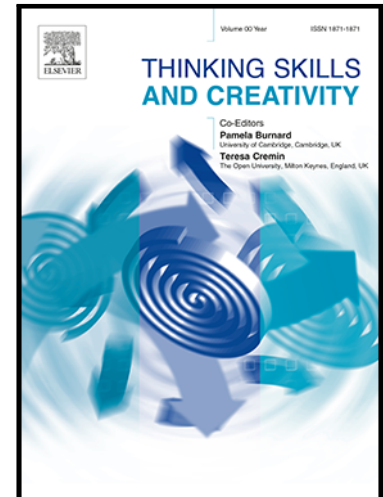


## Journal Pre-proof

The development of critical thinking, team working, and communication skills in a Business School – a Project-Based Learning approach

Eva Dias-Oliveira , Rita Pasion , Rui Vieira da Cunha ,  
Sandra Lima Coelho

PII: S1871-1871(24)00218-9  
DOI: <https://doi.org/10.1016/j.tsc.2024.101680>  
Reference: TSC 101680



To appear in: *Thinking Skills and Creativity*

Received date: 9 June 2023  
Revised date: 31 October 2024  
Accepted date: 1 November 2024

Please cite this article as: Eva Dias-Oliveira , Rita Pasion , Rui Vieira da Cunha , Sandra Lima Coelho , The development of critical thinking, team working, and communication skills in a Business School – a Project-Based Learning approach, *Thinking Skills and Creativity* (2024), doi: <https://doi.org/10.1016/j.tsc.2024.101680>

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2024 Published by Elsevier Ltd.

Highlights:

- We present a Project-based learning approach conducted in a business school
- Business students improved their critical thinking skills
- Business students improved their communication skills
- Business students improved their teamworking skills

Journal Pre-proof

**The development of critical thinking, team working, and communication skills in a  
Business School – a Project-Based Learning approach**

Eva Dias-Oliveira<sup>1, #, \*</sup>, Rita Pasion<sup>1, 2, #</sup>, Rui Vieira da Cunha<sup>1</sup>, Sandra Lima Coelho<sup>1</sup>

Author Note

<sup>1</sup> Universidade Católica Portuguesa, Católica Porto Business School and CEGE

<sup>2</sup> Lusófona University, HEI-Lab: Digital Human-Environment Interaction Labs,  
Portugal

# Rita Pasion and Eva Dias-Oliveira are first co-authors of this article.

\* Correspondence concerning this article should be addressed to Eva Oliveira, [eoliveira@ucp.pt](mailto:eoliveira@ucp.pt)

**Abstract**

This study presents a Project-Based Learning (PBL) approach – the Multidisciplinary Project I course (MPI) - conceived to improve critical thinking skills of first-year business students while also mobilising teamwork and communication skills. The main goals are to 1) describe the methodological PBL approach of MPI and 2) analyse changes in critical thinking, team working, and communication skills during the semester (pre- and post-test) by comparing management and economics students enrolled in MP1 ( $n = 946$ ) to a control group ( $n = 210$ ) including students from other courses. Our findings show that, at the end of the semester, MPI students reported a greater reduction in their critical thinking difficulties and communication apprehension and improvements in teamwork skills. This study provides evidence supporting the inclusion of PBL approaches to promote skills in business students that can be transferable to real-world settings.

*Keywords:* Education; Project-Based Learning; Management; Critical Thinking; Communication; Team working

## Introduction

In 2005, [the school] - a School of Economics and Management – revised its curriculum following Bologna's Agreement principles. This change was grounded on an environmental analysis and stakeholder interviews, identifying key transferable skills for jobs at entry-level positions. Team working, communication skills, and critical thinking stood out as the most nuclear skills [blinded reference], which is consistent with previous studies (e.g., Brink & Costigan, 2015; Calma & Davies, 2021; Cruz et al., 2021; Dias-Oliveira & Guimarães, 2010; Hughes & Jones, 2011). This process promoted a common framework around pre-requisites in employability and teaching practices, leading to reorganising some courses of the old curriculum and designing new ones. Following a systematic procedure, the school focused on developing the targeted, market-valued skills and innovating pedagogically while assessing the effects of the new teaching practices [blinded reference].

Overall, the Management and Economics degree adopted a Project-Based Learning (PBL) approach through a 3-year intervention with three courses (18 ECTS out of the 180) – Multidisciplinary Project I (MP1; 1<sup>st</sup> year, 2<sup>nd</sup> semester), Multidisciplinary Project II (2<sup>nd</sup> year, 1<sup>st</sup> semester), and Final Project (3<sup>rd</sup> year, 1<sup>st</sup> and 2<sup>nd</sup> semester) – one in each year of the undergraduate degree and each one requiring the development of different, yet interconnected projects and skills. These three courses are structured in an incremental way such that students can mobilise competencies developed in the previous year. Overall, they stimulate students to develop their critical thinking abilities, communication and team working skills,

presenting students with challenges and projects related to other courses of their degree (Macroeconomy, Economic Sociology, Introduction to Business Studies, Social Philosophy and Ethics) and the real world (e.g., emerging topics in social philosophy and ethics). Although courses were conceived to target specific skills each year (roughly summarised in the mottos “to think”, for MPI, “to communicate”, for Multidisciplinary Project II, and “to act”, for Final Project), it is important to notice that project tasks may require students to mobilise all these skills at any time and require them to make use of the content from many other courses. Instead of separating content, the courses follow a truly multidisciplinary approach and represented a fundamental paradigm shift, from one centered on the teacher to one focused on students and close cooperation with business companies (e.g., business representatives in academic activities, internships, and field studies).

Currently, the three courses have reached some degree of stability. Thus, it became possible to inquire whether MPI’s “to think”, our PBL approach to promote students’ critical thinking and enhancing market-valued skills, has been truly successful. Guided by this research question, we specifically analyze students’ self-assessment data collected over 5 years regarding critical thinking, communication, and team working skills they are asked to mobilise in the projects they develop in MPI. In the following section we provide context on the importance of PBL as a pedagogical approach to develop the targeted skills.

### **Project-Based Learning in higher education and business schools**

PBL is an inquiry-based instructional method that gained popularity in the 1990s, although its roots in experiential learning can be traced back to John Dewey and its applications in medical and engineering faculties in the 1970s. The concept of learning and teaching through project development was then pioneered by early advocates like Kilpatrick, in the 1920s, who labeled it the "Project Teaching Method." (Clark, 2006). Dewey (1916, 2007) emphasised the need for practical, challenging classroom environments that support individual experiences and

group problem-solving, advocating for a curriculum that encourages students' autonomy and critical thinking. Nussbaum (2016) echoed these views, criticising traditional-expositive methods and proposing active students' participation. Both authors stressed the importance of educational settings that promote practical learning of skills like critical thinking – and business schools are not an exception.

PBL engages learners in knowledge construction through meaningful projects, characterised by free, high-order thinking, constructive investigations, goal setting, collaboration, communication, and reflection within real-world problems (Kokotsaki et al., 2016). Students gain knowledge by completing projects with real-world outcomes (Krajcik & Blumenfeld, 2005), thereby enhancing meaningful learning and skill development (Sharples, 2019). The project is typically decided, planned, and organized by students themselves and guided by the teacher who occupies a mentorship role, providing guidance on the project whenever necessary (Castro & Ricardo, 1993).

Business Schools hold a prominent place in higher education, providing training in economics, management, finance, and sometimes marketing. However, they are increasingly criticised by leading professors (Starkey et al., 2004) for maintaining a curriculum based on a neoclassical economic vision disconnected from post-Industrial Revolution social changes, such as social inequalities, power concentration, climate change, and biodiversity loss (de Muijnck & Tieleman, 2022). The training at these institutions emphasises economic rationality, efficiency, effectiveness, and utility, contributing to an oversimplified view of the field, rendering it crucial to address criticisms regarding students' preparation as future economic agents and citizens (Bennis & O'Toole, 2005; Rasche & Gilbert, 2015).

Criticism on this topic has spurred a global movement among academics, researchers, and students to rethink economics education and its consequences, beyond the growing need to rethink the educational role of higher education in general (Magalhães et al., 2013). This

response can be seen as an "intellectual counterweight" in the economic and political context through training that considers the social context and global interdependence, rethinking the contribution of pedagogical innovation to reviewing traditional economic teaching and learning (Bennis & O'Toole, 2005; Rasche & Gilbert, 2015). By incorporating plural and multidisciplinary knowledge, a more comprehensive and contextualised economic education can prepare students to better understand social, environmental, and economic challenges.

Pedagogical innovation is, therefore, essential for rethinking education in Business Schools. The literature on this topic has introduced new teaching strategies (Fullan, 2015) aimed at active learning methodologies, such as problem-based learning (Duch et al., 2001) and projects (Castro & Ricardo, 1993), as well as the flipped classroom approach (Veiga et al., 2020). Studies indicate that these methods enhance student engagement, their performance, and critical thinking (Carini et al., 2006).

### **The contributions of Project-Based Learning for the development of critical thinking**

A recent meta-analysis of 30 studies (Liu & Pásztor, 2022) revealed that PBL effects are robust in approaches targeting critical thinking in higher education. However, there are only a few studies examining the effectiveness of PBL in promoting critical thinking in business schools and most of these studies rely on inadequate research designs (Bacon & Stewart, 2017; Loyens et al., 2023).

