

## Project-Based Learning versus traditional methods in empirical subjects in Finance and Economics

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### Abstract

*This research compares Project-Based Learning (PBL) with Traditional Practices (TP) in empirical Finance and Economics courses at the Faculty of Economics and Business Studies, Universidad Complutense de Madrid. The experience specifically focused on two subjects: Empirical Analysis of Financial Markets and Econometrics, with 66 and 64 students enrolled, respectively. PBL emphasizes real-world tasks and the development of skills such as analytical reasoning, communication, collaboration, and autonomy. The study examines both student and lecturer perceptions regarding learning outcomes, academic performance, and associated challenges. The findings indicate that PBL boosts engagement, teamwork, and practical competencies but it also increases instructor workload, faces student resistance, and highlights possible gaps in foundational knowledge. Successful PBL implementation requires careful planning to maximize benefits and address challenges.*

**Keywords:** *Project-based learning; Active learning; Students projects; Students engagement; Learning motivation; Empirical task.*

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## 1. Introduction

This work examines the effectiveness of Project-Based Learning (PBL) versus Traditional Practices (TP) in empirical subjects. It assesses students' perceptions of learning, skills, and competencies while evaluating the advantages of PBL over traditional methods from both lecturers' perspectives and student academic outcomes.

The learning experience has been implemented in two subjects on quantitative methods (statistics and econometrics) with an empirical focus, one in the Degree in Finance, Banking and Insurance, FBI (Empirical Analysis of Financial Markets, EAFM) and the other (Econometrics) taught jointly in the Degree in Business Administration and Management (ADE) and the Double Degree in Law and Business Administration and Management (D-ADE),

in the Faculty of Economics and Business Studies at Universidad Complutense de Madrid. Both are empirical subjects insofar as they consist not only of the presentation of quantitative methods for economic and financial analysis but also of the development of applications of these methods in the analysis of real-world data. Both focus on their usefulness in using data to test purely theoretical models and hypotheses. They require collecting economic and financial information from various sources to perform quantitative analysis to test economic theories, estimate relationships between variables, and forecast economic trends, thus improving decision-making based on concrete evidence rather than abstract theory.

These subjects require significant student effort and maturity to understand theoretical concepts and quantitative tools for real-world applications. The empirical projects help students see how quantitative methods are used in data analysis. The main difference between traditional and problem-based learning (PBL) projects is that PBL projects are student-designed based on their interests and focus on results. This method addresses problems economists, managers, and financial market agents face. Thus, we believe PBL enhances engagement and motivation, making it ideal for these subjects. We propose to assess whether students and instructors share this view.

The goal is to expose students to two distinct methodologies for empirical projects. TP and PBL have similarities; both aim for students to solve real data problems using quantitative tools in teams. The main difference lies in the roles of students and lecturers in task design, development, and evaluation. In TP, the lecturer directs the process: informing students what to do, providing materials, and evaluating outcomes. Students take a passive role, valuing the practice based on the grade needed to pass. Conversely, PBL centers on active student involvement in task design, with the lecturer acting as a supervisor and guide to ensure project success is viable.

The next objective is to evaluate the experience by gathering data on assessments from students and lecturers. This includes students' subjective learning evaluations for each project, the objective impact on academic results, and lecturers' overall assessments. Information was collected using evaluation questionnaires. Based on the data analysis, the final objective is to describe the experience, present student and lecturer assessments, and draw key conclusions.

The remainder of the paper is structured as follows. Section 2 reviews PBL literature to frame the study. Section 3 describes the methodology, and Section 4 details the results from student and lecturer perspectives. Section 5 concludes by highlighting the unresolved open questions.

## **2. Motivation**

PBL is an active learning method to enhance students' problem-solving and critical-thinking skills (Chen, C. H. and Yang, Y. C., 2019; Guo et al., 2020; Andrés et al., 2022; Martínez

Casanovas et al., 2022). This student-centered approach promotes autonomy by fostering investigation, collaboration, communication, and reflection through practical exercises mimicking real-world situations (Alorda et al., 2011). PBL boosts students' motivation and engagement; although motivation stems from content, it ignites interest and encourages active learning in concrete projects. Krajcik and Blumenfeld (2006) state that PBL involves posing a question or problem, focusing on skill acquisition as a learning objective, ensuring proactive student participation, promoting collaboration, leveraging technology, and creating tangible products.

PBL resembles scientific research through problem-solving and creative collaboration. A key aspect is creating a final product that shows students' understanding of the topic. Wurdinger et al. (2007) note that as students design their projects, they encounter cognitive challenges and enjoy a level of freedom, leading to strong engagement. They gain self-reliance via goal setting, planning, and organization, enhance collaborative skills through social learning, and become intrinsically motivated by making decisions at their own pace (Bell, 2010).

