2025 APDIO WORKSHOP ON TEACHING OPERATIONAL RESEARCH

Hands-On Edition

Let's make OR irresistible

JUNE 6, 2025

IST, LISBON
Hosted by CEGIST

APDIO
ASSOCIAÇÃO PORTUGUESA
DE INVESTIGAÇÃO OPERACIONAL

Portuguese Association of Operational Research

Hands-on workshop: Teaching Operational Research

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Extended report on preparing and running the workshop that took place on June 6, 2025

at Instituto Superior Técnico, Lisboa

September 11, 2025

Conteúdos

1

Introduction

The APDIO Workshop on Teaching Operational Research – Hands-On Edition was an initiative by the Portuguese Association of Operational Research (APDIO) to foster a discussion among its members on improving pedagogical practices in the teaching of this subject. We were invited to organize the workshop, and from the outset, we aimed to make it a collaborative experience focused on mutual growth and learning. This report outlines the design process behind the workshop, discusses its implementation, and presents the main outcomes.

The workshop brought together Operational Research (OR) professors from across Portugal with a shared goal: to rethink and revitalize teaching practices in this area. Conceived as a practical and interactive experience, it provided a space for sharing experiences and exploring new tools, methodologies, and pedagogical approaches, always with a spirit of openness, creativity, and experimentation. Throughout the day, participants were encouraged to reflect critically on their classroom practices, exchange ideas and strategies, and, above all, co-create effective teaching practices with enthusiasm, rigor, and heart. The result was a unique experience in which each participant left with a set of ready-to-implement ideas, a stronger network of colleagues with whom to continue learning, and a renewed motivation to make OR an even more engaging and transformative subject for students.

This report is structured as follows. After this brief introduction (Section 1), Section 2 focuses on the workshop's design process, describing how the agenda was prepared and outlining its key components. Section 3 presents the outcomes of the design process, including the final agenda, prepared materials, and session plans. Section 3 details the implementation of the workshop, covering participation and the insights gained. Finally, Section 4 summarizes the main lessons learned and offers concluding remarks.

2

Designing the workshop

From the beginning, the APDIO Hands-On Workshop was designed as more than a space for presentations or passive listening. The goal was to create an experience where participants could openly share their teaching challenges and successes, engage in thoughtful discussions about those shared realities, and co-create practical strategies to address them. The intention was to foster a safe, generous, and action-oriented environment—where each participant could speak honestly, learn from others, and build something new together.

2.1 Structuring the agenda

Designing the agenda involved balancing structure with flexibility. We wanted the day to include a clear rhythm—moving from reflection and diagnosis, to inspiration, and finally to co-construction. The program was shaped around a few key moments: a welcoming session to set the tone, short lightning pitches to surface real classroom challenges, a round-table with experienced educators to broaden perspectives, a hands-on session for collaborative development of new practices, and a closing synthesis for sharing and reflection.

To make this possible, we sketched a detailed timeline for the day, from 10:30 AM to 5:30 PM, including time for lunch and informal conversations. Each session was assigned a clear purpose and format, and preparation materials were developed in advance to support participants in engaging fully. The following sections describe the design process for each of these moments.

10:30AM	Opening and welcome: *What's in your toolbox?*
10:45AM	Lightning presentations from participants: *Teach me your pains (and gains)*
11:30AM	Round table: *What if we taught OR differently?*
12:30PM	Lunch break
2PM	Hands-on lab: *Reimagining OR courses*
4PM	Coffee break
4:30PM	Final presentations and synthesis session: *OR hacks in 180 seconds*
5:15PM	Wrap-up: *What will you try first?*

2.2 Pre-workshop work

Before the workshop, participants were asked to prepare a brief 3-minute presentation—referred to as a "lightning pitch", highlighting a specific challenge (or success) related to their experience teaching OR. To support this, we provided a slide template where they could describe

their course context, current teaching approach, and a concrete "pain point" (or "gain"). These pitches were intended to spark discussion and ground the workshop in real classroom experiences. Besides the template, we provided some examples to show the type of experiences and sharing that could be discussed. The template and the examples provided to the participants are presented as Appendix A. Participation in this pitch activity was encouraged but optional. To ensure the session was both focused and inclusive, we requested the slides be submitted a few days in advance, allowing us to organize the sequence and facilitate a smooth flow.

Additionally, participants were invited to complete a short form indicating their preferred topics for the afternoon hands-on session, which helped organizing the working groups in advance. Additional detail about this can be found in Section .

2.3 Workshop activites

2.3.1 Opening and lightning pitches: "Teach me your pains (and gains)"

The workshop began with a **brief welcome session**, which addressed, in summary, the following topics.

> *OR can be (or is already) an irresistible subject, from the perspective of the educators, but also many of the students often express similar enthusiasm, even though the experiences can vary substantially in this regard. The challenge is to sustain the enthusiasm and channel it through thoughtful, rigorous, and heartfelt teaching. This workshop focuses on making the quality of our teaching visible, showing that what makes OR transformative is the way it is taught and learnt. Throughout the day, the goal is to equip each other with practical tools, share experiences, and build new ideas together, so that we can return to our classrooms ready to experiment, inspire, and affirm that OR remains – and becomes even more – irresistible.*

Immediately after the opening, we invited participants to share a 3-minute "**lightning pitch**" about their teaching context. This moment was crucial to ground the day in real in specific challenges from diverse classrooms. Due to the high number of participants, we had to select some of the pitches to be presented. We tried to balance the types of pains and gains described, the affiliation of the participants, and the type of context described. The pitches were roughly ordered, considering the different topics addressed. An audible timer was used during the session to signal the end of each participant's 3-minute pitch, helping to ensure time was kept effectively.

2.3.2 Round table: "What if we taught OR differently?"

Building on the themes raised in the lightning pitches, the round table aimed to bring together three experienced educators with different backgrounds and teaching experience. This moment aimed to shift the focus from individual cases to broader reflections: What are the recurring challenges in teaching OR? What strategies have proven effective in different institutional settings? And how might we reimagine our approaches? The aim was to promote a conversation that was open and exploratory, emphasizing practical insight and critical engagement rather than consensus.

To ensure the discussion was not narrowed by the organizer's experiences, we asked one of the participants – Samuel Moniz – to prepare and moderate the session. The moderator was briefed ahead of time and invited to prepare guiding questions based on the topics submitted by participants. We shared with him the submitted pitches previously and had a preparatory

meeting where we described the main goals of this session. In this preparatory meeting, we selected the three speakers to invite, among the participants who had submitted a lightning pitch: Carlos Henggeler, Cândida Mourão and Graça Costa. The participants were contacted before the workshop and accepted to participate in the round table.

2.3.3 Hands-on lab: "Reimagining OR courses"

The afternoon was dedicated to collaborative design in small groups. Prior to the workshop, participants indicated their preferred topics through a short survey, allowing us to form groups based on shared interests. The participants were asked to grade their interest in each of the open topics below, selecting between *Indifferent*, *Interested*, *Very Interested*, and *My Favourite*:

1. **Engaging the Masses: Energizing Teaching in Large Groups** – How can student engagement be maintained even in very large classes? This theme explores strategies to make theoretical classes participatory, effective, and dynamic, even when faced with the challenge of many students in a single room.

2. **Bridging the Gap: Meaningfully Connecting Theory and Practice** – How can the link between concepts and applications in OR teaching be strengthened? This theme discusses ways to effectively articulate theoretical and practical moments, promoting more solid and applied learning.

3. **From Classroom to Reality: Project-Based Learning** – How can real-world problems be used to teach OR in a contextualized and relevant way? Approaches based on real cases, projects, or real-world data are shared, bringing students closer to the challenges they will face beyond university.

4. **Software in Action: Tools and Simulations in Teaching** – How can tools like Excel Solver, Python, Gurobi, or AnyLogic be integrated into the learning journey? Good practices, limitations, and creative ways of incorporating software and simulations into the classroom are discussed, as well as how to overcome emerging challenges.

5. **Learning Through Stimuli: Multimedia and Interactive Resources** – How can videos, notebooks, quizzes, and visualizations be used to support learning? This theme explores the use of dynamic materials that enhance the understanding of abstract concepts and encourage student autonomy.

6. **Serious Play: Gamification in OR** – How can games, challenges, and competitions be used to motivate students without compromising rigor? Ways to introduce playful elements into OR teaching are analyzed, making learning more engaging and enjoyable — without losing depth.

7. **Thinking Outside the Box: Teaching OR to Non-Traditional Audiences** – How can OR teaching be adapted for students outside management engineering? Strategies are discussed for making the content relevant and accessible to diverse profiles — such as students in biomedicine, environmental studies, design, or even management schools.

8. **Pacing and Pathways: Managing Diversity in the Classroom** – How can we deal with heterogeneous classes in terms of knowledge, skills, and motivation? Practices are shared for teaching inclusively, addressing different levels of mathematical and programming preparation, as well as varying degrees of interest in the subject.

9. **Feedback That Helps Students Grow** – How can useful and actionable feedback be provided in complex modeling and problem-solving contexts? Methods are discussed for giving constructive and effective feedback on challenging exercises, without disrupting the flow of the class.

10. **The First Door: Introductory Activities for OR** – How can interest be sparked at the first contact with OR, inside or outside the classroom? Creative and engaging ways to introduce students to the key concepts of OR are explored, valuing both face-to-face contexts and independent preparation.

