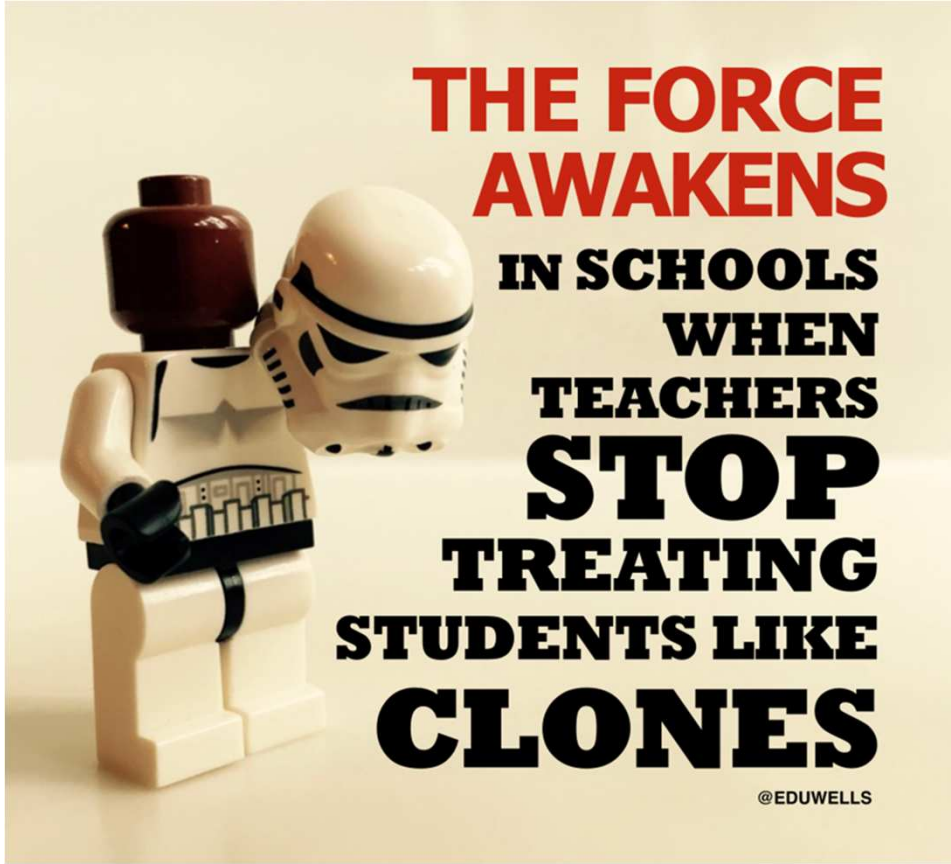
When in noise – “I can’t hear myself think!”

how does it affect teaching and learning activities?

Ecophon SAINT-GOBAIN

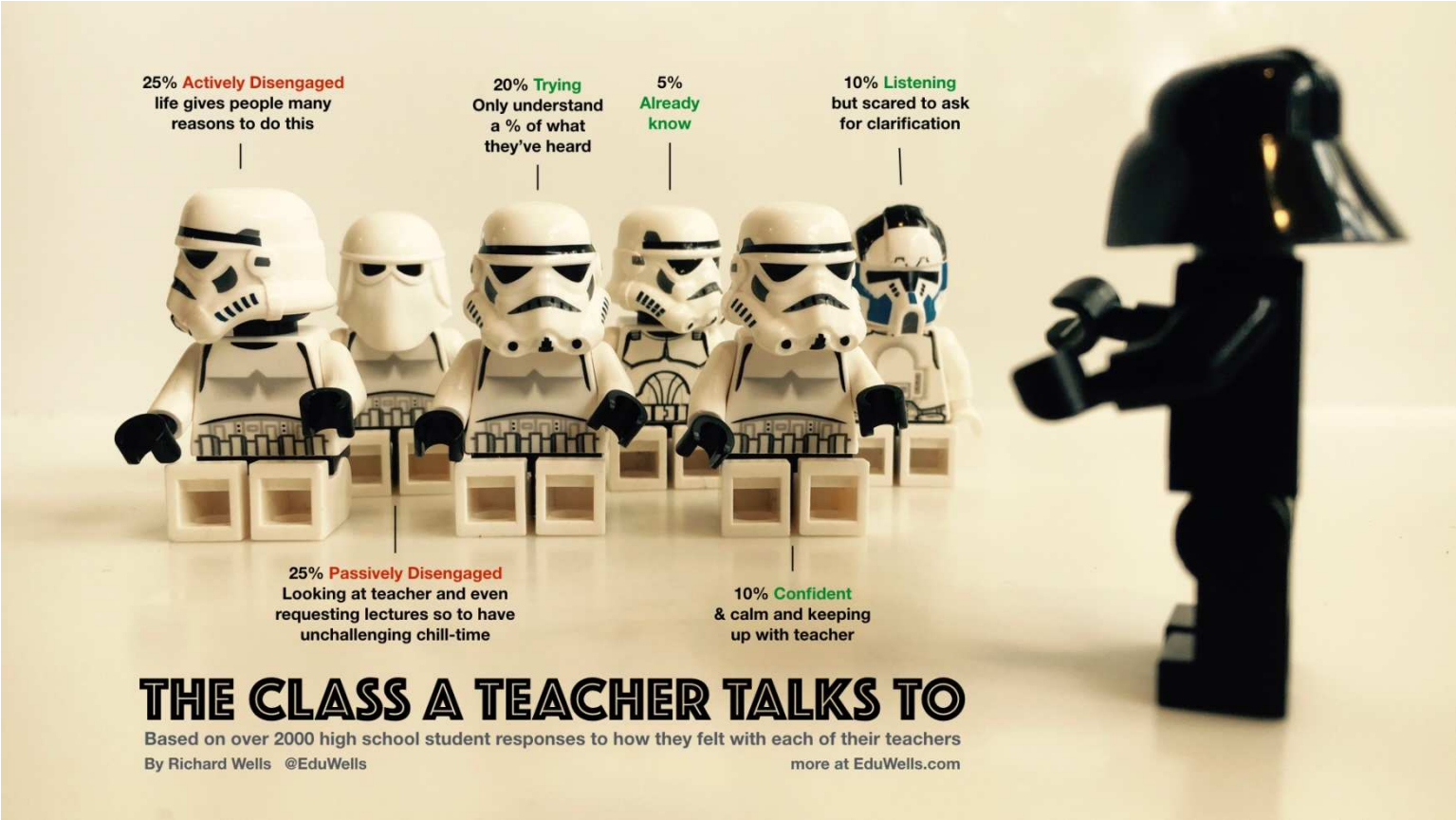
A SOUND EFFECT ON PEOPLE

Education is changing….
It is no longer like it was in my day!



Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

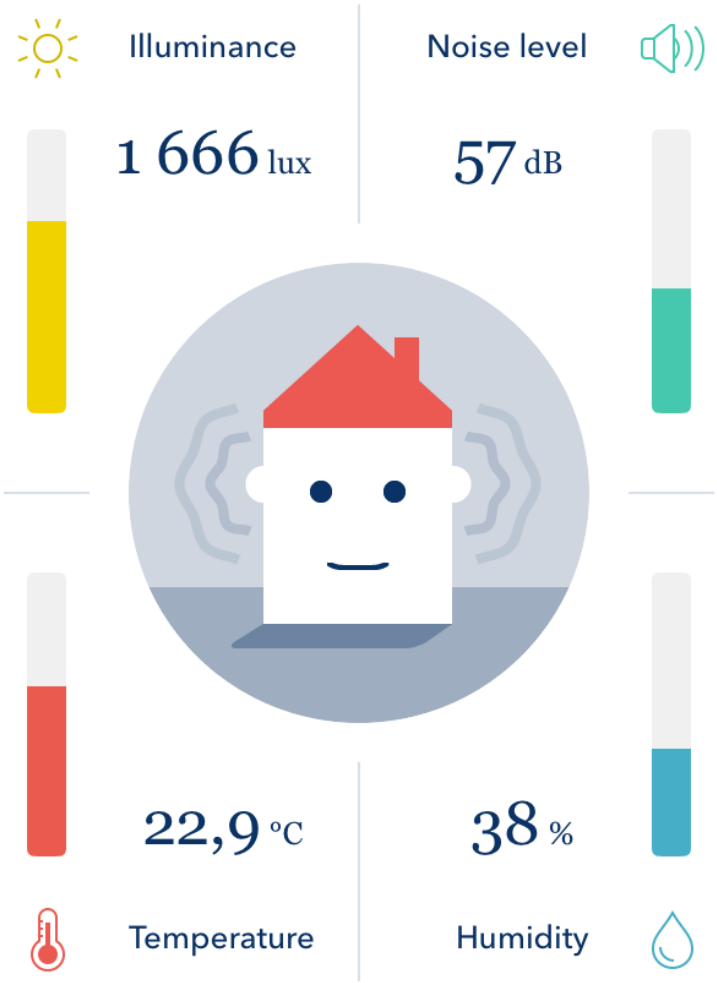
More engagement is needed!



