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## Musical acoustics teaching in a multidisciplinary Master

Benoît Fabre<sup>1</sup>, Jean-Loïc Le Carrou<sup>1</sup> and Christophe Vergez<sup>2</sup>

<sup>1</sup>Equipe Lutheries-Acoustique-Musique (LAM) - Institut Jean Le Rond d'Alembert, Sorbonne Université, CNRS UMR 7190, Ministère de la Culture et de la Communication, 4 Place Jussieu, 75005 PARIS - FRANCE

[benoit.fabre](mailto:benoit.fabre) or [jean-loic.le-carrou](mailto:jean-loic.le-carrou) @sorbonne-universite.fr

<sup>2</sup>Laboratoire de Mécanique et d'Acoustique, Aix-Marseille Univ., CNRS UMR 7031, ECM 4 impasse Nikola Tesla, 13453 MARSEILLE - FRANCE

[vergez@lma.cnrs-mrs.fr](mailto:vergez@lma.cnrs-mrs.fr)



Dec 7-11, 2020

## ATIAM

Acoustics,  
Signal Processing, and  
Computer Science  
applied to Music



### Teaching units - Semester 3 ~ 300 hours

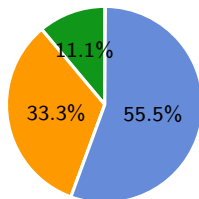
- Basics for ATIAM (6 ects)
- Musical acoustics (6 ects)
- Musical signal processing (6 ects)
- Informatics applied to music (6 ects)
- Projects and Musical applications (6 ects)

### Teaching units - Semester 4

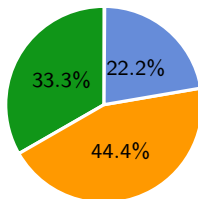
- Career prospects & English (6 ects)
- Internship (24 ects)

# Students background

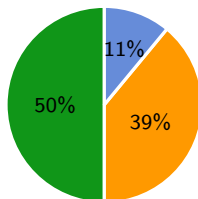
2016-2017



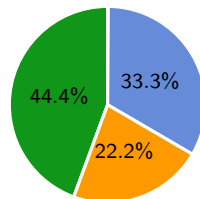
2017-2018



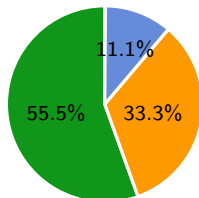
2018-2019



2019-2020



2020-2021

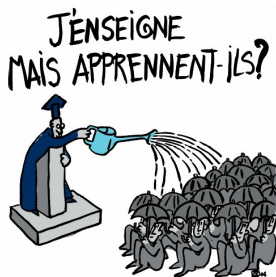


■ Informatics   ■ Acoustics   ■ Signal Processing

- ~ 66% of students have no background in acoustics
- ~ 40% to 50% of students have no background in physics since high school
- Before beginning Musical acoustics teaching, 15 hours for "refresher courses" (acoustics, vibrations and electroacoustics)

## State of the situation 2012-2015

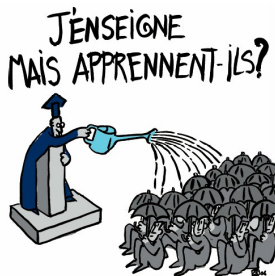
- Students appear to be less interested in acoustics (than signal processing and informatics)
- Increasing gap between hopes of the teacher and the students' results (low marks at the final evaluation)
- Lack of motivation in learning, passive students, use of other students' knowledge
- Wide diversity of student backgrounds, traditional education is limited: prerequisites, in-depth study, difficulties for understanding



fA2l.be - "I Teach but do they learn?"

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fA2l.be - "I Teach but do they learn?"

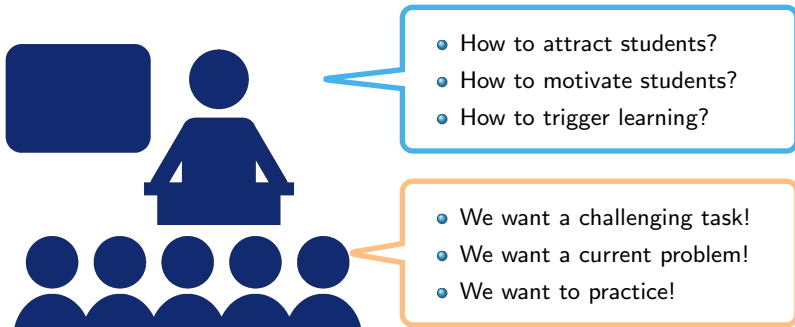
→ **How to make Musical Acoustics great again ?**

Teaching method

Teaching implementation

Teaching evaluation

## Teaching approach



Let's start from the student's point of view!