11. **Hands-On: Practical Activities That Teach** – How can exercises be designed to consolidate skills and motivate students? Approaches are analyzed for creating effective practical activities that reinforce knowledge and stimulate student initiative.

12. **Assess to Learn: Distributed and Formative Assessment** – How can assessment be used as a tool for learning and motivation? This theme explores how to distribute assessment over time, provide useful feedback, and value progress rather than only measuring final results.

13. **OR with AI: Artificial Intelligence as a Teaching Ally** – How can generative AI tools be integrated into OR teaching? Innovative uses of AI are discussed — from model formulation to content creation, support for independent learning, and associated ethical and pedagogical challenges.

Due to the number of participants and the desired number of people in each group (5 or 6), we had to select only some of the topics. To do that, we rated each topic using the following weighted function:

$$\text{score} = \alpha_1 + 4\alpha_2 + 6\alpha_3 + 10\alpha_4$$

where $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ refer to the number of times each topic was selected as *Indifferent*, *Interested*, *Very Interested*, and *My Favourite*, respectively. The rating of each topic is presented in Table 2.1.

Table 2.1: Score of each topic after participants' responses (total of 26 responses out of 35 participants). Selected topics in bold

Topic	Score
Engaging the Masses: Energizing Teaching in Large Groups	116
Bridging the Gap: Meaningfully Connecting Theory and Practice	128
From Classroom to Reality: Project-Based Learning	166
Software in Action: Tools and Simulations in Teaching	146
Learning Through Stimuli: Multimedia and Interactive Resources	126
Serious Play: Gamification in OR	140
Thinking Outside the Box: Teaching OR to Non-Traditional Audiences	108
Pacing and Pathways: Managing Diversity in the Classroom	104
Feedback That Helps Students Grow	134
The First Door: Introductory Activities for OR	146
Hands-On: Practical Activities That Teach	140
Assess to Learn: Distributed and Formative Assessment	136
OR with AI: Artificial Intelligence as a Teaching Ally	154

Considering the number scores and the number of times each topic was selected as *My Favourite*, each of the topics in bold above were selected, with one group per topic, except in the case of **From Classroom to Reality: Project-Based Learning**, with two groups working on it. The participants were allocated to each group considering their preferences and the ideal size of each group.

Each group received a structured guide and a clear challenge: develop a concrete, adaptable teaching strategy related to the topic. We recommended that, whenever possible, the group should focus on a specific topic in OR (e.g., simplex method).

The activity was divided into three phases:

- Idea generation (30 min): Brainstorming of specific challenges and possible responses within the chosen topic;
- Design of a pedagogical strategy (60 min): Developing a practical teaching activity, identifying context, audience, implementation steps, and success conditions;
- Analysis and synthesis (30 min): Reflecting on risks and requirements, and compiling the idea into a short pitch using a provided template.

This structure allowed for creative freedom while ensuring that the final proposals were shareable, specific, and ready for testing. Appendix B presents the instructions that were shared with each group, as well as the template for the group pitch.

2.3.4 Final presentations: "OR hacks in 180 seconds"

To close the hands-on session, each group presented their developed teaching practice in a concise 3-minute pitch. Using the provided template, they highlighted the challenge addressed, the core of their proposal, why it might work, and what would be needed to implement it. There was time after each presentation for questions, comments, and discussion among all participants. This fast-paced, energetic session served both as a celebration of collective creativity and as a practical takeaway moment—providing participants with a toolbox of fresh ideas.

2.3.5 Wrap-Up: "What will you try first?"

The final session brought everyone back together to reflect on the day's insights. Participants were invited to share what had most inspired them, what they planned to experiment with in their own courses, and how they hoped to keep the conversation going. It was a closing moment anchored not in evaluation, but in anticipation of small changes, new beginnings, and continued collaboration.

2.4 Dissemination and certification

The workshop was disseminated through the APDIO mailing list and social media (such as LinkedIn and Facebook). The figures below represent some of the material prepared for dissemination: a poster (Figure 2.1), a LinkedIn post (Figure 2.2), and an accompanying figure for social media posts (Figure 2.3). Additionally, we developed a certificate that was sent to each participant after the workshop (an example is presented in Figure 2.4).

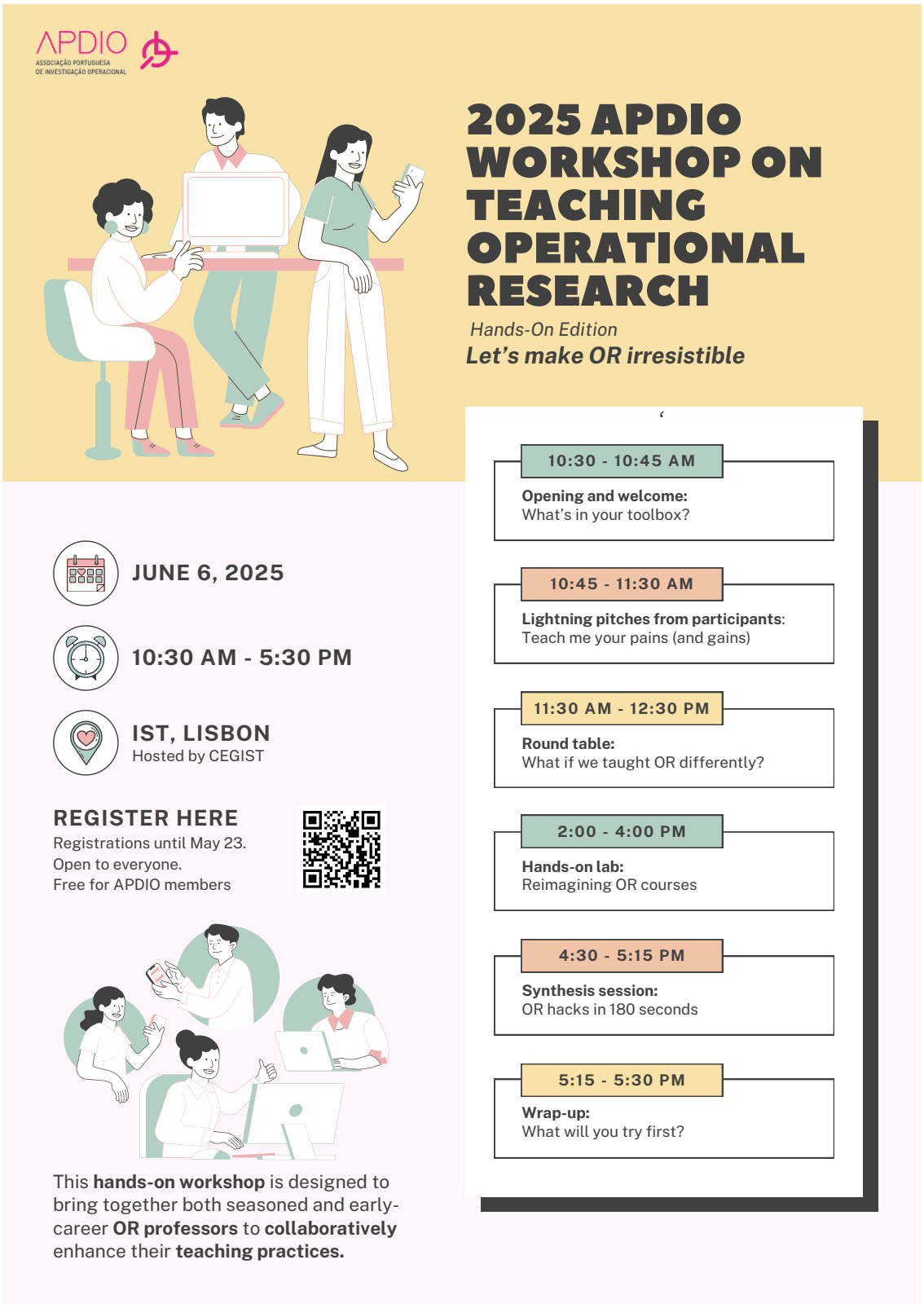


Figure 2.1: Poster

2025 APDIO PT Workshop on Teaching Operational Research - #HandsOnEdition
💥 Let's make OR irresistible 💥

📅 Date: 06/06/2025 (Friday)
📍 Place: Instituto Superior Técnico, Centro de Congressos, Pavilhão de Civil – Lisbon

This hands-on workshop is designed to bring together both seasoned and early-career OR professors to collaboratively enhance their teaching practices. Participants will engage in a day of practical, interactive activities aimed at expanding their teaching toolbox and sparking inspiration. Some light preparation is expected beforehand, and full participation throughout the day is encouraged. We welcome #curiosity, #creativity, and the #courage to try new approaches.

By the end of the day, each participant will leave with:
⚙️ A toolbox of ideas and activities to use in the classroom;
🤝 A network of fellow OR educators;
✨ A boost of motivation and creativity for the next academic year.

Agenda:
10h30: Opening and welcome: What's in your toolbox?
10h45: Lightning pitches from participants: Teach me your pains (and gains)
11h30: Round table: What if we taught OR differently?
12h30: Lunch break
14h00: Hands-on lab: Reimagining OR courses
16h00: Coffee break
16h30: Synthesis session: OR hacks in 180 seconds
17h15: Wrap-up: What will you try first?

