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MOOCs FOR INTRODUCTORY COURSES IN ACOUSTICS AT THE UNIVERSITY OF LE MANS: ASSESSMENT AND PROSPECTS

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ABSTRACT

The University of Le Mans and its acoustic laboratory have initiated a series of MOOCs in French (Massive Open Online Courses) for an introduction to acoustics. The first, "Les bases de l'acoustique - la voix dans tous ses états", is aimed primarily at high school students and physics teachers. Open since 2018, it has more than 20,000 registered students and has been used in particular in several speech therapy schools. The second, "Théorie pour un son - l'acoustique au service musicien", is aimed at musicians and the curious with the aim of creating a generation of acoustically informed musicians. Each chapter begins with a video scenario and offers animations, interactive resources, expert interviews, activities with Audacity and quizzes. Opened in 2024, it has already attracted more than 5,000 registered students. Le Mans University is now working on developing a MOOC on the construction and physics of musical instruments. In collaboration with Itemm (Institut Technologique Européen des Métiers de la Musique), this evolving MOOC, after providing the basics of instrument physics, will detail a certain number of instruments, including the voice. The opening is planned for 2026.

Keywords: *Education, Massive Open Online Courses, Musical acoustics.*

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1. INTRODUCTION

MOOCs, i.e. Massive Open Online Courses, are a tool for disseminating knowledge that has become considerably widespread since 2008. The basis of the MOOCs are short videos completed by some written documents. Other resources are usually proposed such as quiz to test knowledge, exercises to put the lessons into practice and discussion forums to interact with the teaching team and other students. Le Mans University made 2 MOOCs which are still available and started to work on third one. These MOOCs are briefly presented below.

2. FIRST MOOC

This MOOC, "Les bases de l'acoustique - la voix dans tous ses états" was and is still dedicated to high school students. It was designed based on the official baccalaureate acoustics program and is proposed on the French MOOC platform "France Université Numérique" (FUN). It contains 5 lessons and the total time investment needed is evaluated to 10 hours. Each lesson starts with a video putting the subject into context and contains experiments and exercises. First lesson is about waves and their speed. It is asked to the student to measure the speed of sound with their phone and give the result on a forum. Second lesson is about sound analysis and signal processing. Using the software Audacity, it is asked to measure the frequency of whistling and vowels. At the end it is asked, using processing tools to transform the vowel [a] into the vowel [i]. Third lesson is about modes of simple resonators such as string and tubes and finally the fourth lesson is devoted to signal digitization.

This MOOC opened first on spring 2018 for 6 weeks. There were important exchanges in the forums and the teaching team was solicited quite a lot. All these exchanges led to important modifications for the second session of winter 2018. Between 2018 and 2021 there were two sessions per year. During the period we observed an important decrease





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of the use of the forums and despite a still positive evaluation of the MOOC, the teaching team was no longer in demand. So, we decided to leave it open almost permanently.

Over the years this MOOC had more than 20,000 registrations. However, it didn't it did not completely reach its target since most of high school students in France do not know what is a MOOC. They go much more naturally to platforms such as YouTube. The audience was more teachers, retired people working in the sound domain and curious people. We noticed that the MOOC has been included by some speech therapy schools in their teaching program.

3. SECOND MOOC

The idea for this MOOC entitled "Théorie pour un son – l'acoustique au service musicien" comes from an observation: most of the musicians we met have very little basic knowledge of acoustics. This is a real handicap whether in terms of hearing risk prevention, room acoustics, basics of harmony and the question of temperaments and auditory perception in general. We have therefore designed an introductory MOOC on acoustics for musicians to try to fill these gaps by introducing very little mathematics. This MOOC contains 7 lessons and the total time investment needed is evaluated to 12 hours. As for the previous, each lesson starts with a video putting the subject into context followed by an expert interview. It contains also animations, practical works, exercises, and JAVA applets which can be found independently on JPQ.fr. In the first lesson students are invited to discover the spectrogram with audacity and to make the link with the musical score. Second lesson is about room acoustics and third about decibel scale and the summation of sources and masking. In this lesson is also discussed the question of auditive risks. In the fourth lesson the link between frequency and pitch is explained so that musicians can have an informed use of the tuner. The fifth lesson delves deeper into the subject and addresses the dual perception of pitch: tonal pitch related to frequency and resulting from a counting process and spectral pitch related to the center of gravity of the spectrum and resulting from cochlear tonotopy. Lesson 6, according to Helmholtz, give the physical basis of harmony and discuss the question of tuning and temperament. Finally Lesson 7 addresses the issue of timbre.

This MOOC is open since 2024 and has already been followed by more than 5000 students. As the previous one it has forums but these are almost not used by the users. This is a bit disappointing but this shows that despite a high

satisfaction rate, interaction with teachers and other students is not sought.

4. THIRD MOOC

As discussed above, most musicians know very little about acoustics but they also know very little about the making and functioning of their instruments. To try to fill this gap Le Mans Université and the school for instrument making and repair Itemm (Institut Technologique Européen des Métiers de la Musique) join their forces to build a MOOC about making and physics of musical instruments. First lessons will describe the different elements that make up a musical instrument and then the physics of these different elements: exciter, resonator and "radiator". The following courses will deal with specific instruments: piano, voice, guitar, violin and its family, clarinet, flutes, saxophone and oboe, brass, percussions, etc. The MOOC is scheduled to open in 2026, but the different instruments will be covered gradually. For each instrument, the building will be first detailed. Different aspects of their operation will be explained. Our aim is that musicians will find answers about their instruments.

5. CONCLUSION

MOOCs are knowledge dissemination tools that can be both rigorous and user-friendly. They allow for the implementation of different learning methods. They are also a way for universities to develop their reputation in their fields of excellence. Our experience at the University of Le Mans, however, has allowed us to identify two limitations to this tool. First, MOOCs are insufficiently known among young people, who are nevertheless the main target audience. We have indeed noted that the very concept of MOOC is unknown to the majority of students, including those in master's programs. Furthermore, one of the advantages of MOOCs is the possibility of having remote interaction with a teaching team, which implies that they can only be open for limited periods. However, our experience has shown that this interaction is not sought by students, which led us to open our MOOCs permanently.

6. REFERENCES

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