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ACOUCOU Platform to Acquire Professional Skills and Knowledge in the Field of Acoustics.

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ABSTRACT

Today, in the digital era, education must meet the needs and adapt to modern forms of knowledge transfer. While this is often implemented in higher education programs (distance learning, OpenCourseWare platforms), vocational education and training seems to be the most traditional branch of education, especially in the field of specialized courses for engineers. Our goal is to create space for new, innovative and multidisciplinary approaches for teaching and e-learning acoustics (e.g., based on gamification, VR, or web simulators). The ACOUCOU Platform (http://acoucou.org/) is a part of a strategy aimed at expanding and strengthening acoustic knowledge, supporting the development of innovative teaching methods based on attractive and effective delivery of content, services, teaching methodologies and practices at national and international levels. The form of materials and courses published on the Acoustic Courseware Platform are suitable to be used for self-learning as well as in blended learning, where an educator uses materials from platform to carry out training among employees/students. Technical, professional knowledge is usually presented as text including equations and technical drawings. Presenting it in a visually attractive form is more appealing and increases the motivation of the users. The visualization of phenomena simplifies the understanding of problems and makes it easy to acquire knowledge in similar, practical situations of an engineer's work.

Keywords: Education, Industrial Acoustics, Room Acoustics, Noise Awareness, Acoustical Engineering

1. INTRODUCTION

Constant changes in technology, development of the labor market and the emergence of new professions create new challenges for education. Nowadays, employers produce different expectations from professionals - the skillset should not anymore be considered as an ability to work with particular software or machines, since these assets change suddenly, it needs to focus on understanding and proficiency to learn and adapt to new conditions.

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During their formal education, students need to be trained in problem solving, how to learn new skills, how to research, how to interact with new software and technologies. It is very hard to predict what are the relevant technologies in 20 years and what professions will be needed (1). Often, employers expect workers to master usage of particular software or machinery, while even 10 years after the graduation, possibly most of the taught technology is outdated. Companies face new challenges of providing extended training for their newly hired members of the team (2). Therefore, the role of professional organizations becomes more and more important in the course of education and life-long learning, especially in engineering.

Recently, shortage of so-called STEM (science, technology, engineering and mathematics) workers including specialized engineers is widely reported (3, 4, 5, 6) and this situation occurs also in field of acoustics (7).

Moreover, education must meet the needs and adapt to modern forms of knowledge transfer. It's being implemented in higher education programs (distance learning, OCW platforms), but vocational education and training seems to be the most ossified branch of education, especially in the field of specialized courses for engineers. Our intent is to create space for new, innovative and multidisciplinary approaches to teaching and e-learning acoustics.

The ACOUCOU Platform (8) is a part of a large, thought-out strategy aimed at expanding and strengthening acoustic knowledge, supporting the development of innovative teaching methods based on attractive and effective delivery of content, services, teaching methodologies and practices at national and international levels. It incorporates new technologies (e.g. gamification, VR, web simulator). The form of materials and courses published on the Acoustic Courseware Platform are suitable to be used for self-learning as well as in blended learning, where an educator uses materials from platform to carry out training among employees/students. More detailed description of ACOUCOU is provided in the subsequent section. Paragraph 3 discusses strategies utilized in ACOUCOU and final remarks and future development are summarized in paragraph 4.

2. WHAT IS ACOUCOU?

ACOUCOU is an online platform, where professionals, educators, students and other people interested in acoustics can find educational materials regarding various branches of acoustics. It is designed to serve as modern self-development tool for engineers as well as comprehensive solution for professional education in work environment. ACOUCOU has been developed by accomplished practitioners and scientists. It has been created as a space for new, innovative and multidisciplinary approaches to teaching and e-learning in field of acoustics.The main concept of ACOUCOU is to describe and visualize acoustic phenomena and to present acoustic knowledge in a practical way.

Partnership ACOUCOU is based on essential partnerships. List of the contributors is presented in Tab. 1 and develops on each stage of the project. All together (universities and schools, business partners, educators) bring their expertise on essential level along with experience in education, which creates unique combination of knowledge, experience and awareness of needs.