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

#IEQ Indoor Environmental Quality



Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Noise is now recognised as second most damaging to our health after air pollution

World Health Organization

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Drawing in a quiet environment

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Same drawing in a noisy environment

Same child / drawing different sound levels

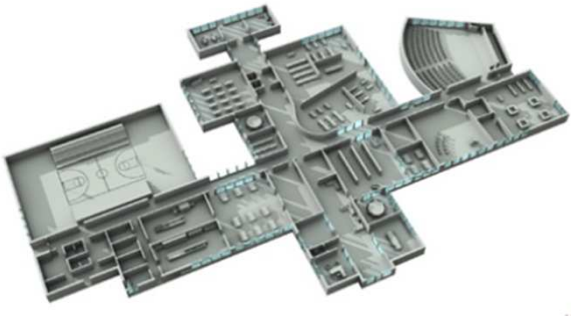
Pictures from 'Sound Education Seminar', Camilla Lydiksen, CEO ADHD-foreningen

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

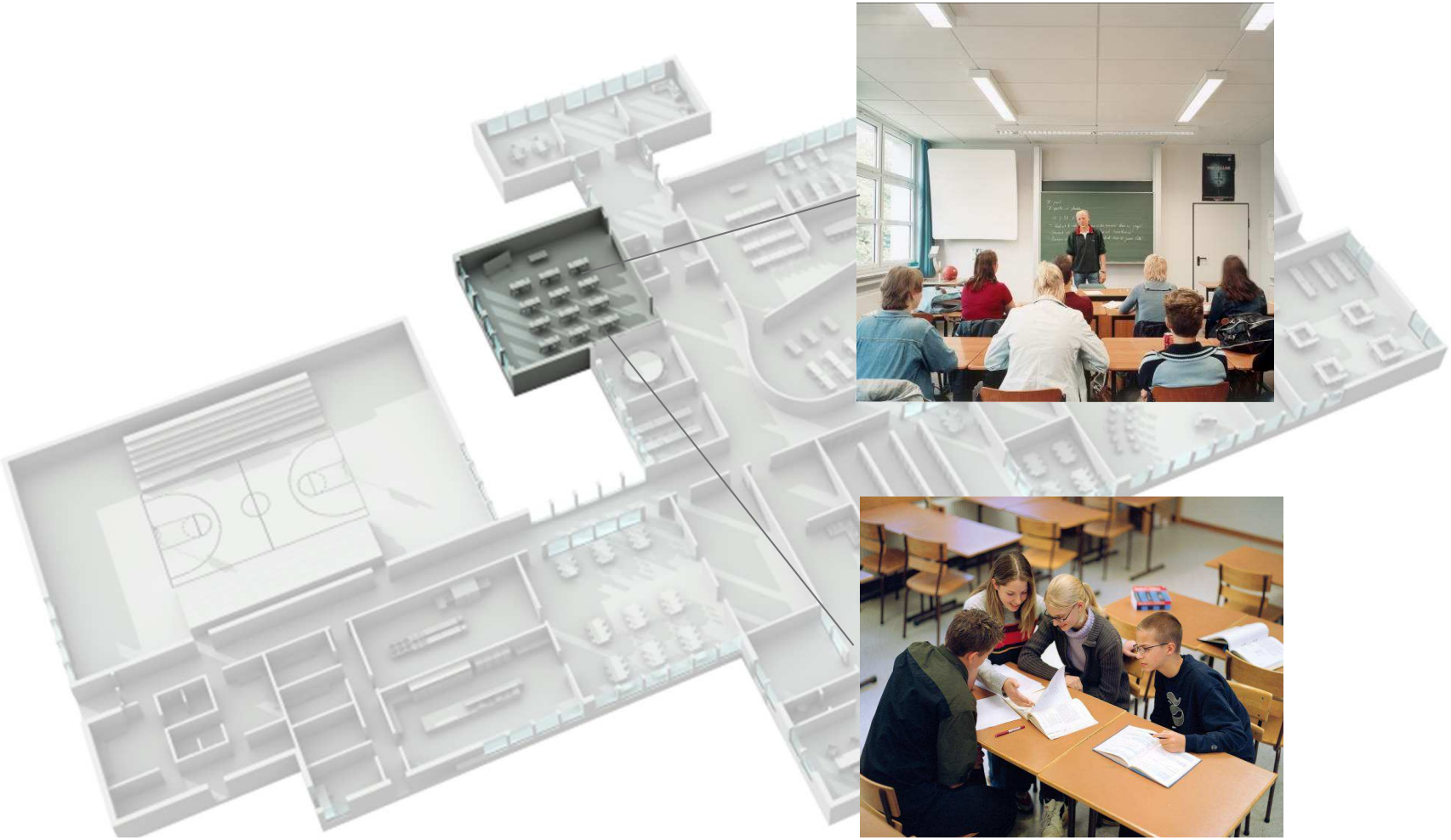
Acoustics in and beyond the classroom

Create the natural outdoors - outdoors vs indoors



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE



Ecophon®
SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Our resources - human capital in EDUnet

Design and acoustics

Acoustics and surveying

Pedagogics and networking

Acoustics and measurements

Expertise in NET

Architecture and acoustics

Teaching and technical

Pedagogics and teaching

Ecophon® SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Key Classroom acoustic studies:

EDUnet
Drive &
cooperation

Heriot-Watt University
Edinburgh

(1997-99)

High performance acoustics leads to higher educational quality

Universität Bremen

(2001-2006)

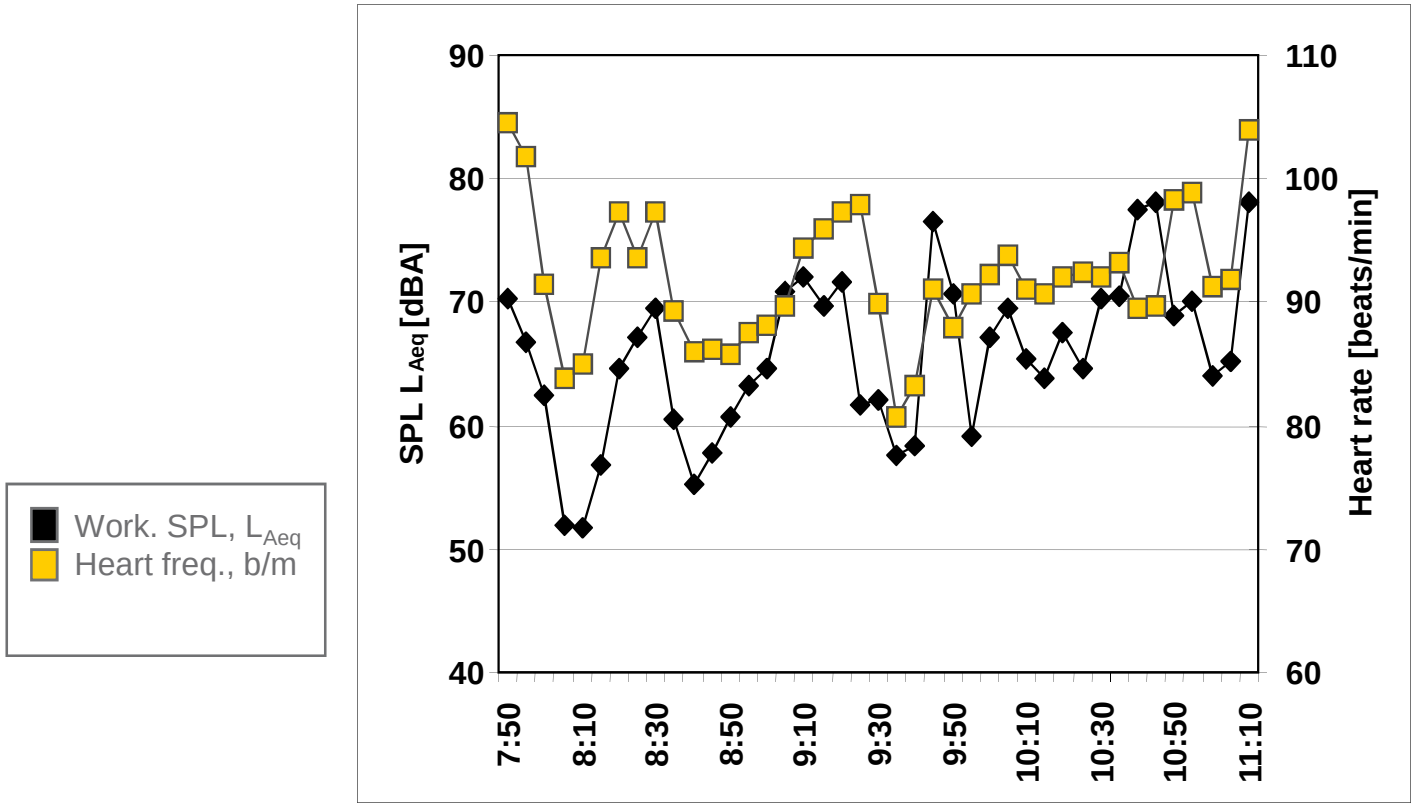
Acoustic focus on teaching and learning conditions. Improved teacher working conditions. Improve student learning conditions.

