



# Efficiency Analysis of classes from an Engineering course

Paulo Nocera Alves Junior<sup>1</sup>, Isotilia Costa Melo<sup>1</sup>, Paul Leger<sup>1</sup>

<sup>1</sup> Escuela de Ingeniería de Coquimbo (EIC), Universidad Católica del Norte (UCN), Coquimbo  
1781421, Chile  
paulo.alves@ucn.cl

**Abstract.** Improving the teaching and learning process of engineering is one of the critical aspects for developing countries. The objective of this project is to analyze the learning performance in the engineering classes of the School of Engineering of Coquimbo (EIC), Universidad Católica del Norte (UCN), Chile. The methodological design is based on Data Envelopment Analysis (DEA) and applied to aspects related to the learning performance of students and teaching. The data from 70 classes of the first semester of 2022 was collected from UCN's educational system database. Based on the DEA methodology and factors related to learning performance, we expect to make recommendations and suggestions based on the results, implying that the UCN, but also engineering courses around the world, can improve aspects related to the classes.

**Keywords:** Data Envelopment Analysis (DEA); Learning performance; Higher Education in Science, Technology, Engineering, and Mathematics (STEM).

## 1 Introduction and Objectives

It is vital to improving the teaching and learning process of students in developing countries because teaching science, technology, engineering, and mathematics (STEM) is a critical aspect for these countries [1]. Given this context, our research problem is related to how to improve the learning process of Engineering careers.

The general objective of this project is to develop a model to analyze the learning performance in the classes of the EIC in UCN and to identify factors that contribute to the improvement of performance in learning and teaching based on the research of [2]. This will be made based on developing a Data Envelopment Analysis (DEA) model to analyze it based on aspects related to the learning performance.

## 2 Method

The first Data Envelopment Analysis (DEA) model was created in 1978, and it is called CCR (the acronym of the authors who created this model: Charnes, Cooper, and Rhodes) [3]. They suggest applying CCR model to analyze the Efficiency of several schools, seen as decision-making units (DMUs) [3].

In an article [2], the authors applied a DEA model to explore the relative Efficiency of 18 classes of first-year students in an English course at a Taiwanese university. The authors identified key learning performance indicators and designed a mechanism for



teacher performance improvement to help teachers focus their efforts on the didactic suggestions made and support decision-makers in designing educational policies.

The richness of the course content, followed by the level of positive attitude, were the most important factors and should be prioritized [2]. The authors suggested that teachers should balance motivating students and correcting their mistakes in classes, while students should show their effort during the learning process and accept criticism.

There are already efficiency studies of universities in the Chilean context [4, 5]. However, these studies focused on comparing Chilean universities, considering aspects of teaching and research, but did not consider the attitude during learning and were not focused on learning performance. Therefore, this project is justified by the focus on classes and centered on students to improve the learning process and adequate teaching.

The data from 70 classes of the first semester of 2022 was collected from UCN's educational system database. DEA was applied to aspects related to teaching and learning performance of students, as the aggregated grades of students, percentage of approved students, aggregated evaluations of the classes, and the percentage of females.

### 3 Preliminary results and Final Remarks

This project's preliminary result identified the average scores as the main indicator that represents learning, respect for the dignity of people, and integrating Information and Communications Technologies (ICT) in learning environments as the main indicators related to teaching that most contributed to the efficiencies of each class. And it is expected to make recommendations and suggestions based on the results, so this engineering school and other STEM higher education institutions can improve aspects related to their classes based on the results of the DEA model to help improve the learning performance of the students. In addition, a functional software prototype will be generated to carry out frequent efficiency analyses for the EIC in UCN.

### References

1. De La Hoz E., Zuluaga R., Mendoza A.: Assessing and Classification of Academic Efficiency in Engineering Teaching Programs, *Journal on Efficiency and Responsibility in Education and Science*, 14(1), 41-52 (2021). <http://doi.org/10.7160/eriesj.2021.140104>
2. Montoneri, B., Lin, T. T., Lee, C. C., Huang, S. L.: Application of data envelopment analysis on the indicators contributing to learning and teaching performance. *Teaching and Teacher Education*, 28(3), 382–395 (2012). <http://doi.org/10.1016/j.tate.2011.11.006>.
3. Charnes, A., Cooper, W. W., Rhodes, E.: Measuring the efficiency of decision-making units, *European Journal of Operational Research*, 2(6), 429–444 (1978). [https://doi.org/10.1016/0377-2217\(78\)90138-8](https://doi.org/10.1016/0377-2217(78)90138-8)
4. Cossani, G., Codoceo, L., Cáceres, H., Tabilo J.: Technical efficiency in Chile's higher education system: A comparison of rankings and accreditation. *Evaluation and Program Planning*, 92, 102058 (2022). <https://doi.org/10.1016/j.evalprogplan.2022.102058>
5. Ramírez P. E., Alfaro, J. L.: Evaluación de la eficiencia de las universidades pertenecientes al consejo de rectores de las universidades chilenas: resultados de un análisis envolvente de datos. *Formación universitaria*, 6, 31-38 (2013). [doi.org/10.4067/S0718-50062013000300005](https://doi.org/10.4067/S0718-50062013000300005)