How to support the achievement of learning inventory models through the use of a mobile application?

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Abstract. This work shows us how to support the achievement of learning, regarding the contents covered in the subject of "Stochastic Models and Simulation" of the Industrial Civil Engineering program at the University of La Serena.

A mobile application was developed based on an inventory model: Economic Order Quantity (EOQ), where the application allowed students to solve problems by using that specific model.

At the end of the monitoring process, it is concluded that it is pertinent to continue the work with the mobile application, which implies, adding other models and considering statistical aspects, in order to determine if the application really contributed to the students´ learning achievements.

Keywords: Deep Learning, Teacher, Student, Engineering, Digital Educational Technology.

1 Introduction

The Educational Model of the University of La Serena (2011), considers the student as the main focus of its work, and also declares the use of information and communication technologies as one of the hallmark competencies in training. Therefore, the use of digital educational technologies is a relevant support for the teaching and learning process.

One of the contents of the subject "Stochastic Models and Simulation" of the Industrial Civil Engineering program, centers on inventory models. When dealing with the content, the students manifested a passive and little participatory behavior during the classes, evidencing a superficial learning (an ephemeral learning focused on studying "only for the test"). It is known that students are familiar with the various

functions of their mobile devices, besides, the use of digital technologies in an educational context implies the use of tools that allow greater interactivity, thus, maintaining the students´ attention more easily (Hidalgo, Salazar and Chile, 2018).

From this point of view, the question arises: How to promote deep learning of inventory models through the use of digital technology?

As a first step, it was proposed the development of an application for mobile devices focused on inventory models. The project was carried out by the Teaching Improvement Unit (UMD[1]) of the University, together with professors from the Department of the Industrial Engineering program*. The name given was: Inventories Engineering Management Support project (IEMS or AGII[2] for its name in Spanish).

This study centers on the effects of the usage of the IEMS on students´ learning, considering its perceptions and grades.

2 Theoretical Framework

The theory of inventory models and the creation of digital educational resources were considered in order to develop this work. For the study were considered: the technical foundations of the EOQ model (Hillier, 2006), the framework defined by the TPACK model (Chai, 2013), and the continuous improvement cycle approach (Salazar, 2020) known as the Deming cycle. The central objective of the study focuses on the learning approaches proposed by Biggs (2006), who states that the students can face the learning process from a superficial or deep approach. The latter supposes deep learning, that is, lasting, flexible and applicable to different professional contexts.

3 Methods

The study was carried out under a mixed approach and quasi-experimental design, it considered within its scope to work with a minimum viable product, which contemplated the simplest model of the existing inventory models. For this, the professionals of the Teaching Improvement Unit, worked with the teacher in charge of the subject of stochastic models, where there were 45 students enrolled.

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[2] AGII: Apoyo a la Gestión de Ingeniería en los Inventarios

In order to collect the information, the sample was divided into two groups: 18 students used the application and 27 students took the subject in a traditional way, without using the application.

The first instrument consisted of an assessment activity focused on solving a problematic situation. It was applied to the entire sample, and sought to account for the achievement of the learning outcome declared in the subject, that is, to solve problems related to inventory models. The evaluation criteria of the assessment considered: analysis (30%), calculation of responses (35%) and conclusions/recommendations (35%).

The second instrument, a perception survey, was applied to the 18 students who worked with the application. It consisted of a perception scale (Likert type), through which was sought to account for the student's perception, regarding their own learning process. Finally, an open question, focused on the elements of improvement from the perspective of the students, was applied to the same group.

4 Results

The results of the project are centered in the achievement of the learning outcomes of the subject, particularly, the one related to the application and use of inventory models. On the one hand, there is the statistical analysis in relation to the grades of the students.

Table 1. Statistical Analysis

	Usage of the App	Without the App
Mean =	**6,14**	**5,97**
Variance =	**0,03353**	**0,06994**
Standard Deviation =	**0,183**	**0,264**

It can be seen that the sample mean does not present a significant differential. Considering that, it is evidenced that those students who used the application, scored slightly higher than those students who did not, to which it can be added, that the dispersion is somewhat greater in the latter in relation to the former.

Regarding the results of the perception survey, it was answered by 50% of the universe of participants.

A 100% of those who responded, stated that they “totally agreed” or “agreed” with the following: the application is a tool that supports decision-making in the presented case; the graph presented at the end, helps to better understand the usage of the model through the case; the navigation interface is intuitive and the “help” integrated into the application is effective.

66% of the students, said they "totally agreed" or "agreed" that the application allows them to support the work done, and 34% said they "neither agreed" "nor disagreed" with it. Finally, 89% expressed the same degree of agreement when asked about their satisfaction using the application.

Among the most frequent suggestions, they focused on the need to consider other models in the application, modification or expansion of the time horizon and the range of values.

5 Discussion

The results from the quantitative point of view, are not decisive enough to estimate that the incorporation of the mobile application had an important effect on the results of the students´ grades. The difference in mean is marginal, despite evidencing that those students who used the app scored slightly higher than those who did not. This, in the best of cases, can suggest a positive contribution, as long as some methodological improvements are made.

Regarding the perception of the students, it is suggested that the application was a contribution to learning in terms of understanding and decision-making about the subject, which is effectively supported by the visual support and the interface with intuitive features.

Regarding the 34% who stated that they "neither agreed" "nor disagreed" with the item associated with the capacity of the device to support the work done, its correlation is inferred with those perceptions that indicate the need to consider other models in the application, modification or extension to the time horizon and the range of values.

6 Conclusions

Both, the results regarding the grades of the students and what was stated in the perception survey, suggest that the implementation of the IEMS application is coherent with a process oriented to the promoting deep learning about inventory models.

In this regard, the achievement of the objective of the study, must be strengthened with the optimization of those aspects that were detected as improvable in relation to the methodology. With them, in a next stage of this investigation, there could be findings that clearly demonstrate the type of contribution of this type of applications to the achievement of learning inventory models.

7 Limitations and Future Research

The sample that was used to see the impact of the application is an important aspect to improve, since only 40% of the students in the course actually worked with it. The selection of the subsamples was conditioned by the platform of the students' smartphones: the app was designed only for the Android platform.

For future research, it is relevant to add other inventory models to the IEMS application, because it would allow a greater number of students to participate, establishing a larger sample to more reliably account for the results and findings.

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