Table 1 – Partners involved in the ACOUCOU Platform

No.	Partner
1	KFB Acoustics, Poland (9)
2	Kahle Acoustics, Belgium (10)
3	gfai tech, Germany (11)
4	HEAD Acoustics, Germany (12)
5	Jazzy Innovations, Poland (13)
6	Laboratoire d'Acoustique de l'Université du Mans, France (14)
7	Institute of Technical Acoustics, RWTH Aachen University, Germany (15)
8	KU LEUVEN, Belgium (16)
9	University Zagreb, Faculty of Electrical Engineering and Computing, Zagreb, Croatia (17)

10	Wrocław University of Science and Technology, Poland (18)
11	Slovak University of Technology, Slovakia (19)
12	RUHR University Bochum, Germany (20)

Multidisciplinary networking ACOUCOU provides also networking for a group of people with very diverse interests. Not only it addresses needs of education for various target groups (i.e. acousticians, architecture, engineering, EHS), but also brings together experts and professionals from all around the world. Creative team work on educational materials involves scientists, edTech enthusiasts and new technologies content producers. All these assets allow creating unique place for networking for universities and schools, business partners, educators and end users (Fig. 1).

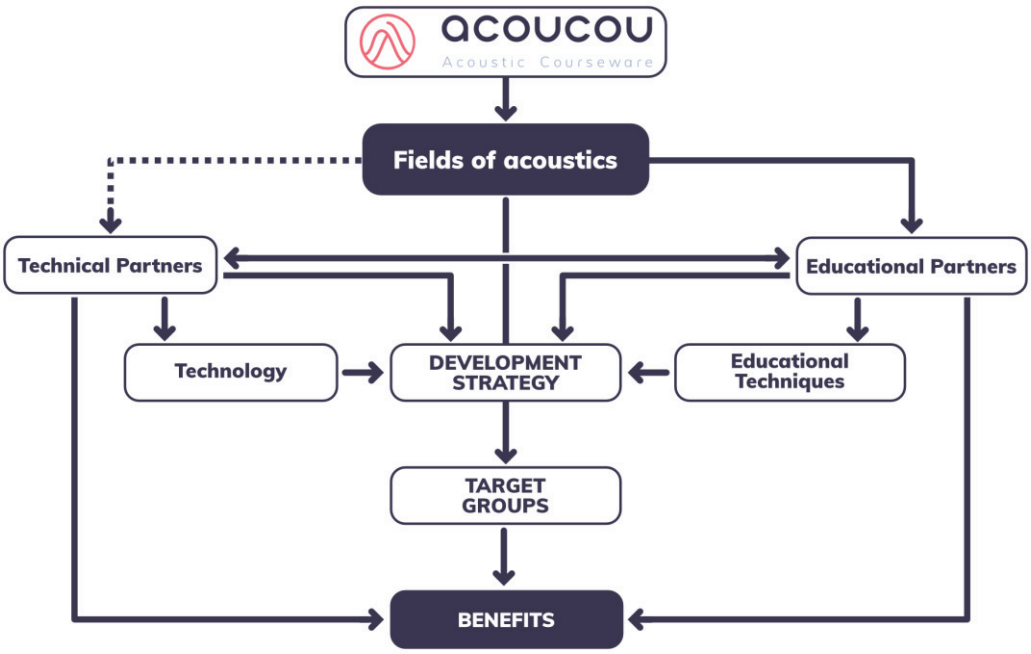

Figure 1 – ACOUCOU platform is created and aimed for an interdisciplinary team

Various fields of acoustics ACOUCOU contains modules, which cover various fields of acoustics such as sound and vibration, psychoacoustics, hearing and room and theater acoustics. Lindsay's Wheel of Acoustics (21) is presented in Fig. 2 and describes the scope of acoustics starting from the four broad fields of Engineering, Earth Sciences, Life Sciences, and the Arts.

Content is designated for different target groups i.e. acousticians, architecture, civil engineering, EHS specialization, mechanical engineering, electrical engineering, process engineering, environmental engineering. ArAc introduces room acoustics of in context of architecture and design. Acoustic Course for Engineers (ACE) helps understanding the basic concepts of noise control in machinery and equipment. Acoustic Course for Industry (ACI) is a visual introduction to industrial acoustics including noise in environment and industry, impact of noise on human health and noise management.

Figure 2 – Branches of acoustics presented as Lindsay's Wheel of Acoustics (21)

Visualizations Technical, professional knowledge is usually presented as text with formulas and technical drawings. Presenting it in a new, visually attractive form, it is certainly more interesting and address needs of engineers according to theories of learning (22). The visualization of phenomena leads to a better understanding of the discussed issues as well as it enables easy conversion of acquired knowledge into particular situations and problems encountered in an engineer's work. The main idea was to simply describe and visualize acoustic phenomena and to present acoustic knowledge in a practical way. An example of the interactive visualization utilized in ACOUCOU is presented in Fig. 3. User can modify relationship between velocities in both media, and visualization changes according to these settings. According to learning theories, abstract conceptualization (generalizing and drawing conclusions from the experience).

