



*The Playful Engineer In **IMC² Project**: An **Innovative Learning Approach** based on **TRIZ** and **Bending techniques***

*Designed by Professors – **Industrial Engineering (Lean Learning)***

IMC² Project

*Inter-Master **Coaching Course***

France, Ireland, Norway

2023 – 2026

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Introduction: Context

- Mainly **Master level** programs (M1, M2)
- **Lack of motivation:** Know – how? Knowledge accumulation
- Traditional lecture-based teaching are **no longer suitable** particularly evident in **Engineering** (Faregh et al., 2023; Lin et al., 2020)
- **Engineering Programs** require hands-on methods that **mirror the real world**
- **Learning by playing: Coaching plays** a critical role in **experiential learning** by guiding students, fostering reflection, and helping them apply concepts in real-world contexts.

Introduction: Collaboration Research – Teaching

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Develop SMEs with **the skills** and competencies required to transition to Industry 4.0 (**Erasmus +, 2019**)

Develop digital toolkit for instructional technologies in **higher education** engineering (**2021 – 2023**)

Develop **creativity** and problem-solving in higher education engineering (**2022 – 2024**)

Network **Action Learning** approach to lean supplier development (**2014 – 2019**)

Problem-based learning approach (The Sensei Way), using scrap and defects as learning / improvement opportunities (**2019 – 2023**)

Using **problem-based learning** to enhance lean education: Gemba as classroom (**2022 – 2023 Norway and Romania**).

Innovative Hybrid Learning relating I4EU Industry 4.0 for Europe project (**2019 – 2021**) – **30% English content achieved, Case Study Pedagogy**.

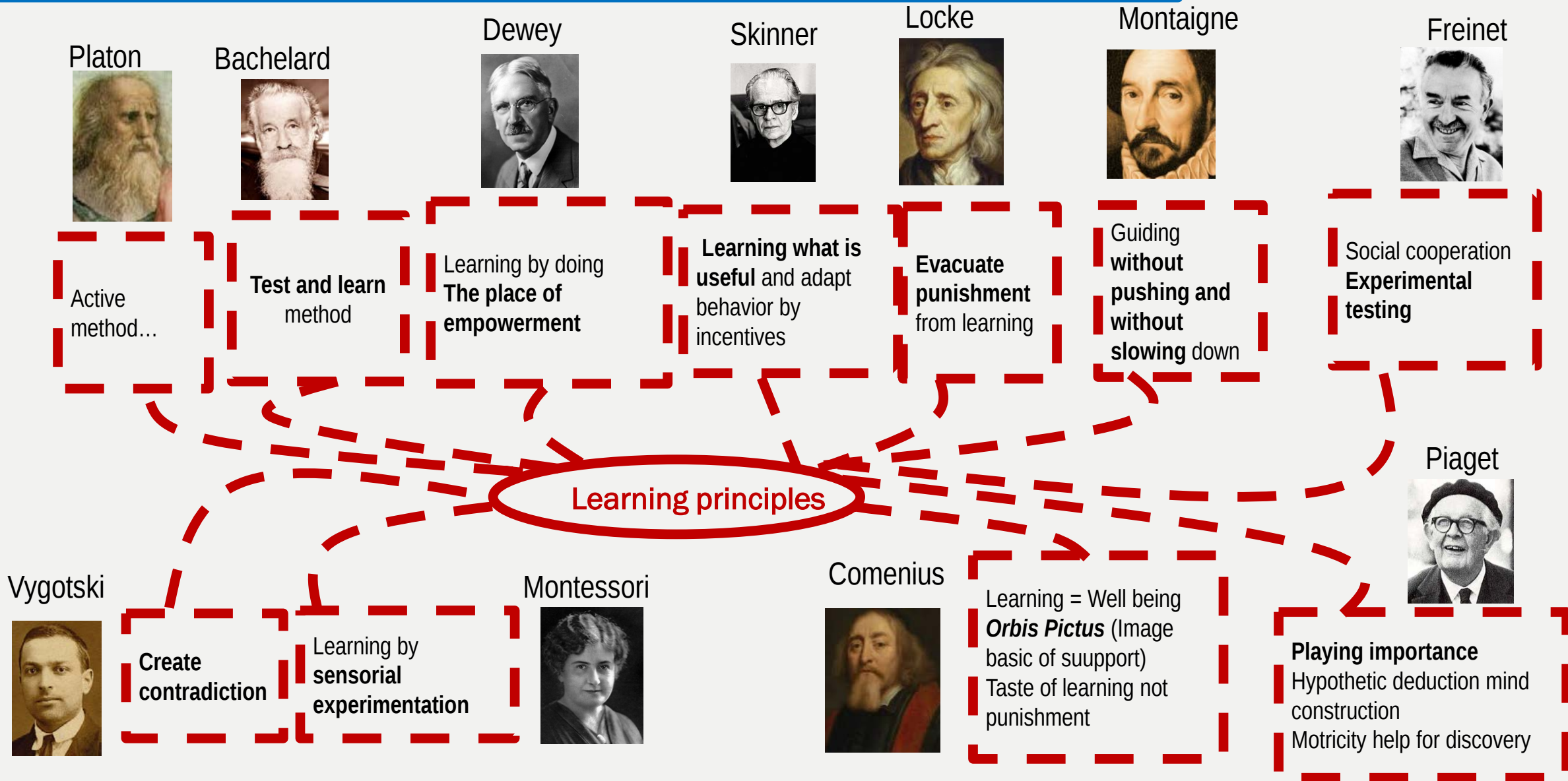
Research Transfer to Learning:

