

Fluid networks: from science-based training to a learning-centered pathway, a collaborative development involving a teacher, a pedagogical engineer and a learning management system

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The Ecole des Mines d'Albi of Toulouse University offers a master degree in process engineering with a specialization in materials and energy in the building sector. This communication deals with a course about fluid networks originally designed for the student program, which was then adapted for apprentices.

Training in French engineering schools is three years long and leads to a master's degree. Students classically enter engineering schools after a two years intensive training based on fundamentals of mathematics and physics and have to pass a competitive entrance examination. They have excellent skills in mathematics and other scientific subjects. For more than a decade, engineering schools have offered an alternative way to obtain the degree in the form of sandwich courses. Engineer-apprentices enter the school having already obtained a technical qualification. They have more technical and practical skills than students but are weaker in scientific subjects. Their training is also three years long but it combines a work experience in a company. While a classical deductive approach is suitable for students, an inductive approach has been shown to be preferable for the apprentices. Although the two populations have different ways of learning and different course formats, they both have to meet the same requirements to obtain an identical master's degree.

In its original form the course was a series of lectures about fluid mechanics, graph theory and numerical resolution completed with exercises in the form of tutorial classes. The teacher in charge of the evolution of this course was not the one who had created it and neither the new teacher nor the students were totally at ease with these three input subjects and its theoretical and linear approach. The new teacher was supported in this task by a pedagogical engineer, their shared diagnosis was: "The students feel the subject is important but difficult, highly academic, they do not make the connections between scientific fields, and their results are not that good".

Not a revolution, but step by step, many changes, through an intensive, very pleasant and fruitful" collaboration. Two principles underpin this work: the course has to make sense for the students, the learning outcomes have to be specific and clear; and the way of learning must harness student involvement, autonomy and self-direction.

Five years later, the course looks quite different:

- It is now a blended course, with courses at school and e-learning sessions on the school's LMS (learning management system: in this case a Moodle open source platform),
- A course based on industrial case studies, such as Mines Albi's alumni now working on a city's heating network,
- And many activities on the platform: students have to train, they receive automatic feedback through the platform, they interact on the forum, they self-evaluate their skills and have to give feedback on their way of learning [1], on their progresses and also

on the remaining difficulties.

The new version of this course was proposed first to the apprentices and is now applied to the students' training. The impacts of all the changes are still being analyzed, but some results can already be observed:

- The teacher no longer feels alone to re-build the course,
- The teacher feels that she has a different teaching position: no longer expert above students, rather trainer alongside (passing from one side to the other of "Jean Houssaye's pedagogical triangle [2])
- Last but not least, both apprentices and students are more involved in their learning process: "they even stay after the end of the lesson!".

These qualitative results will rapidly be completed by quantitative data. And the evolution is going on, collaborative and peer-review process will soon be introduced in the course.

Making those changes was (and will still be) possible due to:

- A teacher who was aware of the difficulties faced by learners when studying "Fluid networks", and who wanted to facilitate their learning,
- A pedagogical engineer who helped to analyze the situation, and proposed some ways and methods to make learning more active and involving,
- Technology : without the LMS, those changes would not have been workable.

References

[1] Benjamin Bloom, *Taxonomy of Educational Objectives*, 1954, New York, Longmans, Green and Co.

[2] Jean Houssaye, *Le triangle pédagogique : les différentes facettes de la pédagogie*, Issy les Moulineaux, ESF éditeur, 2014

What
about ?

Context

Back to fluids

Course evolution

Feeling ?

Conclusion



“Frugal” innovation **in fluid networks teaching**

from science-based training
to a learning-centered pathway



Nathalie VEUILLEZ & Cendrine GATUMEL
AIChE, San Francisco, nov. 2016



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Context ?

Master degree in process engineering
...in a **French** engineering school



Institut Mines-Télécom



Context ?