→ Building of a new teaching unit centered on challenging and current problems and projects





- Sound synthesis by physical modelling
  - Experimental identification of physical parameters
- are challenging and current topics which are adapted to the ATIAM curriculum with a direct link to signal processing and informatics

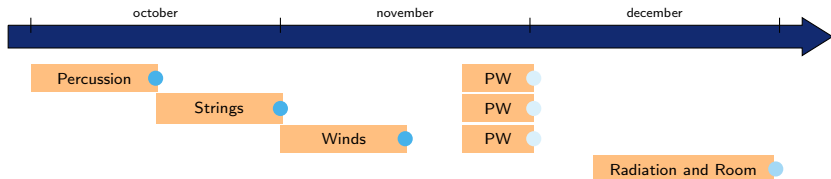
## Problems and projects defined by instrument family

- *Percussion*: glockenspiel & kettledrum
- *Strings*: damped string & Kora
- *Winds*: trumpet & clarinet
- Room acoustics & sound recording



- Increasing the scientific complexity, from free to forced oscillations, integrating progressively damping mechanisms and couplings between structures, radiation in a room
- Identification of learning outcomes shared with the students (contract)

## Teaching implementation



- For each instrumental family:
  - 2 *Problem-Based Learning* in 2 weeks → define problems that lead to specific learning outcomes
  - 1 *Practical Work* → compare models to actual instruments (complexity)
  - Evaluation on learning outcomes + report
- Radiation, Room acoustics & Sound recording
  - 1 *Project-Based Learning* in 2/3 weeks → including experimental data gathering and processing; model implementation
  - 2 lectures used as references for the problem
  - Oral presentation + evaluation on learning outcomes
- Final evaluation at the end of the semester

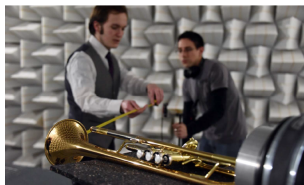
## Practical teaching linked to selected problems

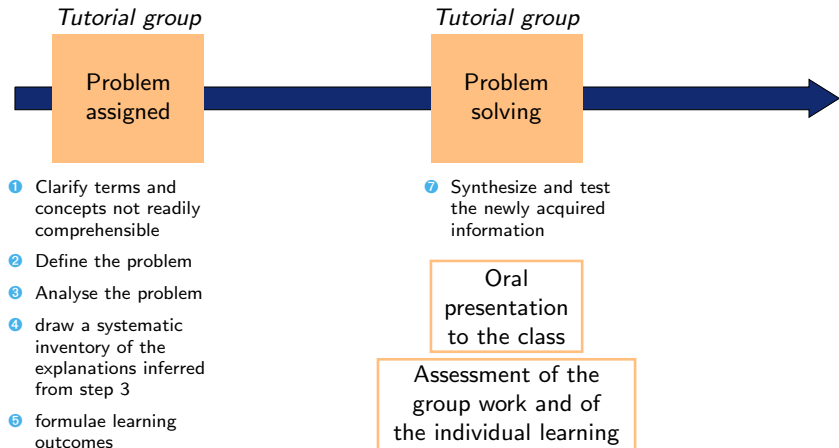
- First modes identification of a glockenspiel and a vibraphone and a kettledrum
- Model and measure mobility of a classical guitar in low frequencies
- Study losses due to viscous and thermal effects when propagating in a recorder