In MBA programs, a more practical approach to teaching, particularly in finance courses, promotes active student participation and contact with business realities. In a sample of 1620 executive MBA students, students with higher critical thinking had the best performance in all the academic areas studied - Operations, Marketing, Finance, and Strategy & Leadership, indicating it is an important skill to increase academic performance, impacting future professional performance (D'Alessio et al., 2019). A PBL experiment in a postgraduate finance program found that students perceived PBL as effective for improving

creativity, communication, team working, organisation, and information management (Parrado-Martínez & Sánchez-Andújar, 2020). In accounting education, Research-Based Learning has shown to improve students' critical thinking skills in business ethics (Nuraini et al., 2021). This set of studies shows that teachers can help students to become critical thinkers by posing meaningful challenges and engaging them in active problem-solving. As such, the benefits of PBL in business education include enhanced learning through the integration of theory and practice, development of essential lifelong skills, improved understanding of the application and relevance of skills in future careers, and facilitation of knowledge transfer across different subject areas (Gibbins et al., 2015). However, challenges such as time constraints, and the need for adequate training in collaboration tools should also be considered (Abdul Manaf et al., 2011).

The implementation of PBL in business schools involves several key elements. First, projects must be designed to address real-world problems that are relevant to the students' field of study. Guo and colleagues (2020) emphasise the importance of aligning projects with current market needs, ensuring that students develop skills that are directly applicable to their future careers. Second, collaboration is a critical component of PBL. Students work in teams, which helps them develop essential skills such as communication, teamwork, and conflict resolution. PBL fosters a sense of community among students, encouraging them to share knowledge and support each other's learning processes (Granado-Alcón et al., 2020). This mirrors the professional environment where most managers operate. Third, assessment in PBL differs significantly from traditional methods. Instead of standard exams, students are evaluated based on their project outcomes, presentations, and reflections on their learning journey. This form of assessment provides a more integrative view of students' abilities, with a strong focus on feedback throughout the project so students can improve their performance (Da Silva et al., 2018). Fourth, PBL requires the role of the instructor to shift from a traditional lecturer to a

facilitator or coach. Professors – in the role of instructors - guide students through the project process, providing support and resources as needed. They help students set realistic goals, manage their time effectively, and reflect on their learning experiences. Kokotsaki and colleagues (2016) note that successful PBL implementation requires teachers to be well-prepared and supported by their institutions, emphasising the need for professional development opportunities that equip educators with the skills needed to implement PBL. While effective PBL implementation requires a significant shift in educational setting and its agenda, cultivating critical thinking skills remains a goal of paramount importance in business education.

However, there is no single, universally accepted definition of critical thinking (Davies, 2015). One widely cited definition comes from a Delphi Report, which characterises critical thinking as: "purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based" (Facione, 1990, p. 3). This work laid the foundation for the categories of skills involved in critical thinking, such identify and frame the problem at hand, analyse arguments, posing and answering questions, challenging questions, clarifying answers, search and collecting pieces of reliable information, being skeptical about common sense and dominant ideas, being open to a plurality of views, recognising the subjectivity of knowledge and the existence of multiple perspectives on the topic, judging sources' credibility, and questioning the validity of assumptions underlying specific hypotheses. For instance, it also encompasses verifying hypotheses, conducting data analysis, recognising possible reasoning bias, and from then proceeding to inference and induction, summarise ideas, translate abstract ideas, and communicate them in an effective way. These abilities can be organized around broader and psychometrically-derived dimensions (i.e., argumentation, defining problems, induction,

generate explanations, drawing conclusions) that might be used to assess challenges that students commonly face in higher education (Powers, 2002), more specifically in the context of PBL that requires critical thinking competencies at its basis (Behar-Horenstein & Niu, 2011a; Braun, 2004; R. Ennis, 2011; Gold et al., 2002; Liu & Pásztor, 2022).

In the context of business education, critical thinking is indeed often linked to managerial capabilities such as strategic thinking, leadership, and effective decision-making (D'Alessio et al., 2019; Smith, 2003). It involves the ability to analyse information, evaluate arguments, and make well-reasoned decisions, based on the available data, in complex business environments (Braun, 2004). The end product is a set of well-reasoned solutions to complex problems in a business world where there are no simple answers (Bandyopadhyay & Szostek, 2019). This foundational role of critical thinking underscores the ongoing debate about the mismatch between students' skills and labour market needs. Calma and Davies (2021) note that critical thinking is underdeveloped in business schools compared to health schools, despite being essential for business. Cruz et al. (2021) clearly state that new graduates in [our country] often lack critical thinking skills needed in the workplace.

Luckily, there is a growing consensus on incorporating active methodologies and critical thinking in higher education (Andrews, 2015; Behar-Horenstein & Niu, 2011a; Loyens et al., 2023; Song, 2016) and business training programs (American Management Association, 2022; Bacon & Stewart, 2017; Braun, 2004; Calma & Cotronei-Baird, 2021; Calma & Davies, 2021; Smith, 2003). This is because this high-order thinking ability is placed by several authorities among one of the most important skills in the repertoire required for adapting to different workplaces in the 21<sup>st</sup> century (Calma & Davies, 2020). Currently, critical thinking is considered as a top priority goal for the planned education achievements of the International Commission on the Futures of Education (2021), mainly because the ability to think critically about oneself and the world is related to higher levels of complexity when solving problems

and proposing innovative solutions in several domains of everyday life, also translating into active citizenship in democratic societies (Halpern, 2013).

There are several methods for teaching critical reasoning, and business schools have adopted various approaches. As discussed in the literature (Abrami et al., 2008; R. H. Ennis, 1989), mixed approaches explicitly teach the fundamental aspects of critical thinking as an independent course - as is the case of MPI - with either infusion or immersion methods. Following an infusion approach, MPI integrates critical thinking into the explicit instructions of existing subject-matter areas and emerging topics in other courses of the degree. Holmes and colleagues (2015) found that explicit instructions in a laboratorial project positively affected the development of critical thinking, which was expressed when students supported data through arguments and integrated reflection during scientific analysis. In business education, following an infusion approach means integrating critical thinking into existing courses by incorporating relevant activities and assignments within marketing, accounting, finance, or management contexts (Roy & Macchiette, 2005; Snyder & Snyder, 2008). This may involve analysing real-world business scenarios, solving complex, open-ended problems collaboratively, engaging in debates on business-related topics, and effective communication (Athanassiou et al., 2003; Borg & Stranahan, 2010; Roy & Macchiette, 2005). Teaching strategies often include employing questioning strategies to challenge assumptions within the framework of managerial decision-making. More specifically, MPI includes the teaching of formal aspects of critical reasoning in the Lectures and practical activities for infusing critical reasoning (e.g., defining problems, induction, generating explanations, drawing conclusions, and argumentation) into existing subject-matter areas in the Workshops. All these activities were devised in articulation with the key courses of Management and Economics (Macroeconomy, Economic Sociology, Introduction to Business Studies, Social Philosophy

and Ethics), such that general teaching practices take place in articulation with real-world emerging topics.

Importantly, argument mapping and argumentation are used as the main tools to promote higher-order reasoning in increasingly complex business environments (Braun, 2004; Davies, 2011; Freeley & Steinberg, 2013; Gold et al., 2002; Kunsch et al., 2014; McPeck, 2016; Suter, 2011; Twardy, 2004). Argument mapping was introduced in MPI: (1) to support the conceptualisation of a PBL program aiming to promote critical thinking, and (2) to provide a concrete tool for students to apply repeatedly critical thinking skills to situations and decisions that mirror those they can find in their professional context.

Following argument mapping practice, students are also required to conduct a debate. The debate context is suitable for the use of argument mapping while mobilising related skills. Debate preparation puts together competencies such as: synthesising and articulating key points of an argument, balancing the priority of these different points, gathering empirical data to sustain an idea, challenging assumptions, recognising contradictions, and thinking about, evaluating, and rebutting opposing arguments (Doody & Condon, 2012; Zare & Othman, 2015). Remarkably, a meta-analysis from Abrami and colleagues (2015) revealed that opportunities for dialogue and group discussions, mentoring and the exposure of students to authentic problems have positive effects on critical thinking. Moreover, students rate debate as being more effective than role plays to explore new perspectives (Latif et al., 2018), which unveils the importance of the argument-debate interplay to promote critical thinking (Doody & Condon, 2012; Omelicheva, 2007; Zare & Othman, 2015).