Case Study Digital Kanban **2020 – 2021**

Case Study Digital Tracking lot Based **2021 – 2022**.

International communication: **Conference (2021) (China), Enlight 2023 (Bordeaux), Enlight 2024: Multidisciplinary Biology, robotics, logistics (Estonia), Publication in Study & Pedagogy 2023 (inter-UF)**

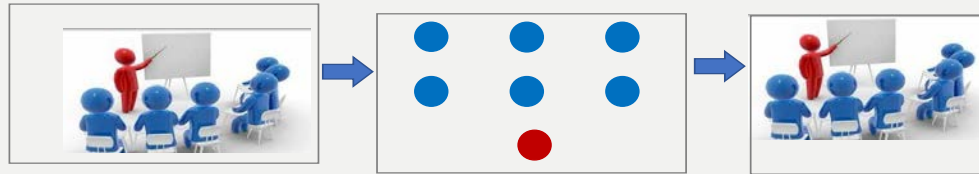
Introduction: Learning principles



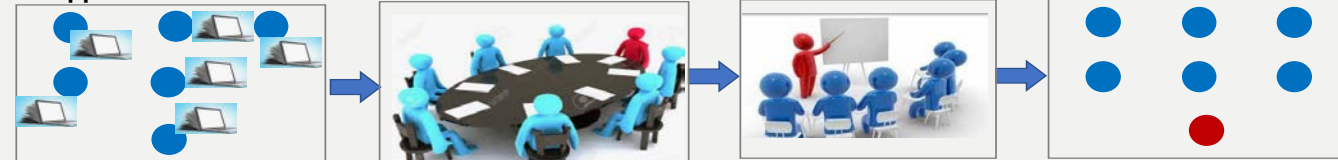
Literature review: Teaching methods

- HE: How do we teach?
- Methods : **flipped classrooms** and **project-based learning**, **blended learning**