Please register by May 23. The registration is free for APDIO members, but mandatory. Non-members are also welcome to register (at a 40€ fee).
Registration link: https://lnkd.in/dMdGW2KT

Beatriz Brito Oliveira
Maria Antónia Carravilla

Figure 2.2: Linkedin Post

Figure 2.3: Social media figure

CERTIFICATE OF ATTENDANCE

This is to certify that

Beatriz Oliveira

attended the "2025 APDIO Workshop on Teaching Operational Research" held on June 6th, 2025 at the Instituto Superior Técnico, Lisbon.

Issued on June 6th, 2025

Maria Antónia Carravilla — Beatriz Brito Oliveira

Workshop organizers

Figure 2.4: Example of a certificate

3

Implementation: Workshop experiences and results

This section includes the main results from the workshop. Here, we detail the participants, all the initial lightning pitches submitted, a summary of the main insights from the round table, and the pedagogical practices that resulted from the group work in the hands-on lab. It should be noted that all the results presented here were originally written in Portuguese and translated to English specifically for this report.

3.1 Participants

Name	Affiliation
Ana Moura	Universidade de Aveiro
Ana Sara Costa Domingues	Universidade de Évora
Ana Viana	INESC TEC/ISEP
Beatriz Oliveira	FEUP
Bruna Mota	IST
C. Marta Castilho Gomes	Instituto Superior Técnico
Cândida Mourão	ISEG, ULisboa
Carlos Henggeler	INESC Coimbra, Universidade de Coimbra
Carlos M. Fonseca	University of Coimbra
Cátia Medeiros da Silva	IST
Daniel Santos	Instituto Superior Técnico
Diana Jorge	CEGIST, Instituto Superior Técnico, Universidade de Lisboa
Elsa Silva	Universidade do Minho
Filipe Alvelos	Universidade do Minho
Filipe Rodrigues	ISEG
Isabel Gomes	NOVA FCT
Joana Matos Dias	FEUC e INESC Coimbra
Maria Antónia Carravilla	FEUP
Maria da Graça Rodrigues Gomes da Costa	Instituto Politécnico de Setúbal
Maria João Alves	Faculdade de Economia da Universidade de Coimbra / CeBER
Maria João dos Santos Fernandes	Escola Superior de Tecnologia e Gestão de Viseu
Maria João Santos	FEUP
Maria Pereira	ISEP - Instituto Superior de Engenharia do Porto
Miguel Alves Pereira	Instituto Superior Técnico, Universidade de Lisboa
Miguel Vieira	Universidade Lusófona
Mónica Gaboleiro	FCT UNL
Parisa Ahani	NOVA University Lisbon
Paula Sarabando	ESTGV e INESCC
Raquel Bernardino	ISEG - Lisbon School of Economics & Management
Rohollah Garmanjani	Universidade NOVA de Lisboa
Samuel Moniz	Universidade de Coimbra
Sara Martins	ESTG, P.PORTO
Simone Lima	Universidade do Porto - INESC TEC
Tânia Ramos	CEGIST/IST
Telmo Pinto	University of Coimbra

3.2 Lightning pitches

3.2.1 Ana Moura, University of Aveiro

Context Course unit "Advanced Topics in Operational Research" Master's in Industrial Engineering and Management and elective course in the Master's in Mechanical Engineering and Integrated Master's in Electronics and Telecommunications Engineering
Class of about 90 students, with a single 3-hour weekly T/P class
Most students are familiar with programming and mathematics, but have little motivation for the theoretical aspects of OR.

Current approach / methodology The T/P class combines moments of theoretical exposition with practical activities, in which students, organized in groups, solve small exercises related to the topics covered.
Mini real-world case studies, adapted from research projects, PhD theses, and/or master's dissertations, are also presented to illustrate the applicability of the concepts taught.
Additionally, students or alumni are invited to share their academic and professional experiences in the field, promoting a concrete link between the subject and the real world.

What is working well? Students enjoy seeing the application of T/P concepts taught in class to real-world cases.
They understand how OR is transversal and can support problems in mechanics, electronics, production, management, etc.

What is working less well? During theoretical lectures, students tend to lose focus, showing greater interest in solution techniques than in understanding the theoretical foundations behind them.
Only when faced with the need to solve concrete problems do they become more receptive to assimilating the underlying theoretical concepts.

3.2.2 Beatriz Oliveira, FEUP

Context Course unit "Operational Research"
1st year of the Master's in Bioengineering
About 100 students are divided into three groups
Very capable students with strong backgrounds in mathematics and statistics
Course unit is very different from others (more lab-based and area-specific) – for some, this is positive, but for many, it's negative

Current approach/methodology 3-hour TP classes (with a 10-minute break)
Class with 3 segments: theoretical exposition, group exercises, and a mini-quiz at the end (15 min)
The time allocated to theoretical and practical parts depends on the topic
I give feedback on the mini-quizzes in the following class
Assessment: mini-quizzes (50%), test (20%), exam (30%)

What is working well? High attendance (due to assessment)
Very proactive and autonomous group work

What is working less well? Some topics involve very dense theoretical exposition, and I don't know how to cover everything in the available time (e.g., introduction to queueing theory)
Requesting prior work at home doesn't align well with the assessment method

3.2.3 Cândida Mourão, ISEG, ULisboa

Context 1. OR course unit for master's students in quantitative methods (with backgrounds in management, economics, some in mathematics and engineering) who struggle with formalizations.
2. OR course unit for undergraduate students in management.

Current approach/methodology 1. Students are assessed through assignments for each chapter and a mini-test at the end, focused on more theoretical content.
2. Due to the large number of students, assessment is based solely on a final exam.

What is working well? 1. The classes and assignments throughout the semester work well, and progress is evident!
2. Although it generally works well, there is a sharp decline in student numbers halfway through the semester.

What is working less well? 1. How to assess the use of AI in assignments, even though students must prepare a presentation in which everyone participates.
2. How to keep students attending classes?

3.2.4 Carlos Henggeler, University of Coimbra

Context Course unit "Planning and Management Techniques / Operational Planning and Management Techniques" – LEEC, MEB, MEF; 230 students
Course unit "Foundations of OR" – LEGI, MEEC, ...; 115 students
Course unit "Advanced OR" – MEGI, MEEC, MEB; 60 students
Course unit "Decision Support and Risk Analysis" – MECD; 45 students
Single class, 4h/week
Limited perception of OR's usefulness in their areas of interest.

Current approach/methodology Tutorial-style classes with many illustrative examples on the board
Motivating topics through practical examples
Group mini-tests at the end of each chapter
Publication of the (minimally developed) solution for the regular exam.

What is working well? Small group of attentive and participative students
Illustrative examples encourage participation (though limited)
Students generally understand the operational nature of OR

What is working less well? Low ability to engage most students
Large single classes hinder interaction and group work
Keeping students focused during 2-hour, and especially 4-hour, classes
Too much time spent on grading

3.2.5 Carlos M. Fonseca, University of Coimbra

Context Course unit "Heuristic Methods" (elective)
Master's in Data Science and Engineering / Master's in Computer Engineering
Class of 12 students (2023/2024)
2h theoretical + 2h practical per week
Covers optimization in AI and Evolutionary Computation
Students have a programming and algorithms background (with exceptions)
No knowledge of mathematical programming

Current approach/methodology Focus on combinatorial optimization
Computational modeling methodology for constructive and local search based on abstractions (API)
(Meta-)Heuristics are introduced using the same abstractions
Group projects (2 students) on computational modeling of classical OR problems (different for each group): code, report, oral defense
Written test replicates the project at the conceptual level

What is working well? Systematic approach instead of "case-by-case artistry"
Bridges between heuristics and exact methods (e.g., lower bounds)
Programming activity is motivating/challenging

What is working less well? More formal aspects generate less interest
Written test sometimes shows that concepts were not understood, despite reasonably successful projects

3.2.6 Daniel Santos, Department of Engineering and Management, IST

Context Course unit "Advanced Topics in Operational Research"
Syllabus: Linear Programming review, Integer Programming, Network Algorithms, Metaheuristics
1st year, 1st semester of the Master's in Industrial Engineering and Management
Around 100 students, divided into two classes

Current approach/methodology Theory-practice classes
50% of the grade from tests/exam
50% from a group project (4 students)
Project involves a topic chosen by the group, for which they must develop an integer programming model and implement it
Using CPLEX or Python
Peer evaluation included

What is working well? Students are better prepared to understand and develop models in other courses and in their dissertation
Variety of topics and interesting problems
Very good student feedback

What is working less well? Differentiating project grades
For example, a student scores 19 on the project but only 10 on the tests

3.2.7 Diana Jorge, CEGIST, Instituto Superior Técnico, University of Lisbon

Context Course unit "Production and Operations Management"
1st year of the Master's in Biological Engineering
Around 50 students
No familiarity with decision-making or modeling
Only one class available to introduce basic concepts and provide tools to solve a linear OR problem
Students have little perception of OR's usefulness in Biological Engineering

Current approach/methodology Class:
Expository segment introducing basic OR concepts (linear programming)
Presentation of a problem and its resolution using OR (mathematical formulation and code)
Quiz covering the main concepts presented
Assessment:
A project in which students are expected to solve a problem similar to the one presented in class using OR

What is working well? Despite the lack of familiarity with OR, the most engaged students are able to develop high-quality projects

What is working less well? Some students do not understand the importance of OR for their field of study

3.2.8 Filipe Alvelos, University of Minho

Context Course unit "Operational Research and Optimization"
2nd year of the Bachelor's in Industrial Engineering and Management
Around 80 students
Two 2-hour TP classes
One 2-hour common theoretical class
Students have a background in mathematics and statistics, but little familiarity with decision-making, modeling, or programming