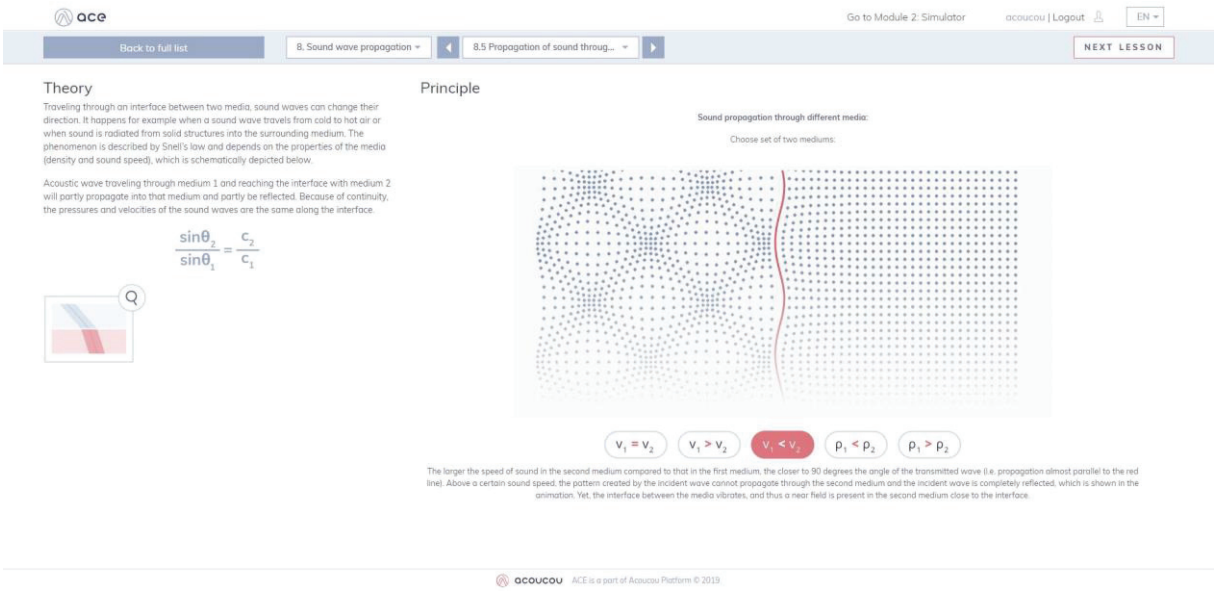

Figure 3 – ACOUCOU Interactive visualization of the sound wave traveling between media (22)

Hands-on simulation Theories of learning state that active experimentation is extremely important especially in field of engineering (24). Therefore ACOUCOU contains modules containing simulation based on real machines and measurements.

Technology Incorporating newest technologies, ACOUCOU offers interactive visualizations, videos and VR experiences. Users are attracted and motivated using new technologies (gamification, VR, Virtual Acoustics, multibook, web simulator).

All of the issues discussed in this paragraph are explored by the ACOUCOU Team and result in the set of strategies, to provide space for learning and networking. Key points of the utilized approach are described in subsequent paragraphs.

3. STRATEGIES

Strategies incorporated in ACOUCOU are result of work of interdisciplinary team of experts in acoustics, educators, business partners and new technologies experts. Target groups representatives are also very important part of the creation process and their feedback is crucial to the final form of the products.

3.1 Learning process

ACOUCOU follows philosophy of experiential learning, where both, theoretical and practical approach supplement each other (25). Experiential learning perceives knowledge as created through the transformation of experience Kolb's popular experiential learning cycle describes four stages of the learning process:

1. Concrete experience - immersing in a task, doing
2. Reflective observation - stepping back from doing by thinking on what has been done
3. Abstract conceptualization - generalizing and drawing conclusions from the experience
4. Active experimentation - testing, redoing the task and refining the performance

In this perspective, experience is the basic foundation of learning and is actively changed into deeper understanding by reflection. These generalizations give a framework for further actions, leading to new experiences - and so the cycle continues. The learning process may begin at any stage of the circle and can be continued limitlessly. ACOUCOU support the learner at every stage of the process: by allowing for and enriching experience, facilitating reflection, leading to conceptualization and giving space for the application of newly formed concepts in active experimentation. Besides ACOUCOU, some other modern engineering training programs (i.e. Eaton's program for consulting engineers) include the experiential learning concept in their curriculum (26, 27).