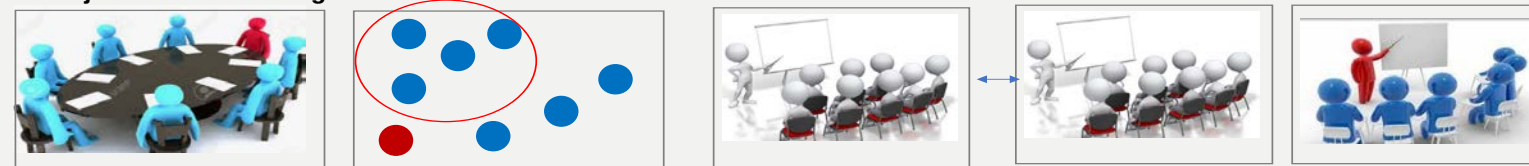
■ Classic class: CM + TD



■ Flipped classroom



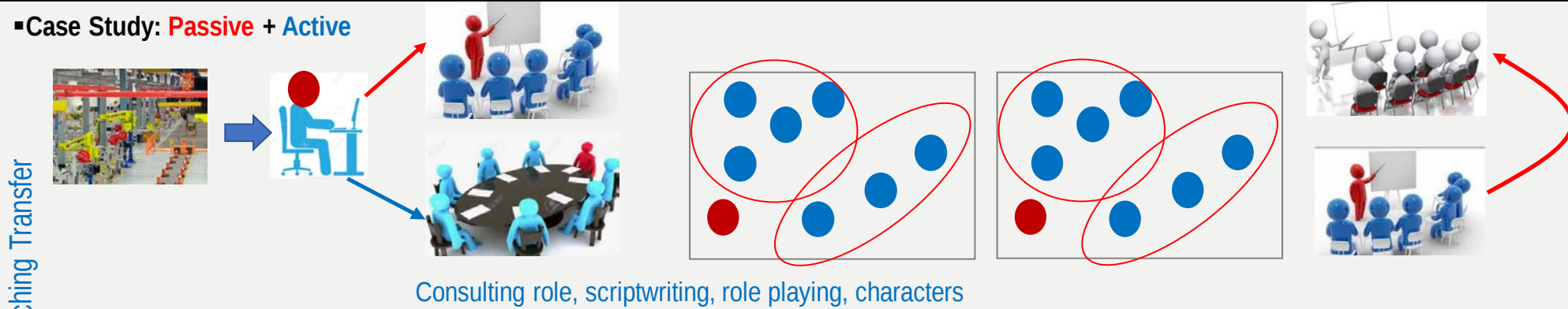
■ Project-Based Learning



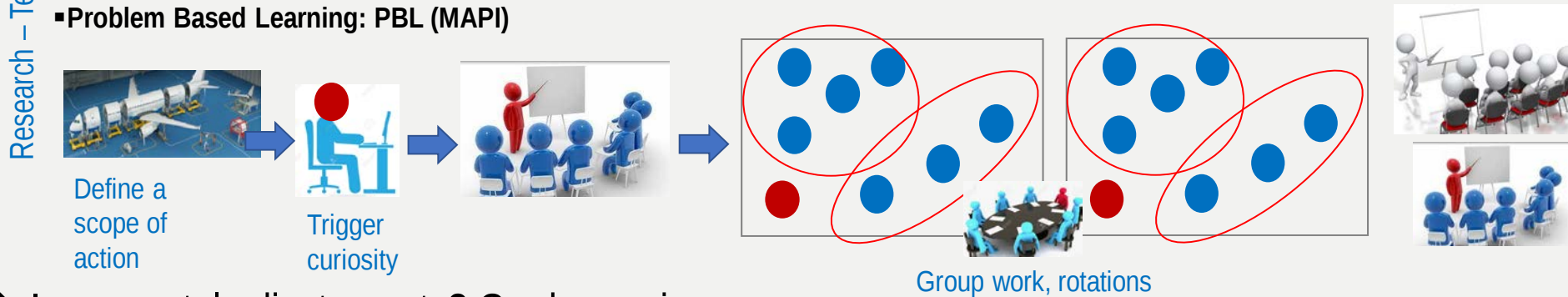
➔ Instructors require more **constructive methods** that enable **personalized teaching strategies** based on factors such as **subject matter, class size and student needs**

Literature review: Exploring new ideas...

Case Study: **Passive** + **Active**



Problem Based Learning: PBL (MAPI)



➔ Incremental adjustments? Go deeper in...

