

## Birth of a Serious Escape Game for Chemical Engineering Labs

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I am very happy to present in this talk the feedback from the birth of a serious escape game for chemical engineering labs; the topic of the lab is stirring.

# Le Cnam : Conservatoire National des Arts et Métiers

Public education institution dedicated to professional lifelong higher education

- established under the Convention in 1794
- on a proposal by Abbe Henri Grégoire : “to perfect national industry” & “illuminate the ignorance of he who does not know and the poverty of he who has no means of knowing”
- **teaching everywhere for everyone:**
  - ✓ 13 Cnam centers in metropolitan regions
  - ✓ 7 overseas Cnam centers
  - ✓ 6 associated Cnam centers (China, Ivory Coast, Lebanon, Madagascar, Morocco, Senegal)
- learners = adults; workers; all different



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Let me first say a few words about « le Cnam »: this French institution is dedicated to professional lifelong higher education; it was established under the French revolution with a great assignment as you can read here. This education should be open to all, anywhere.

And indeed, my learners are:

- adults, sometimes with kids;
- workers, often in chemical engineering companies;
- all different (considering their initial training, level and ability).

## A Serious Escape Game

Who for?



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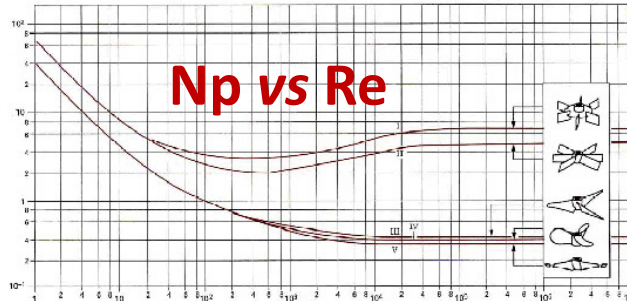
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As I already mentioned, the context of this serious escape game is labs about stirring. The learners are adults, employees, mostly in chemical engineering.

# A Serious Escape Game: why?

## Issues

- Difficulties preparing labs
  - ✓ find how to calculate dimensionless numbers from measured quantities



- Excessively easy (and boring) manipulations

Why did I decide to develop a pedagogical game? with the help of my colleagues pedagogical engineers.

I found two problems with this lab:

1/ my learners had difficulties preparing calculations, as they were unable to find out by themselves how to calculate dimensionless numbers from measured quantities;

2/ manipulations are excessively easy (and, quite frankly, boring): they just have to implement the tank, vary the rotation speed, read the value of the torque, change the stirrer and start over.

# A Serious Escape Game: how?

## Methods

- Reading literature about pedagogical games
  - ✓ benefits of pedagogical games
- Playing card-based games (**Unlock & Exit**) + searching in **scape.enepe.fr**
  - ✓ understand game “mechanics” and identify types of puzzle
- Defining aim of the game
  - ✓ cf. “Why?”
- **Scripting** the game + producing the cards and other stuff
- Testing with the first “**crash-test**” group, modifying for the second, adjusting again for the third: game in “perfect” running order for the fourth and last group

How did we build the game?

First by reading literature about pedagogical games, which highlights their benefits.

Then we played card-based escape games and explored a french website dedicated to pedagogical escape games: this step was very usefull to understand the game “mechanics” and identify types of puzzle.

In parallel the aim of the game was defined, related to my previous slide « Why? ».

After that we have scripted the game and produced the cards and other stuff.

And finally we tested the game with a “crash-test” group, modified it for the second, adjusted again for the third. The game was in “perfect” running order for the fourth and last group.