Finally, MPI provides the opportunity for students to mobilise communication and teamwork skills. Activities designed for the writing up of arguments and for preparing the debate sessions yield close connections with team working and communication in complex and unstructured challenges (Camp & Schnader, 2010; Darby, 2007; Freeley & Steinberg,

2013; Garrett et al., 1996; Latif et al., 2018; Zare & Othman, 2015). It is commonly agreed that communication skills are fundamental for everyday interactions and influence the way students can be evaluated in real-life situations, namely in a first impression (Brink & Costigan, 2015; Liao, 2009). Thus, students are expected to master the skills necessary to work effectively with their teams, especially considering that some form of team-oriented work is needed in most organisations today (Hughes & Jones, 2011; Prichard et al., 2006). Debate-related activities seem to promote a wide variety of teamwork abilities, especially when it is used as a learning experience and not as a test of knowledge (Darby, 2007). Students need to prepare the debate and the main argument, and this requires not only critical thinking skills but also to communicate effectively with the group, define a concerted strategy, share duties, divide roles and gather efforts to complete a common task (Latif et al., 2018; Prichard et al., 2006). Therefore, debates involve both task-oriented behaviours related to critical thinking (e.g., task planning and search for information) and socio-emotional skills related to communication and teamwork skills (e.g., to release group tension during conflicts, support and encourage others, and group cohesion) (Seymour, 2013). In a sample of about 1000 individuals enrolled in the Financial Accounting Principles course, a survey demonstrated that students in the PBL class improved their presentation skills, teamwork, and leadership, compared to the non-PBL class, and especially when they showed some basic accounting knowledge (Abdul Manaf et al., 2011). During a Project Management course (Universitat Internacional de Catalunya, Business Administration degree), where students had to perform several presentations following a PBL methodology, findings reveal they developed communication skills that helped them presenting their work in front of the public (Berbegal Mirabent et al., 2016). After PBL-based interventions, previous studies show indeed that business students improve their teamworking and communication skills (Llorente et al., 2023; Loyens et al., 2023; Macho-Stadler & Elejalde-García, 2013; Morimoto, 2016;

Parrado-Martínez & Sánchez-Andújar, 2020; Walters & Sirotiak, 2011). Together with critical thinking, these skills are important because in students' daily professional life, since they will be continuously asked to lead meetings and negotiations, manage teams, collaborate with other departments, and make decisions.

From the literature review, and considering all the evidence together, we establish the following hypotheses: using a PBL approach, MPI students improve critical reasoning, communication, and team working skills over the course of the semester.

## **Methods**

### **MPI - "To think" training program**

The MPI "To think" training program was designed to develop critical reasoning skills in Business Schools using PBL principles. Its main goals are to improve students' discourse abilities, as well as skills around identifying problems, elaborating an argument, inductive thinking, in-group collaboration, and communication skills. The program focuses on analysing the logical and argumentative structure of texts, by constructing evidence-based arguments and exploring different perspectives. It also includes support from psychologists from the Career and Development Office – the strategic hub of the school - to help students manage the complexity of the course and public speaking anxiety (4 sessions, of 1h30m each, in a total of 6 hours in the semester).

In MPI, the semester unfolds in 14 weeks with 12 Lectures (1h30 length, 18h in total) and 14 Workshops (3h length, 42h in total). Lectures (in large classes of 50 to 100 students) provide the theoretical backbone, covering argumentation theory and fallacies (Bowell & Kemp, 2005; Walton, 2005; Weston, 2018), current research on cognitive bias (Kahneman, 2011), rhetoric in economics and management (Hartelius & Browning, 2008; McCloskey, 1983), as well as the neuropsychology of persuasion (Kaplan et al., 2016). Guest lecturers from business highlight the practical importance of argumentation and critical reasoning in

real-world settings. This aligns with Guo et al.'s (2020) emphasis on aligning PBL projects with industry needs and current market trends.

Working with classes of 20 to 25 students, the Workshops further subdivide into smaller groups of 4-5 students, working on projects related to core courses like Macroeconomics, Economic Sociology, and Business Studies. These projects follow three learning cycles in a recursive model, involving argument exploration, tutoring, debate, and feedback. Each cycle builds upon the previous one, allowing students to refine their skills through iterative learning, in line with Kokotsaki, Menzies, & Wiggins (2016) and the PBL model outlined by Liu & Pásztor (2023). Table 1 systematises the main activities of the Workshops.

The first phase of the learning cycle - Exploration of the Topics for Debate - involves the Workshops' class in exploring a topic through videos or texts, followed by unstructured debates. For example, in the Introduction to Business Studies module, students debated whether a manager's main goal is shareholder satisfaction. Bibliography and tools for argument analysis and mapping are provided to promote critical thinking at this stage. In this activity, students are provided with bibliography to conduct argument analysis and argument mapping to promote higher-order reasoning (Davies, 2011; Freeley & Steinberg, 2013; Gold et al., 2002; Kunsch et al., 2014; McPeck, 2016; Suter, 2011; Twardy, 2004). This gives students a first use of critical thinking tools applied to economics and management themes, before moving on to working in smaller groups. It also ensures a basic understanding of both argumentation tools and debates' topics. These activities are based on the constructivist principles underlying PBL, where learning is context-specific, involves active participation, and is achieved through social interactions and shared knowledge (Biggs, 1996).

The second phase involves research and personalised tutoring in small groups of 4-5 students (i.e., Orientation Meetings per group). Each group researches a topic and prepares arguments for the debate. For example, one debate topic focused on artificial intelligence's

impact on managerial roles. Groups autonomously draft their arguments, with feedback from the instructor, but final decisions rest with the students. This process incorporates critical thinking elements (Facione, 1990) and reflects the instructor's facilitative role in PBL (Kokotsaki, Menzies, & Wiggins, 2016). On the one hand, the students lead the process of building the written arguments and preparing the debate, in which they can practice key elements of critical thinking, including interpretation, analysis, evaluation, and induction, as well as explanation of evidential and contextual considerations (Facione, 1990). On the other hand, the personalised tutoring approach reflects the PBL's shift in instructor role described by Kokotsaki, Menzies, and Wiggins (2016), where teachers become facilitators who guide students through the project process, providing support and resources as needed.

The third phase is the debate itself, where groups present their arguments in an oral debate. The debate combines features of different competitive models (Karl Popper, Parliamentary and Cross-Examination – Omelicheva, 2007) and each one takes 21 minutes in total with distinct, sequential moments – argument presentation, 1st conference, 1st refutation, 2nd conference, 2nd refutation, 3rd conference, and conclusion. The duration of the classes allows for all six groups to participate, amounting to 3 debates. The group presentation of the project/argument is a public session which is crucial to ensure that PBL's principles are met, with evidence showing that group active learning and mastery in formal debates promote critical reasoning, communication, and team working – that can extend beyond the day of the debate itself (Doody & Condon, 2012; Zare & Othman, 2015). Students receive feedback from the instructor and peers after each debate, which helps students improve in subsequent learning cycles, aligning with PBL principles and fostering skills in reasoning, communication, and teamwork (Doody & Condon, 2012; Zare & Othman, 2015).

Assessment in the MPI program differs from traditional methods, focusing on project outcomes, presentations, and reflections rather than standard exams. The grading system

includes both individual and group components, with individual assessments based on argument analysis and argument construction, and group assessments based on written and oral performance in debates. This reflects the comprehensive assessment methods advocated by Da Silva et al. (2018) for PBL, incorporating both formative and summative evaluations.

In sum, the MPI “To Think” training program effectively implements PBL, and critical thinking principles as described in the literature, providing a robust educational experience for business students. By focusing on practical application, interdisciplinary thinking, and iterative learning, MPI prepares students to tackle complex problems and communicate effectively in professional settings.

Table 1.

Sequence of MPI activities and examples of topics approached.

week	Lecture – Topics approached	Workshop - Activities	Workshop – Examples of topics approached
1	L1 Basic aspects and types of arguments, especially by examples, authority and analogy	Ws1 Course introduction Assessment - pre-test	
2	L2 Analysis and argument reconstruction	Ws2 Exploration of Topics for Debate 1	Ws2 A manager's primordial goal IS / ISN'T to guarantee the satisfaction of the shareholders economic interests.
3	L3 The structure of debate, the speaker and their audience	Ws3 Tutoring/Orientation Meetings 1	Ws3 cf. Debate 1 below
4	L4 Deductive arguments	Ws4 Debate 1 and Feedback	Ws4 D1.1: The growing presence of artificial intelligence in companies IS / ISN'T a threat to the roles that managers perform.  D1.2: To perform well, an organisation NEEDS / DOESN'T NEED a young workforce.  D1.3: A manager's technical competence IS / ISN'T more important than their behavioural integrity.
5		Ws5 Individual Written Assessment 1	Ws5 In the global organisational context, autonomy IS / ISN'T more valued than obedience.

6	L5 Inductive arguments	Ws6 Exploration of Topics for Debate 2	Ws6 Success in life IS / ISN'T determined mainly by the individual (such as through skills and hard work).
7	L6 Fallacies	Ws7 Tutoring/Orientation Meetings 2	Ws7 cf. Debate 2 below
8	L7 Rhetoric in economics and management	Ws8 Debate 2 and Feedback	Ws8 D2.1: It IS / ISN'T legitimate that, today, work takes precedence over family life.  D2.2: European Union member states SHOULD / SHOULDN'T implement unconditional basic income.  D2.3: Degrowth SHOULD / SHOULDN'T be implemented.
9		Ws9 Individual Written Assessment 2	Ws9 Current Western societies, such as Portugal, ARE / AREN'T truly meritocratic.
10	L8 Guest Lecturer	Ws10 Exploration of Topics for Debate 3	Ws10 The State IS / ISN'T the main driver of economic growth.
11	L9 Guest Lecturer	Ws11 Tutoring/Orientation Meetings 3	Ws11 cf. Debate 3 below
12	L10 Heuristics and biases	Ws12 Debate 3 and Feedback	Ws12 D3.1: State intervention in the financial sector IS / ISN'T beneficial to society.  D3.2: Monetary policy SHOULD / SHOULDN'T be discretionary.  D3.3: School vouchers SHOULD / SHOULDN'T be implemented.
13	L11 Neuroscience and psychology of persuasion (critical thinking, biases, persuasion and influence)	Ws13 Individual Written Assessment 3	Ws13 International financial institutions SHOULD / SHOULDN'T take a central role in managing the sovereign debt of countries in crisis.
14	L12 Final Debates	Ws14 Final Debates Assessment - post- test	Ws14 Economic inequality IS / ISN'T an obstacle to economic growth.  In Portugal, Social Security SHOULD / SHOULDN'T be privatised.  There SHOULD / SHOULDN'T be a market for buying and selling human organs.