Current approach/methodology Assessment: two written tests
Supports the "Integrated Project in Industrial Engineering and Management" course unit alongside: Advanced Statistics, Technologies and Information Systems, and Numerical Methods

What is working well? Good student evaluation of the course unit
Link with the project course broadens the course's context

What is working less well? Class participation could be higher
Lack of worked solutions for textbook exercises
The link with the project course, in some aspects, limits the course unit

3.2.9 Filipe Rodrigues, ISEG

Context Course unit "Operational Research"
Bachelor's in Management with many international students from varied backgrounds
Class of 60 students

Current approach/methodology Throughout the semester, optional homework is given in class, which students can submit by the next class and receive feedback
These assignments are not graded and are easy to mark

What is working well? These assignments provide a clearer picture of the class's progress
Mistakes made in the homework are generally not repeated in tests

What is working less well? Only half of the students submit the homework assignments

3.2.10 Graça Costa, Polytechnic Institute of Setúbal

Context Course unit "Operational Research"
2nd year of the Bachelor's in Distribution and Logistics Management (daytime and evening programs)
96 students in the daytime course with 1 theoretical and 3 practical classes
90 students in the evening course with 1 theoretical and 2 practical classes
Very weak background in mathematics and logical reasoning
No familiarity with modeling

Current approach/methodology Assessment includes 3 mini-tests and a group project (GP)
In the GP, students create a fictional company and describe its problem. They must build a linear programming model for the problem, calculate the optimal solution (using Solver), and conduct sensitivity analysis

What is working well? Greater interaction between teachers and students
Students are more engaged throughout the semester
Development of logical reasoning

What is working less well? Difficulty maintaining focus during 2-hour classes
Disparity in mathematical knowledge (evening course)
Many hours required to support group projects
Plagiarism in group project work

3.2.11 Joana Matos Dias, Faculty of Economics, University of Coimbra

Context Course unit "Modeling in Management" in the Bachelor's in Management
Course unit discontinued following curriculum reform
About 120 students are divided into 4 groups
Theory-practice classes held in rooms without computers (2 hours, twice a week)
Course focused on building mathematical models (no algorithmic solution component)

Current approach/methodology Use of gamification-inspired tools: Badges, quick feedback, and varied activity formats
Solving real problems from within the Faculty, requiring students to go from data collection to proposing a solution
Example: Study of the library's opening hours

What is working well? Surprise element in every class
Personalized feedback is highly valued by students
Learning the real-world impact of OR models

What is working less well? Diversity in students' knowledge and interests within the group
Students who do not engage from the beginning struggle to catch up

3.2.12 Maria Antónia Carravilla, FEUP

Context Course unit in the final semester of the 3rd year of the Bachelor's in Information Science
Internship takes place in the second part of the semester
Around 30–40 students
Students have diverse attitudes toward quantitative content

Current approach/methodology Theoretical and practical sessions held on the same day (morning/afternoon)
Theoretical sessions involve active participation: pair discussions
Assessment:
- Micro-tests (50%) in each practical session
- Midterm test (25%)
- Group project (25%)
* Problems based on AI-generated cases (reviewed by instructor) and related to professional practice in Information Science
* Groups formed:
- after all topics have been covered
- after students' performance is known

What is working well? High participation in theoretical sessions
Micro-tests
Strong engagement and quality in some group projects

What is working less well? Some groups submit (very) weak projects, even when composed of strong students — How to ensure that stronger students contribute meaningfully to peer learning?
Detailed feedback is provided — How to ensure that it is read, reflected on, and used for learning?

3.2.13 Maria João Alves, Faculty of Economics, University of Coimbra

Context Course unit "Modeling and Optimization in Management"
2nd year of the Bachelor's in Management
Around 120 students, divided into 4 TP groups (4h/week: 2h in a regular room + 2h in a computer lab)
Students have backgrounds in mathematics and statistics (2 course units in each), but no familiarity with programming, modeling, or decision-making

Current approach/methodology Use of Excel in lab sessions: Solver and for calculations (e.g., matrix multiplication)
Assessment includes two tests, each with a written and a computational component (done in shifts)
At certain points, students work in groups to model and solve problems with minimal support, and then analyze the results

What is working well? Computer lab sessions and Excel use increase motivation and perceived usefulness of OR
Independent work moments, with limited support, have a very positive impact on more engaged students

What is working less well? Low participation by most students
During independent work, some students lose motivation and leave when they realize support is only provided per group and there won't be a shared solution discussion

3.2.14 Maria Teresa Pereira, ISEP

Context MODES – Decision Support Models
2nd year of the Bachelor's in Industrial Engineering and Management
Around 71 students were divided into 2 TP groups (2h each) and 4 lab groups (2h each)
Background in mathematics and linear algebra
Little familiarity with industrial processes and contexts, which hinders decision-making or modeling

Current approach/methodology Use of the questioning method and various active learning techniques (problem-solving and case study analysis)
In the lab sessions, active learning techniques (MT3) are used, such as group work and problem-based learning, with tools like Excel Solver / SolverStudio, Python, etc.

What is working well? Formulating and solving problems and case studies with the help of tools reinforces modeling skills and critical analysis of results
Working on real projects encourages practical application of acquired knowledge (hard skills), peer knowledge transfer, and the development of specific skills (soft skills)
Group work includes peer evaluation

What is working less well? Presenting and assessing group work is time-consuming due to the number of groups (12 to 16)
Students have uneven academic backgrounds

3.2.15 Miguel Alves Pereira, Instituto Superior Técnico, University of Lisbon

Context Course unit "Modeling and Optimization of Systems"
Elective course for students in the Minor in Industrial and Systems Management, the Master's in Innovation and Entrepreneurship Engineering and Management, and the Minor in Decision Support Systems and Methods
Around 30 students per year, with diverse profiles and strong quantitative background; intensive workload (6h/week: 2h/day, 3 days/week)

Current approach/methodology Combination of theoretical content and practical application
Approach based on lectures with solved examples and guided exercises, comparing CPLEX and Gurobi in Python
Students work on a group project where they must structure, model, and solve a real problem
Continuous assessment includes two tests (MAP30) and the project

What is working well? Parallel use of solvers helps consolidate concepts
The integration of exact and heuristic modeling is well received

What is working less well? Many students struggle to translate real-world problems into mathematical language

3.2.16 Miguel Vieira, Universidade Lusófona

Context Course unit "Advanced Topics in Operational Research" in the Master's in Industrial Engineering and Management
Small class (~15) but very diverse backgrounds, including students from non-engineering degrees
Initial classes need to cover linear programming review in order to continue with the course content

Current approach/methodology The first two weeks of class are dedicated to reviewing concepts
A worksheet is assigned for students to work on the review content independently and submit in the 4th week

What is working well? Allows leveling of students before advancing to more complex OR topics

What is working less well? Some students require more time on review topics, which reduces available time for the main syllabus
An individual worksheet may not be the best way to consolidate these concepts

3.2.17 Mónica Gaboleiro (PhD Candidate FCT UNL) – Polytechnic Institute of Setúbal

Context Practical classes for the Operational Research course unit
Bachelor's in Distribution and Logistics Management
Students lack mathematical foundations
The course is seen as "the toughest one"
Many students have little perception of OR's relevance to their field
Lack of interest and motivation

Current approach/methodology Practical classes consist of solving exercises from the workbook

What is working well? Classroom atmosphere is positive, with good relationships among students and between students and instructor
Students feel free to ask questions and clarify doubts

What is working less well? Some students face major difficulties and are unable to overcome them
Others show strong disinterest, which is reflected in attendance and, consequently, performance

3.2.18 Raquel Bernardino, ISEG, ULisboa

Context Course unit "Topics in Operational Research"
Syllabus includes: Heuristics, Inventory Management, Discrete Event Simulation
2nd year of the Bachelor's in Applied Mathematics to Economics and Management
Around 60 students, divided into two groups

Current approach/methodology Theory-practice classes
Content is taught in modules
Module 1 – Heuristics – assessed via group project
Module 2 – Inventory Management + Discrete Event Simulation – assessed via final exam

What is working well? Mid-term submission of the group project
Classes dedicated to project development

What is working less well? Low attendance (10 out of 30 students)

3.2.19 Simone Lima, INESC TEC / Universidade Portucalense

Context Course unit: Operational Research
2nd year of the Bachelor's in Management Engineering
Gaps in mathematical training
Difficulty in connecting the practical applicability of the concepts studied

Current approach/methodology Proposed a manual methodology, viable even with limited resources such as paper
Construction of items similar to products, considering resource quantity constraints and aiming for maximum profitability
Support in sensitivity analysis (slack variables)

What is working well? This integration may promote more concrete/meaningful learning
Students may find it easier to learn complementary content

What is working less well? Initial difficulties in participating in activities that differ from traditional lecture-based methods

3.3 Round table insights

Moderation: Samuel Moniz
Panel: Cândida Mourão, Carlos Henggeler, Graça Costa

The round table *What if we taught OR differently?* was based on the individual contributions of participants, highlighting the diversity of contexts and challenges faced in teaching Operational Research (OR), particularly in how to capture students' interest and motivation, the articulation between theory and practice, the assessment of learning, and the integration of OR with other fields of knowledge. Among the key emerging points, the importance of modeling as a core skill was emphasized, noting that it is essential for students to develop the ability to translate real-world problems into formal models.