(2007- 2012)

Increasing acoustic shows a clear link preferred acoustic qualities for both teachers and students

Work Load Stress

Working SPL and average Heart Rate$_{5min}$
of the teacher

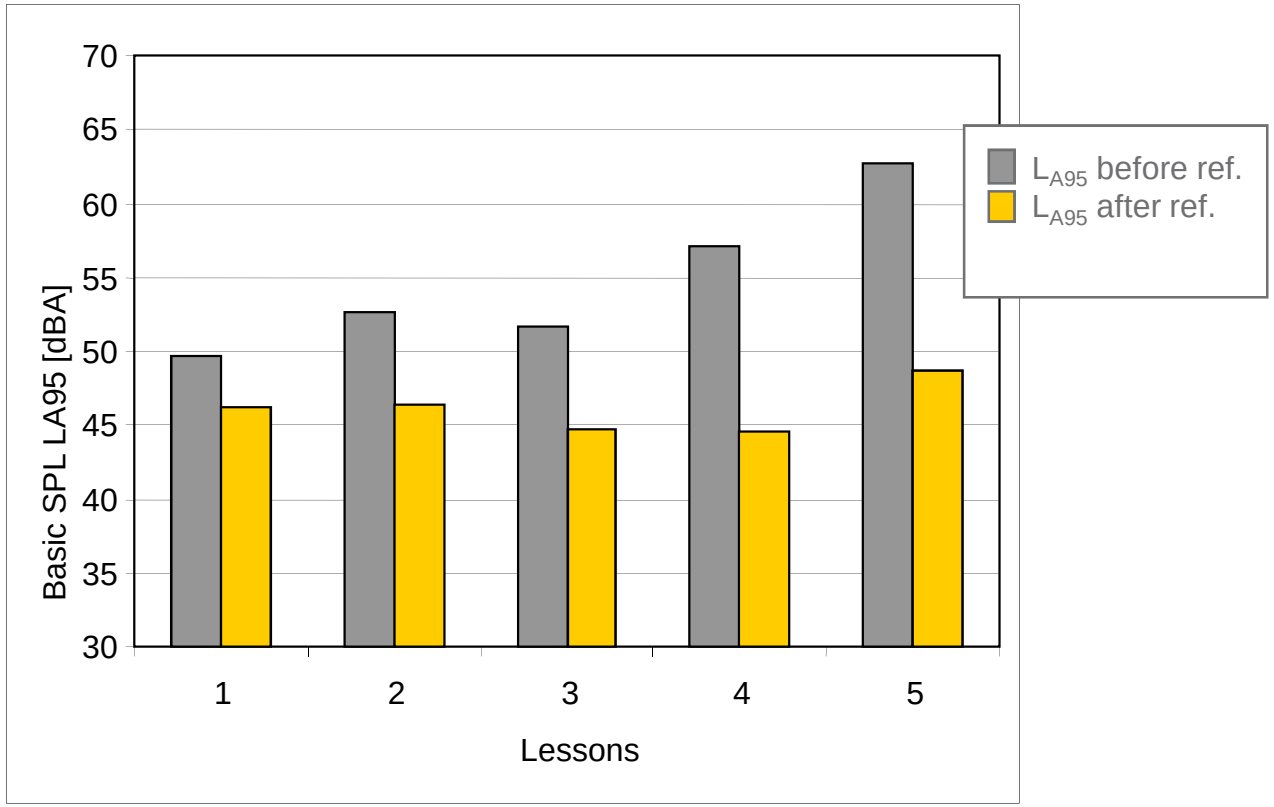


Universität Bremen

Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Classroom noise and concentration

Increase of Basic SPL (L_{A95}) before and after refurbishment



Data: Lab School, all lessons

Universität Bremen

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Teaching styles and sound level differences

Working Sound Pressure levels ($L_{Aeq,5min}$) before and after refurbishment

13 dB !!!

Universität Bremen

Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Essex Study- Optimised classroom acoustics for all

Study financed by Essex County Council, NDCS, FPS and the ANC
Carried out by Hear2Learn and AJA Ltd

Is there a benefit designing for the Inclusion of Hearing Impaired students - for all students and teachers?

OECD

CELE
OECD Centre for Effective Learning Environments

European Investment Bank

(2007- 2012) UK

Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Essex Study - 4 classrooms – 3 acoustic criteria

1.Untreated ”control” room

2.BB93 Min (Tmf)

3.BB93 Hi (Tmf)

4.BATOD (125-4000Hz)

Essex County Council

Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

sound education

Sound Education

Essex Study - "Balloon pop"- room response

Short Version Bad - Good

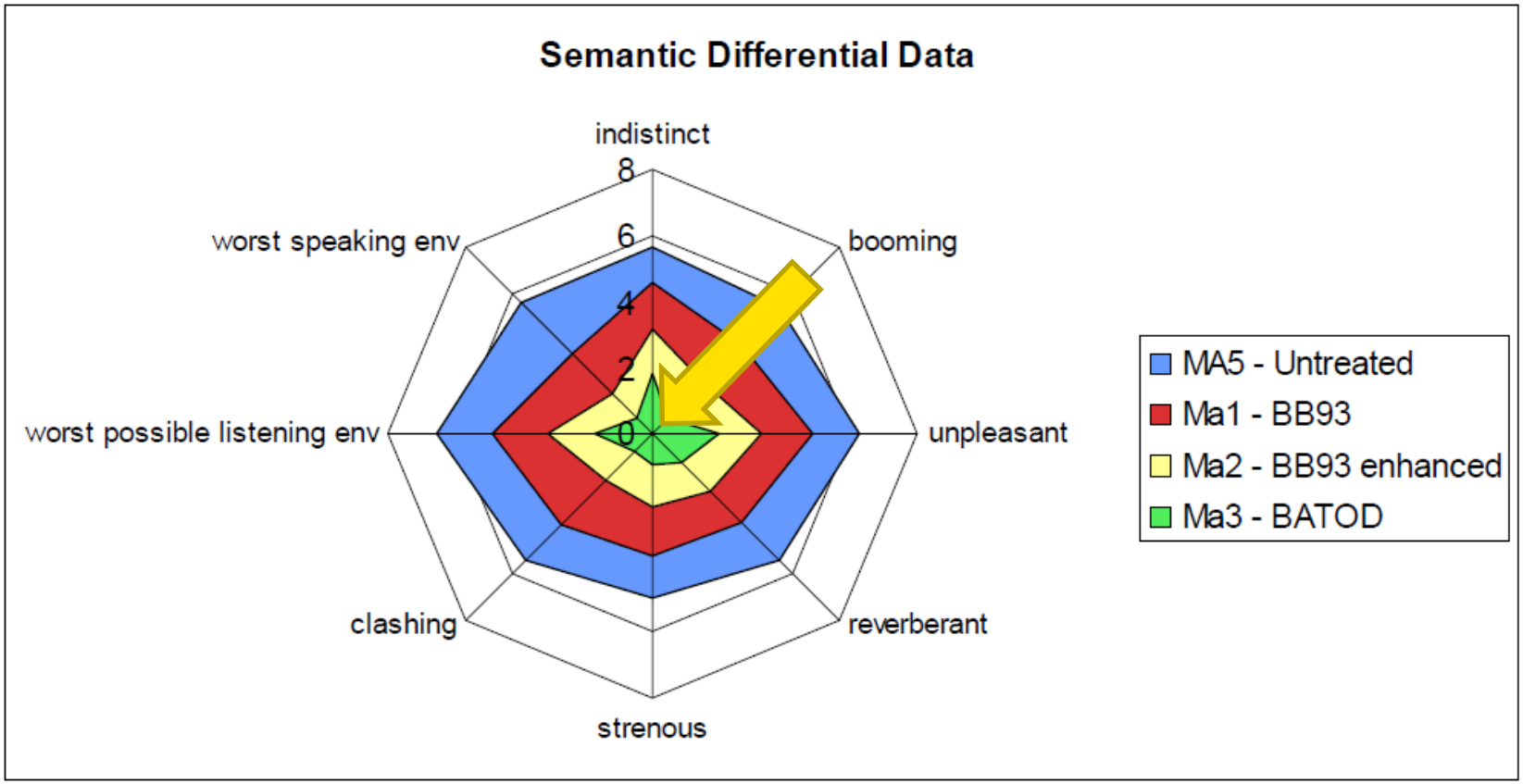
Visit www.soundeducation.tv

Brought to you by Ecophon SAINT-GOBAIN A SOUND EFFECT ON PEOPLE

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Eliminating the perceived negatives