Paris

Albi



**MINES
Albi-Carmaux**

Institut Mines-Télécom



**I N S T I T U T
Mines-Télécom**

Université Fédérale



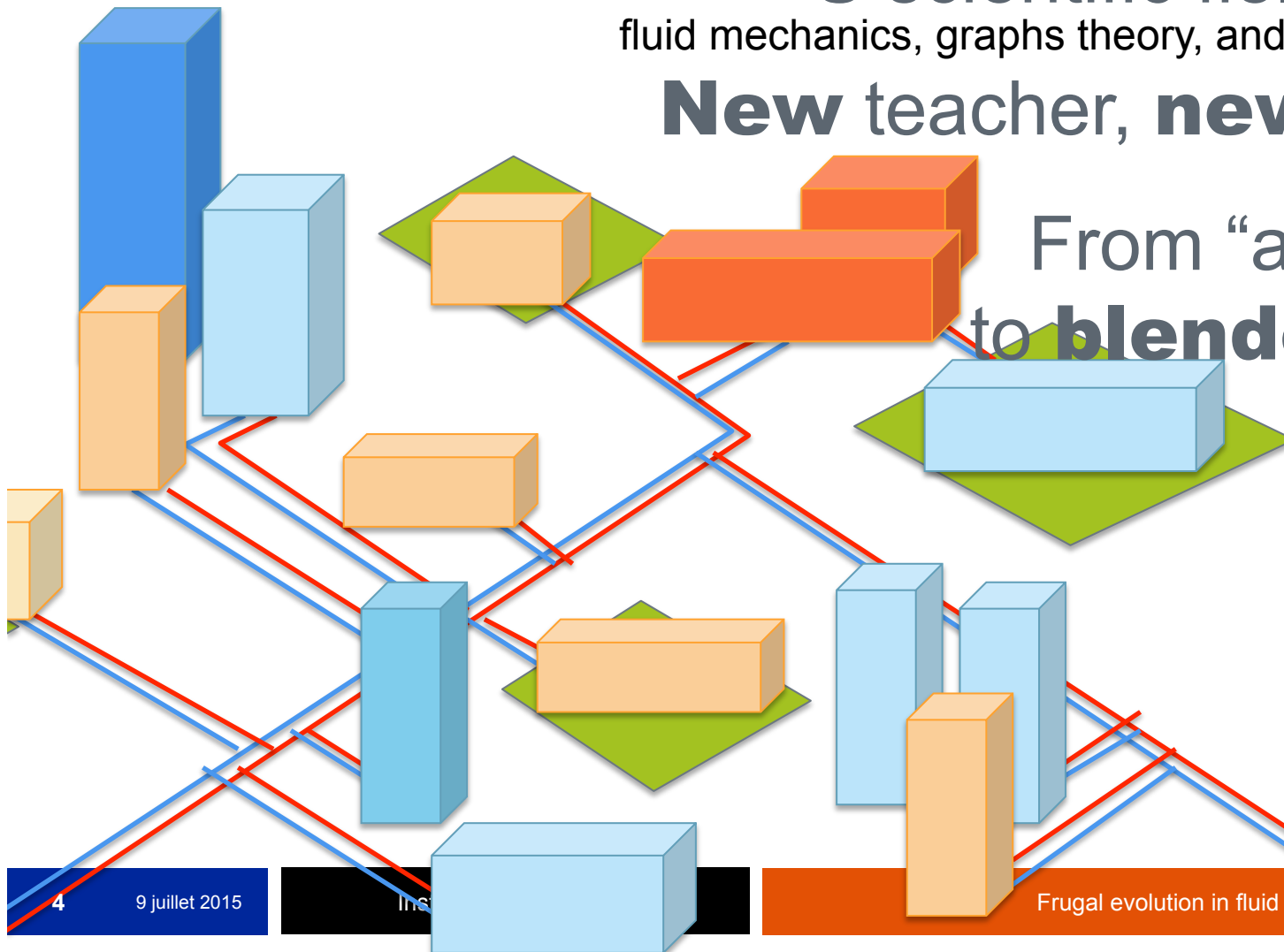
Toulouse Midi-Pyrénées

Back to fluids...

