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TEACHING ACOUSTICS AT THE EELISA THINK TANK ON SUSTAINABLE BUILDINGS

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ABSTRACT

Building acoustics should be seen as a transversal discussion with all the disciplines involved in construction and introducing acoustics to non-acousticians in the construction industry is often challenging. This paper aims at describing the outcomes and methodology of teaching acoustics used during the THINK TANK on SUSTAINABLE BUILDINGS, an activity organized by EELISA, an alliance of Higher Education Institutions from different countries in Europe meant to define and implement a common model of European engineer rooted in society.

The EELISA Community "SUSBCC. Technical and Social Challenges for Sustainable Buildings, Cities and Communities" together with the European Space Agency (ESA) planned and coordinated more than 30 workshops in Madrid ESA Headquarters, which were held between students, industry and scientific communities as well as wrap up and integrating sessions.

Keywords: *Education in acoustics, sustainable buildings, building acoustics.*

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1. INTRODUCTION

What are EELISA and SUSBCC?
European Engineering Learning Innovation and Science Alliance (EELISA) [1] is the first alliance of Higher Education Institutions (graduate engineering schools, technology universities and full-spectrum universities) from different countries in Europe meant to define and implement a common model of European engineer rooted in society.
In the Council Resolution on a strategic framework for European cooperation in education and training towards the European Education Area and beyond (2021-2030), reinforcing European higher education was established as a fourth strategic priority, recognizing that in the next decade higher education institutions will be encouraged to find new forms of more intense cooperation, in particular by creating transnational alliances, especially through the full implementation of the "European Universities" Initiative [2].
“European Universities” sets the goal of supporting 60 European Universities made up of more than 500 higher education institutions by mid-2024. Following the 2022 Erasmus+ call for proposals, there are now 44 European Universities made up of approximately 340 higher education institutions, both from capitals and remote regions of 31 countries, including all EU Member States, Iceland, Norway, Serbia and Turkey.
One of the 44 Universities is the EELISA European Engineering Learning Innovation and Science Alliance, coordinated by the UPM (Technical University of Madrid). The UPM, together with 8 other prestigious universities from Germany, France, Hungary, Italy, Romania and Turkey make up the consortium bringing together 180,000

students, 16,000 professors and 11,000 staff. Its main objective is to define a figure of "European Engineer", recognizable both for its technical competence and for its understanding of social challenges.
The goal of EELISA is to create a renewed concept of Engineering (the European Engineering model), broadening its scope from the traditional technological approach to fully address contemporary societal challenges.
EELISA students will have to design their educational path recognizing that learning is more than just the acquisition of knowledge and skills: it also has a human dimension and requires tools to cope with a changing world, complex life and transformative work environment, with the necessary vision to tackle our great challenges, such as the United Nations Sustainable Development Goals (SDG), the Green Deal and the rest of the European Agendas.
Universities must understand that their role within the "lifelong learning" society is not to maintain an oligopoly of content, but to guarantee valid scientific knowledge linked to the evolution of social challenges, to participate in their practical solution.
Traditional technical universities are structured into Departments of a single discipline. However, the challenges facing Engineering today are complex and transdisciplinary. To face them, it seems essential to be able to cross our internal borders to offer an interdisciplinary education, despite our monodisciplinary structure, for which EELISA has created the EELISA Communities.
The EELISA Communities seek to be the place where Education, Research, Innovation, and public debate coexist and connect, improving the link between Engineering and Society.
The Communities are constituted between countries and institutions as multidisciplinary teams of a few hundred actors (students from all our universities, professors, researchers, staff, campus managers, companies, local authorities, NGOs, European agencies…). They will jointly focus on the Global and European Agendas.
The task of the communities is to carry out innovative, active, and interdisciplinary teaching activities connected with society challenges.
The work presented here is part of the results on an activity organized by EELISA Community SUSBCC "Technical and Social Challenges for Sustainable Buildings, Cities and Communities". This community's mission is to promote a European university ecosystem that exploits synergies to innovate, educate, and raise awareness to boost the challenge of building more sustainable, efficient, and carbon-neutral buildings, cities, and communities.

SUSBCC Community is based on three pillars: innovation through research, awareness through work in contact with society challenges and education.
The challenges facing the SUSBCC community are the following:
- Take advantage of the dynamism and creativity of European university students to stimulate the technical and social transition towards more efficient and sustainable cities and communities.
- Explore and exploit synergies between cross-cutting technical and social branches.
- Integrate companies and professionals, researchers, students and other citizens into the Ecosystems.

