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► **To cite this version:**

Benoît Fabre, Jean-Loïc Le Carrou, Christophe Vergez. Musical acoustics teaching in a multidisciplinary master. Forum Acusticum, Dec 2020, Lyon, France. pp.1887-1887, 10.48465/fa.2020.1075 . hal-03234067

HAL Id: hal-03234067

<https://hal.science/hal-03234067v1>

Submitted on 27 Feb 2022

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Musical acoustics teaching in a multidisciplinary Master

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Dec 7-11, 2020

ATIAM

Acoustics,
Signal Processing, and
Computer Science
applied to Music



Teaching units - Semester 3 ~ 300 hours

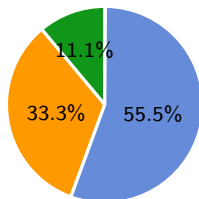
- Basics for ATIAM (6 ects)
- Musical acoustics (6 ects)
- Musical signal processing (6 ects)
- Informatics applied to music (6 ects)
- Projects and Musical applications (6 ects)

Teaching units - Semester 4

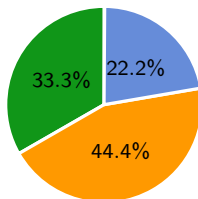
- Career prospects & English (6 ects)
- Internship (24 ects)

Students background

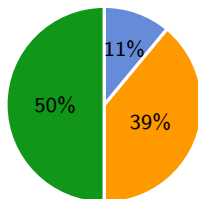
2016-2017



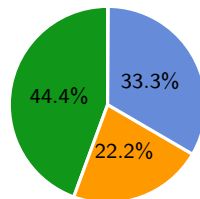
2017-2018



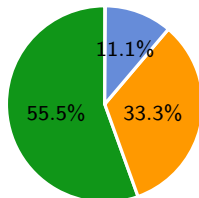
2018-2019



2019-2020



2020-2021

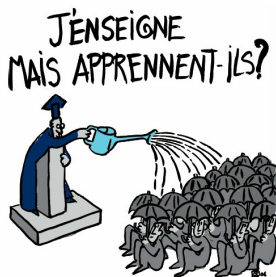


■ Informatics ■ Acoustics ■ Signal Processing

- ~ 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

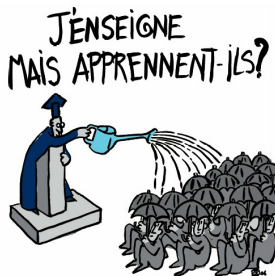
- Students appear to be less interested in acoustics (than signal processing and informatics)
- Increasing gap between hopes of the teacher and the students' results (low marks at the final evaluation)
- Lack of motivation in learning, passive students, use of other students' knowledge
- Wide diversity 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?"

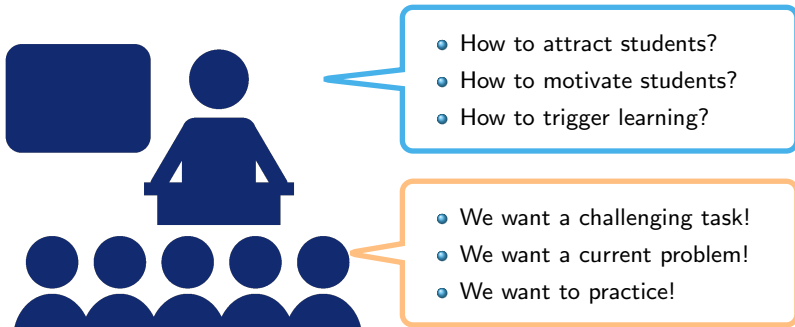
→ **How to make Musical Acoustics great again ?**

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

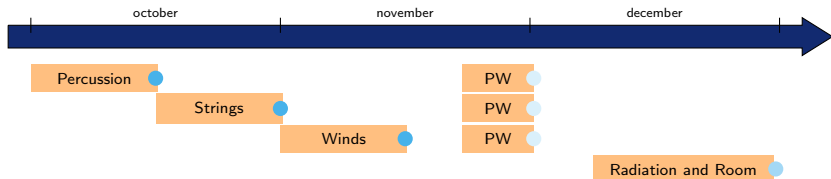
Problems and projects defined by instrument family

- *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

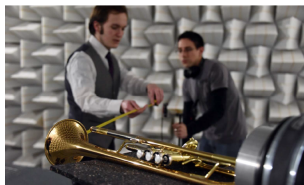
Practical teaching linked to selected problems

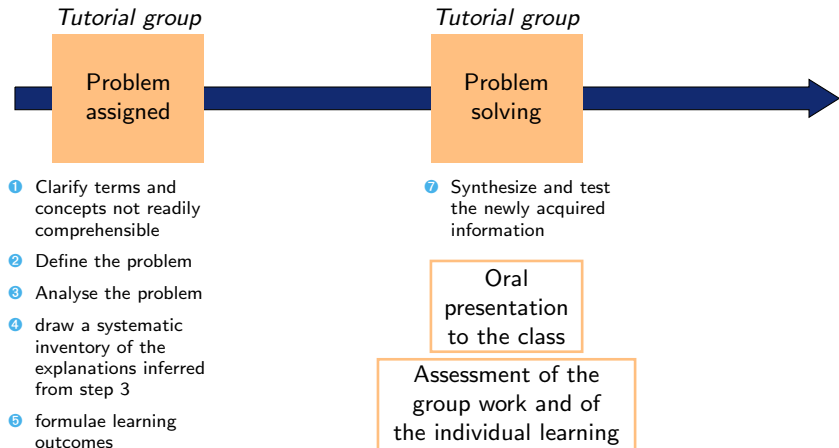
- First modes identification of a glockenspiel and a vibraphone and a kettledrum
- Model and measure mobility of a classical guitar in low frequencies
- Study losses due to viscous and thermal effects when propagating in a recorder