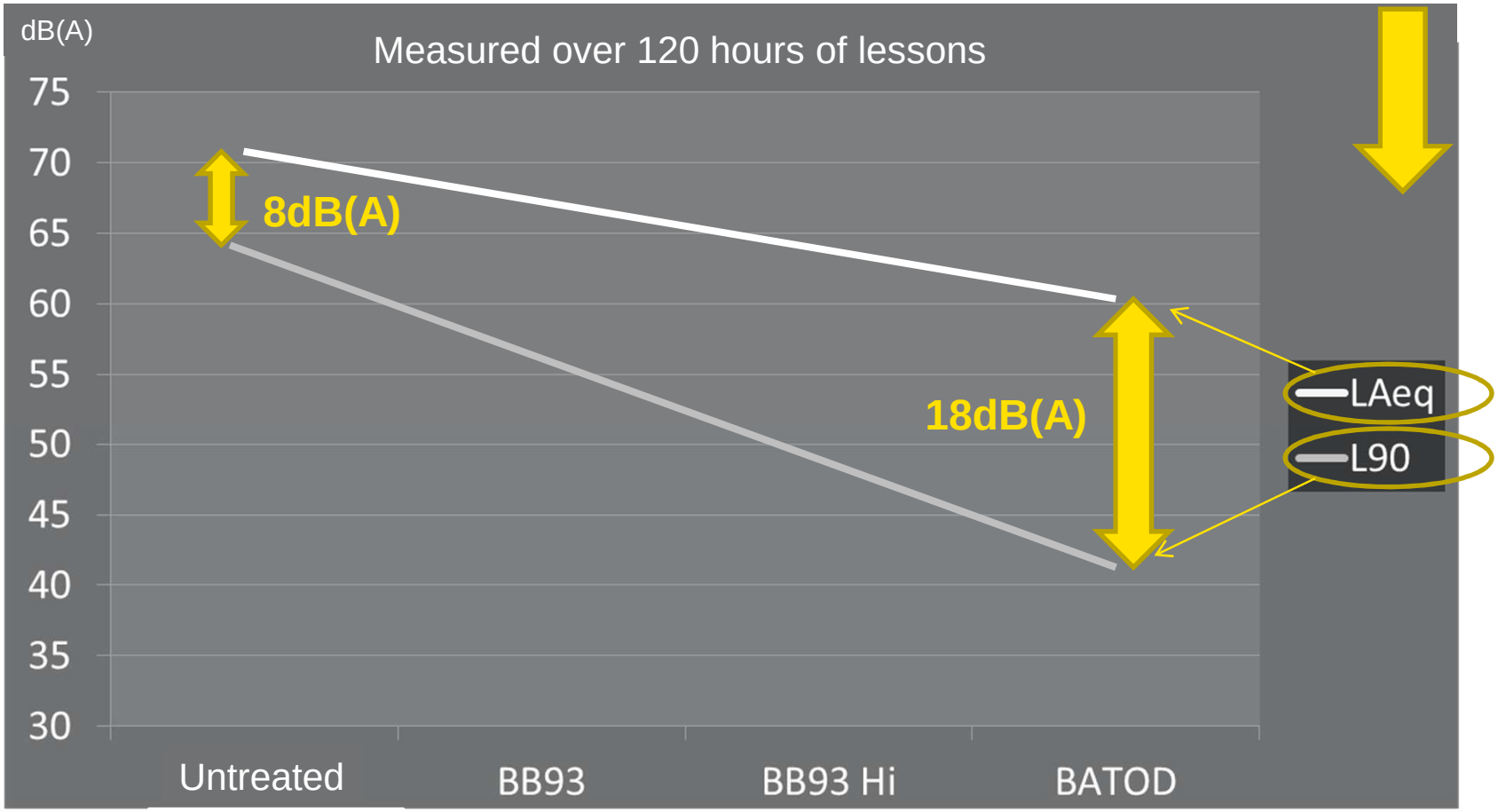


Essex County Council

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

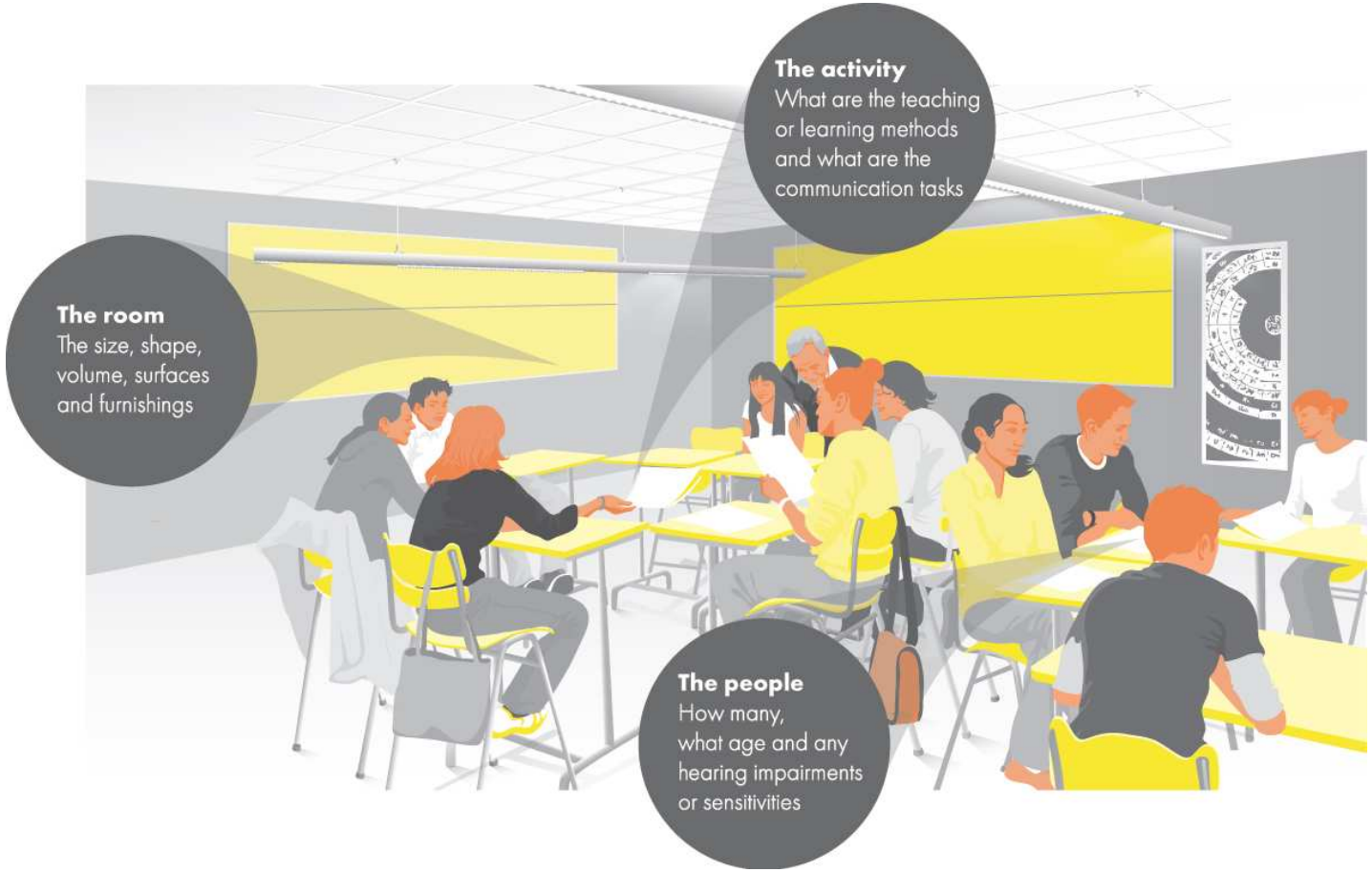
Sound levels (SNR) – ”Reverse Lombard”