The "ESA-ESAC - SUSTAINABLE BCC Think Tank" is an educational activity to promote innovation and generate cutting edge ideas to launch a comprehensive sustainable retrofitting of the European Space Agency (ESA) building "A" in Madrid (Spain).

Together with ESA-ESAC (partner of SUSBCC) a high impact activity consisting of a large think tank was organized., with the participating students and the support of professors, researchers, and professionals, to undertake a comprehensive retrofitting operation in the spirit of the New European Bauhaus and with the triple bottom line approach of sustainability (social, economic, and environmental).
This activity was a very good opportunity for students who participated, to acquire a global and integrative vision from the spirit of the New European Bauhaus and sustainability, gaining awareness and commitment to social, economic, energy, and environmental concerns, as well as discovering the potential offered by current digital trends to support and promote them from a perspective of efficiency.
This activity took place in a creative and collaborative international environment with the participation 55 international students and 54 international professors, researchers and professionals.

The development of this ESA-ESAC-SUSBCC think tank took place in a hybrid format in the last week of January 2023 (23-27 January) at the ESA-ESAC headquarters in Villanueva de la Cañada. The scope of development will cover the entire academic year 2022-2023, with activities in both the first and second semester.
The think tank is composed of 6 different think tanks: 4 working in thematical parallel sessions from the three pillars of sustainability, 1 cross-cutting think tank on digitalization, and 1 comprehensive think tank on integration through the New European Bauhaus Spirit. See Figure 1.

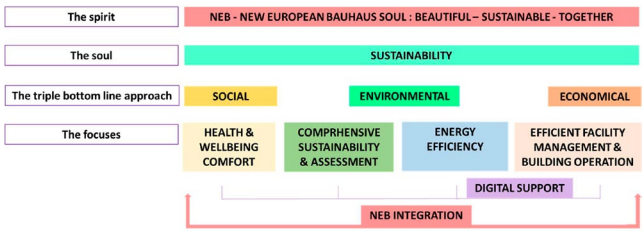

Figure 1. ESA-ESAC-SUSBCC think tank structure.

Each of the parallel think tanks consists of 8 thematic workshops of 2h. Figure 2 shows the different think tank workshops. In the different collaborative working groups (4 to 8 per parallel think tank) a specific challenge was proposed to discuss and generate ideas, analyzing and trying to reach common conclusions. In addition to this, there were four workshops for analysis and integrating the conclusions and lessons learned.

Prior to the development of the activity, the students had access to a repository of material on each of the topics under analysis, in the form of a flipped classroom.

PARALLEL THEMATIC THINK TANKS

Think tank Workshops	COMPREHENSIVE SUSTAINABILITY Code	HEALTH AND WELLBEING Code	ENERGY EFFICIENCY Code	EFFICIENT FACILITY MANAGEMENT Code
1	CSA1	H&W1	EE1	EFM 1
2	CSA2	H&W2	EE2	EFM 2
3	CSA3	H&W3	EE3	EFM 3
NEB 1	NEB 1	Sustainable Building Retrofitting		
4	DS4	Digital Twins & BIM		
5	DS5	Data Governance & Prioritisation		
6	DS6	Internet of Things & Artificial Intelligence		
7	CSA7	H&W7	EE7	EFM 7
8	CSA8	H&W8	EE8	EFM 8
NEB 2	NEB 2	Innovation in Buiding Retrofitting. Towards NZEB and NZEC		
9 Wrap up	ES9 WUP	H&W9 WUP	EE9 WUP	EFM 9 WUP
NEB wrap up	NEB WUP	Think Tank Wrap up conclusions and Lessons Learned		

Figure 2. Parallel Thematic Think Tanks.

Every thematic workshop of each of the think tanks was organized with 30 minutes of a master class to unify criteria, and define the specific challenges proposed to each working group. These challenges were proposed for collaborative work for 1 h (mixed face-to-face-virtual groups) and an additional half hour of sharing the findings and conclusions consolidated in the workshop.
The integration workshops are to share the partial and final conclusions of each of the think tanks in the different thematic workshops.

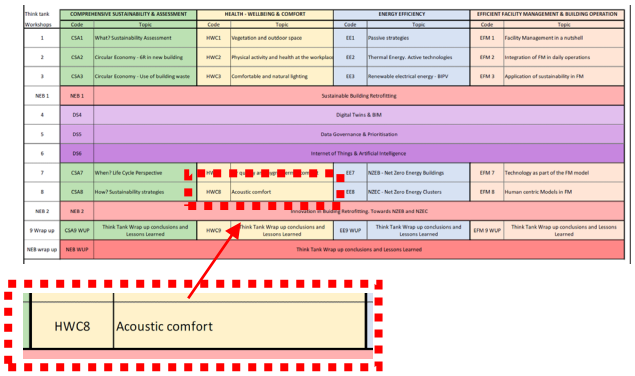

Figure 3. Thematic workshops: acoustic comfort.