## Sample

A total of 1156 first year undergraduate students were included in the sample of the current study.). 946 students (47.0% male,  $M_{age} = 18.5$  years-old,  $SD_{age} = 1.03$ ,  $M_{GPA}^1 = 16,8/20$ ,  $SD_{GPA} = 1,18$ ) were enrolled in MPI, [the school] - (Economics (17%) and Management (83%). 210 students were assigned to the control group (20,9% male,  $M_{age} = 19,5$  years-old,  $SD_{age} = 4.48$ ,  $M_{GPA} = 16,7/20$ ,  $SD_{GPA} = 1.45$ ) and they were mainly recruited from Psychology (55%), Law (18%), Engineering (6%), Economics (6%), and Health schools (6%). The control group had no formal training on critical thinking (i.e., no courses in which this learning goal was explicit).

Both groups completed the same protocol (i.e, pre- (T1) and post-test measures (T2)), at the same time-interval (i.e., 1<sup>st</sup> year, 2<sup>nd</sup> semester). The pre-test was completed at the beginning of the semester (e.g., class 1, first week of the semester for MPI students) and the post-test assessment was conducted at the end of the semester (e.g., class 14, last week of the semester for MPI students). Data collection took place from 2017/2018 to 2021/2022 academic years.

Both groups completed the questionnaires online on Qualtrics. All participants gave informed consent and were aware that they could refuse to participate or withdraw at any time. Students from [the school] were also told that their answers would never be known by professors, and participants generated anonymous codes to match pre- and post-test assessments. All procedures were approved by the Local Ethical Committee (ref. CE.275.2018).

## Measures

**Critical thinking skills.** The Self-Assessment of Reasoning Skills (Powers, 2002) was conceived to measure reasoning skills commonly conceptualised under the critical

---

<sup>1</sup> Grade Point Average at the entrance of the university

thinking definitions we reviewed in the introduction section. It includes various reasoning tasks and requires students to identify the difficulty of each task. More specifically, it measures capabilities around argumentation (5 items,  $\alpha_{T1/T2} = .69/.74$ , e.g., “elaborating an argument and developing its implications”), drawing conclusions (4 items,  $\alpha_{T1/T2} = .75/.78$ , e.g., “determining if conclusions are consistent with and supported by the data”), defining problems (4 items,  $\alpha_{T1/T2} = .63/.73$ , e.g., “breaking down complex problems into simpler ones”), induction (4 items,  $\alpha_{T1/T2} = .68/.76$ , e.g., “synthesising two different positions into a third one”), and generating explanations (3 items,  $\alpha_{T1/T2} = .68/.75$ , e.g., “searching for counterexamples to test an argument or explanation”). Higher scores in these subscales indicate greater difficulties in critical thinking (4-point Likert scale, from 1- “very easy” to 4 -“very difficult”). The Argumentativeness Scale (Infante & Rancer, 1982) was developed to measure individual tendencies toward engaging in intellectual challenges such as actively searching for competitive situations that include defending a point of view. It is highly influenced by the probability of success and failure when presenting an argument and, hence, this scale measures either the tendency to approach (10 items,  $\alpha_{T1/T2} = .86/.88$ , e.g., “I enjoy a good argument over a controversial issue”) or avoid argumentation (10 items,  $\alpha_{T1/T2} = .80/.86$ , e.g., “Once I finish an argument I promise myself that I will not get into another”). Higher scores in these subscales reveal, respectively, higher approach or avoidance to argumentation contexts (5-point Likert scale, from 1- “almost never true” to 5 - “almost always true”).

**Communication skills.** The Personal Report of Communication Apprehension (McCroskey, 1978) evaluates levels of fear or anxiety in four communication contexts: one-to-one interactions (6 items,  $\alpha_{T1/T2} = .85/.85$ ), small groups (6 items,  $\alpha_{T1/T2} = .88/.86$ ), meetings (6 items,  $\alpha_{T1/T2} = .92/.90$ ), public (6 items,  $\alpha_{T1/T2} = .88/.88$ ). Sample items include: “I dislike participating in group discussions”, “I am afraid to express myself at meetings”, “I have no fear of speaking up in conversations (reverse coded)”, and “I feel relaxed while giving a

speech (reverse coded)”. Higher scores in these subscales indicate higher apprehension and anxiety when communicating in different contexts (5-point Likert scale, from 1 - “strongly agree” to 5 - “strongly disagree”).

**Team working skills.** The Teamwork Evaluation Form (Hobson et al., 2014) measures the behaviours in group discussion exercises. It assesses both positive (15 items,  $\alpha_{T1/T2} = .85/.90$ , e.g., “gave positive feedback to teammate”) and negative behaviours (10 items,  $\alpha_{T1/T2} = .83/.92$ , e.g., “started a side conversation while a teammate was talking”). Higher scores on these scales represent a higher frequency of such behaviours (5-point Likert Scale, from 0 - “never” to 4 - “always”).

### Data analysis

The two groups clearly differed from the beginning, especially because the control group includes students enrolled in different courses and universities as compared to the intervention group. To account for this, T1 scores were subtracted to T2 scores. In other words, for each scale dimension, differences between pre- to post-test scores were used to remove any discrepancies between groups at the baseline that could not be attributed to training.

Since the included questionnaires have several subscales, we conducted Multivariate ANOVAs with a between-subject factor (Group: MP1 and controls) and a within-group factor to account for the covariance between these subdimensions (i.e., all subdimensions were included for each questionnaire at the same time in the model). Group post-hoc comparisons were adjusted with Bonferroni’s correction.

We further conducted paired-sample t-tests to evaluate the progress of each group along the semester. Means, Standard Deviations, p-values and Cohen’s d (Cohen, 1988) are reported to evaluate mean differences between T2 and T1 for each group.

## Results

### Critical thinking and argumentativeness

There were differences between groups in 3 dimensions of critical reasoning: drawing conclusions,  $F(1, 1116) = 6.62, p = .010, \eta_p^2 = .006$ , defining problems,  $F(1, 1116) = 7.35, p = .007, \eta_p^2 = .007$ , and induction,  $F(1, 1115) = 4.71, p = .030, \eta_p^2 = .004$ . That is, MPI students reported a significant reduction in their difficulties in critical thinking at the end of the semester (Table 2). There were no differences in elaborating an argument and generating explanations, both  $p > .249$ . Evaluating the progress from T1 to T2, both groups showed less difficulties in induction at the end of the semester, even though effects are stronger in magnitude for the MPI group (MP1,  $d = -.336, p < .001$ ; controls,  $d = -.170, p = .008$ ). In the remaining dimensions (i.e., elaborating an argument, drawing conclusions, defining problems, generating explanations), only the MPI group show less difficulties in critical reasoning.

Moreover, there were differences in argument approach  $F(1, 1111) = 4.13, p = .042, \eta_p^2 = .004$  (but not in argument avoidance,  $F < 1$ ) such that MPI students reported at the end of the semester a higher propensity to look for opportunities to discuss a point of view (Table 2). From T1 to T2, we can see that only MPI students improved in both dimensions of argumentativeness (all  $p < .001$ ; Table 2).

### Communication skills

Differences were statistically significant between groups for all the communication apprehension dimensions: one-to-one interactions,  $F(1, 1110) = 5.27, p = .022, \eta_p^2 = .005$ , small groups,  $F(1, 1110) = 12.2, p < .001, \eta_p^2 = .011$ , meetings,  $F(1, 1110) = 17.7, p < .001, \eta_p^2 = .016$ , public speaking,  $F(1, 1110) = 9.88, p = .002, \eta_p^2 = .009$ . At the end of the semester, MPI students perceived lower communication apprehension than controls in these dimensions (Table 2).

In the longitudinal approach, both groups reduced apprehension for communicating in meetings (MP1,  $p < .001$ ; controls  $p = .002$ ), although the result is stronger for MPI (Cohen's  $d$  -

.499 vs. -.202). In the remaining dimensions only the MPI group reported significant reductions in apprehension in communication.

### Team working skills

No differences were found between groups regarding the teamwork dimension of positive behaviours,  $F(1, 1107) = 1.32, p = .250, \eta_p^2 = .001$  - both groups displayed improvements from T1 to T2 on the positive teamwork behaviours dimension (MPI,  $d = .351, p < .001$ ; controls,  $d = .228, p < .001$ ). However, MPI students reduced their negative behaviours when working with peers compared to controls who seemed, in the opposite direction, to increase their negative behaviours.  $F(1, 1107) = 10.32, p = .001, \eta_p^2 = .009$  (Table 2). From a within-group longitudinal analyses, there were no significant differences in MPI students' teamwork negative behaviours between T1 and T2, while the control group exhibited higher teamwork negative behaviours in T2 when comparing to T1 ( $d = .242, p < .001$ ).