## A Serious Escape Game: what?



### “The carnivorous yoghurts”

- 1 sheet “Rules of the game”
- 7 “place” cards
- 80 “object” or “puzzle” or “penalty” cards
- help cards (still under development)
- other stuff: Lab Notebook + several things...
- ✚ 1 game master (present throughout the game)

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« The carnivorous yoghurts » is composed of several things:

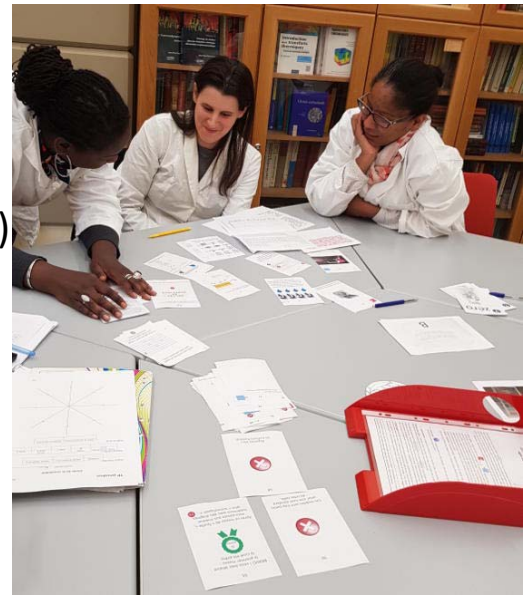
- 1 sheet with the rules of the game;
- 7 “place” cards, which are actually photos of a room with apparent and hidden card numbers leading to various:
- “object” cards or “puzzle” cards or sometimes “penalty” cards;
- help cards are still under development; for the first experiment, the game master gives help when necessary;
- and other stuff: Lab Notebook, and all the things that I have here in my hands...

I was the game master and I was present throughout the game.

# A Serious Escape Game: where & when?

## Cnam Paris - April-May 2019

- introduction (rules & spirit)
- game (about 1 hour; teams of 2 to 3 learners)
- Immediate debriefing (with + without teacher)



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The game was first experimented in April-May at Cnam in Paris:

1. I first explained the rules of the game and reminded participants of the main element: which is that it doesn't matter if you make mistakes!
2. Then the game was run in pairs or groups of three for usually an hour; in the presence of at least one pedagogical engineer.
3. At the end of the game, I did the debriefing and remediation with the learners and then I left the room; the pedagogical engineer then tried to get more or different feedback from the learners.

## A Serious Escape Game: how much?

### Nearly free

- card stock + printer
- colorful plastic pouches
- 1 paper clip



### Time-consuming!!!

- 1-2 months thinking
- 1 month intensive production



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The cost of this serious escape game was nearly zero euros: as you see, only usual office supplies were needed. However, the design of the game takes some time to “mature”, and its production is very time-consuming.



# A Serious Escape Game for Chemical Engineering Labs

Let's play together!


# Can you see card numbers on this view?

E : the multi-purpose room



## The proper association:

7



The right-hand drawer of the desk is locked.

+


4



Well spotted, there's a key in the overall pocket!

=

11



The drawer contains: impellers; a key; punchcards (for the last level of the game).

## The wrong association:



13



The electrical cabinet is locked.

+

4



Well spotted, there's a key  
in the overall pocket!

=

17



It's the wrong key.

# A Serious Escape Game for Chemical Engineering Labs

Results

&

Conclusion

Now the results of this first experiment; and a conclusion.

## Feedback from learners

Goal achieved 

Game = concentrator & facilitator 

- immerse the learner so that he focuses all his cognitive abilities on the aim of the game

I do not know if they still eat yogurt, but they are autonomous during the lab!

### About the attendance of the teacher:

- need for help
- BUT inhibits players-learners who don't dare to try
- AND teacher wanted elsewhere!

First of all, the goal is achieved: this lab session is less boring; the learners are totally autonomous and very efficient.

This is because at the end of the game, they know exactly how to implement the tank and have the equations to calculate the dimensionless numbers from the measurements (with the right units and coefficients).

The game has the desired effect of any pedagogical game, namely immersing the learner so that he focuses all his cognitive abilities on the purpose of the game.