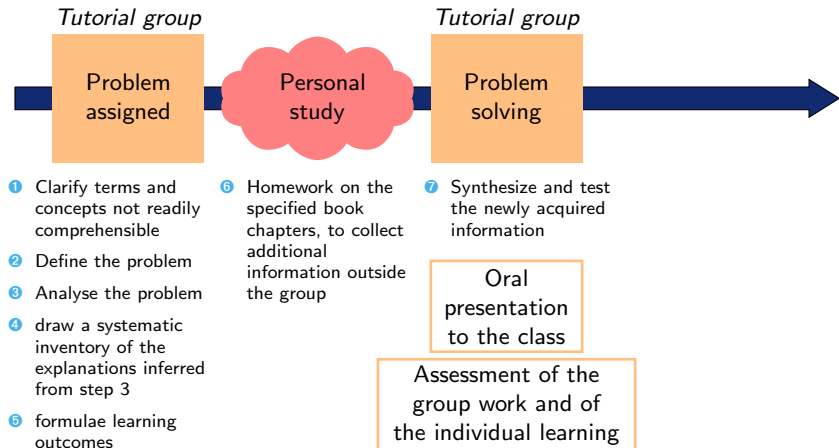


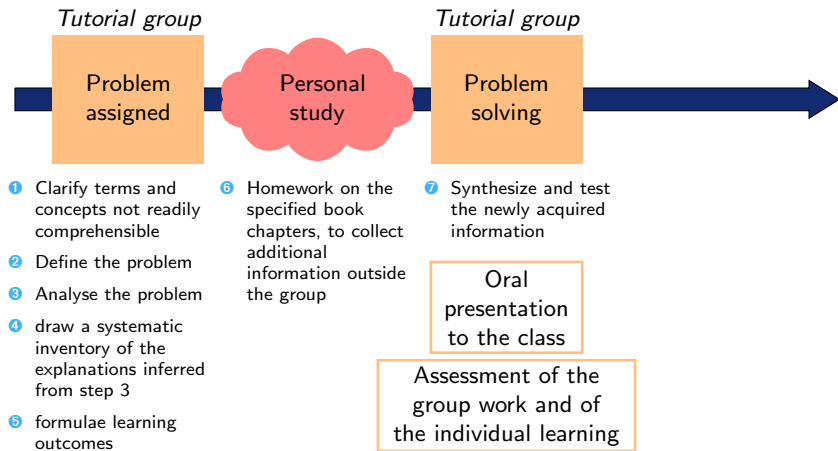
## Room acoustics project

Students are asked to synthesise the impulse response allowing, by convolution of the anechoic recordings, to obtain a result comparable to the sound recording they made in a concert hall.



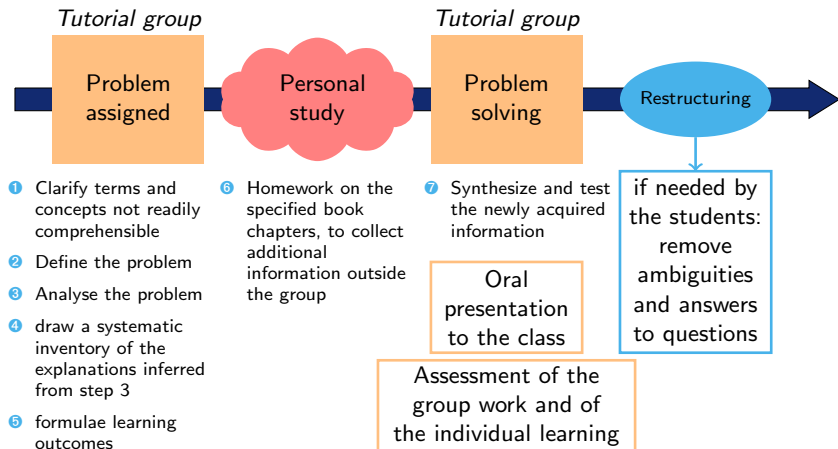






→ The problem/scenario is the key-point of this teaching method

→ Each student has a role (Scribe, Chair, etc) and the teacher is a tutor



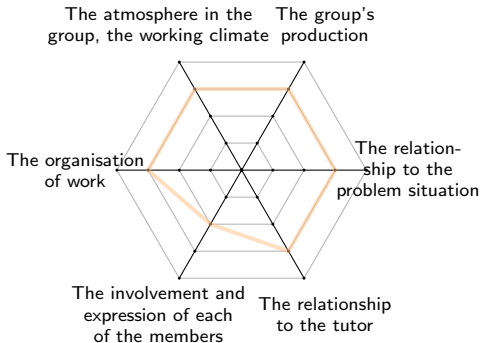
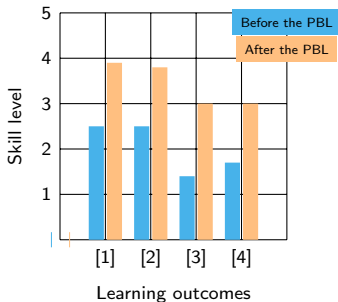
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## Teaching evaluation

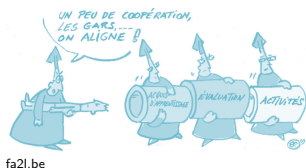
## Averaging over 18 students...



- Approximate time devoted to homework between the two sessions reported by students 2h30
- Overall time devoted to homework has significantly increased (8 to ~32 h)
- The involvement of students is spread throughout the teaching unit

## Advantages

- Define detailed learning outcomes (instead of a program)
- Define sequences regularly assessed to record the students progress
- Improve the teaching alignment
- Significant increase the student's time devoted to the learning
- Students develop a sense of ownership of their learning and knowledge
- Significant improvement the student' skills at the end of the teaching unit



## Drawbacks

- Questioning the teaching work
- Significant amount of time to set up (problem design, training of teachers)
- Requires the collaboration of colleagues from others units during the same period for side effect: time-slots devoted to student personal study
- Few students do not play the game (less and less over years)

## Conclusion

# Take home message

- Active learning method is now used by ATIAM' students to study Musical Acoustics
- The teacher's new role as a tutor requires a learning that is, over time, extremely inspiring : the knowledge is in the book chapters given to the students, the tutor only has to focus on the students' difficulties
- In addition to technical and scientific knowledge, the students acquire complementary skills (communication, teamwork, problem solving, information sharing ...)

in 2019



in 2020