Table 2.

Means ( $M$ ), Standard Deviations ( $SD$ ), Minimum and Maximum Scores for all study variables at pre- and post-test (T1 and T2, respectively) by group (Project I and Controls). *Legend: + suggests students' positive progression on the specific skill, - suggests students' negative outcomes on the specific skill.*

	GROUP: MPI				Cohen's d	p- value	GROUP: CONTROLS				Cohen's d	p- value
	T1		T2				T1		T2			
	$M \pm SD$	Min- max	$M \pm SD$	Min- max			$M \pm SD$	Min- max	$M \pm SD$	Min- max		
<b>Argumentativeness</b>												
Approach (10 items)	36,5 $\pm 6,19$	15-50	37,5 $\pm$ 6,47	12-50	.183 (+)	< .001	36,4 $\pm 6,74$	17-50	36,4 $\pm$ 7,00	19-50	.036 (ns)	.306
Avoidance (10 items)	23,9 $\pm 6,11$	10-45	23,3 $\pm$ 6,95	10-50	-.102 (+)	.001	24,9 $\pm 6,69$	10-45	23,5 $\pm$ 6,91	10-50	-.111 (ns)	.059
<b>Difficulties - Critical Thinking</b>												
Difficulties - Elaborating an argument (5 items)	11,8 $\pm 2,22$	5-9	11,4 $\pm$ 2,45	5-20	-.125 (+)	< .001	11,2 $\pm 2,46$	5-17	11,1 $\pm$ 2,42	5-20	-.042 (ns)	.276
Difficulties - Drawing conclusions (4 items)	9,05 $\pm 1,98$	4-16	8,59 $\pm$ 2,13	4-16	-.198 (+)	< .001	8,43 $\pm 2,13$	4-14	8,43 $\pm$ 2,11	4-16	-.002 (ns)	.487

Difficulties - Defining problems (4 items)	9,91 ±1,87	4-16	9,20 ± 2,12	4-16	-.307 (+)	< .001	9,51 ±2,14	4-15	9,31 ± 2,20	4-16	-.087 (ns)	.106
Difficulties - Induction (4 items)	10,2 ±1,93	4-16	9,42 ± 2,14	4-16	-.336 (+)	< .001	10,1 ±2,08	4-15	9,67 ± 2,26	4-16	-.170 (+)	.008
Difficulties - Generating explanations (3 items)	6,88 ±1,65	3-12	6,51 ± 1,71	3-12	-.196 (+)	< .001	6,50 ±1,64	3-12	6,55 ± 1,81	3-12	.037 (ns)	.297
<b>Apprehension in Communication</b>												
Apprehension - One-to-one interactions (6 items)	15,1 ± 4,49	6-30	14,5 ± 4,43	6-30	-.141 (+)	< .001	15,8 ± 4,85	6-28	16,0 ± 4,94	6-30	.038 (ns)	.295
Apprehension - Small Groups (6 items)	16,9 ± 4,98	6-30	15,4 ± 4,71	6-30	-.329 (+)	< .001	17,0 ± 5,35	6-30	16,8 ± 5,09	6-29	-.063 (ns)	.186
Apprehension - Meetings (6 items)	16,8 ± 5,45	6-30	14,2 ± 5,02	6-30	-.499 (+)	< .001	17,5 ± 5,84	6-30	16,7 ± 5,42	6-29	-.202 (+)	.002
Apprehension - Public speaking (6 items)	18,6 ± 5,19	6-30	17,3 ± 4,97	6-30	-.315 (+)	< .001	18,5 ± 5,44	6-30	18,4 ± 5,74	6-30	-.081 (ns)	.128
<b>Team working</b>												
Positive Behaviours (15 items)	59,9 ± 6,73	30-75	62,6 ± 7,91	39-75	.351 (+)	< .001	58,9 ± 8,29	32-75	60,8 ± 7,47	15-75	.228 (+)	< .001
Negative Behaviours (10 items)	18,0 ± 4,87	10-47	17,6 ± 7,36	10-50	-.044 (ns)	.091	15,7 ± 4,89	0-34	17,0 ± 5,72	10-50	.242 (-)	< .001

## Discussion

Several studies highlight that there is a need to develop pedagogical programs that match students' skills and labour market needs (Bacon & Stewart, 2017; Calma & Davies, 2021; Cruz et al., 2021; Dias-Oliveira & Guimarães, 2010). Academic knowledge seems insufficient in complex business contexts where critical thinking-related aspects such as problem-solving, weighing possible alternatives, information evaluation, and informed decisions are constantly required. As a result, critical thinking is thought to be a nuclear skill in business contexts. Contemporary teaching methodologies – such as PBL - emphasise the need for developing students' transversal skills based on a bidirectional flow of knowledge from teacher to student. In this context, MPI was conceived to improve critical thinking skills while also mobilising team working and communication skills. There is a lack of studies, especially in business schools, assessing changes in learning outcomes related to these skills. This is a necessary step to determine whether the implemented learning procedure was truly effective (Bacon & Stewart, 2017; Loyens et al., 2023). For instance, Calma and Davies (2021) recently posed the question: do the critical thinking skills of students improve at the end of business

studies, as evaluated by well-validated pre- and post-test indicators and including experimental and control groups?

The current study aimed to examine the pedagogical program of MPI in developing critical thinking, team working, and communication skills throughout the semester. We anticipated that students enrolled in MPI would display higher critical thinking, team working, and communication skills at the end of the semester compared to the control group.

This hypothesis on group comparison was partially confirmed and, importantly, while effects sizes were on the small-to-medium range when comparing T1 and T2 scores in the intervention group, they were mostly negligible in the control group. The next sections will explore the main results for each skill separately.

### **Critical Thinking**

Previous studies reported that active learning methodologies, such as PBL, can enhance students' critical thinking, ability to questioning established norms, and autonomy with a positive impact in increasingly complex business worlds (Braun, 2004; Carini et al., 2006; Davies, 2011; Freeley & Steinberg, 2013; Gold et al., 2002; Kunsch et al., 2014; McPeck, 2016; Suter, 2011; Twardy, 2004)

Students from MPI reported a greater reduction in their difficulties across several dimensions of critical thinking by the end of the semester compared to the control group. They reported being more able to define problems, use induction, and draw conclusions. That is, MPI students seemed to perceive themselves as more able at the end of the semester to break down complex problems into simpler ones, identify the main variables of a problem, deriving abstract or general principles from individual facts or cases, translate abstract pieces of information into explicit ones, drawing sound inferences from observations, supporting conclusions with sufficient information. Effects seem to be stronger from T1 to T2 in the intervention group in dimensions related to defining problems and induction, with small-to-

medium effect sizes being observed. Despite significant, the dimension drawing conclusions yielded a negligible-to-small effect.

In the longitudinal analyses, there were also differences in MPI students' perceptions around their ability of being more capable of elaborating an argument and generating justifications. However, effect sizes were very small in magnitude. Moreover, when we compare the score differences in MPI students' and the control group in these dimensions the results are not statistically significant. We suggest MPI students may have more difficulties in elaborating an argument and generating justifications comparing to other dimensions of critical thinking; that is, recognising the main argument of a thesis and its implicit premises, fallacies, and evidence that can refute hypotheses, finding it difficult to search for counterexamples and alternative explanations for this kind of data. This was unexpected considering the focus of MPI tasks, but it provides valuable information for the team to target these skills more deeply in the future. Students likely become so focused on searching for information supporting their point of view in the debate that they do not invest enough time in thinking about alternative hypotheses and possible refutations. This may be particularly true when students must argue in favour of an idea that already matches their initial beliefs. The debate topics and their respective positions are attributed randomly between groups, but sometimes students inevitably defend what they already believe.

An alternative explanation is that students received considerable feedback on how they should write justifications and refutations – a skill required in the course -, which may have made students more aware of their real capacities, thereby adjusting their initial beliefs. It is also important to acknowledge that MPI tasks increase gradually in their difficulty during the semester, possibly also marking out what students can do.

Nevertheless, our results clearly advocate that it should not be expected that critical thinking will merely improve because students are enrolled in higher education courses, as the

longitudinal effects in the control group were non-significant. These findings are consistent with previous studies in MBA, postgraduate finance programs, and in accounting education (D'Alessio et al., 2019; Nuraini et al., 2021; Parrado-Martínez & Sánchez-Andújar, 2020). Specifically, PBL can promote active learning and critical thinking because it creates several problem-solving contexts, requiring in turn many other related skills and promoting a good learning atmosphere (Nuraini et al., 2020). Our study corroborates that teachers can help students to become critical thinkers, which is likely to influence long-term professional outcomes and citizenship (Bennis & O'Toole, 2005; Halpern, 2013; Rasche & Gilbert, 2015).