TRIZ theory

Bending techniques and “what if” scenarios

Design a new Course (IMC²) as engineers develop new product

Project IMC²: Principles and Execution

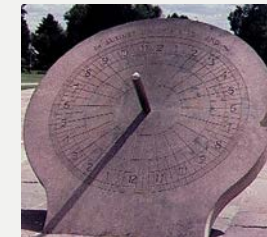
TRIZ: 40 principles of innovation

- Assimilate a **course to a product** and play with possible changes
- Create **components and design** and overcoming **contradictions**



BENDING TECHNIQUES

- Creativity theory
- Bending is a creative mind process leading to innovation
- Change **material**, change **structure**, change the **shape**, change **order**, **change the source**....





Project IMC²: Principles and Execution

Bending direction (teacher – students , teacher-coaches)

Bending the pattern(face-to-face , distance)

Question Distorsion (What if scenarios %occupacy)

Bending space (room, outside)

Bending the materials (VSM pictograms , VSM maps , MP4)

BENDING

coaches (n) => Distance coaches (n+1)



Case Study

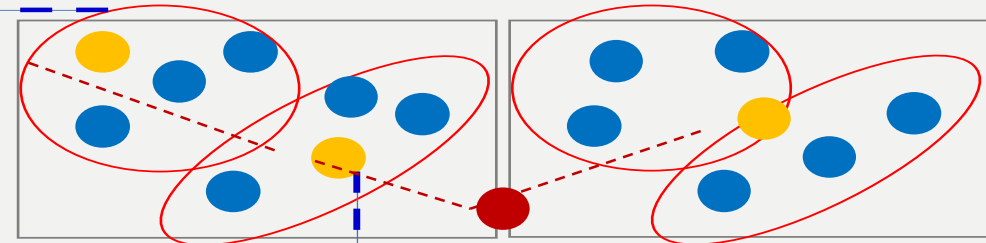


PBL + experimentation



Year (n)

Year (n+1)



Duplication, Moving Coaches

TRIZ

Segmentation (Tabular Guide , VSM tutorial)

Inclusion (autonomisation, gaming, learning)

Inversion (Teacher – Coaches)