The work presented here is the development and results of the acoustic comfort. Thematic workshop, which is part of the Think Tank: Health and wellbeing. See Figure 3.

2. ACOUSTIC WORKSHOP

During the workshop the work was divided into two phases, a first theoretical phase (masterclass) where different aspects related to acoustics such as acoustic insulation, room acoustics, mechanical noise and psychoacoustics were explained to the students and a second part where a challenge workshop was carried out through the MIRO platform. The workshop was initially attended by more than 10 international students, a workshop coordinator and 4 guest lecturers and experts from leading companies in the different subjects.

2.1 Masterclass

In the first section, acoustics concepts related to acoustic design were explained in a 30 minute masterclass. During this time, topics such as noise insulation, room acoustic design, mechanical noise control and psychoacoustics were explained. In each of these topics, the relevant aspects to the subsequent challenge were detailed. For example, concepts of acoustic design of facades, roofs, interior partitions, reverberation time, mechanical and building services noise control or concepts of psychoacoustics were provided.
Lecturers from different universities were present (Universidad Politécnica de Madrid and Budapest University of Technology and Economics), as well as various experts from international engineering companies and acoustic product manufacturers. Once the masterclass

was over, a debate was held between the students and the guest lecturers. They were then presented with a design challenge: How to deal with a building refurbishment, reaching acoustic insulation and room acoustic criteria in dialogue with concepts such as natural ventilation, lighting, sun protection, biophilia or life cycle of used materials.

2.2 Design workshop

For the second part, the design workshop, the MIRO platform was used. Miro is an online collaboration platform that allows teams to work remotely and visually. With a focus on real-time collaboration, Miro provides a virtual canvas for creating and sharing ideas, diagrams, mind maps, prototypes and more. The platform offers a wide range of customizable tools and templates, making it easy to create interactive and dynamic presentations. In addition, Miro integrates chat, video conferencing and real-time feedback features to foster effective communication between team members. With its intuitive and flexible approach. Figure 4 shows different MIRO boards created during the ESA-ESAC - SUSTAINABLE BCC Think Tank.
Using this tool, 3 steps were carried out: individual work (15 minutes), Analysis and discussion (10 minutes) and final workshop conclusion (5 minutes)

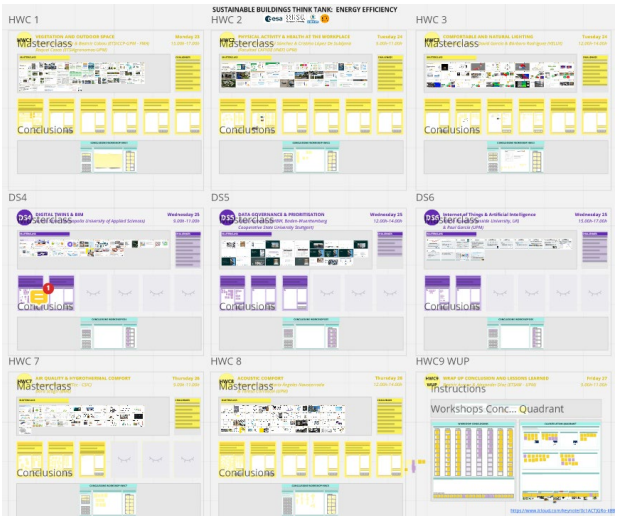

Figure 4 ESA-ESAC-SUSBCC think tank MIRO board

The first step consisted of a brain storming where in a time of 15 minutes the students independently, inserted in the MIRO platform different concepts of acoustic design and its interaction with the concepts of natural ventilation, lighting, protection and biophilia. See Figure 5.

Figure 5. MIRO screenshot step 1: Brainstorming.

After this period of time, the students themselves ranked the different topics in four groups: design & layout, façade & structure, human perspective and systems. They ranked the different elements in each of the subgroups and then voted using MIRO platform those aspects that were most relevant to them. See Figure 6 for step 2: Analysis and discussion.