Regarding argumentativeness, MPI students perceived a higher propensity to approach arguments at the end of the semester, when compared to the control group. Also, longitudinal analysis revealed that within-group, MPI students reported a reduction in their tendency to avoid argumentation over the course of the semester, despite the small effects (non-significant in controls). This is in line with Sharples's study (2019) which proposes that when students have the chance to work in real problems, as they do in MPI, they learn in a more meaningful way and, therefore, may be more motivated to produce arguments with higher validity and quality. Altogether, this leaves open the possibility that MPI students will look in the future for opportunities for discussing a point of view – which may contribute to further developing their critical thinking abilities. Critical thinking is not expected to develop at once but gradually to higher levels of complexity. Overall, it seems that each learning cycle and project in MPI provided an important foundation for students to think critically – an ability that will be continuously required and reinforced during the training years, especially in the courses of Multidisciplinary Project II and Final Project.

### **Communication skills**

At the end of the semester, MPI students perceived lower levels of communication apprehension and anxiety than controls. In some of the variables, MPI students and controls

began with similar scores, but substantial reductions in communication apprehension were observed only in the MPI group. This effect was found in all four dimensions of communication apprehension. Interestingly, effects were less robust in one-to-one interactions and more robust in dimensions that MPI targets - speaking in small group interactions, in group meetings, and in public. Comparing T1 and T2, Cohen's  $d$  of group meetings in the intervention group is in the threshold of a moderate effect size, while public speaking and small group interactions are in the small-to-medium range. The effect size in one-to-one interactions was negligible, despite significant.

The results seem to indicate that the debate promotes a decrease in communication apprehension – which is an essential step for the challenge students will face in Multidisciplinary Project II, where they are expected to deepen their communication skills more systematically, and in business contexts. For instance, debate contexts can be even more complex scenarios than oral presentations because they include moments where students must rebut arguments they were not expecting, being virtually impossible to anticipate and train at home all the main arguments to be used in refutations. This is especially true given non-significant results in the control group; that is, the unique context that debates offer to train complex communication skills should be intentionally integrated into the curriculum.

Seymour (2013) asserts that debates involve a set of group task-oriented behaviours and socio-emotional skills that play an important role in communication and teamwork skills. Earlier studies documented that PBL classes in business schools had positive effects in presentations skills, and public communication (Abdul Manaf et al., 2011; Berbegal Mirabent et al., 2016; Llorente et al., 2023; Macho-Stadler & Elejalde-García, 2013; Morimoto, 2016; Parrado-Martínez & Sánchez-Andújar, 2020; Walters & Sirotiak, 2011). Some authors further argue that initial distress, anxiety, and communication apprehension can weaken or vanish with practice, making students ready for their future professional challenges (Goodwin, 2003;

Omelicheva, 2007; Zare & Othman, 2015). Our findings align with previous investigations since communication apprehension and feelings of anxiety seem to be reduced in students that were continuously exposed to debates and public speaking – apart from small group conversations and meetings that can also be stressful, especially when disagreements exist.

Nevertheless, some extreme anxiety manifestations can be hard to deal with, especially at the individual level and in the classroom context. This is precisely one of the challenges that PBL approaches face. For this reason, MPI articulates with counseling services of the university.

### **Team working skills**

Providing students the opportunity to work together on group products is expected to increase their understanding of how to work more effectively together and gain more experience in effective strategies. Nonetheless, requiring students to work together will not turn them into a team automatically, being necessary to invest and spend time in this process (Prichard et al., 2006). Problem-solving and critical thinking is such a way to facilitate the development of team-skills abilities. More specifically, MPI is directed at concrete goals that require detailed action planning to determine how they can be achieved and requires the development of communication and role clarification in dividing tasks and public interventions during debates.

From our results, no difference exists between groups in positive behaviours displayed during work groups. Indeed, longitudinal analysis showed that both groups improved positive behaviours, although effects were stronger in MPI. In what concerns teamwork negative behaviours, only students enrolled in MPI display a reduction in this sort of behaviours at the end of the semester. MPI may contribute to reduce students' propensity of not giving verbal inputs during team discussions, interrupt a teammate, give derogatory criticism directed to a specific person, brought-up topics unrelated to the discussion, start side conversations, refuse

to compromise, fail to allow others to talk, insisting that his/her idea is the only right one, create inappropriate humor situations, be pessimistic and complaining. By contrast, the students included in the control group increased their teamwork negative behaviours at the end of the semester, probably demonstrating how important it is to assign specific tasks, mentoring students and provide continuous feedback.

These findings highlight that MPI is targeting team working skills and conflict resolution among groups in a context much closer to a learning experience than an individual test of knowledge (Darby, 2007). Students are required to complete a set of tasks of high complexity (e.g., writing the argument and conducting the debate), which will likely to expose students to moments of conflict that need to be solved to complete a common task (Latif et al., 2018; Prichard et al., 2006) – especially because MPI groups are randomly assigned. Actually, previous research had demonstrated that PBL promotes nuclear competences in business students such as collaboration, conflict solving, and teamwork (Abdul Manaf et al., 2011; Berbegal Mirabent et al., 2016; Llorente et al., 2023; Loyens et al., 2023; Macho-Stadler & Elejalde-García, 2013; Morimoto, 2016; Parrado-Martínez & Sánchez-Andújar, 2020, 2020; Walters & Sirotiak, 2011).

Once again, these results provide valuable information to the team to improve their strategies, namely on how to manage and solve conflicts within groups. The structure and rules of the debate in MPI offer a concrete prompt that can foster cooperation and emotional regulation (Cortázar et al., 2022), promoting positive interactions among group members and preventing negative teamwork behaviours. This reinforces the key role of the other PBL courses that follow, which are expected to continuously improve value-market skills throughout students' academic plan.

### **Limitations**

This study has some limitations. The control group was recruited by convenience and the sample was smaller, especially considering that only 6% of the participants were enrolled in another Economics school. This group would more closely match [the school] group. Still, it was hard to establish protocols with other universities and the main comparison had to rely on three critical criteria: 1) all the participants had to be enrolled in the first year, 2) complete the questionnaires in similar timings, and 3) participants in the control group could not be enrolled in courses with tasks like those conducted in MPI. Nonetheless, we must recognise our control group is quite heterogeneous. Bacon and colleagues (2017) indeed call for more rigorous educational research in business schools, such as the use of appropriate control groups. However, in the authors' words "while more powerful statistical designs are theoretically possible, practically they are unattainable for many programs" (p. 186). This is our case, as it would be unethical to conduct the intervention with one group of MPI students and exclude the others from the intervention (and the course itself).

Also, we did not include a follow-up to evaluate whether the differences in the MPI group remain stable over time. However, students proceed to Multidisciplinary Project II, and it would be difficult to isolate the effects that were only due to MPI training. Finally, the pandemic required some adjustments in activities but, overall, the pedagogical program was maintained, and students had the opportunity to perform at in-person debates and data was collected for the control group in the same period.

## **Conclusion**

High-order thinking abilities are considered critical for adapting to different workplaces and dealing with challenges in complex business contexts. Despite the growing interest in incorporating critical thinking into business schools training programs, measuring post-change outcomes to determine whether the implemented pedagogical plans produced the desired improvements in targeted skills remains particularly challenging. Contributing to evidence-

based educational practices, our research provides sound conclusions that, by the end of the semester, MPI students perceived themselves as being more able to think in a critical manner, defend their point of view, communicate in a more effective way and promote a good environment in teamworking. Thus, the MPI approach, grounded in PBL, appears to effectively promote a set of skills in business students that hold significant value and transferability to real-world settings.

### References

- Abdul Manaf, N. A., Ishak, Z., & Wan-Hussin, W. N. (2011). *Application of Problem Based Learning (PBL) in a Course on Financial Accounting Principles*. <https://papers.ssrn.com/abstract=1914079>
- Abrami, P. C., Bernard, R. M., Borokhovski, E., Waddington, D. I., Wade, C. A., & Persson, T. (2015). Strategies for Teaching Students to Think Critically: A Meta-Analysis. *Review of Educational Research*, 85(2), 275–314. <https://doi.org/10.3102/0034654314551063>
- Abrami, P. C., Bernard, R. M., Borokhovski, E., Wade, A., Surkes, M. A., Tamim, R., & Zhang, D. (2008). Instructional Interventions Affecting Critical Thinking Skills and Dispositions: A Stage 1 Meta-Analysis. *Review of Educational Research*, 78(4), 1102–1134. <https://doi.org/10.3102/0034654308326084>
- American Management Association. (2022). *Critical Thinking*. <https://www.amanet.org/critical-thinking/>
- Andrews, R. (2015). Critical Thinking and/or Argumentation in Higher Education. Em M. Davies & R. Barnett (Eds.), *The Palgrave Handbook of Critical Thinking in Higher Education* (pp. 49–62). Palgrave Macmillan US. [https://doi.org/10.1057/9781137378057\\_3](https://doi.org/10.1057/9781137378057_3)
- Athanassiou, N., McNett, J. M., & Harvey, C. (2003). Critical Thinking in the Management Classroom: Bloom's Taxonomy as a Learning Tool. *Journal of Management Education*, 27(5), 533–555. <https://doi.org/10.1177/1052562903252515>
- Bacon, D. R., & Stewart, K. A. (2017). Why Assessment Will Never Work at Many Business Schools: A Call for Better Utilization of Pedagogical Research. *Journal of Management Education*, 41(2), 181–200. <https://doi.org/10.1177/1052562916645837>
- Bandyopadhyay, S., & Szostek, J. (2019). Thinking critically about critical thinking: Assessing