Essex County Council

Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Activity Based Acoustic Design approach



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Need for balancing room acoustic qualities

- Sound
- Speech Clarity
- Reverberance
- Reverberance in low frequencies

Sound Strength

Speech Clarity

Reverberation Time

Low frequencies

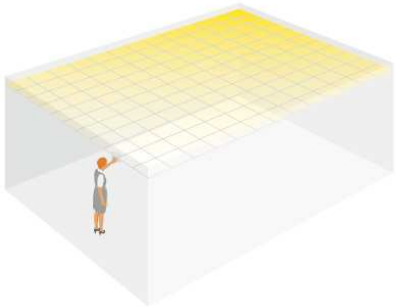
Ecophon SAINT-GOBAIN

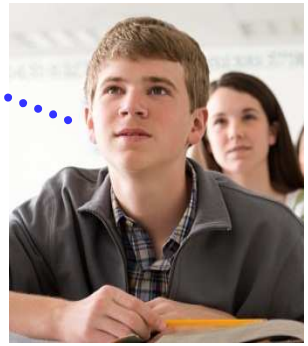
A SOUND EFFECT ON PEOPLE

Acoustic conditions for Speech, Listening & Learning

Speakers voice

Room acoustics





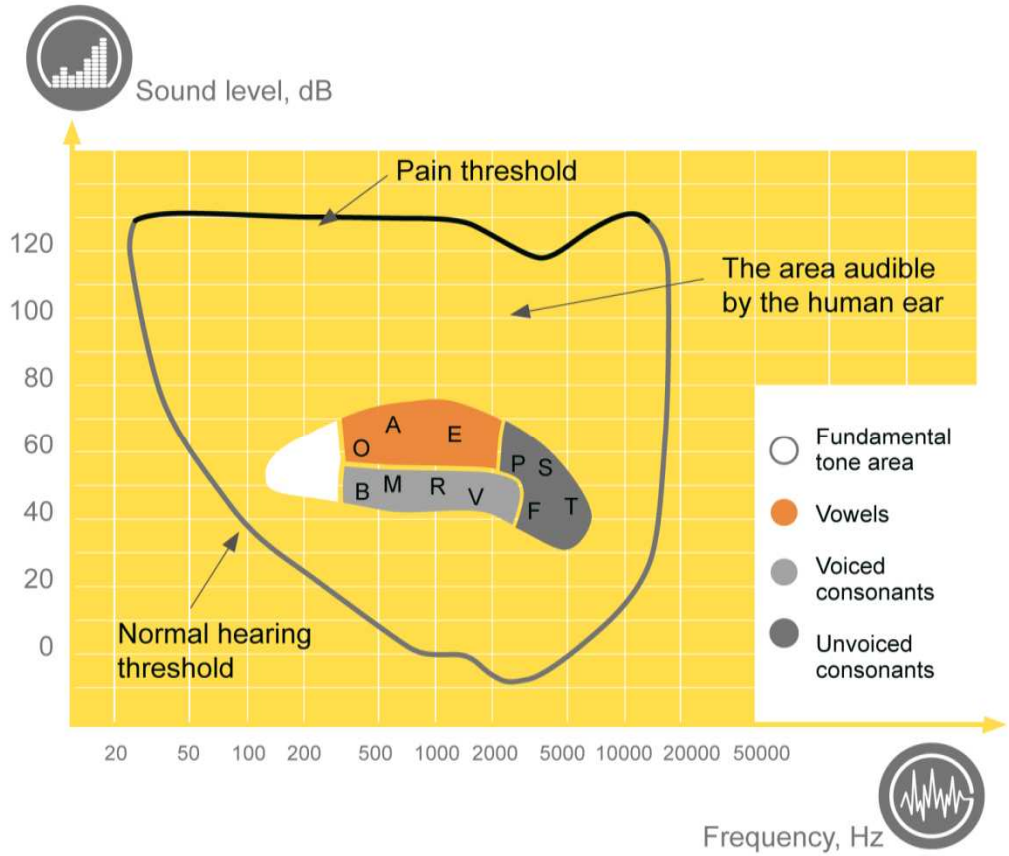
Listeners ears

- Hear the speech clearly
- Understand what is said
- Remember what was said
- Capacity to think

Ecophon® SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

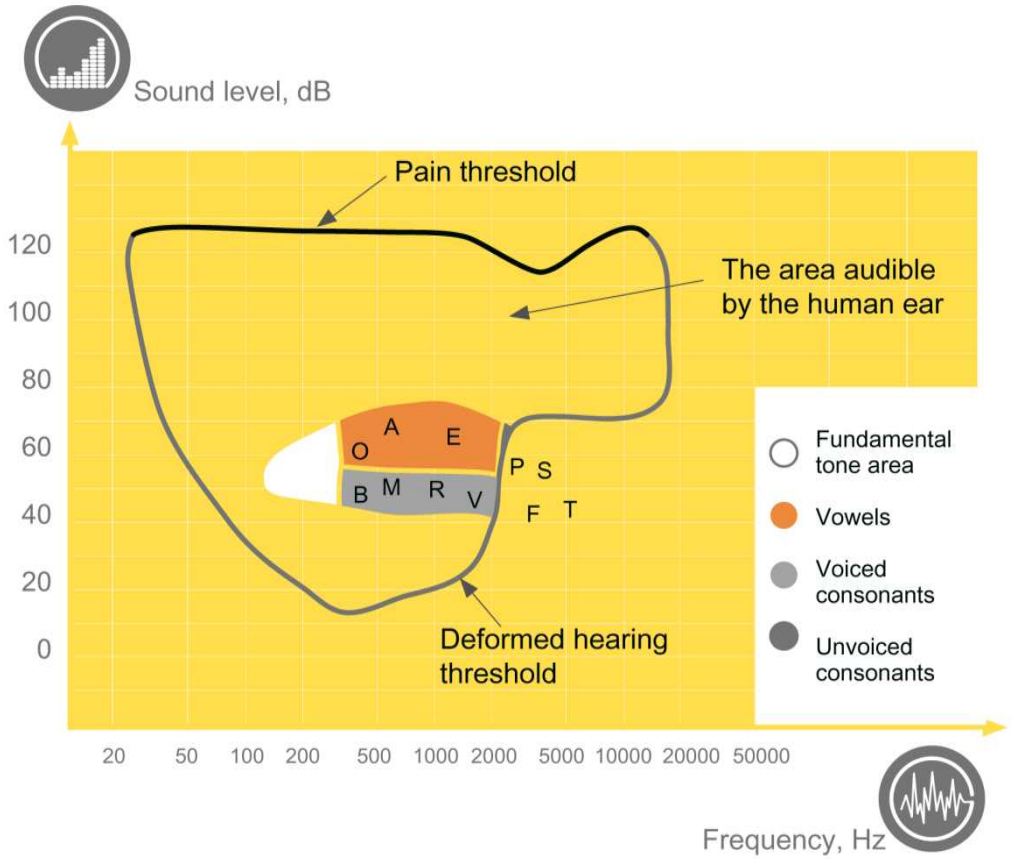
Typical persons hearing threshold



Ecophon® SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

1. Impaired hearing



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Speech (im)balance - Information and Energy