Special attention was given to the role of the simplex algorithm in OR teaching. While it is recognized as a fundamental tool, discussions addressed its place in curricula and its suitability for different types of students. It was clear that understanding the inner workings of "black boxes" is crucial, especially in engineering programs, where structural understanding of methods is valued.

Artificial intelligence (AI) emerged as a cross-cutting topic. Tools such as LLMs (like ChatGPT) and other optimization add-ins (such as Gurobi AI Modelling Assistant) raise questions about the best ways to use them to support modeling and problem-solving, as well as the difficulty of assessing student projects in this context. It was reinforced that AI should be used as a support tool for developing students' critical thinking and analytical skills, not as a replacement for the learning process. The use of AI in student projects requires a pedagogical approach centered on mentoring and guidance, enabling assessment of more than just the final answer: the understanding of the process and the decisions involved. Regarding assessment, concerns were expressed about the impact of AI on the reliability of results. The importance

of assessment methods that promote explanation and reflection—not just mechanical execution—was emphasized. Oral defense and critical analysis were highlighted as valuable tools to ensure the authenticity of knowledge.

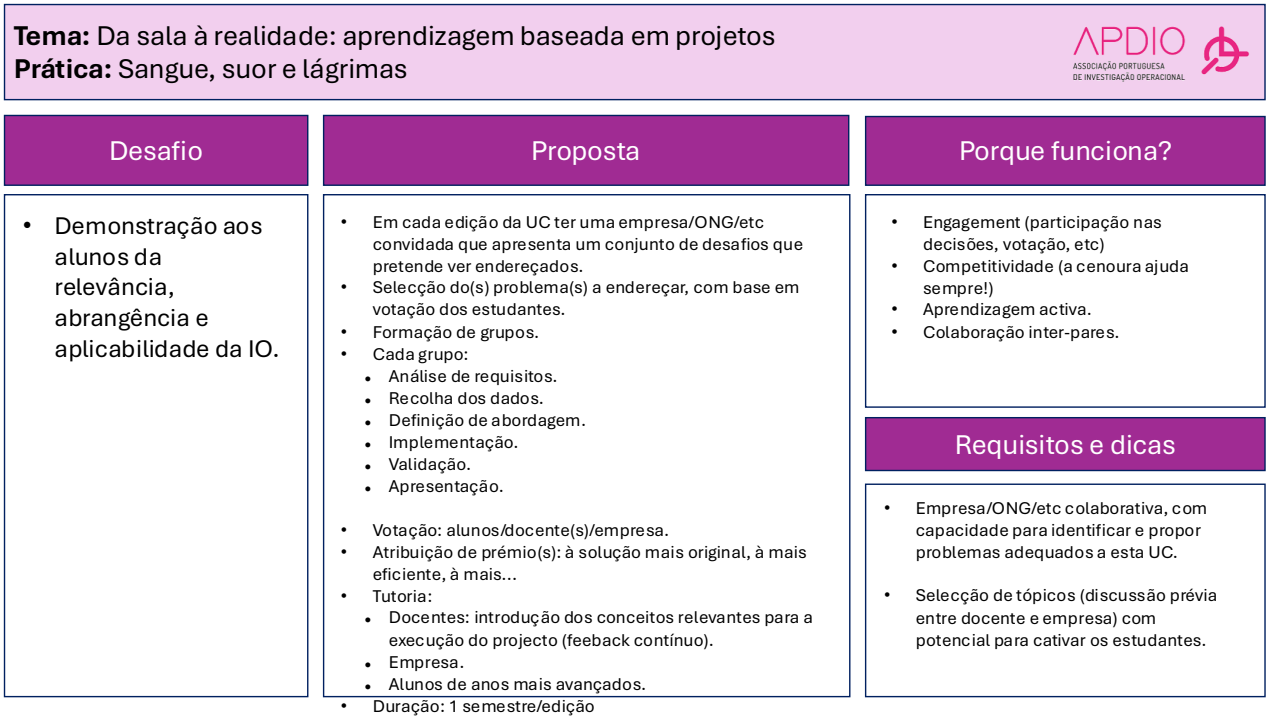
Finally, the round table underscored the importance of preserving the space of OR in programs and departments less directly linked to the field, reiterating that complex problems continue to require abstract, structured, and rigorous thinking. OR, with its specific tools and approaches, thus remains vital in an academic and professional context that is rapidly evolving.

3.4 Pedagogical practices proposed

This chapter presents the original pedagogical proposals, or "pitches", developed by each of the working groups during the workshop. These pitches were created in response to specific teaching challenges and reflect the creativity, experience, and collaborative spirit of the participants.

To support understanding and dissemination, each original pitch (in Portuguese) is accompanied by a brief contextualization and interpretable translation (in English). These explanatory texts and translations were generated with the help of Generative AI and aim to clarify the intent and structure of each proposal, while remaining faithful to its original content.

3.4.1 From Classroom to Reality: Project-Based Learning *Blood, Sweat, and Tears*



This project-based approach was designed to bring realism and engagement into the teaching of OR. By involving external organizations and giving students ownership over the problems they solve, the initiative aims to demonstrate the concrete relevance and wide applicability of OR methods, while also fostering skills in modeling, implementation, and communication.

Challenge

Showing students the relevance, scope, and applicability of OR.

Proposal

In each edition of the course, a company, NGO, or similar institution is invited to present a set of challenges they would like to see addressed. Students vote to select which problem(s) will be tackled that semester. Based on this, groups are formed to work collaboratively.

Each group undertakes a structured project development process, including:

- Requirement analysis
- Data collection
- Definition of approach
- Implementation
- Validation
- Presentation

The final presentations are evaluated by students, instructors, and company representatives through a voting process. Awards are given to recognize the most original, efficient, or otherwise outstanding solutions.

Mentoring plays a key role throughout the semester and is provided by instructors (who introduce relevant concepts and give continuous feedback), by representatives from the partner organization, and by senior students acting as peer mentors.

The duration of the project corresponds to one semester per edition.

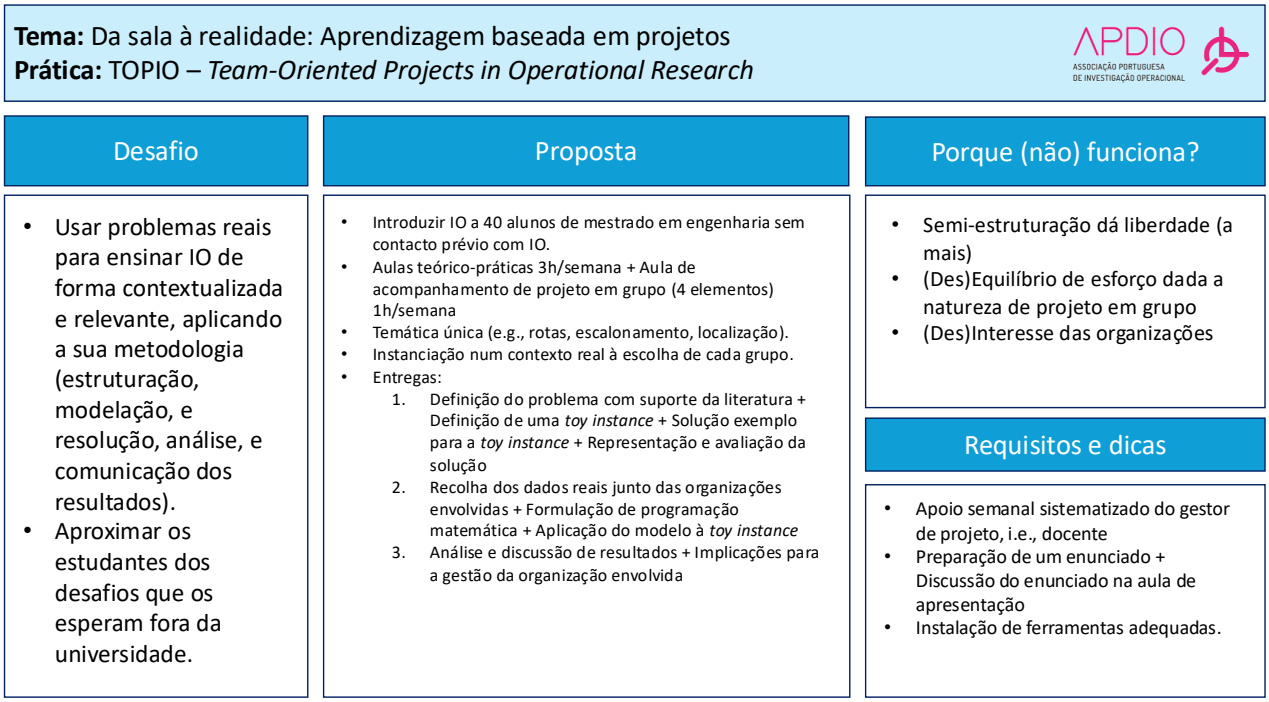
Why does it work?

- Engagement: students are involved in decision-making and voting processes.
- Competitiveness: the prospect of awards and recognition adds motivation.
- Active learning: theoretical content is applied in a practical and meaningful way.
- Peer collaboration: students work closely with each other, sharing knowledge and responsibility.

Requirements and tips

Success depends on identifying a collaborative organization capable of proposing problems aligned with course objectives. A prior discussion between the instructor and the organization is recommended to ensure that topics are both pedagogically appropriate and likely to capture student interest.

