests were developed, but in a different way than they are in textbooks, in order to draw the attention of the students. The idea was to set learning objectives, in such a way that the topic was developed and thus understood more clearly. Based on the above, it is intended to reorient and update the approach with which the study of the aforementioned issues should be approached, awakening the concern to learn and solve the problems and cases raised.

In the theoretical part of the completely random design topics and tests, learning objectives were established, to achieve these objectives, the development of the topics was carried out based on questions and answers. Figure 3 shows us the theoretical part developed for the hypothesis testing section of the E-learning course.

*Figure 3. Analysis of variance topic of the E-learning course.*

Videos of the aforementioned topics were made, since these are a didactic means that facilitates the discovery of knowledge and the assimilation of the topics. In addition, it can be motivating for students, as the moving image and sound can capture their attention.

These videos have some advantages, since they allow adapting the teacher's speech to the level of understanding of the students or to their situation at a given moment, through their use the participation of the students can be elicited.

On the other hand, the video can also be used fulfilling diverse didactic functions. For example: with an informative, motivational, evaluative or investigative function. Figure 4 shows us the video corresponding to the theme of Design completely at random.

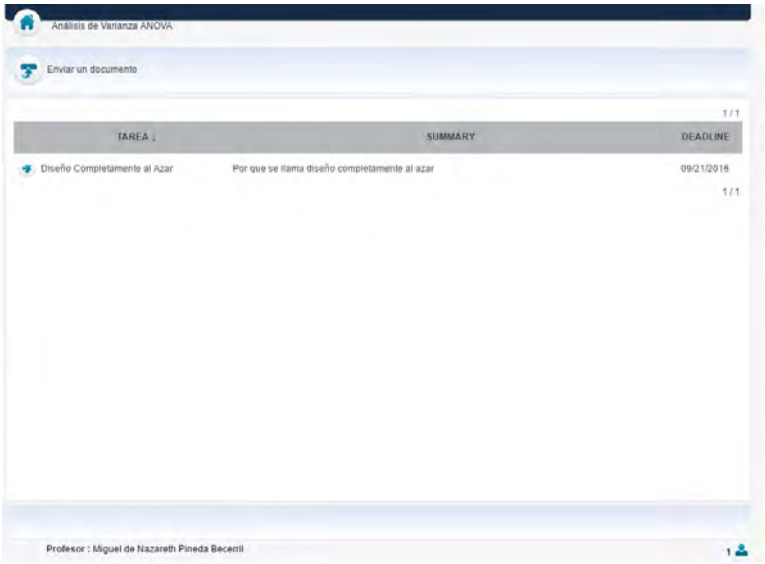
*Figure 4. Video of the design theme completely of the E-learning course.*


For the topics of completely randomized design and that of tests, application cases and dot com exercises were developed, these exercises are solved with an internet connection. This section provides the student with exercises and case studies that must be solved in an interactive environment, using the resources available on the Internet, in such a way that they can develop them in learning environments that allow them to build knowledge.

To reinforce the students' knowledge of the topics, a part containing applets of the aforementioned topics was developed. These applets (applet) are programs written in Java that serve to "give life" to web pages (interaction in real time, inclusion of animations, sounds), hence its power, Kenneth (2012). Applets serve as a new teaching and learning process that encourages students to search for more active and personalized methodologies for each topic.

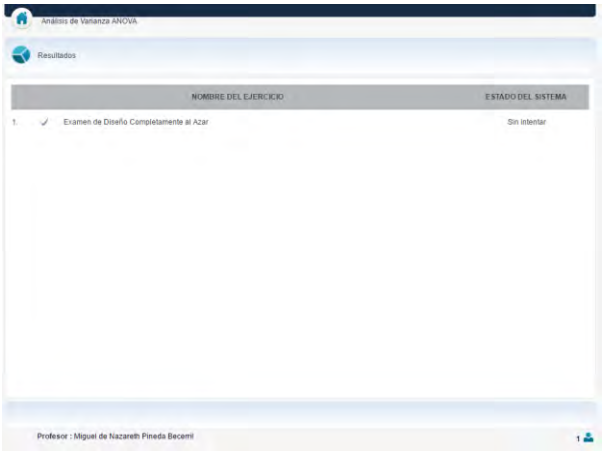
The Task Mailbox was created with the in order to facilitate the exchange of files between the course participants. This section of files can easily send files to one or all students and they in turn can send the teacher of the course and also send files between them. Additionally, submitted files may contain comments; in this way, the teacher can comment on the personal work of a student or the student can inform the teacher that the document sent is perhaps not very clear. Figure 5 shows us the content of the task mailbox for this topic.