INFORMATION

ENERGY

INFORMATION

ENERGY

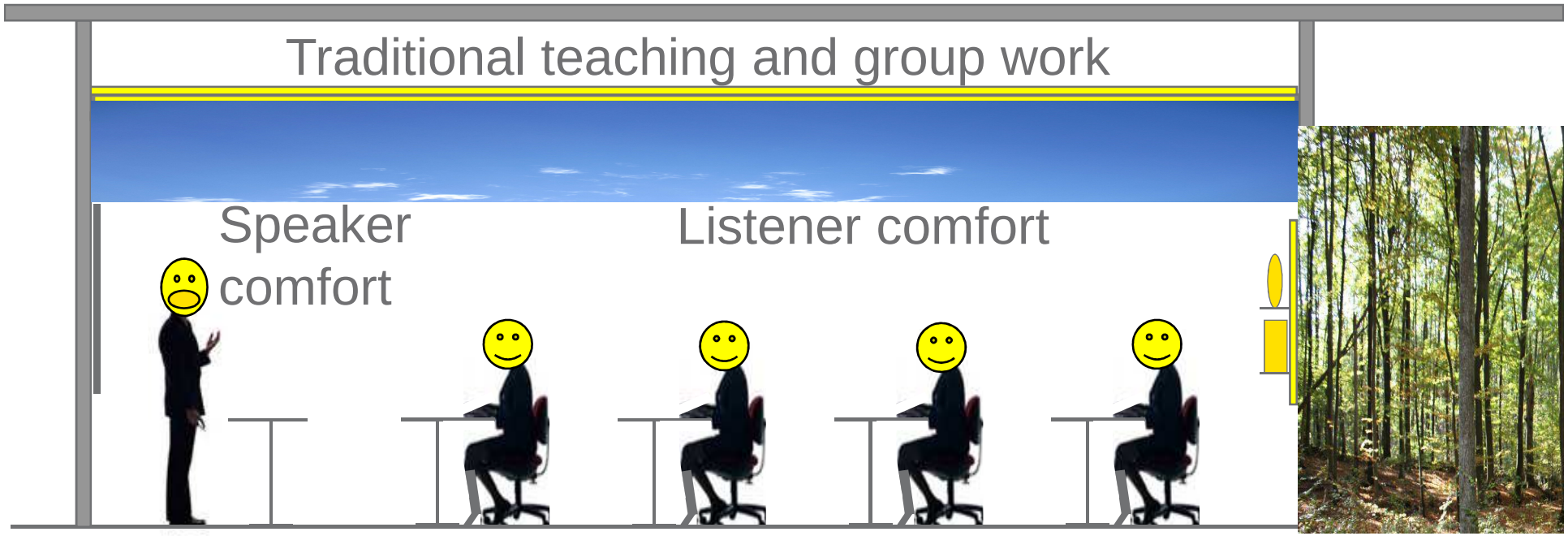
Consonants

Vowels

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Summary for speech and listener comfort



Acoustic Sky

Acoustic Forest

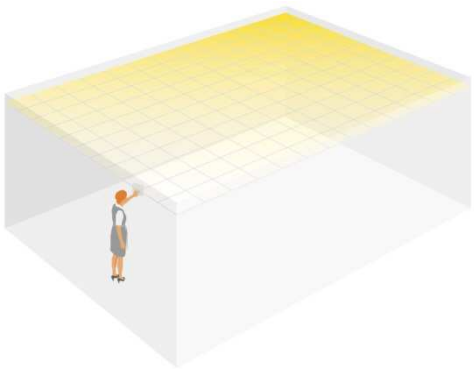
Reflector

Ecophon SAINT-GOBAIN

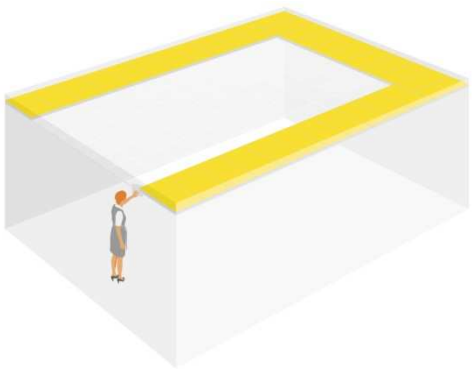
A SOUND EFFECT ON PEOPLE

Benefits of combined acoustic systems

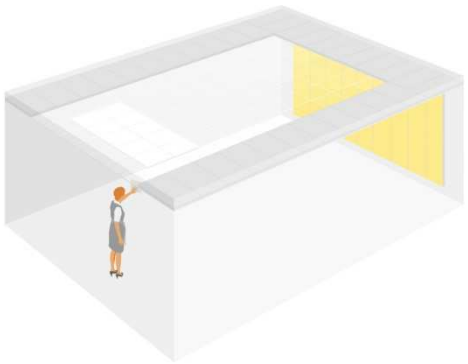
1. Lower sound levels



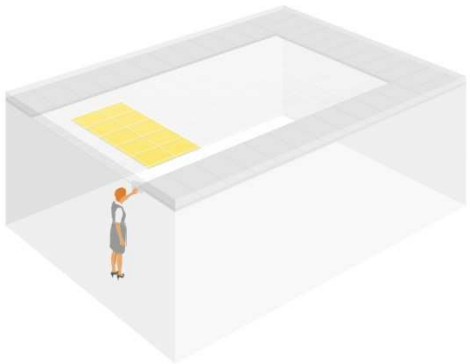
2. Balance speech & hearing frequencies



3. Increase the speech intelligibility



4. Increase speaker comfort



Ecophon® SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Flexible classroom solutions - beyond min standards

Working environment – Teachers` speech comfort

Learning environment – Students` listening comfort

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Other spaces, beyond the traditional classroom

Moving around,

communicating and concentrating

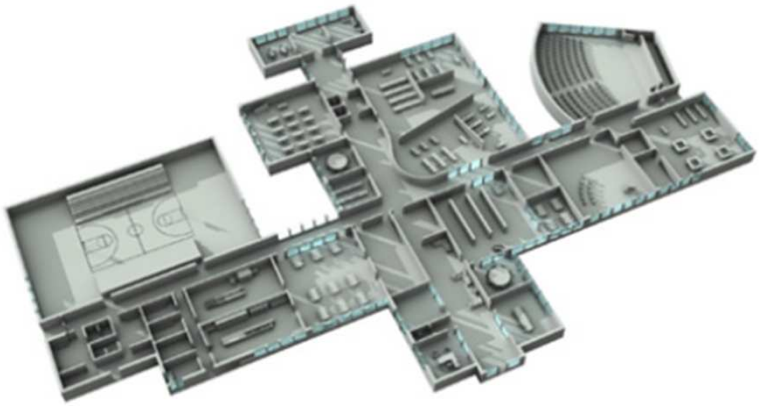
As students and teachers leave one class they should be able to relax and prepare for the next one. But since corridors and breakout spaces are increasingly used as learning environments and group work areas during lesson hours, they have become areas that are highly multipurpose. At any given time there can be people moving from class to class, students talking and playing around, group work and individual students trying to concentrate. If left unchecked, a cacophony of noise will easily be created. The noise will spread throughout the space and can also enter adjoining classrooms.

The key to turning these spaces into good sound environments is to stop sound from spreading.

Challenge: *To reduce sound levels and to prevent sound from spreading.*

Solution: *Using a sound-absorbing ceiling with good absorption qualities and high efficiency in reducing sound propagation, and wall absorbers wherever needed and possible.*

Corridors and breakout spaces need to be able to cope with the unexpected. It is therefore a good idea to make sure that the ceiling is impact-resistant. This will increase its durability.



Ecophon® SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Educational Environments Research

- Innovative Learning Environments and Teacher Change

Australasian educators and their industry partners are going to explore how space enhances teaching

The University of Melbourne's *Learning Environments Applied Research Network* (LEaRN) is partnering schools in NSW, Queensland, the ACT, Victoria and New Zealand to research how teachers can utilise 'innovative learning environments' to improve their teaching skills.

The *Innovative Learning Environments and Teacher Change* project was awarded a four-year ARC

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

ILETC – background and aims

- It is becoming clear that **new learning environments require new teaching methods**, and apart from a small number of examples, teaching practices in ILEs remain the same as in traditional classrooms.
- This project aims to demonstrate how **maximising the use of ILEs facilitates improved teaching practices and learning outcomes**. It will collect data on how teachers enable learning most effectively in ILEs and identify causal evidence concerning the relationship between quality teaching and effective use of ILEs.

This project will **bridge the gap between the unrealised educational potential of innovative learning environment design and how they are currently used**

ILETC
INNOVATIVE LEARNING ENVIRONMENTS AND TEACHER CHANGE
A 2016-2019 ARC LINKAGE PROJECT

Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

ILETC – further aims

- Develop mechanisms to **identify ”teacher mindset” characteristics**.
- Develop strategies to **assist teachers to maximise benefits available by the spaces in which they teach**.
- Conduct research on the effect this increased knowledge has on the **quality of teaching, student’s deep learning and learning outcomes.**

Can altering teacher mind frames **unlock the potential of innovative learning environments**

Collaborating on effective use of these learning spaces

Acoustics is included, 1st time in a large pedagogic study

ILETC
INNOVATIVE LEARNING ENVIRONMENTS AND TEACHER CHANGE
A 2016-2019 ARC LINKAGE PROJECT

Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Beyond traditional cellular learning spaces…

Key considerations for a transition from cellular to open learning landscapes.