The lecturer should create effective learning scenarios and serve as a guide rather than just transmitting knowledge. PBL success relies on the lecturer's ability to organize learning, motivate, support, and guide students, helping to reduce their cognitive load (Hmelo-Silver et al., 2007). He must discuss the project's purpose, assist in setting clear objectives, and decide on the pace and sequence of work (Helle et al., 2006).

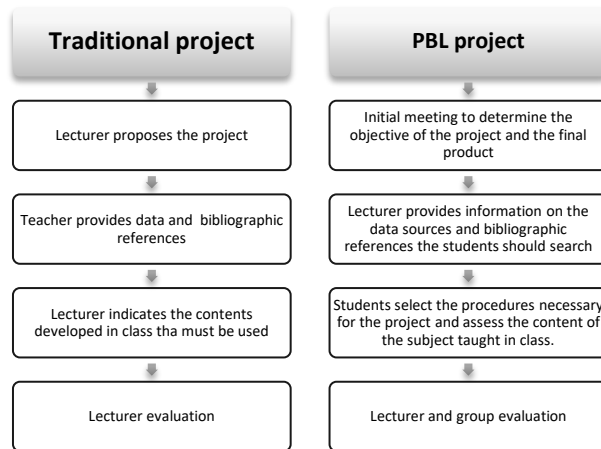
### **3. Methodology**

The methodology has focused on two main objectives: designing and implementing the learning experience, designing assessment questionnaires, and collecting and analyzing data. Figure 1 shows the steps followed in designing both types of empirical projects. It clearly shows that the difference lies in the degree of student involvement and level of responsibility, as TP is fully lecturer-directed. In all cases, the project is developed by a group of students. In the case of the PBL practice, under the lecturer's supervision, the group decided on the tasks to be carried out for each team member and the schedule to meet the required timing.

The methodology used to evaluate the learning experience was subject-specific questionnaires designed to collect the students' assessments using a Likert scale implemented through Google Forms. The student assessment questionnaires were designed in such a way as to state the students' views on the following clearly:

- The importance of PBL practice in the acquisition of competencies.
- The role of PBL practice in the improvement of subject knowledge.
- The importance of the different aspects relevant to the project's design.
- The assessment of the role played by the lecturer in the development of the project.

- The assessment of PBL methodology versus traditional practices.
- Other information they consider relevant.



*Figure 1. Project overview.*

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- The assessment of PBL methodology versus traditional practices.
- Other information they consider relevant.

The lecturers' opinions and assessments have been collected through personal interviews, aimed at obtaining an overall assessment of the experience and its impact on the development of the course and on the attitude, performance, and results of the students.

#### **4. Implementation of the learning experience and results**

In all cases, participation in the empirical projects was voluntary. Students worked in groups of up to three members. Depending on their performance, the project could contribute up to one point to their final course grade. Table 1 displays the project titles, and the student participation rates by project type and subject.

It is worth noting that the voluntary nature of the activity may introduce potential selection bias, as only students with intrinsic motivation for the subject might choose to participate. This appears particularly concerning for EAFM, where only 30% of the projects were returned, while Econometrics shows a less pronounced pattern with a 75% submission rate.

**Table 1. Empirical projects developed.**

| Subject             | Title                                                                                                                   | Reception by students                                                                    |
|---------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| <b>EAFM</b>         |                                                                                                                         |                                                                                          |
| TP                  | Estimating and testing the CAPM asset pricing model.                                                                    | 66 students enrolled/47 followed the course.                                             |
| PBL                 | Valuation of interest rate variation scenarios to contribute to the Basel Committee's proposal.                         | There was an initial positive reception.<br>Only 30% returned the projects.              |
| <b>Econometrics</b> |                                                                                                                         |                                                                                          |
| TP                  | Design a strategy to identify personal characteristics that affect health at birth and propose measures to increase it. | 64 students enrolled/45 followed the course.<br>There was an initial positive reception. |
| PBL                 | Study of birth weight depending on socio-economic characteristics of the family and the mother's habits.                | 75% returned the projects.                                                               |

Delving deeper into the differences between the PBL projects and the TP, in the latter, students were provided with a complete bibliography related to the problem to be addressed, along with a previous example in which the task was nearly solved by the instructor during a seminar-type session.

In the case of Econometrics, the TP approach involved a practical example drawn from the recommended textbook for the course. For EAFM, the CAPM asset pricing estimation had already been covered using different data than that used in the TP assignment.

In contrast, for the PBL assignments, students were required to independently search for relevant literature to support their decisions and justify their actions. In Econometrics, for instance, students had to explore the literature on birth weight over recent decades and develop an estimation model based on their findings. They were expected to gather appropriate data, compare their results with those in the literature, and present a report summarizing their key findings, similar in format to a research paper.

For EAFM, students were asked to take the role of advisors to the Basel Committee legislators, drafting a formal letter evaluating the consequences of proposed legislation under various economic scenarios. To do so, they had to collect relevant data, carry out necessary estimations, and structure their letter as a real advisor would.