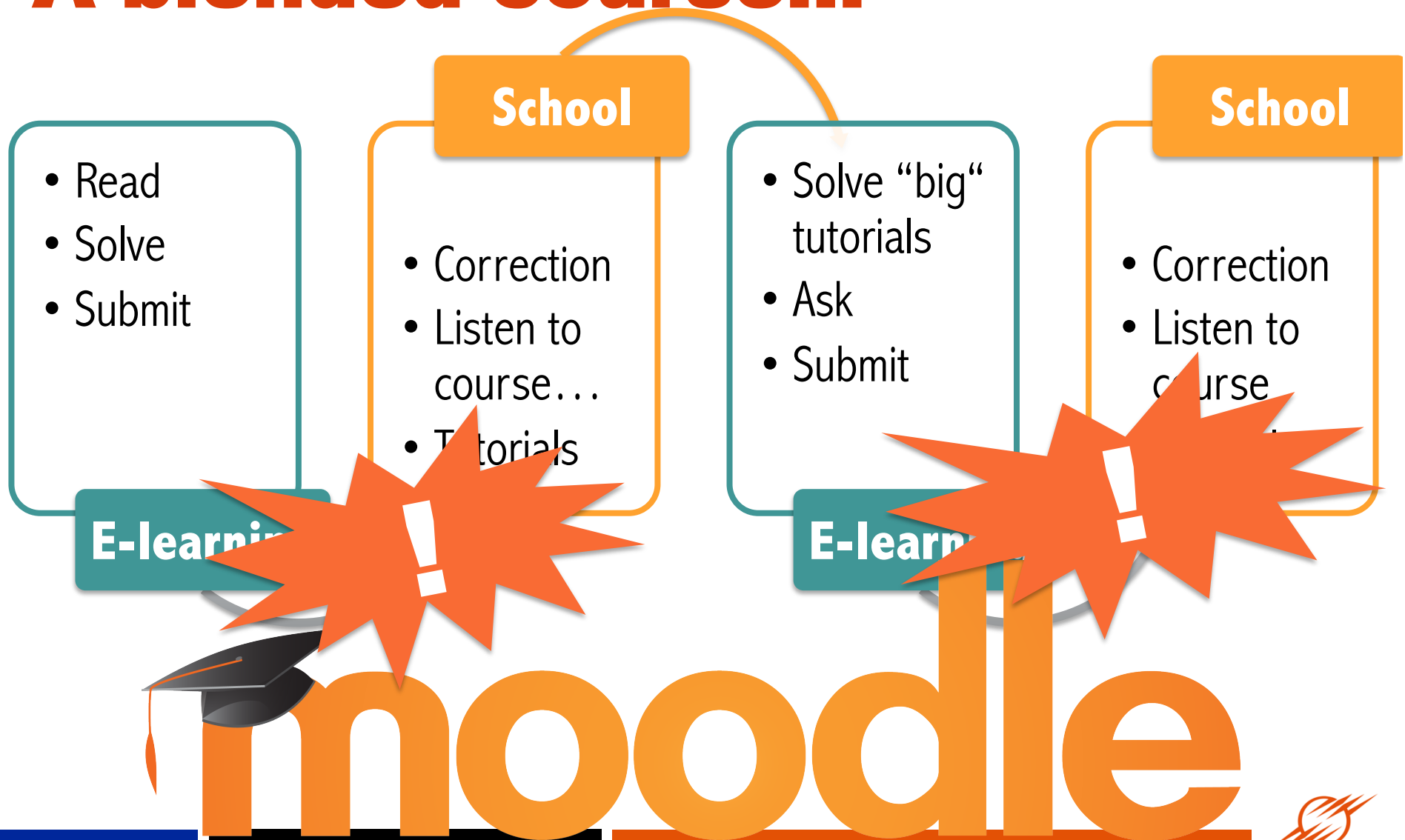
3 scientific fields involved
fluid mechanics, graphs theory, and numerical resolution

New teacher, **new** position ?