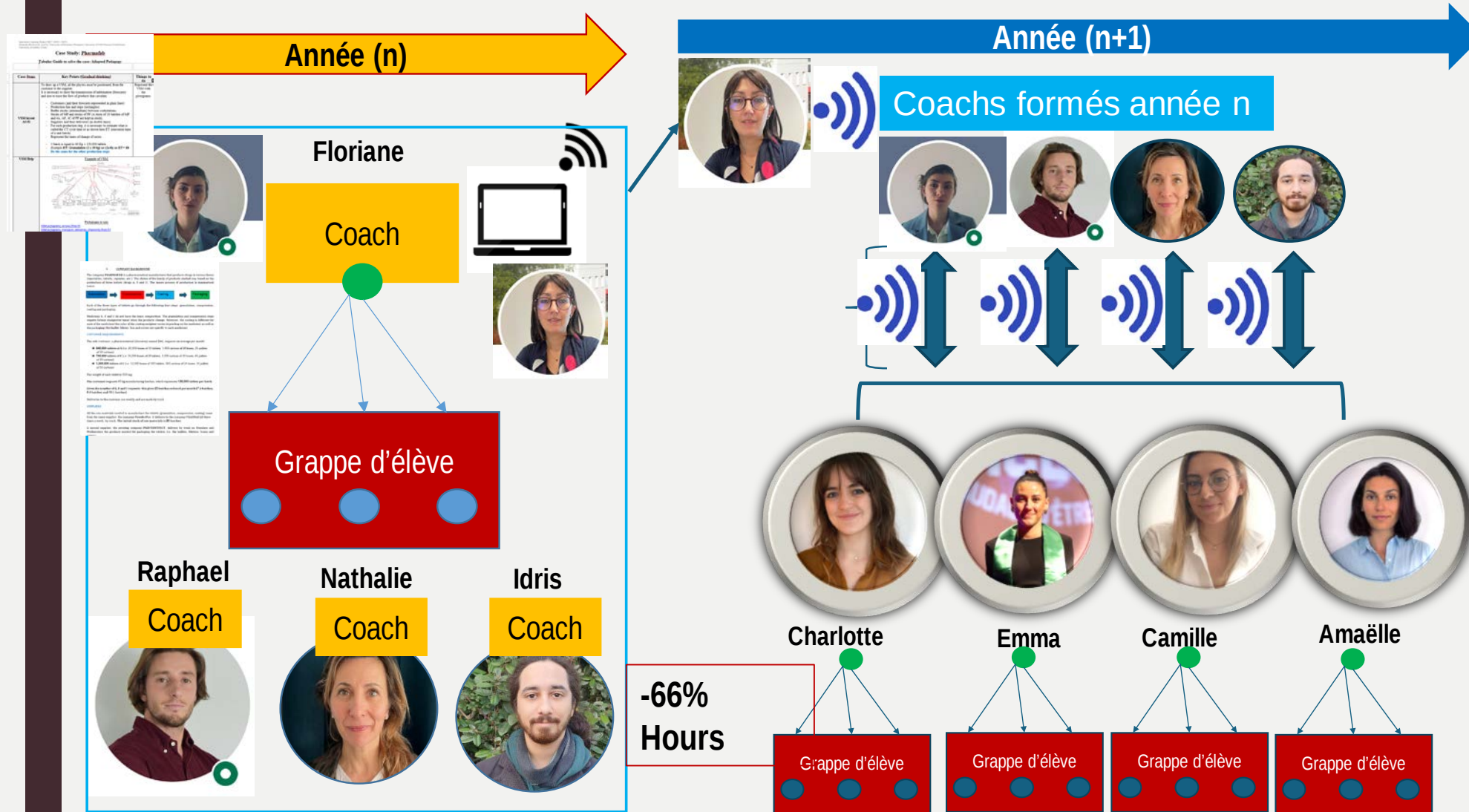
Preliminary action (tabular guide)

Multifonction (teacher-student-intermediate)

Dynamicity : (interchangeable coaches , interchangeable members)

Modular use
40 principles to
explore

Project IMC²: Principles and Execution



- In-person + remote
- Identifying motivated coaches (certificate of participation)
- A teacher prepares a coach
- Coach prepares their group + Tabular guide
- Preparation: 1 session/week (4 weeks)
- Each coach/group of 3-5
- **Coaches (n) become coach trainers at (n+1)**
- Coaches (n) + Coaches (n+1): Motivated + commitment /2 years

Project IMC² : Principles and Execution

■ The shift with **IMC²** !

Fostering ***engagement, interaction, playfulness + reducing cognitive overload*** for educators.

- **IMC² is a scalable, adaptable model** designed to redefine higher education:
 - **collaborative learning** approach where students mentor and support each other to develop new skills and competencies
 - Instructors supported by **students-assistants**
 - **Playful environment**: Students becomes teacher-assimilated

Project IMC²: Duration 2023 – 2026

WP.1 – PBL Design

- Learning material development
 - Company/Problem : choice
- Building the PBL approach (sequence , questions, appendixes , data compilation)

2023

2024

WP.3 – Pilot Project UB

n and n+1: caochs UB test

- Coaches (n): EC + coaches
- Coaches (n+1): coaches + Coaches (n)

2025

WP.5 – Validation and Evaluation

- Integrating feedbacks of scaling
- Qualitative and quantitative feedback questionnaires

2026

WP.2 – The industrial case

- Execution steps
- Team constitution
- Unfolding of sessions
- Document the unfolding chronologically
- Define periods of experimentation

WP.4 – Scalability Lean Program

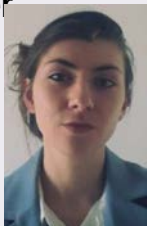
- Define course
- Define Coaches
- Build training France – Norway – Ireland