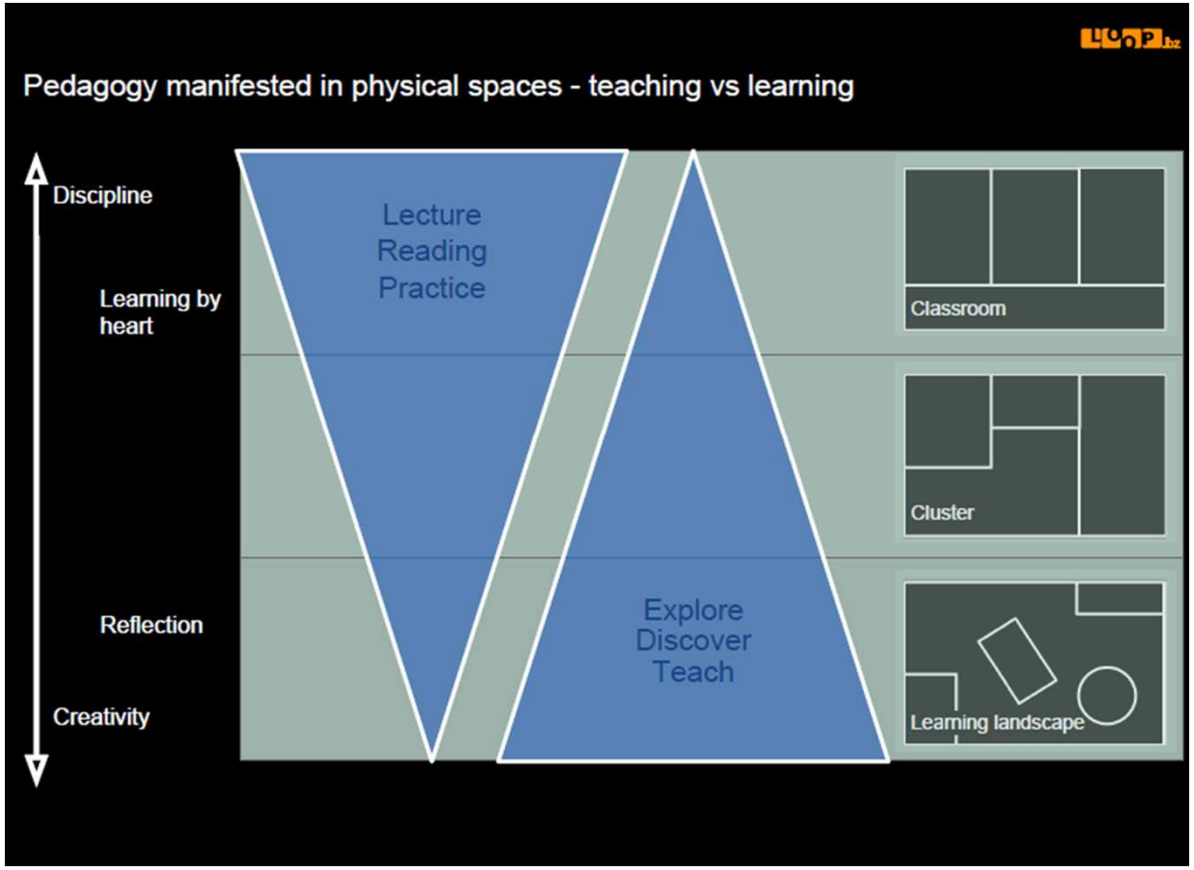
Guidance for the transition
from cellular to open learning:

1. Educational vision
2. Pedagogic approach
3. Activity Based Working
4. Case study examples
5. Simple Activity Based Acoustic Design guidance

Figure 1. Dovey and Fisher's learning space typologies (2014), adapted by Soccio & Cleveland, 2015

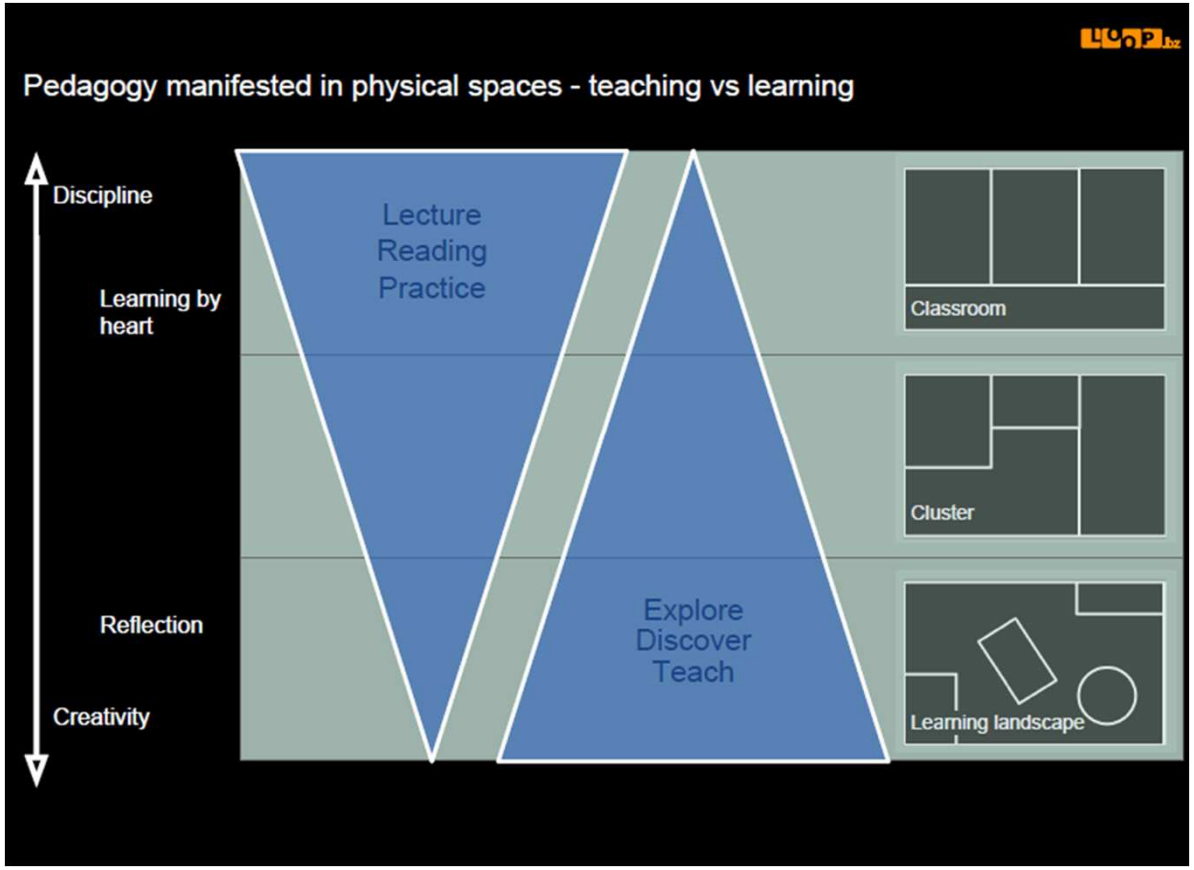
Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Innovative Learning Environments……



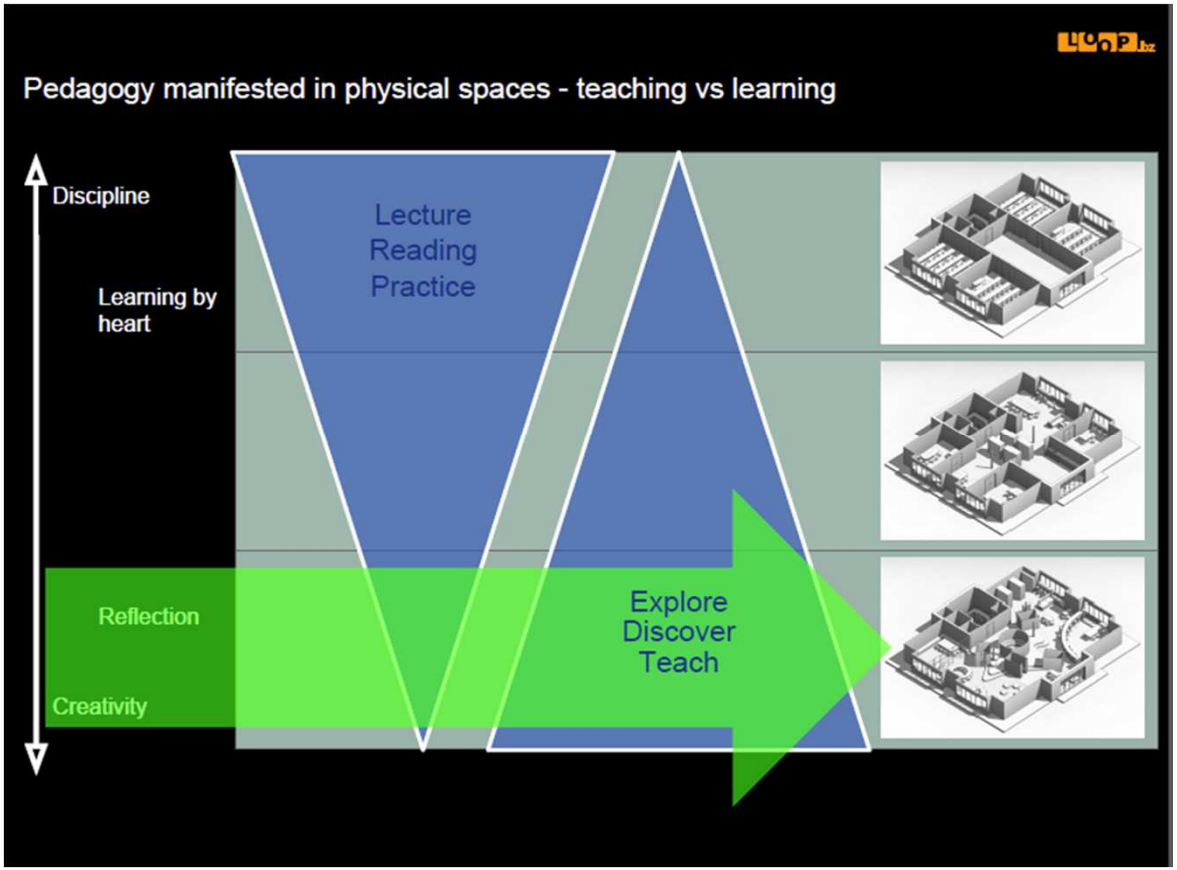
Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Teaching control vs Learning Freedom