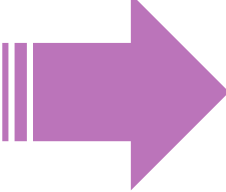
From “all in school”
to **blended** learning



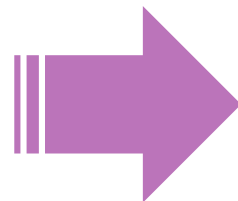
A blended course...



The way, the results?

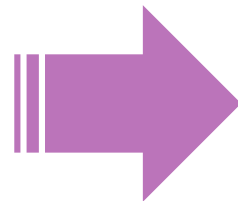
C- (10.5/20)  **B** (14/20)

Students
passive



active & self-directed

Teacher
expert



“learning coach”

The course evolution

Teacher's opinion

Students survey

- Read
- Solve
- Submit

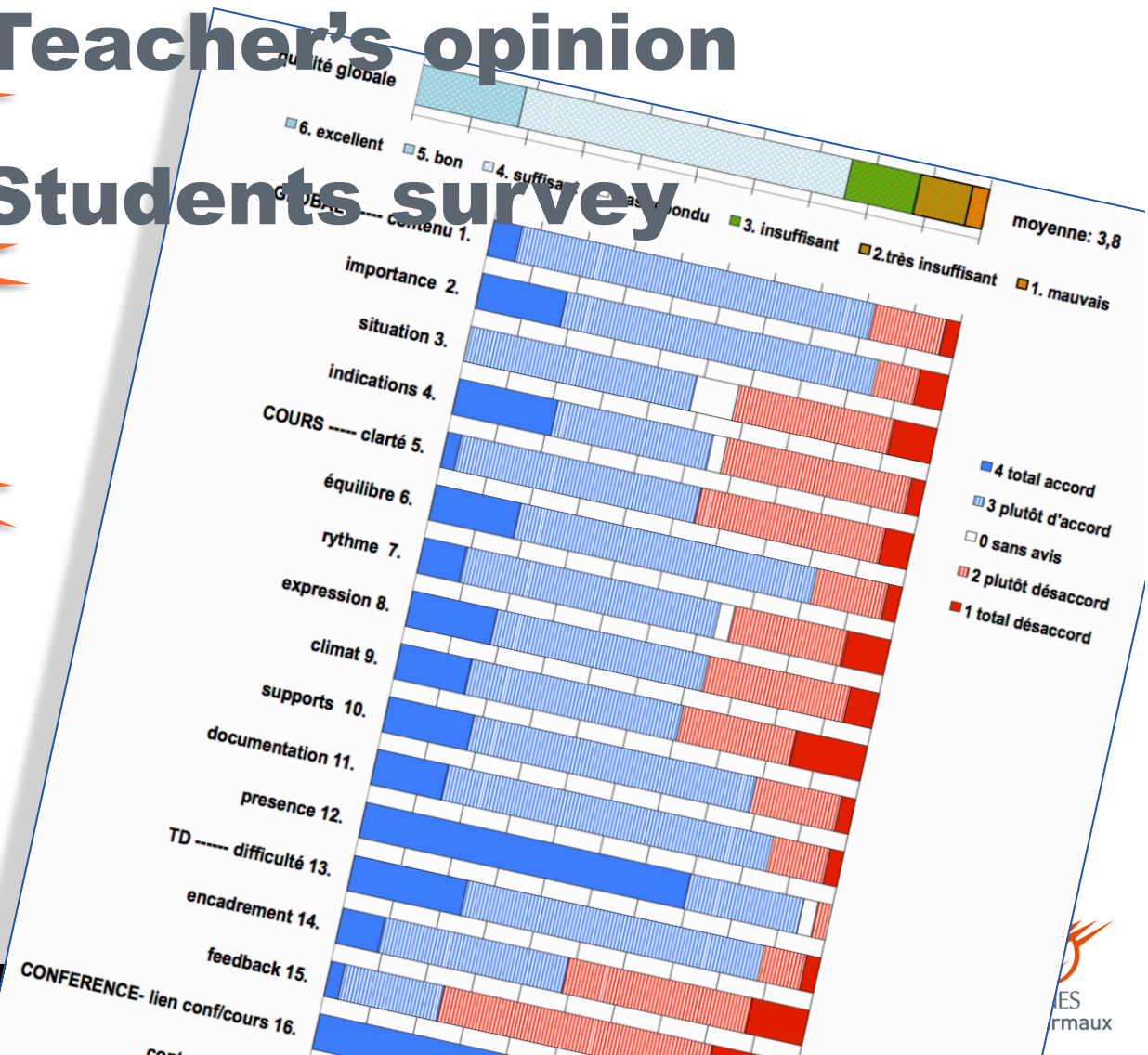
theoretical

no help...