3.4.2 From Classroom to Reality: Project-Based Learning *TOPIO – Team-Oriented Projects in Operational Research*



2

This proposal presents a structured approach to introducing OR to master's students in engineering, most of whom have no prior exposure to the subject. The objective is to make the learning process relevant and context-driven by engaging students in group projects grounded in real-world challenges.

Challenge

Use real problems to teach OR in a contextualized and relevant way, applying its methodology: structuring, modeling, solving, analyzing, and communicating results.

Bring students closer to the challenges they will face outside the university.

Proposal

The course targets a cohort of 40 master's students in engineering with no previous contact with OR. The teaching format includes a weekly 3-hour theory-practice session and a 1-hour project mentoring session for each group (groups of 4 students).

Each project focuses on a single OR theme, such as routing, scheduling, or location, and is instantiated in a real context selected by the group. The project evolves over three key deliverables:

1. Problem definition: supported by relevant literature; includes definition of a toy instance, example solution, and evaluation of the proposed solution.
2. Model development: involves real data collection from associated organizations, formulation of a mathematical programming model, and application of the model to the toy instance.
3. Analysis and discussion: students analyze and discuss the results and reflect on their implications for the management of the organization involved.

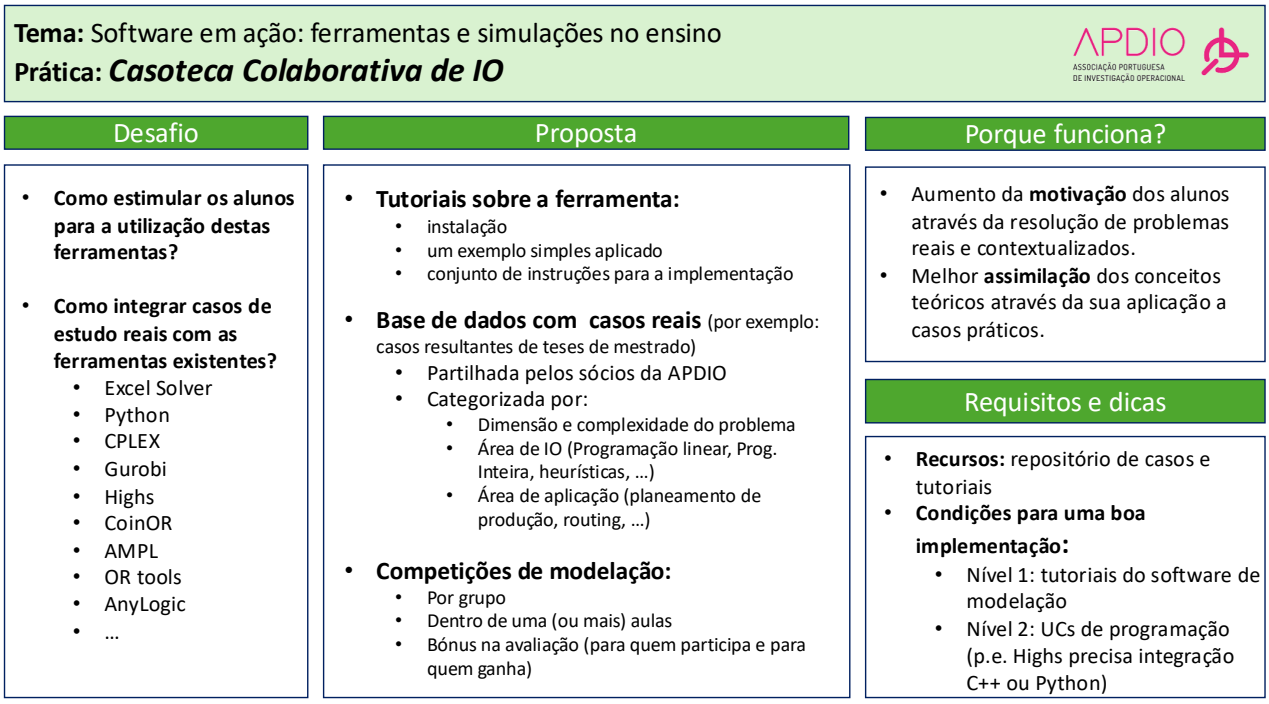
Why (doesn't) it work?

The semi-structured nature of the approach gives students a high degree of freedom, which can be both empowering and overwhelming. The effort required can become unbalanced within groups, depending on the dynamics and commitment of each member. Success is also influenced by the interest and engagement level of the external organizations involved.

Requirements and tips

Weekly project mentoring by the instructor is essential to provide guidance and ensure progress. Preparation of a written project brief, followed by an in-class discussion during the first session, helps set clear expectations. Access to and installation of appropriate software tools should be ensured early in the course.

3.4.3 Software in Action: Tools and Simulations in Teaching *Collaborative OR Case Library*



This proposal explores ways to increase student engagement and learning in OR through the use of software tools and real-world case studies. The aim is to bridge theory and practice by giving students the opportunity to apply OR methods using professional tools and real data.

Challenge

How to encourage students to use these tools? How to integrate real case studies with available tools: Excel, Solver, Python, CPLEX, Gurobi, Highs, CoinOR, AMPL, OR Tools, AnyLogic, . . .

Proposal

To address these challenges, the proposal includes a set of practical strategies centered on tool tutorials and the use of a collaborative case database. The tutorials should cover:

- Installation procedures
- A simple applied example
- Step-by-step implementation instructions

Alongside this, a shared database of real case studies would be created, ideally populated with examples drawn from master's theses and other academic projects. This database would be shared among APDIO members and categorized by problem size and complexity, OR domain (e.g., Linear Programming, Integer Programming, heuristics), and application area (e.g., production planning, routing).

Another proposed activity is the organization of group-based modeling competitions, possibly held during class sessions. These would carry incentives in the form of bonus marks, both for participation and for winning teams.

Why does it work?

This approach increases student motivation by involving them in the solution of real, contextualized problems. It also supports a better assimilation of theoretical concepts by linking them directly to practical applications.

Requirements and tips

The key resources required include a well-organized repository of case studies and tutorial materials. Successful implementation also depends on:

- **Level 1:** availability of modeling software tutorials
- **Level 2:** alignment with programming course units (some tools, like Highs, require integration with C++ or Python)

3.4.4 Serious Play: Gamification in OR *GamIO*

Tema: Jogar a sério: gamificação na IO
Prática: GamIO

APDIO ASSOCIAÇÃO PORTUGUESA DE INVESTIGAÇÃO OPERACIONAL

Desafio	Proposta	Porque funciona?
• Como motivar com jogos, desafios e competições sem perder o rigor? • Analisam-se formas de introduzir elementos lúdicos no ensino da IO para tornar a aprendizagem mais envolvente e divertida, sem comprometer a profundidade.	• Haver um sistema de XP que os alunos ganham por **atividades realizadas em aula** (15 min, em grupos de 2 ou 3) • Haver um sistema de Achievements single-player e/ou co-op com **desafios mais difíceis** • 15% da avaliação XP / 5% achievements • Modelação: tentar encontrar a melhor solução sem modelo – 200XP + 50XP bonus • Modelação: fazer um modelo (qnts. mais restrições melhor) – XP por cada componente • Res. gráfica/Simplex: resolver um ex. em aula – XP p/ componente + achievement • Análise de sensibilidade: tentar alterar os valores para encontrar uma sol. melhor	• Ajuda a virem às aulas • Motivação para acompanhar a matéria • Aprendizagem ativa / avaliação contínua • Componentes de competição • Divertido

Requisitos, dicas e riscos

- Como gerir múltiplas turmas?
- Como gerir muitos alunos?
- Questões com grupos e de alguns se "colarem"
- Tecnologia/Logística
- Onde ir buscar os 15 minutos?
- Níveis de XP para avaliação

4

This pitch presents a gamified approach to OR teaching, aiming to boost student engagement and participation through structured incentives and playful learning mechanics.

Challenge

How to motivate with games, challenges, and competitions without sacrificing rigor? Exploring ways to introduce playful elements into OR teaching to make learning more engaging and fun, without compromising depth.

Proposal

Implement an XP (experience points) system where students earn XP by completing short in-class activities (around 15 minutes), usually in pairs or small groups. Introduce an achievements system for more challenging tasks, available in both single-player and cooperative formats.

Assessment breakdown: 15% of the final grade is derived from XP, and 5% from achievements.

Example activities include:

- Modeling: try to find the best solution without a model - 200XP + 50XP bonus
- Modeling: build a model - the more constraints, the more XP earned
- Graphical solution/Simplex: solve an example in class - XP per component + achievement unlocked
- Sensitivity analysis: attempt to adjust parameters to improve the solution

Why does it work?

- Encourages class attendance
- Motivates students to keep up with the content
- Supports active learning and continuous assessment
- Adds a competitive dimension
- Makes learning fun

Requirements, tips, and risks

- Managing multiple classes and large student groups
- Preventing "free riding" in group activities
- Addressing logistical and technological constraints
- Finding class time for game-based activities (e.g., 15 minutes)
- Defining XP thresholds and achievement criteria for assessment

3.4.5 The First Door: Introductory Activities for OR *Why OR?*

Tema: A primeira porta: atividades de introdução à IO
Prática: IO para quê?

APDIO
ASSOCIAÇÃO PORTUGUESA DE INVESTIGAÇÃO OPERACIONAL

Desafio	Proposta	Porque funciona?

