# IMPLEMENTATION OF PROJECT IN SOFTWARE R IN A LINEAR ALGEBRA COURSE FOR STUDENTS OF BUSINESS COMPUTING AT THE UNIVERSITY OF COSTA RICA

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## Abstract

This paper covers accumulated experiences over approximately five years of developing evaluation strategies oriented to projects within linear algebra course for students of business computing career. Evaluation strategies aimed at developing programmed routines have applied with the R software of the main contents of the course (matrix, determinants,.., etc), this with the aim that students of computing area can establish a relationship between theory and practice from concepts studied in class. The obtained results have shown that yield of promotion for course approval have increased, but the most important thing is how students show interest for developing programmed routines in R.

## Perception of the mathematic, for students of business computing.

The current situation of mathematics teaching at secondary level in Costa Rica is like in most of Latin American countries which are in time of changes, due to teaching models used in previous decades have begun to show gaps and have caused bad promotions to school levels. The main shortcomings that different researchers have found is that teaching model is algorithmic, based on problem solving with calculator machine help, very far from a mathematical logical development of mathematical concepts, and even further from a relationship between mathematics and the environment that surround to students. This combination of factors causes that student's leap, from high school to university, possess a negative perception of mathematics, and the bases of mathematical concepts that they should know to face the math courses at college are very bad.

In the particular case of business computing students, they are not excepts of this situation and it can be reflected in a diagnostic test performed in the mathematics school of the university, which evaluate questions related to the contents studied in high school, none student career approved the exam from 2011 to 2018 years. Students before reaching the linear algebra course, must pass courses like discrete structures and calculus for computing, where the average of times reproved in each course is 2 times per student, which cause that many students develop negative attitudes for math courses. *In general terms we can say, that the students are indisposed to a linear algebra course, which they categorized it as a course: bored, abstract, devoid useful for the career they study and very hard to pass.*

## Implementation of projects applications in R

Dubinsky (1997), warned that the difficulties of students with the concepts of linear algebra cannot and should not be avoided focusing on the computational aspects of this matter and avoiding abstraction. It was the reason why instead of performing projects where the software R will be used as calculation tool, we chose to use it as a programming tool. R.

We use the R software, so that students can develop collaborative research projects, where they can computationally implement the theoretical elements studied in the course, and thus be able to experience problems of greater complexity, which in turn can be related to part concepts economic of the carrier. An example of a project developed by students is to develop different algorithms to calculate the determinant of a matrix of order n, compare execution times and from that, choose a method that helps solve Leontif problems, all this in R software.



## Results

- The first major result is the increase in course approval promotion, which went from 42.13% to 72.45%.
- Students express that scheduled projects help them understand the concepts studied in class. In fact, before the question: *It considers that the implementation of projects programmed in R helps to establish a relationship between practice and theoretical concepts.*

- **Yes, since the realization of programmed projects in R, it helps to thoroughly study the concepts to implement better programming.**
- **Sure enough support, it is a tool that helps to achieve scheduled projects to study and understand the concepts that the teacher evaluates in the exam, in addition at this level of the career we already notice the applicability that have mathematics at area of computing.**

- Although, initially the students face the difficulty of facing a programming language, which they are not accustom to , after this stage of they show taste for using a software like R.
- It has been shown that most to students like the implementation of scheduled projects in the course. Actually they answer at the question: *Do you think it is convenient the implementing of projects in mathematics courses of the career?*

- **Yes, because it gives another perception mathematical usefulness. Also, to release another type of environment which we can perform as computer scientist.**
- **Yes, because it helps to understand why mathematical courses in the career are important and where it can be applied to the mathematic into computer scientist.**
- **Yes, as it gives us a new challenge to face, also a new horizon of job that is not common but many things can be done and here we can see how mathematical is closely linked to computer scientist.**

- 94% of students assure that the development of scheduled projects was useful for their learning process in the course of linear algebra, and the course turned more attractive to them.
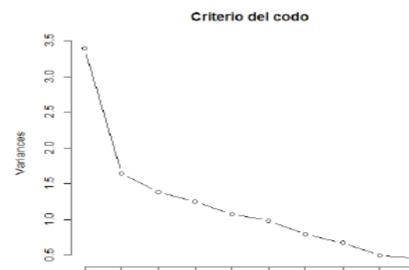
## Conclusions

- Some students consider to whom the programming do not like them, and state that such projects are unnecessary and tedious.
- Some students expressed that they prefer a strictly theorical course.
- Over semester the development of projects has been consolidated within the evaluation of the course and students demonstrate taste for working on them.
- Projects have achieved to change the wrong perception of mathematics that possess most of students when they started the linear algebra course.



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