3.2 Adequate form

Over the last decades, much research has been conducted that shows advantages of transferring knowledge visually. Their results prove that visual methods can learning time and improve understanding of the subject matter, enhance the time of remembering and help to speed up the process of recalling. Moreover, the effectiveness of learning with the use of visual methods increases with time. It's happening in school education (new learning methods such as Montessori, using educational applications and games), it's being implemented in higher education programs (distance learning), but vocational education and training seems to be the most ossified branch of education, especially in the field of specialized courses for engineers.

In ACOUCOU, the entire team works on the form how educational materials are presented and how the interaction between a user and course induces learning process results. Another advantage is that the professional skills of engineers can be easily upgraded and adapted to current trends in the use of information and communication technologies in vocational education. Technical, professional knowledge is usually presented as text with formulas and technical drawings. Presenting it in visually attractive form is surely more interesting and draws attention of engineers. The visualization of phenomena let understand discussed issues better as well as makes it easy to convert acquired knowledge into particular situations and problems present in an engineer's work (28).

One of the biggest and most popular MOOCs – edX (29)– offers course management system called „Open edX". Analysis of its possibilities, requirements and possible ways of development showed limitations that could not be accepted. The main limitation is the structure of the course and the ability to use various knowledge transfer methods – Open edX does not provide mechanisms for using simulations, virtual reality or gamification.

Partnership with its own ACOUSTIC COURSEWARE PLATFORM goes a step further. Specification of the platform allows one to go beyond the framework of a typical online course. ACE uses gamification methods as well as virtual simulations based on real measurements (perfect method for problem-based teaching and learning). ACI consists of materials enriched with case studies as VR videos. Effects can be watched on a computer or using the VR headset.

The form of materials and courses published on the ACOUCOU Platform is suitable to be used for self-learning as well as in blended learning, where an educator uses materials from platform to carry out training among employees/students.

3.3 Availability

Free access to the knowledge is one of the main foundations of ACOUCOU. The platform is designed to serve as modern self-development tool for engineers, young professionals, students and other people interested in acoustics. The ACOUCOU team not only cares to find the most adequate form of the materials, but also to make them accessible for a wide range of users.

Besides being a hosting for courses (with extended functionality unlike the other MOOCs) the Acoustic Courseware Platform will be a place where companies, VET institutions, educational units, educators, trainers can publish articles, findings, result of studies. It is a platform for sharing knowledge, experience between all participating users as well as for establishing new contacts.

3.4 Noise awareness and public policy

The importance of sound in today's world has been emphasized by Unesco (30). The noise problem has become large: in the developed countries, about 40% of the population is exposed to road traffic with an equivalent sound pressure level exceeding 55 dB during daytime, which is considered too much.

A recent scientific study has also classified noise, from road traffic alone, as the second worst environmental stressor affecting human health in Europe (31), just behind air pollution caused by very fine particulate matter. Media use term "noise pollution" (32) to emphasize serious costs to wildlife and human health caused by noise levels. By better informing the public, not only noise awareness is increased but also the public interest in noise control and political support of investment into noise control is increased.

ACOUCOU addresses challenge of noise awareness in the society by educating in the area of industrial noise. ACI module is a visual introduction to industrial acoustics including noise in environment and industry and impact of noise on human health and noise management. It is aimed mianly for the Enviroment, Health & Safety teams but can also succesfully serve everyone as a free resource about noise and its consequenses.

3.5 Constant development

The ACOUCOU Team constantly develops by creating new partnerships, organizing conferences, including more branches of acoustics and incorporating new technologies. It also applies to the utilized tools and adequate form of the materials - while ArAc was created as a multibook, ACE contains numerous interactive and engaging visualizations, ACI uses Virtuar Reality to show the essence and consequences of the noise.

4. FINAL REMARKS

As the constant evolution is one of the ACOUCOU strategies, future plans include further development by continuous networking, including more materials dedicated for diverse target groups, utilizing modern edTech tools and finding adequate form for each aim. At the same time, all of the recently available resources are going to be monitored and updated accordingly to the users' needs.

ACOUCOU receives positive feedback from universities, business partners, educators and self-educating professionals. In future, ACOUCOU Team is hoping to continuously address upcoming challenges in education and awareness in field of acoustics.

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