• Alunos não compreendem a importância de IO no curso e, por consequência, não entendem a utilidade no futuro profissional
• Alunos com dois perfis diferentes mas cujo desafio é igual:
  • com bases de matemática mas de cursos de engenharia distante de EGI
  • sem bases de matemática
	• 1ª aula introduzir IO com vídeo de ex-alunos a mostrar como aplicam IO nos seus trabalhos
	• Desafiar alunos a trazerem problemas relevantes para aula seguinte e selecionar problemas
	• Selecionar um problema – este será o problema base para ser dado na sala de aula
	• Formação de grupos (aleatório ou não)
	• À medida que fossem dados os conceitos, trabalhar cada um dos problemas ao longo do semestre
	• Cada grupo apresenta no final as conclusões e pede-se uma análise crítica ao próprio trabalho.
		• Sendo um problema que resulta da reflexão dos alunos, deverá ser interessante para eles e para perceberem a utilidade
		
		Requisitos e dicas
		• Necessário usar tempo de aula para acompanhar grupos
		• Avaliar apresentação

5

This proposal introduces OR to students from diverse backgrounds through personal relevance and reflection, fostering a stronger connection to the subject early on.

Challenge

Students do not understand the importance of OR in their degree and therefore do not see its professional relevance. Two different student profiles face this challenge:
- Students with a math background but from engineering courses far from Industrial Engineering and Management (IEM)
- Students without a math background

Proposal

Start the first class with a video featuring alumni who demonstrate how they use OR in their professional lives.

Challenge students to bring real problems they consider relevant to the next class. Select one of these problems to serve as a semester-long case study. Form groups (randomly or not) to work on the selected problem.

As OR concepts are introduced throughout the semester, groups apply them directly to the evolving problem. At the end, each group presents their findings and reflects critically on their work.

Why does it work?

Since the central problem stems from student reflection, it is more likely to be meaningful to them and helps demonstrate OR's usefulness.

Requirements and tips

- Allocate class time to monitor group progress
- Include an evaluation component for the final presentations

3.4.6 Hands-On: Practical Activities That Teach *Mission Optimal – Adventure in the Feasible Region*

Tema: Mãos à obra: atividades práticas que ensinam
Prática: Missão ótimo – aventura na Região Admissível

APDIO ASSOCIAÇÃO PORTUGUESA DE INVESTIGAÇÃO OPERACIONAL

Desafio	Proposta	Porque funciona?
• Como demonstrar visualmente o que o algoritmo Simplex faz? • Assumimos que os estudantes já deram Programação Linear e resolução geométrica	• Damos um problema com 3 variáveis e muitas restrições para ter muitas faces, com origem admissível; modelamos • **Cada grupo de 2/4 estudantes têm um poliedro correspondentes à região admissível** • **Regras do jogo:** começar na "casa de partida" (0,0,0); só podem ir pelas arestas; têm de arranjar um critério de escolha coerente para quando chegam a um ponto; têm de arranjar maneira de saber quando chegaram ao ponto ótimo • Podemos ter problemas diferentes (funções objetivo diferentes para obter soluções diferentes para grupos diferentes) • Mostrar no final no GeoGebra • Podemos usar para introduzir PI também (imprimir modelo "contínuo"/ "inteiro" • Variante: usar um poliedro que se desmonta para exemplificar o B&B	• Permite compreender conceitos menos imediatos do simplex, como • Ajuda à inclusão de estudantes amblíopes e invisuais **Requisitos e dicas** • Impressora 3D disponível para imprimir os poliedros • Fita cola papel / marcadores para marcar o caminho • GeoGebra para demonstrar (gratuito e fácil de usar)

6

This hands-on activity helps students visualize the Simplex algorithm in three dimensions and better understand abstract concepts through physical interaction and gameplay.

Challenge

How to visually demonstrate what the Simplex algorithm does? This activity assumes students have already covered Linear Programming and geometric resolution.

Proposal

Present a problem with 3 variables and multiple constraints, creating a complex feasible region with an admissible origin. Each group of 2–4 students receives a polyhedron representing this region. Each group must do the following (game rules):

- Start at "home" (0,0,0)
- Navigate only along the edges of the polyhedron
- Define a consistent decision rule for choosing directions at each vertex
- Identify when the optimal point has been reached

Each group can be given a different objective function, leading to different optimal solutions. The class concludes with a demonstration in GeoGebra.

This approach can also be extended to introduce Integer Programming by printing both continuous and discrete versions of the models. A variant uses a disassemblable polyhedron to illustrate the Branch & Bound method.

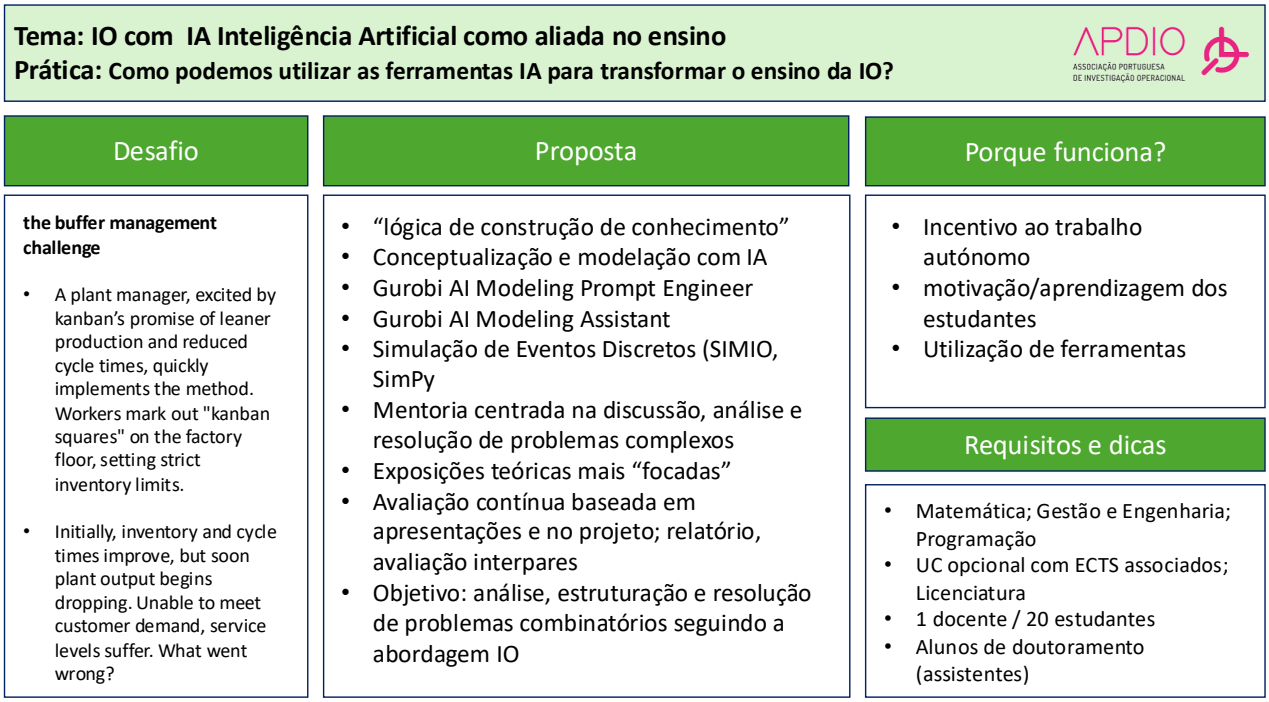
Why does it work?

- Helps students understand less intuitive aspects of the Simplex algorithm
- Supports inclusion of visually impaired and blind students

Requirements and tips

- Access to a 3D printer to create the polyhedra
- Use paper tape and markers to track paths
- GeoGebra software for visual demonstrations (free and easy to use)

3.4.7 OR with Artificial Intelligence as an Ally in Teaching
How Can We Use AI Tools to Transform OR Teaching?



This proposal explores how artificial intelligence tools can support the teaching and learning of complex OR problems, while promoting analytical thinking and student autonomy.

Challenge

The buffer management challenge:

- A plant manager, excited by Kanban's promise of leaner production and reduced cycle times, quickly implements the method. Workers mark out "Kanban squares" on the factory floor, setting strict inventory limits.
- Initially, inventory and cycle times improve, but soon plant output begins dropping. Unable to meet customer demand, service levels suffer. What went wrong?

Proposal

Adopt a "knowledge construction logic" using AI tools to support conceptualization and modeling. These tools include:

- Gurobi AI Modeling Prompt Engineer
- Gurobi AI Modeling Assistant
- Discrete Event Simulation tools (e.g., SIMIO, SimPy)

Mentoring is centered on discussion, analysis, and solving complex problems. Theoretical lectures are streamlined and focused. Continuous assessment is based on student presentations, project reports, and peer evaluation. The core goal is to develop skills in problem analysis, structuring, and solving combinatorial problems using OR methodology.

Why does it work?