Project IMC²: Stakeholders feedbacks - Students testimonies

Members	Pedagogical interest	Which gain?	Simulation of real condition?	So after?
Raphael Chagnaud	Fort intérêt pour la méthodologie utilisée et l'organisation mise en place	Nécessité de connaissances de base sur les outils Lean et également très formateur pour mieux les utiliser et les appréhender	Jeu joué au maximum malgré les conditions de travail compliquées	Format avec un peu de présentiel à discuter pour plus de contact Attrayant et bien construit malgré le timing serré quelques difficultés mais dû au peu de temps accordé pour l'expérience
Nathalie Guichard	Le format en autonomie avec les données du terrain permet à chacun d'appréhender le sujet à sa façon dans un premier temps et de mettre en commun avec les autres par la suite.	L'application au domaine pharma est un plus notamment dans la compréhension des étapes de Fab. déjà acquise.	L'approche « conditions réelles » apporte une bonne dynamique à l'étude : - Réunion d'avancement - Délais à tenir en vue du point avec le coach	Expérience formatrice qui m'a permis de mieux comprendre l'objectif d'une VSM et l'évolution recherchée pour cette dernière.
Idris Kafi	Comprendre les flux et voir les points d'amélioration	sujet proche de la réalité, plus facile de trouver des points d'intérêt	Pas facile sur le temps disponible mais envisageable sur une application au groupe entier. Difficultés néanmoins à s'y mettre	global : pas le timing le plus optimal, difficultés personnelles au travail et à la concentration mais enrichissant. Rythme trop différent vis à vis des collègues j'ai mal compris le déroulé total de l'expérience

Floriane Lory
(Pharmaceutical professional – former student)
Guest speaker



Beyond analyzing VSM, Build it is essential skill for production engineer

Step by step approach with regular remote meetings

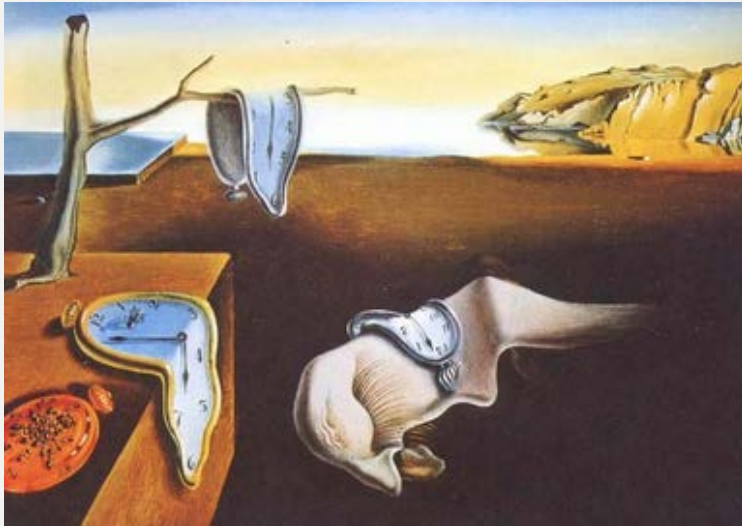
The ratio :
Gained learning/ Invested time is interesting

Playing the role of assistant (small committee)
The case goes into enough detail to allow **full immersion**
Gamification is positive point for coaches
Learners have **quicker answer** to questions

A stimulating and educational experience, → requiring **prerequisites Investment, interest**
The tabular guide provides the group with a solid support to move forward
Definitely **worth repeating**

Conclusion

- **Playful & interactive learning:** Technical engineering skills and soft skills development
- Tackle challenges in HE: **Teaching hours decrease**, and student **competencies increase**
- **Scalable and adaptable framework** beyond **engineering disciplines**



S.Dali: *The Persistence of Memory*, 1931



M.Escher: *Belvedere*, 1958

« Creativity is thinking up new things. Innovation is doing new things » *Theodore Levitt*