stop

moodle

E-learning



The course evolution

Media
noodle

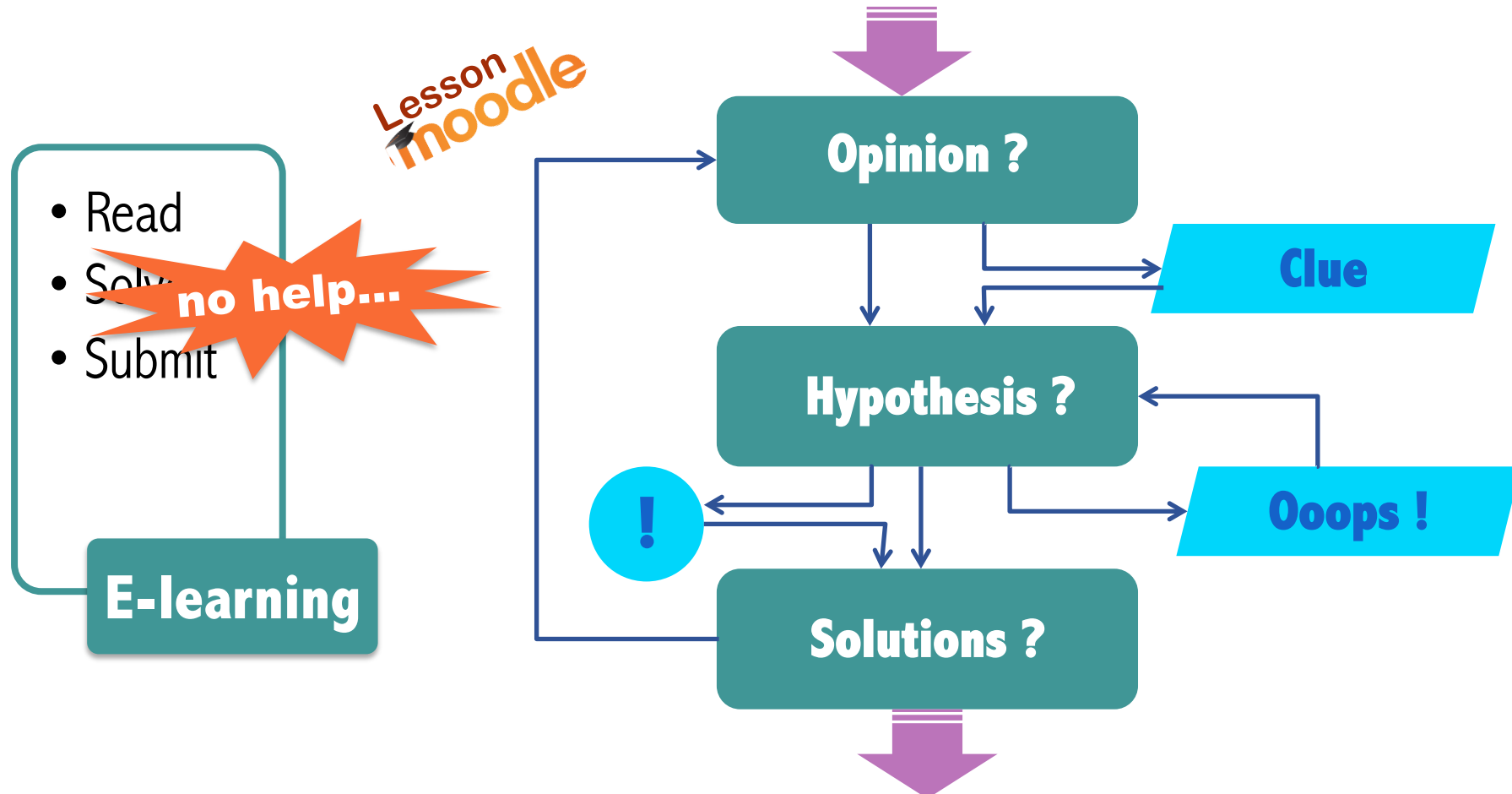
theoretical

- Read
- Solve
- Submit