- Encourages independent learning
- Increases student motivation and engagement
- Promotes meaningful use of professional tools

Requirements and tips

- Students need background in mathematics, management/engineering, and programming
- Recommended as an elective undergraduate course with ECTS credits
- Ideal instructor-to-student ratio: 1 per 20 students
- Involvement of PhD students as teaching assistants

4

Conclusions

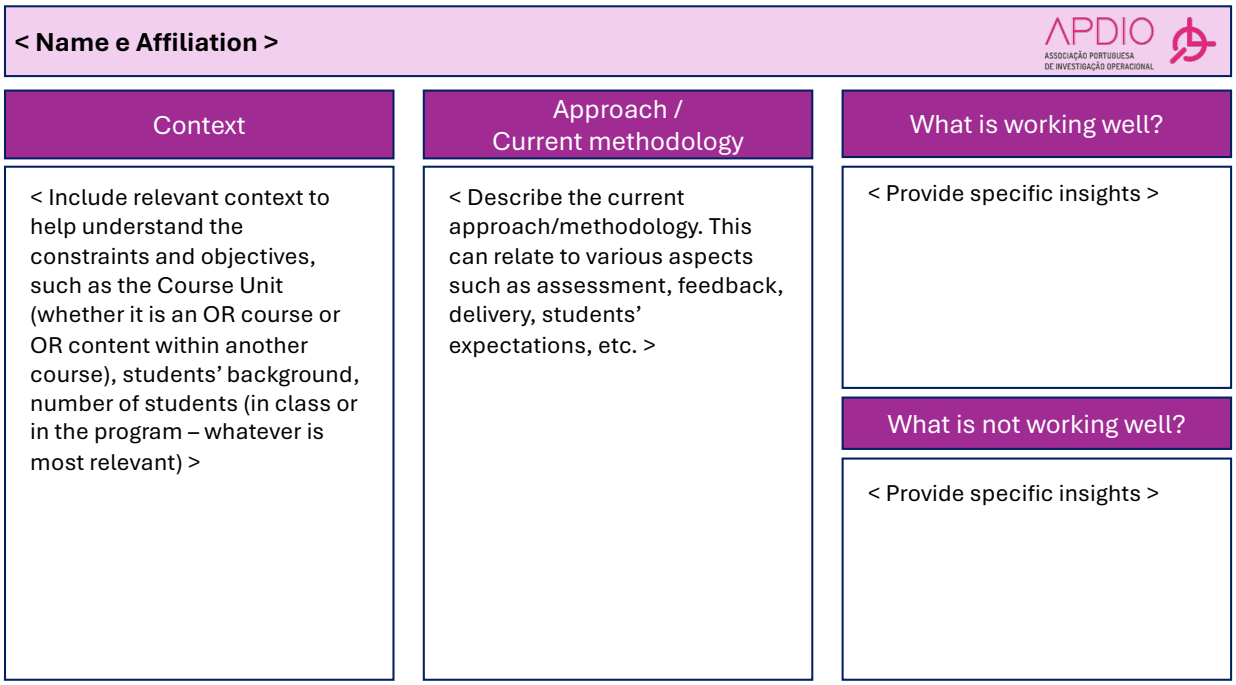
The **APDIO Workshop on Teaching Operational Research – Hands-On Edition** reaffirmed the value of creating spaces where educators can learn with and from each other. Through open sharing, critical reflection, and collaborative design, the participants demonstrated that the diverse challenges faced when teaching Operational Research can be met with creativity, empathy, and rigor. The diverse contributions revealed not only the richness of practices already in place but also the collective desire to make learning experiences in OR more engaging, meaningful, and transformative.

This report documents the process and outcomes of a workshop built on trust, experimentation, and mutual support. While each participant brought their own context, all left with new ideas, renewed motivation, and a stronger sense of community. The practices and prototypes generated during the day are not final products, but starting points, which should be concrete enough to be tested, and open enough to be adapted. As OR continues to evolve as a field and as a pedagogical challenge, we hope this experience serves as an invitation: to teach boldly, to share generously, and to keep building together.

Appendix A

Individual lightning pitches

A.1 Template



A.2 Examples

The following examples were given to the participants as a source of motivation and inspiration. There was a disclaimer that these examples were created by ChatGPT and any resemblance to real situations was purely coincidental.

Example 1

Educator Joana Ribeiro, University of Minho

Context Course: "Operational Research I". 2nd year of the BSc in Industrial Engineering and Management. About 120 students are divided into two classes. Students have a background in math and statistics, little familiarity with decision-making or modeling

Current approach/methodology Assessment includes two tests and a mini-project. New practice: after each test, I provide individualized feedback based on mistakes, and students may submit a critical reflection and corrected solution, earning up to 20% of the points lost.

What is working well? Students pay more attention to the logic of their mistakes. The reflections help develop critical thinking and self-awareness.

What is working less well? Not all students participate. About 40% don't submit the reflection. It takes a long time to correct.

Example 2

Educator Carlos Martins, Instituto Superior Técnico

Context Course: "Optimization Models". Integrated MSc in Industrial Engineering and Management. Class of about 180 students, all in a single weekly lecture. Familiar with programming and math, but not very motivated by the theoretical aspects of OR.

Current approach/methodology Methodology based on "mini-cases" distributed at the start of the lecture. Each case introduces an operational decision (e.g., "how to schedule hospital shifts"). Lecture alternates between explanation and short pair-based exercises related to the day's theoretical model.

What is working well? Students are more engaged (ask more questions, better concept retention). The cases help anchor theoretical knowledge in concrete examples.

What is working less well? Time management (sometimes I don't cover all planned topics). Keeping students focused during tasks without getting distracted, especially at the back of the lecture hall.

Example 3

Educator Margarida Lopes, University of Aveiro

Context Cross-disciplinary course: "Decision Techniques". For students in Environmental and Mechanical Engineering About 90 students total, divided into sections. Many students see little relevance of OR to their fields

Current approach/methodology Students bring a real-life problem (personal, professional, or related to their field). They try to express it as a linear programming problem, with in-class and online forum support. Examples: optimizing recycling container distribution, task allocation in a sports club.

What is working well? Greater motivation, even in students with weak test performance. Increased participation in practical sessions.

What is working less well? The diversity of problems makes assessment harder. Many models are incomplete or incorrect, making it difficult to apply consistent grading. How to balance creative freedom with methodological rigor?

Appendix B

Group hands-on activity

B.1 Guide for group hands-on lab

Objective of the activity: To develop a concrete and practical proposal for a pedagogical approach related to the assigned theme, which can be adapted and applied by other instructors. We will have 2 hours for this activity, and the times indicated below are only suggestions.

Each group should:

1. **Generate ideas** (30 minutes):
   - **Conduct a brainstorming session on potential specific challenges** within the assigned theme (e.g., in the theme "Hands-On", what is the main obstacle to student motivation? Lack of proactivity? Distraction?) that can be tackled. Discuss possible **pedagogical practices** to address the challenge.
   - Below are **some ideas (suggested by ChatGPT) to break the ice** and launch the discussion — but brainstorming is not limited to these and should go beyond them.
   - Choose one **specific challenge and a pedagogical practice** to develop as a group.
2. **Design the pedagogical practice** (1 hour):
   - **Describe the context** in which the practice could be applied. That is, are there any limitations regarding the type of course, student profile, class size, type of instruction (in-person/online), etc.?
   - What is being **proposed**?
     - Activity/approach
     - Target audience
     - Duration
     - ... (other relevant points the group deems important)
   - How will it be **implemented**?
     - Concrete steps
     - Materials and prior preparation needed
3. **Analyze the pedagogical practice by identifying risks and success conditions** (15 minutes):

- What are the main challenges in applying this practice?
- What is needed for it to work well? (time, training, support, etc.)
- How does it contribute to improving student learning?

4. **Systematize the idea using the provided pitch template** (15 minutes)

Suggested Practices to Inspire the Groups – by ChatGPT

- From Classroom to Reality: Project-Based Learning
  - Group projects using real data from, for example, transportation, production, or healthcare.
  - Challenges proposed by companies/NGOs, with final presentation sessions.
  - Open-ended problems: collaboratively defining the research question.
- Software in Action
  - "Rapid modeling" workshop using specific software (e.g., PuLP), with short time limits and simple goals, plus step-by-step tutorials.
  - Informal modeling competition around a common problem (e.g., "Who gets the lowest cost?").
  - Simulation lab using AnyLogic with ready-made cases and analysis questions.
- Serious Play: Gamification
  - "Escape room" with OR problems: students can only progress by solving each stage.
  - Points and badges system to track progress in activities.
  - Programming or simulation tournaments (individual or team-based).
  - Modeling challenge with a weekly leaderboard posted on Moodle.
- The First Door: Introductory Activities for OR
  - Simulation of a real situation (e.g., role-playing as "production managers").
  - Impactful videos showing unexpected applications (Netflix, airports, hospitals).
  - Practical challenges before teaching the theory (learning by need).
  - "Everyday modeling" activity (e.g., "how to optimize your day").
- Hands-On: Practical Activities
  - Collaborative modeling on the board or in a digital tool.
  - Activity stations: each with a different type of problem/model.
  - Weekly tasks with solutions discussed in class and self-correction.
- OR with AI
  - Using ChatGPT or similar tools to explain models in plain language.
  - Task with AI support: "model with help and then explain the model you created."
  - Critical analysis of AI-generated responses: errors, limitations, useful insights.
  - Creation of exercise prompts or datasets using AI.

B.2 Template for group pitch

Theme: <name of the theme the group worked on>
Practice: <Short, appealing, and representative name of the proposal>

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Challenge	Proposal	Why it works
• Summary of the specific problem being addressed (2–3 bullet points)	• Brief description of the pedagogical activity/approach (4–5 bullet points), including points such as target audience.	• Expected impact on student motivation/learning (2–3 bullet points)
		Requirements and tips
		• Resources, skills, or conditions needed for successful implementation (2–3 bullet points)