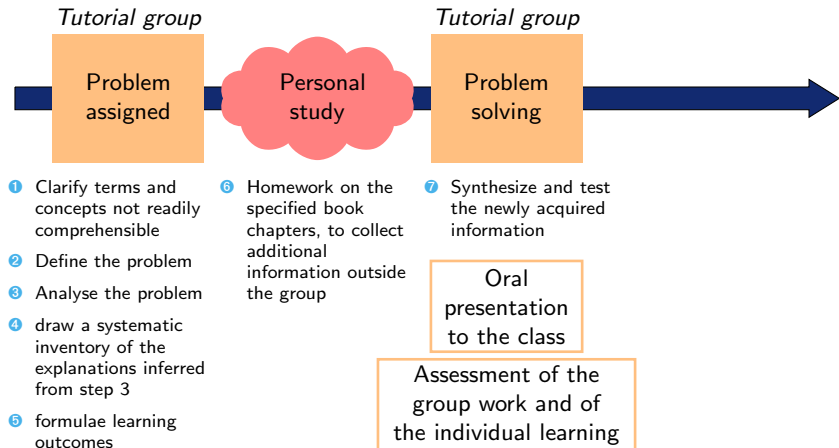


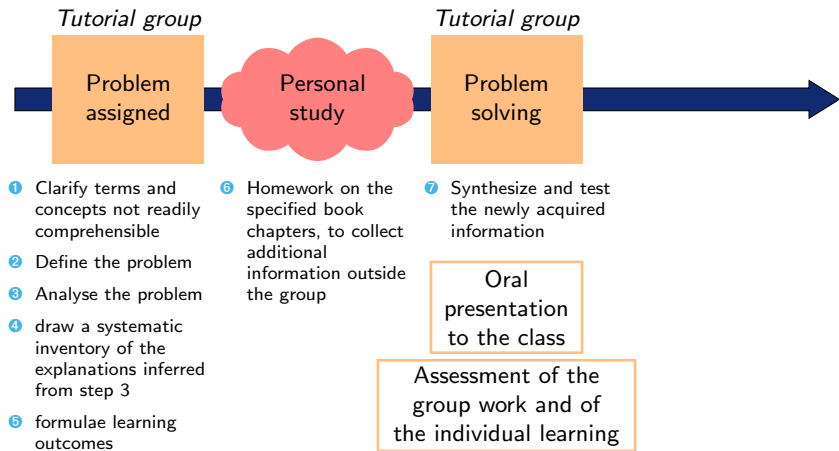
Room acoustics project

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.



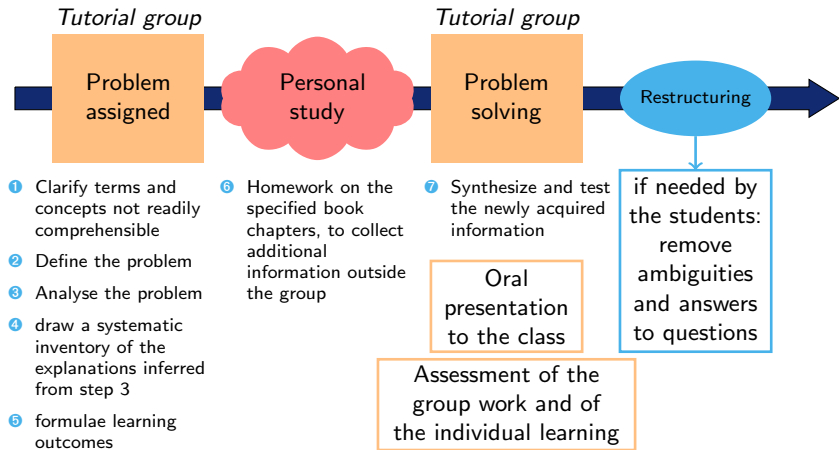






→ The problem/scenario is the key-point of this teaching method

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

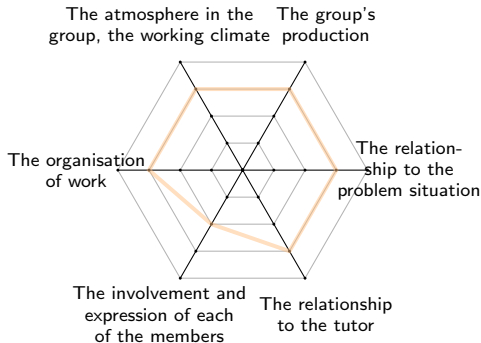
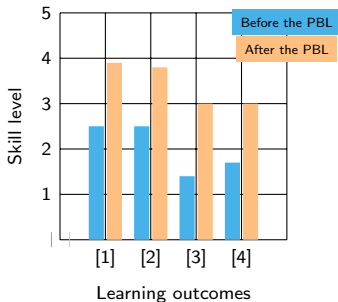


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Teaching evaluation

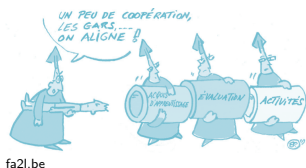
Averaging over 18 students...



- 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