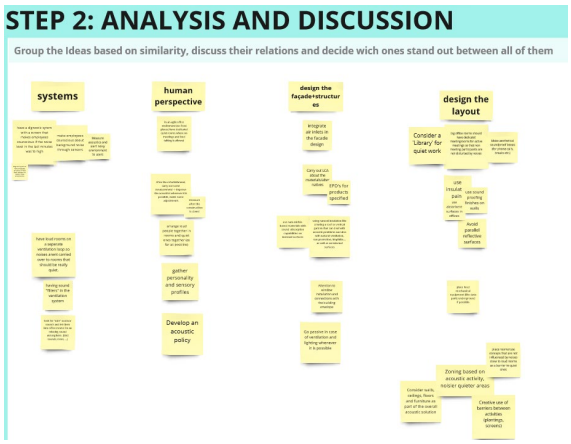

Figure 6. MIRO screenshot step 2: Analysis and discussion.

After a discussion process of about 20 minutes between all participants (students and the guest lecturers), the conclusions of the workshop were drawn by selecting the 10 most important topics for them. Some other topics were either systems based, such as the selection of silencers or background noise alarms, acoustic legislative policies, or design approaches such as making phonebooths, more including dedicated spaces for meetings or concentration areas y offices. See Figure 7 and Table 1, which compiles conclusions drawn by students.

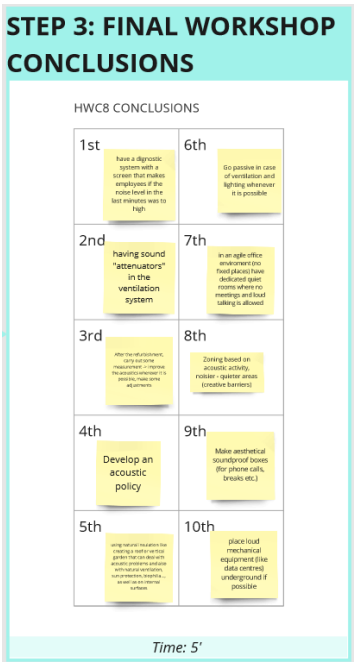

Figure 7. MIRO screenshot step 3; Final workshop conclusions.

Table 1. ESA-ESAC-SUSBCC think tank workshop 8_acoustic conclusions

Conclusion 1	Having a diagnostic system with a screen that makes employees if the noise level in the last minutes was to high
Conclusion 2	Having sound "attenuators" in the ventilation system
Conclusion 3	After the refurbishment, carry out measurement → improve the acoustics wherever it is possible, make some adjustments
Conclusion 4	Develop an acoustic policy
Conclusion 5	Using natural insulation like creating a roof or vertical garden that can deal with acoustic problems and also with natural ventilation, sun protection, biophilia..., as well as on internal surfaces
Conclusion 6	Go passive in case of ventilation and lighting whenever it is possible
Conclusion 7	In an agile office environment (no fixed places), having dedicated quiet rooms where no meetings and loud talking is allowed
Conclusion 8	Zoning based on acoustic activity, noisier - quieter areas
Conclusion 9	Make aesthetical soundproof boxes (for phone calls, breaks etc.)
Conclusion 10	Place loud mechanical equipment (like data centers) underground if possible

In a later phase, the conclusions of this workshop were unified with the conclusions of all the workshops held during the ESA-ESAC-SUSBCC think tank. All the students worked in groups, designing spaces reflecting aspects such as air quality, hygrothermal comfort, acoustics, lighting, vegetation and outdoor space, physical space and health at the workplace.

3. CONCLUSIONS

Acoustics should be seen as a transversal discussion with all the disciplines involved in construction and introducing acoustics to non-acousticians in the construction industry is often challenging. Using online collaboration platforms offers several benefits for educators in the field of acoustics when it comes to educating students. MIRO provides a virtual collaborative space where students and educators can visually represent and discuss acoustic concepts, allowing for a more engaging and interactive learning experience. Through the platform's interactive whiteboard and various tools, students can create diagrams, mind maps, and presentations that help them understand complex acoustic principles.

Online platforms enable real-time collaboration, allowing students and educators to work together regardless of their physical location. This feature is particularly useful for remote learning scenarios or when students are spread across different campuses or institutions. Additionally, MIRO offers a range of templates that could be customized to suit the specific needs of each lesson or workshop.

During the THINK TANK on SUSTAINABLE BUILDINGS, an activity organized by EELISA, an alliance of Higher Education Institutions from different countries in Europe, using online collaboration platforms offered a dynamic and collaborative environment that enhanced the teaching and learning of acoustics. It promoted active student participation, facilitated remote learning from all the European region EELISA members and provided structured templates, fosters effective communication, all of which contributed to a comprehensive and engaging educational experience in the field of acoustics.

4. ACKNOWLEDGMENTS

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5. REFERENCES

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