- critical thinking of business students using multiple measures. *Journal of Education for Business*, 94(4), 259–270. <https://doi.org/10.1080/08832323.2018.1524355>
- Behar-Horenstein, L. S., & Niu, L. (2011a). Teaching Critical Thinking Skills In Higher Education: A Review Of The Literature. *Journal of College Teaching & Learning (TLC)*, 8(2). <https://doi.org/10.19030/tlc.v8i2.3554>
- Behar-Horenstein, L. S., & Niu, L. (2011b). Teaching Critical Thinking Skills In Higher Education: A Review Of The Literature. *Journal of College Teaching & Learning (TLC)*, 8(2), Artigo 2. <https://doi.org/10.19030/tlc.v8i2.3554>
- Bennis, W., & O’Toole, J. (2005, maio 1). How Business Schools Lost Their Way. *Harvard Business Review*. <https://hbr.org/2005/05/how-business-schools-lost-their-way>
- Berbegal Mirabent, J., Gil Doménech, M. D., & Alegre, I. (2016). Improving business plan development and entrepreneurial skills through a project-based activity. *Journal of Entrepreneurship Education*, 19(2), 89–97.
- Borg, M. O., & Stranahan, H. A. (2010). Evidence on the Relationship Between Economics and Critical Thinking Skills. *Contemporary Economic Policy*, 28(1), 80–93. <https://doi.org/10.1111/j.1465-7287.2008.00134.x>
- Bowell, T., & Kemp, G. (2005). *Critical Thinking: A Concise Guide* (2.<sup>a</sup> ed.). Routledge. <https://doi.org/10.4324/9780203482889>
- Braun, N. M. (2004). Critical Thinking in the Business Curriculum. *Journal of Education for Business*, 79(4), 232–236. <https://doi.org/10.1080/08832323.2020.12088718>
- Brink, K. E., & Costigan, R. D. (2015). Oral Communication Skills: Are the Priorities of the Workplace and AACSB-Accredited Business Programs Aligned? *Academy of Management Learning & Education*, 14(2), 205–221. <https://doi.org/10.5465/amle.2013.0044>
- Calma, A., & Cotronei-Baird, V. (2021). Assessing critical thinking in business education: Key issues and practical solutions. *The International Journal of Management Education*, 19(3), 100531. <https://doi.org/10.1016/j.ijme.2021.100531>
- Calma, A., & Davies, M. (2021). Critical thinking in business education: Current outlook and future prospects. *Studies in Higher Education*, 46(11), 2279–2295. <https://doi.org/10.1080/03075079.2020.1716324>
- Camp, J. M., & Schnader, A. L. (2010). Using Debate to Enhance Critical Thinking in the Accounting Classroom: The Sarbanes-Oxley Act and U.S. Tax Policy. *Issues in Accounting Education*, 25(4), 655–675. <https://doi.org/10.2308/iace.2010.25.4.655>
- Carini, R. M., Kuh, G. D., & Klein, S. P. (2006). Student Engagement and Student Learning: Testing the Linkages\*. *Research in Higher Education*, 47(1), 1–32. <https://doi.org/10.1007/s11162-005-8150-9>
- Castro, L. B. de, & Ricardo, M. manuel C. (1993). *Gerir o Trabalho de Projecto: Um manual para professores e formadores* (3<sup>a</sup> ed). Texto Editora.
- Clark, A.-M. (2006). Changing Classroom Practice to Include the Project Approach. *Early Childhood Research & Practice*, 8(2). <https://eric.ed.gov/?id=EJ1084959>
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2.<sup>a</sup> ed.). Routledge. <https://doi.org/10.4324/9780203771587>
- Cortázar, C., Nussbaum, M., Alario-Hoyos, C., Goñi, J., & Alvares, D. (2022). The impacts of scaffolding socially shared regulation on teamwork in an online project-based course.

- The Internet and Higher Education*, 55, 100877.  
<https://doi.org/10.1016/j.iheduc.2022.100877>
- Cruz, G., Payan-Carreira, R., Dominguez, C., Silva, H., & Morais, F. (2021). What critical thinking skills and dispositions do new graduates need for professional life? Views from Portuguese employers in different fields. *Higher Education Research & Development*, 40(4), 721–737. <https://doi.org/10.1080/07294360.2020.1785401>
- D'Alessio, F. A., Avolio, B. E., & Charles, V. (2019). Studying the impact of critical thinking on the academic performance of executive MBA students. *Thinking Skills and Creativity*, 31, 275–283. <https://doi.org/10.1016/j.tsc.2019.02.002>
- Darby, M. (2007). Debate: A teaching-learning strategy for developing competence in communication and critical thinking. *Journal of Dental Hygiene: JDH*, 81(4), 78.
- Davies, M. (2011). Concept mapping, mind mapping and argument mapping: What are the differences and do they matter? *Higher Education*, 62(3), 279–301. <https://doi.org/10.1007/s10734-010-9387-6>
- Davies, M. (2015). A Model of Critical Thinking in Higher Education. Em M. B. Paulsen (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 30, pp. 41–92). Springer International Publishing. [https://doi.org/10.1007/978-3-319-12835-1\\_2](https://doi.org/10.1007/978-3-319-12835-1_2)
- de Muijnck, S., & Tieleman, J. (2022). *Economy Studies: A Guide to Rethinking Economics Education*. Amsterdam University Press. <https://library.oapen.org/handle/20.500.12657/51541>
- Dewey, J. (1916). *Essays in experimental logic* (pp. vii, 444). University of Chicago Press. <https://doi.org/10.1037/13833-000>
- Dewey, J. (2007). *Essays in Experimental Logic*. SIU Press.
- Dias-Oliveira, E., & Guimarães, I. (2010). Employability through competencies and curricular innovation: A Portuguese account. *EDUIMHE Full papers*, 1–6. [https://repositorio.ucp.pt/bitstream/10400.14/4674/1/com-inter\\_2009\\_FEG\\_1153\\_Oliveira\\_Eva\\_1.pdf](https://repositorio.ucp.pt/bitstream/10400.14/4674/1/com-inter_2009_FEG_1153_Oliveira_Eva_1.pdf)
- Doody, O., & Condon, M. (2012). Increasing student involvement and learning through using debate as an assessment. *Nurse Education in Practice*, 12(4), 232–237. <https://doi.org/10.1016/j.nepr.2012.03.002>
- Duch, B., D., G., & Allen, D. (2001). *The Power of Problem-Based Learning*.
- Ennis, R. (2011). Critical Thinking. *Inquiry: Critical Thinking Across the Disciplines*, 26(1), 4–18. <https://doi.org/10.5840/inquiryctnews20112613>
- Ennis, R. H. (1989). Critical Thinking and Subject Specificity: Clarification and Needed Research. *Educational Researcher*, 18(3), 4–10. <https://doi.org/10.3102/0013189X018003004>
- Facione, P. A. (1990). *Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction. Research Findings and Recommendations*. <https://eric.ed.gov/?id=ED315423>
- Freeley, A. J., & Steinberg, D. L. (2013). *Argumentation and Debate*. Cengage Learning.
- Fullan, M. (2015). *The New Meaning of Educational Change* (5th edition). Teachers College Press.
- Garrett, M., Schoener, L., & Hood, L. (1996). Debate: A Teaching Strategy to Improve Verbal Communication and Critical-Thinking Skills. *Nurse Educator*, 21(4), 37–40.

- Gibbins, P., Lidstone, J., & Bruce, C. (2015). Students' experience of problem-based learning in virtual space. *Higher Education Research & Development*, 34(1), 74–88. <https://doi.org/10.1080/07294360.2014.934327>
- Gold, J., Holman, D., & Thorpe, R. (2002). The Role of Argument Analysis and Story Telling in Facilitating Critical Thinking. *Management Learning*, 33(3), 371–388. <https://doi.org/10.1177/1350507602333005>
- Goodwin, J. (2003). Students' Perspectives on Debate Exercises in Content Area Classes. *Communication Education*, 52(2), 157–163. <https://doi.org/10.1080/03634520302466>
- Granado-Alcón, M. del C., Gómez-Baya, D., Herrera-Gutiérrez, E., Vélez-Toral, M., Alonso-Martín, P., & Martínez-Frutos, M. T. (2020). Project-Based Learning and the Acquisition of Competencies and Knowledge Transfer in Higher Education. *Sustainability*, 12(23), Artículo 23. <https://doi.org/10.3390/su122310062>
- Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, 102, 101586. <https://doi.org/10.1016/j.ijer.2020.101586>
- Halpern, D. F. (2013). *Critical Thinking Across the Curriculum: A Brief Edition of Thought & Knowledge*. Routledge. <https://doi.org/10.4324/9781315805719>
- Hartelius, E. J., & Browning, L. D. (2008). The Application of Rhetorical Theory in Managerial Research: A Literature Review. *Management Communication Quarterly*, 22(1), 13–39. <https://doi.org/10.1177/0893318908318513>
- Hobson, C. J., Strupeck, D., Griffin, A., Szostek, J., & Rominger, A. S. (2014). Teaching MBA Students Teamwork And Team Leadership Skills: An Empirical Evaluation Of A Classroom Educational Program. *American Journal of Business Education (AJBE)*, 7(3), Artículo 3. <https://doi.org/10.19030/ajbe.v7i3.8629>
- Holmes, N. G., Wieman, C. E., & Bonn, D. A. (2015). Teaching critical thinking. *Proceedings of the National Academy of Sciences*, 112(36), 11199–11204. <https://doi.org/10.1073/pnas.1505329112>
- Hughes, R. L., & Jones, S. K. (2011). Developing and assessing college student teamwork skills. *New Directions for Institutional Research*, 2011(149), 53–64. <https://doi.org/10.1002/ir.380>
- Infante, D. A., & Rancer, A. S. (1982). A conceptualization and measure of argumentativeness. *Journal of Personality Assessment*, 46(1), 72–80. [https://doi.org/10.1207/s15327752jpa4601\\_13](https://doi.org/10.1207/s15327752jpa4601_13)
- International Commission on the Futures of Education. (2021). *Reimagining our futures together: A new social contract for education*. UNESCO. <https://doi.org/10.54675/ASRB4722>
- Kahneman, D. (2011). *Thinking, fast and slow* (p. 499). Farrar, Straus and Giroux.
- Kaplan, J. T., Gimbel, S. I., & Harris, S. (2016). Neural correlates of maintaining one's political beliefs in the face of counterevidence. *Scientific Reports*, 6(1), 39589. <https://doi.org/10.1038/srep39589>
- Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools*, 19(3), 267–277. <https://doi.org/10.1177/1365480216659733>
- Krajcik, J. S., & Blumenfeld, P. C. (2005). Project-Based Learning. Em R. K. Sawyer (Ed.),