*Figure 5. Task mailbox.*




This tool allowed us to create self-assessment tests, which allowed us to ask any number of questions. For the topics of hypothesis tests for one mean, for two means, for one proportion and for two proportions, questions with different types of answers were developed, such as multiple choice, reasoning and open questions. The purpose of applying the exam is to collect evidence of the degree or magnitude in which the learning of this topic was achieved; since it seeks to achieve the objectives set. In this topic, it is important to know what knowledge the student acquired, what skills or abilities he developed to perform the necessary operations to calculate the different sums of squares of the analysis of variance. Figure 6 shows us the evaluation questions for the completely random design theme.

*Figure 6. Evaluation of the hypothesis test topic.*

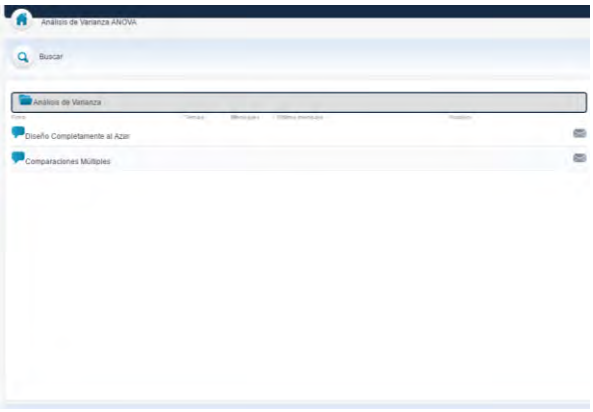



One of the technological tools that favors remote and asynchronous interaction is the Electronic Forum or newsgroup, which allows us to discuss among the different students on the topics of hypothesis testing for one mean, for two means, for a proportion and for two proportions and when to use each of these. This tool has a wide utility; since, if it is used with didactic property, to favor collaborative learning of the probability distribution issues, it allows us to communicate and interact among a group of students in the pursuit of the objectives set out in this topic. Figure 7 shows us what the "Doubts" forum looks like for completely random design topics and multiple comparisons.

One of the technological tools that favors distance and asynchronous interaction is the electronic forum or newsgroup, which allows us the discussion between the different students, on the topics of hypothesis tests for one mean, for two means, for a proportion and for two proportions and also know when to use each of these.

This tool has a wide utility since if it is used with didactic properties, it can favor the collaborative learning of the subjects of probability distribution and it allows us the communication and interaction between a group of students in the search of the objectives raised in this subject.

*Figure 7. Us what the "Doubts" forum looks like for completely random design topics and multiple comparisons.*




## 3. Conclusions

We consider that the use of new technologies awakens the teacher's interest in using new strategies for teaching statistics. Since one of the problems that the teacher faces is the monotony of repeating the same contents for many semesters, changing teaching strategies has resulted in the motivation of teachers in such a way that they have revised the contents of the course. material made with renewed enthusiasm. This motivation is an achievement, since, if the teacher manages to stimulate his classroom, he will transmit it to his students, which will contribute to the improvement of teaching.

Through E-Learning courses as support for traditional courses, the teacher faces the challenge of modifying the design of the contents, the tasks and the forms of evaluation to adapt them to the new demands. For their part, students must commit to fulfill their obligations and be an active part in the teaching-learning process and in the evaluation, both individually and in groups (collaborative learning).

To assess multimedia as an "important" teaching-learning strategy, it is necessary to know the benefits they can offer, taking as a reference the traditional education scenario and the current state of virtual education.

## *References*

Anderson. D. R., & Sweeney, (2011) Statistics for Business and Economics, South-Western College Pub; 11.

Devore, J. (2011) Probability and Statistics for Engineering and the Sciences. CENGAGE Learning, 8 edition

Kenneth, C.L., Laudon, (2012) Sistemas de Información Gerencial, Always Learning Pearson, 12 edición.

Levin, R. I. & Rubin, D.S. (2010). Estadística para Administración y Economía. Ed. Pearson Prentice Hall, 7ª. Edición

McClave, T. & Benson, P. (2010) Statistics for Business and Economics, Prentice Hall; 11 edition.

Triola, M. (2010). Estadística México: Pearson Educación 11 edición.