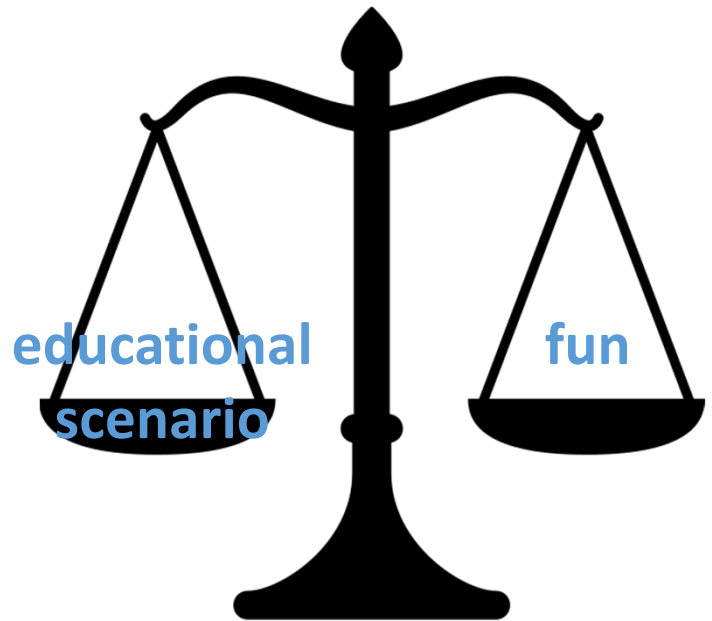
Learners unanimously state that the game master must be present throughout the game: his attendance seems necessary to help learners over the game; BUT this probably inhibits players-learners who do not dare to try (and sometimes fail); AND other groups are working in parallel on other pilot-plants and the teacher needs to go and help them out at times.

# A pedagogical game

A tricky balance between:

## Keywords

- immersion
- emotional register
- gamification
- not be a simple simulator
- feedback



As a conclusion, always remember that a pedagogical game is a tricky balance between an educational scenario and having fun.

We highlight here some keywords:

- immersion and emotions are very important in such an experience;
- true gamification (and not being a simple simulator) is required for a pedagogical game;
- finally, feedback is crucial.

# Some guidelines for developing a pedago-game 1/2

## Clear goals

- well defined upstream; explained at the beginning; validated at the end

## Screenplay

- first stages of the game must be easy for learners

- stay in the “flow” (= maximum state of concentration)

Means



“flow” (= maximum state of concentration)

main issue of  
a pedagogical game

## Debriefing

- must reconnect game to goals & skills (and the rest of teaching)

Let me give you some guidelines for developing a pedagogical game:

- clear goals must be well defined upstream; explained at the beginning of the game and validated at the end;
- the screenplay is essential, so as not to forget the learning objectives: the first stages in the game must be easy (so that learners get immersed in the game) and the scenario must allow them to stay in the “flow” (which is a state of maximum concentration of the player/learner);
- all the material (the cards and other stuff) is designed to help players stay in the “flow”;
- once again, debriefing should not be neglected and must reconnect the game to goals & skills (and the rest of the teaching);



## Some guidelines for developing a pedago-game 2/2

### Atmosphere of the game (ergonomics & facilitate)

- should lead learners not to hesitate to try things out (even fail)

### Iterate to adjust difficulty (“crash-test” group(s))

### Do not expand the game with too much content

### Sustainability



some game mechanics can quickly become obsolete

### Versatility

- try to design a game concept that can be applied to other cases

- the atmosphere of the game should lead learners to try things out: the principle of trial/error is very important in the process of learning with a game;
- you always have to iterate to adjust the level of difficulty: if you do not have anyone to test upstream, it will be necessary to inform the first groups that they will be in “crash-test” mode;
- teachers tend to include too many concepts in a game, which is harmful;
- the sustainability of the game should be considered, because some game mechanics can quickly become obsolete;
- and last but not least, we suggest from the beginning you have versatility in mind, that is: try to design a game concept that can be applied to other cases; in the hope of saving time for future games.

Thank you for your  
attention

le cnam



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If some of you want to test the game: I have one copy in English and one in French. I can't promise that you will still want to eat yogurt after that, however!  
Thank you for your attention.