E-learning



The course evolution



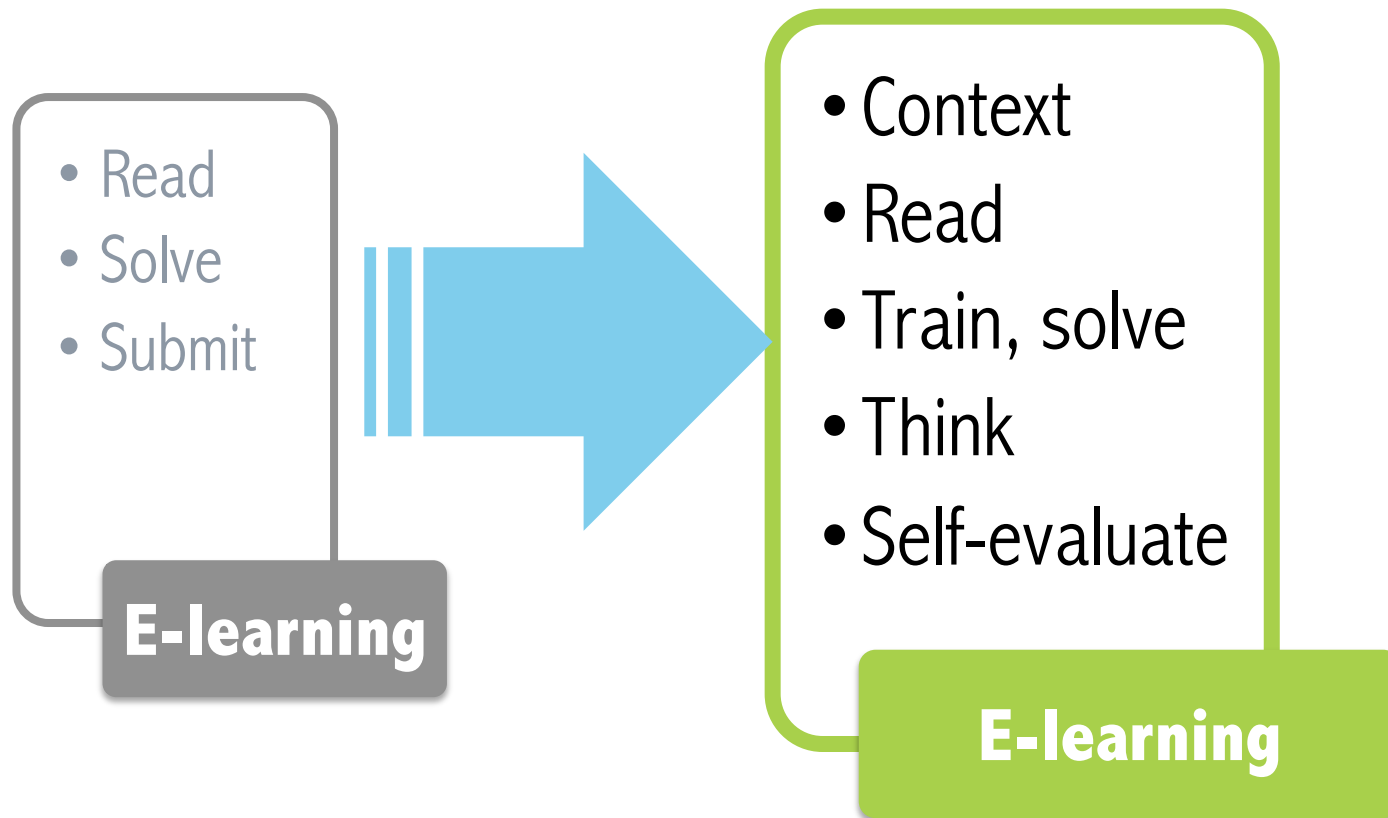
Problems : train, get indication, iterate, figure out

