

# COMPETENCY-BASED EDUCATION AND PROJECT-BASED LEARNING APPLIED TO ELECTRONICS AND DIGITAL SYSTEMS TEACHING AT ESTIA: A STUDY ABOUT THEIR IMPACT ON DUAL HIGHER EDUCATION MULTIDISCIPLINARY ENGINEERING STUDENTS

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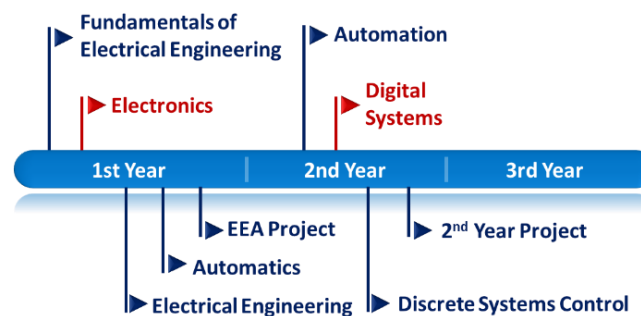
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## 1. Introduction

Analog (AE) and Digital Electronics (DE) make part of the elementary modules in ESTIA's first-year engineering curriculum, mandatory for "dual program" students and "classical program" ones, whose academic calendars follow different pathways. The fundamentals of Electronics, taught through theoretical and practical courses, are essential for subsequent disciplines such as Automatics and Electrical Engineering (1<sup>st</sup> year), and Digital Systems (2<sup>nd</sup> year). Figure 1 provides a simplified version of the academic pathway followed by all ESTIA students, related to the Electronics, Electrical Engineering and Automatics area (EEA).



**Figure 1.** EEA area-related courses followed in the 1<sup>st</sup> and 2<sup>nd</sup> years by all students.

Furthermore, given ESTIA delivers a multidisciplinary engineering degree, it is crucial for teachers to implement learning and assessment methods that accommodate students with varying levels of proficiency in Electronics. Thus, the goal is to ensure that despite different calendars, both "dual" and "classical" students receive identical content and evaluation [1].

## 2. Case presentation

### 2.1. Electronics Module in 1<sup>st</sup> year

This Module is composed of two parts: AE and DE. For each part, there are 7 sessions of 2 hours each, combining lectures and theoretical exercises, together with a 4-hour circuit

simulation practice, for the two academic ways. The main difference is that for “dual” students, these hours are concentrated in 6 weeks, whereas for “classical” ones, the same teaching load is spread over 3 months. To try to overcome the eventual inequalities due to these different calendars, competency-based education (CBE) was applied during the last two years in AE [2]. The list of competencies that will be assessed to achieve the learning outcomes [3] are presented to the students, and the content of the lessons and the exam subject are selected to match these competencies, which can be classified as “acquired”, “partially acquired” or “not acquired” during the evaluation stage. The final score is calculated consequently.

## 2.2. Digital Systems Module in 2<sup>nd</sup> year

Digital Systems Module is composed of practical courses. To make the subjects more attractive for students, project-based learning (PBL) is applied [4], replicating real-world professional scenarios of a company to assess the target competencies. The suitability of this teaching approach to electronic systems was proved many years ago [5].

## 3. Results & Discussion

Table 1 shows the pass rates in AE for the five last academic years. The values in bold are those obtained applying the CBE method, resulting in the best results ever obtained, in the 2023-24 academic year. The decrease in values in 2024-25 can be explained by the new minimum score required to validate AE, now equal to 10/20, previously set at 9/20. The interesting results reached in 2021-22 could be due in part to the assessment procedures adopted to palliate the effects of confinement, during the pandemic, on students’ knowledge.

**Table 1.** Pass rates in AE.

Students’ profile	2020-21	2021-22	2022-23	<b>2023-24</b>	<b>2024-25</b>
“Classical program”	60.1%	80.1%	60.3%	91.7%	77.1%
“Dual program”	63.2%	87.0%	65.4%	<b>87.8%</b>	<b>77.3%</b>

## 4. Conclusions & Recommendations

Results indicate an increase of pass rates in AE, even with the adoption of a new score to validate it. This study must be continued over the next academic years to consolidate the trend shown by the presented results, and to measure other factors such as the impact of CBE and PBL on students’ interest towards Electronics and related careers.

## References

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