- The Cambridge Handbook of the Learning Sciences* (pp. 317–334). Cambridge University Press. <https://doi.org/10.1017/CBO9780511816833.020>
- Kunsch, D. W., Schnarr, K., & van Tyle, R. (2014). The Use of Argument Mapping to Enhance Critical Thinking Skills in Business Education. *Journal of Education for Business*, 89(8), 403–410. <https://doi.org/10.1080/08832323.2014.925416>
- Latif, R., Mumtaz, S., Mumtaz, R., & Hussain, A. (2018). A comparison of debate and role play in enhancing critical thinking and communication skills of medical students during problem based learning. *Biochemistry and Molecular Biology Education*, 46(4), 336–342. <https://doi.org/10.1002/bmb.21124>
- Liao, G. (2009). Improvement of Speaking Ability through Interrelated Skills. *English Language Teaching*, 2(3), 11–14.
- Liu, Y., & Pásztor, A. (2022). Effects of problem-based learning instructional intervention on critical thinking in higher education: A meta-analysis. *Thinking Skills and Creativity*, 45, 101069. <https://doi.org/10.1016/j.tsc.2022.101069>
- Llorente, I., Odriozola, M. D., & Baraibar-Diez, E. (2023). Fostering communication skills in entrepreneurship education. *Journal of Management and Business Education*, 6(1), Artigo 1. <https://doi.org/10.35564/jmbe.2023.0004>
- Loyens, S. M. M., van Meerten, J. E., Schaap, L., & Wijnia, L. (2023). Situating Higher-Order, Critical, and Critical-Analytic Thinking in Problem- and Project-Based Learning Environments: A Systematic Review. *Educational Psychology Review*, 35(2), 39. <https://doi.org/10.1007/s10648-023-09757-x>
- Macho-Stadler, E., & Elejalde-García, M. J. (2013). Case study of a problem-based learning course of physics in a telecommunications engineering degree. *European Journal of Engineering Education*. <https://www.tandfonline.com/doi/full/10.1080/03043797.2013.780012>
- Magalhães, A., Veiga, A., Amaral, A., Sousa, S., & Ribeiro, F. (2013). Governance of Governance in Higher Education: Practices and lessons drawn from the Portuguese case. *Higher Education Quarterly*, 67(3), 295–311. <https://doi.org/10.1111/hequ.12021>
- McCloskey, D. N. (1983). The rhetoric of economics. *Journal of economic literature*, 21(2), 481–517.
- McCroskey, J. C. (1978). Validity of the PRCA as an index of oral communication apprehension. *Communication Monographs*, 45(3), 192–203. <https://doi.org/10.1080/03637757809375965>
- McPeck, J. E. (2016). *Teaching Critical Thinking: Dialogue and Dialectic*. Routledge.
- Morimoto, C. (2016). Improvement of IT Students' Communication Skills using Project Based Learning: *Proceedings of the 8th International Conference on Computer Supported Education*, 147–152. <https://doi.org/10.5220/0005891501470152>
- Nuraini, U., Restuningdiah, N., Sidharta, E. A., & Utami, H. (2021). *Research-Based Learning to Improve Students' Critical Thinking Skills in Studying Business Ethics*. 186–191. <https://doi.org/10.2991/aebmr.k.210220.033>
- Nussbaum, M. C. (2016). *Not for Profit: Why Democracy Needs the Humanities - Updated Edition* (Revised edition). Princeton University Press.
- Omelicheva, M. Y. (2007). Resolved: Academic Debate Should Be a Part of Political Science Curricula. *Journal of Political Science Education*, 3(2), 161–175.

<https://doi.org/10.1080/15512160701338320>

- Parrado-Martínez, P., & Sánchez-Andújar, S. (2020). Development of competences in postgraduate studies of finance: A project-based learning (PBL) case study. *International Review of Economics Education*, 35, 100192. <https://doi.org/10.1016/j.iree.2020.100192>
- Powers, D. (2002). Self-assessment of Reasoning Skills. *ETS Research Report Series*, 2002. <https://doi.org/10.1002/j.2333-8504.2002.tb01889.x>
- Prichard, J. S., Bizo, L. A., & Stratford, R. J. (2006). The educational impact of team-skills training: Preparing students to work in groups. *The British Journal of Educational Psychology*, 76(Pt 1), 119–140. <https://doi.org/10.1348/000709904X24564>
- Rasche, A., & Gilbert, D. U. (2015). Decoupling Responsible Management Education: Why Business Schools May Not Walk Their Talk. *Journal of Management Inquiry*, 24(3), 239–252. <https://doi.org/10.1177/1056492614567315>
- Roy, A., & Macchiette, B. (2005). Debating the Issues: A Tool for Augmenting Critical Thinking Skills of Marketing Students. *Journal of Marketing Education*, 27(3), 264–276. <https://doi.org/10.1177/0273475305280533>
- Seymour, A. (2013). A qualitative investigation into how problem-based learning impacts on the development of team-working skills in occupational therapy students. *Journal of Further and Higher Education*, 37(1), 1–20. <https://doi.org/10.1080/0309877X.2011.643774>
- Sharples, M. (2019). *Practical Pedagogy: 40 New Ways to Teach and Learn*. Routledge. <https://doi.org/10.4324/9780429485534>
- Smith, G. F. (2003). Beyond Critical Thinking And Decision Making: Teaching Business Students How To Think. *Journal of Management Education*, 27(1), 24–51. <https://doi.org/10.1177/1052562902239247>
- Snyder, L. G., & Snyder, M. J. (2008). Teaching Critical Thinking and Problem Solving Skills. *Delta Pi Epsilon Journal*, 50(2), 90–99.
- Song, X. (2016). ‘Critical Thinking’ and Pedagogical Implications for Higher Education. *East Asia*, 33(1), 25–40. <https://doi.org/10.1007/s12140-015-9250-6>
- Starkey, K., Hatchuel, A., & Tempest, S. (2004). Rethinking the Business School\*. *Journal of Management Studies*, 41(8), 1521–1531. <https://doi.org/10.1111/j.1467-6486.2004.00485.x>
- Suter, W. N. (2011). *Introduction to Educational Research: A Critical Thinking Approach*. SAGE Publications.
- Twardy, C. (2004). Argument Maps Improve Critical Thinking. *Teaching Philosophy*, 27(2), 95–116. <https://doi.org/10.5840/teachphil200427213>
- Veiga, A., Remião, F., & Pêgo, J. P. (2020). *Aulas Invertidas: Relato de um estudo transdisciplinar*. <https://repositorio-aberto.up.pt/handle/10216/129486>
- Walters, R., & Sirotiak, T. L. (2011). *Assessing the effect of project based learning on leadership abilities and communication skills*. <https://www.semanticscholar.org/paper/Assessing-the-effect-of-project-based-learning-on-Walters-Sirotiak/f4cafeb6910923f5ff7251b20a678e50db33e7f6>
- Walton, D. (2005). *Fundamentals of Critical Argumentation* (First Edition). Cambridge University Press.
- Weston, A. (2018). *A Rulebook for Arguments*. Hackett Publishing.

Zare, P., & Othman, M. (2015). Students' Perceptions toward Using Classroom Debate to Develop Critical Thinking and Oral Communication Ability. *Asian Social Science*, 11(9), 158–170. <https://doi.org/10.5539/ass.v11n9p158>

**Funding:** Financial support from the Fundação para a Ciência e

Tecnologia to CEGE (through project UIDB/00731/2020) is gratefully acknowledged. HEI-Lab R&D Unit (UIDB/05380/2020,

<https://doi.org/10.54499/UIDB/05380/2020>) is funded by Fundação para a Ciência e Tecnologia (FCT).

**Conflicts of interest:** no conflicts to disclosure.