#### **4.1. Results of students' assessment**

The results concerning the improvement in the acquisition of competencies are:

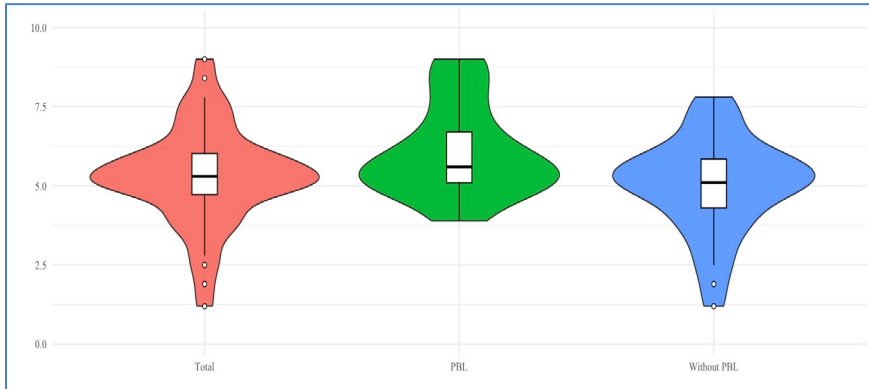
- The competencies identified from the students' responses as most developed by PBL practice are problem-solving, teamwork, time management, and leadership.
- Students felt that the PBL exercises did not particularly contribute to developing Synthesis Skills, Oral Communication skills, Writing Skills, and Creativity.

Concerning knowledge of the subject, most students consider that the PBL practice has increased their interest in the subject, helped them understand its importance in their training, and calibrated the subject difficulty. Evaluating their attitude towards the project, the majority opinion is that they have found it interesting, that it has allowed them to learn the subject better, more than with other types of tasks, and that it has increased their interest in the subject. They consider that they have made good use of the time spent, although they do not consider it fun. Regarding the characteristics of the tasks, the majority are very satisfied with the aspects related to the formation of the groups and the interactions between their components. However, this opinion is not so unanimous regarding the distribution of tasks or the involvement of the members. Again, the opinion unanimously confirms that they would not have done better in individual work. The assessment of the lecturer's role in developing the empirical project also generates unanimity, valuing his role in the initial stage, providing accurate information to the students to carry out the empirical project, and his role as supervisor throughout the process. Finally, the students have a good or very good general assessment of the PBL practice and its role in the active learning of the subject; they are satisfied with the result obtained and would recommend using this methodology in other subjects.

#### **4.2. Results of lecturers' assessment**

Lecturers were interviewed about PBL practices versus traditional methods, costs to lecturers, practical implementation, and effects on academic results. They unanimously consider that PBL practices should encourage students to acquire and apply their knowledge to solve complex real-life problems with tangible results, enabling them to gain a deeper understanding of the subjects in question and lasting knowledge. However, they recognize that they pose a significant challenge for students, which impacted the implementation of this project.

PBL requires significant time investment for designing projects that integrate learning objectives, promote inquiry, develop problem-solving skills, and provide supervision and continuous feedback. However, students show some resistance to change, resulting in participation below expectations, as PBL demands personal responsibility for learning and adjustments in study habits. Many students prefer traditional methods and lack essential prior knowledge, particularly from the FBI grade. Additionally, their attitude isn't conducive to activities needing theoretical, practical, and reflective skills.



*Figure 2. Academic performance by group of students: PBL vs not PBL.*

Lecturers lack a definitive stance on academic results but noted that participants' final grades exceeded the group average. Figure 2 compares results between PBL participants and non-participants in EAFM using a violin plot, illustrating the distribution of marks. The median is slightly higher for PBL participants, with their marks skewed towards the upper tail, in contrast to the lower tail for non-participants, indicating superior performance. Additionally, both maximum and minimum grades are higher for PBL participants, suggesting a positive impact on their academic results.

Lecturers expected higher involvement of students, as PBL proposals were designed as real professional exercises, pushing to the limit of students' previous knowledge base. On the other hand, voluntary participation may have biased the results. Participants may have characteristics related to good performance, such as higher motivation, communication skills, teamwork skills, or prior knowledge. Finally, they consider that to overcome the problems detected, this type of practice should be given more importance, making it compulsory. This would thus overcome their resistance to change and their insecurities. It would also allow for a more effective evaluation of their usefulness in improving students' academic performance.

## **5. Conclusions**

This project has allowed us to prove that PBL is an innovative educational methodology with great potential to transform the way students learn. It encourages active learning, collaboration, critical thinking, problem-solving, and the application of knowledge to real situations.

However, we have also encountered significant challenges in practical implementation, as it has required a significant restructuring of instructional planning and a change in the mindset of students and lecturers to overcome resistance to change. On the other hand, we have observed that the experience needs to be restructured to avoid the selection bias associated with asking students to do it voluntarily when assessing performance.

Finally, it is essential to continue implementing PBL in future courses better to understand its benefits and challenges in empirical subjects. This will allow informed decisions to be made about its larger-scale implementation and maximize its impact on student learning.

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