The course evolution

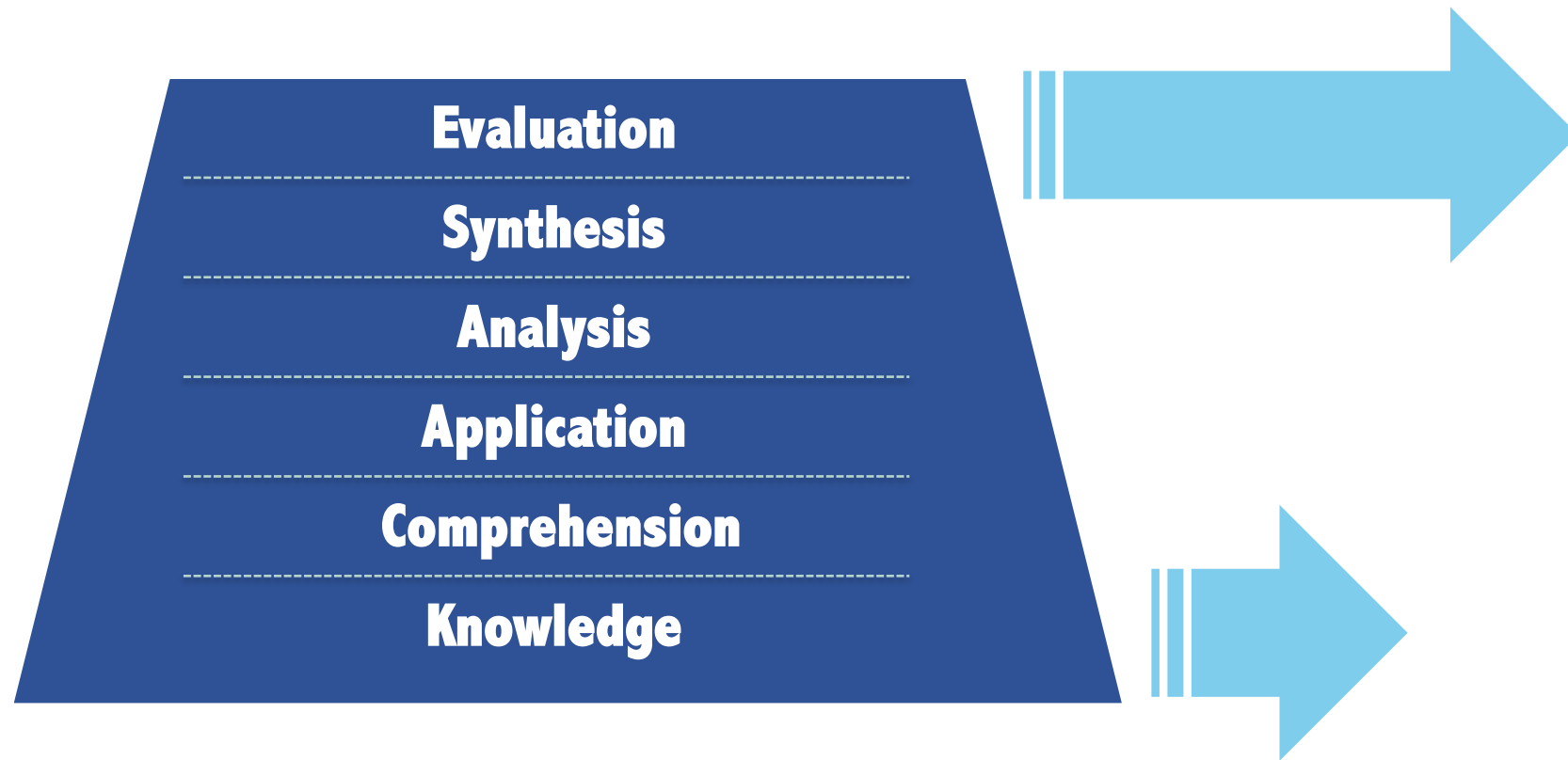


Stop, look back at what is learnt and how it was learnt

The course evolution

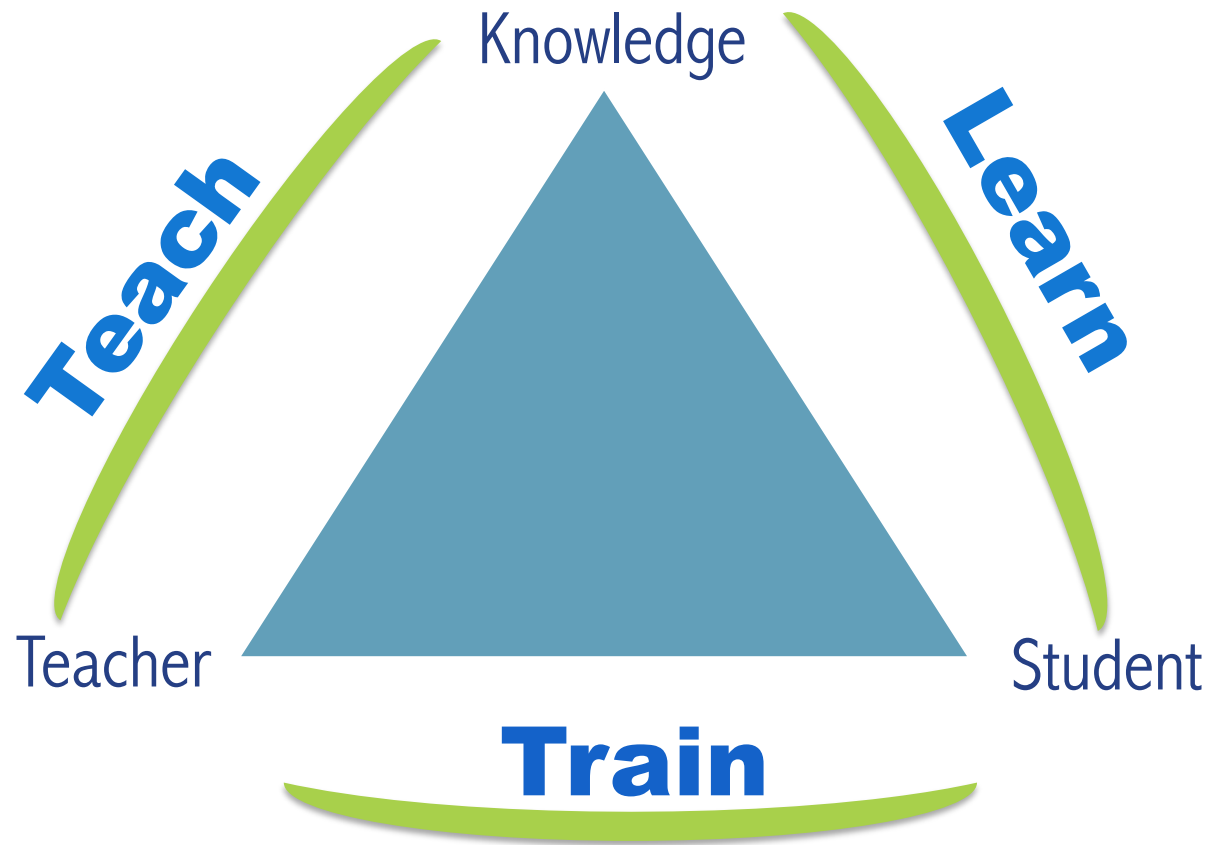


Just a question of feeling ?



Benjamin Bloom

Just a question of feeling ?



Jean Houssaye

And now ?

Cendrine : peer evaluation? Student survey?

Blended : 3 years, 1 diploma

LMS : with or without ?

Cooperation : teacher / p-a