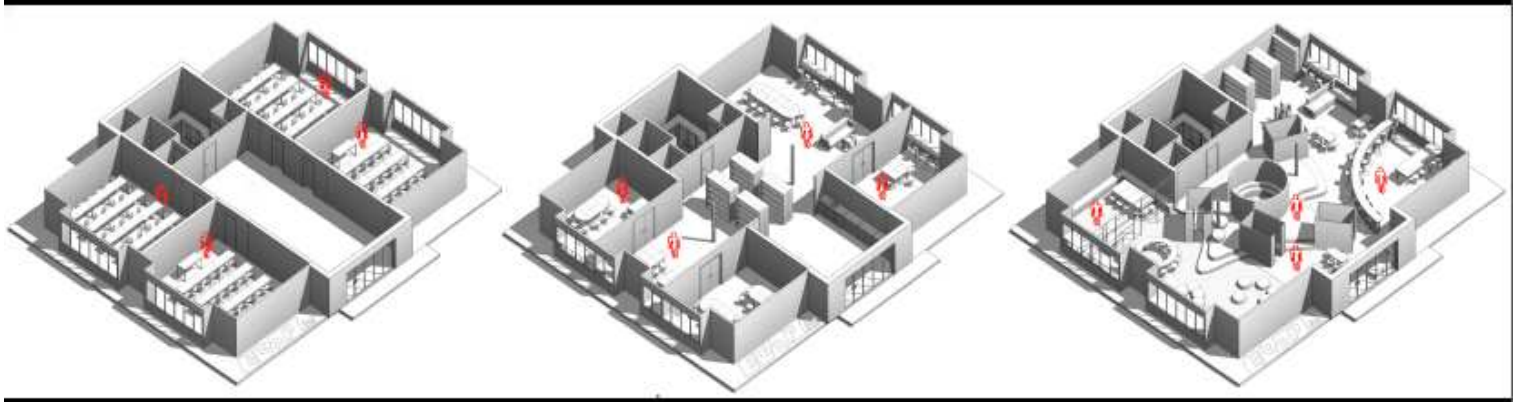


Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Matching the activities to the spaces



Mobility - for teachers as well as students



If collaboration is important, how frequently do teachers engage in it? The picture is actually mixed. When it comes to informal exchange and co-ordination, teachers are generally very active. However, the kind of deep professional collaboration I referred to ... is actually quite rare ... And the picture is similar for collaborative professional development ... on this you still find only a third of teachers doing this at least once per month. And least frequent is classroom observation that you also saw closely related to job satisfaction.

(Andreas Schleicher, OECD 2016)

Devolved responsibility for learning

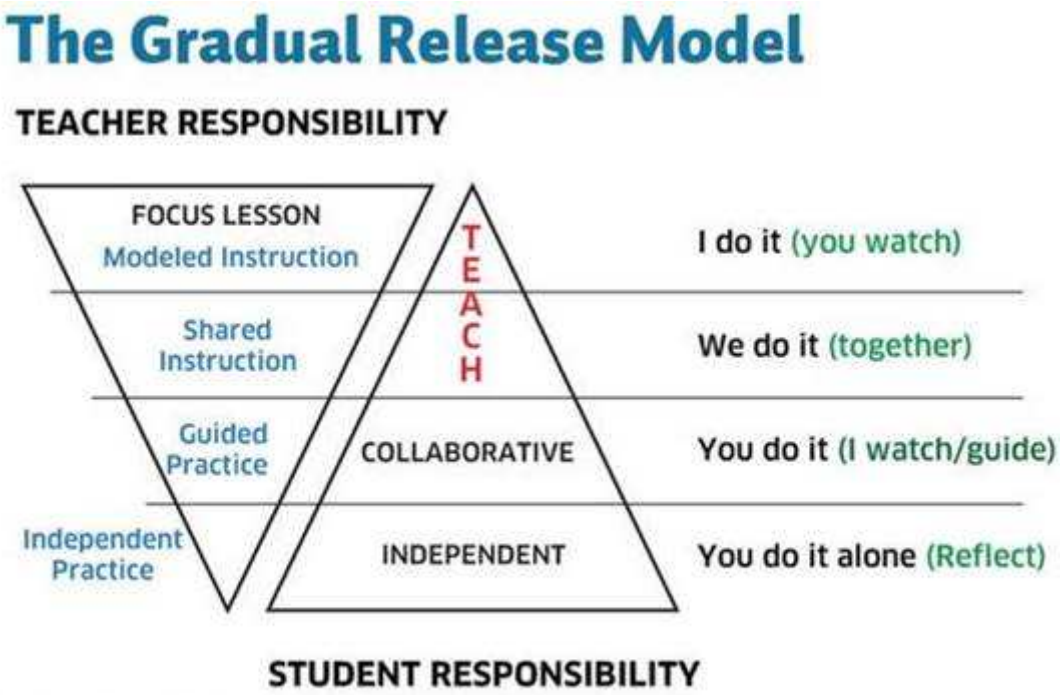
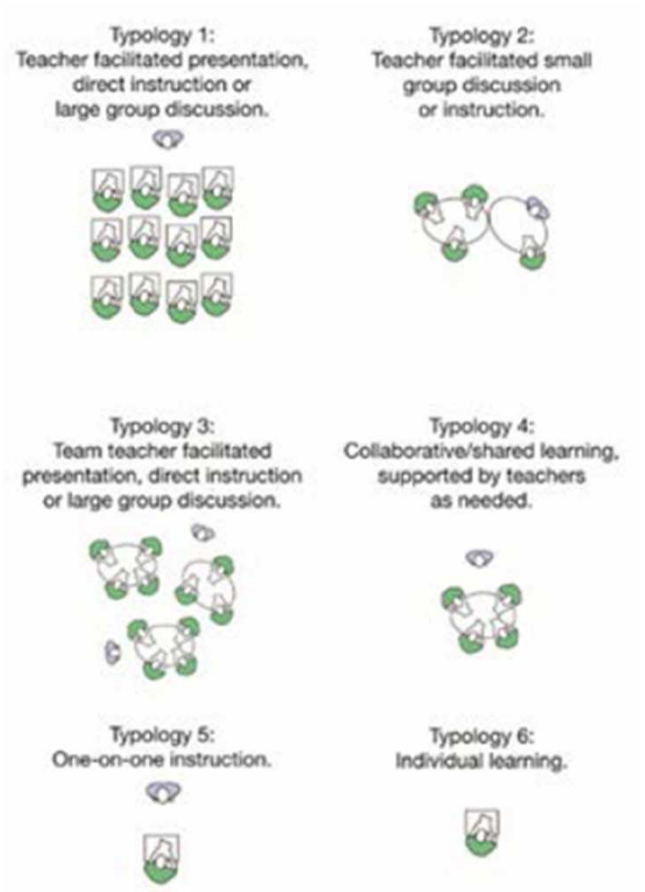


Figure 1: The Gradual Release Model

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Teaching and Learning Typologies - ILETC



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Learning Space Typologies - ILETC

Figure 1. Dovey and Fisher's learning space typologies (2014), adapted by Soccio & Cleveland, 2015

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

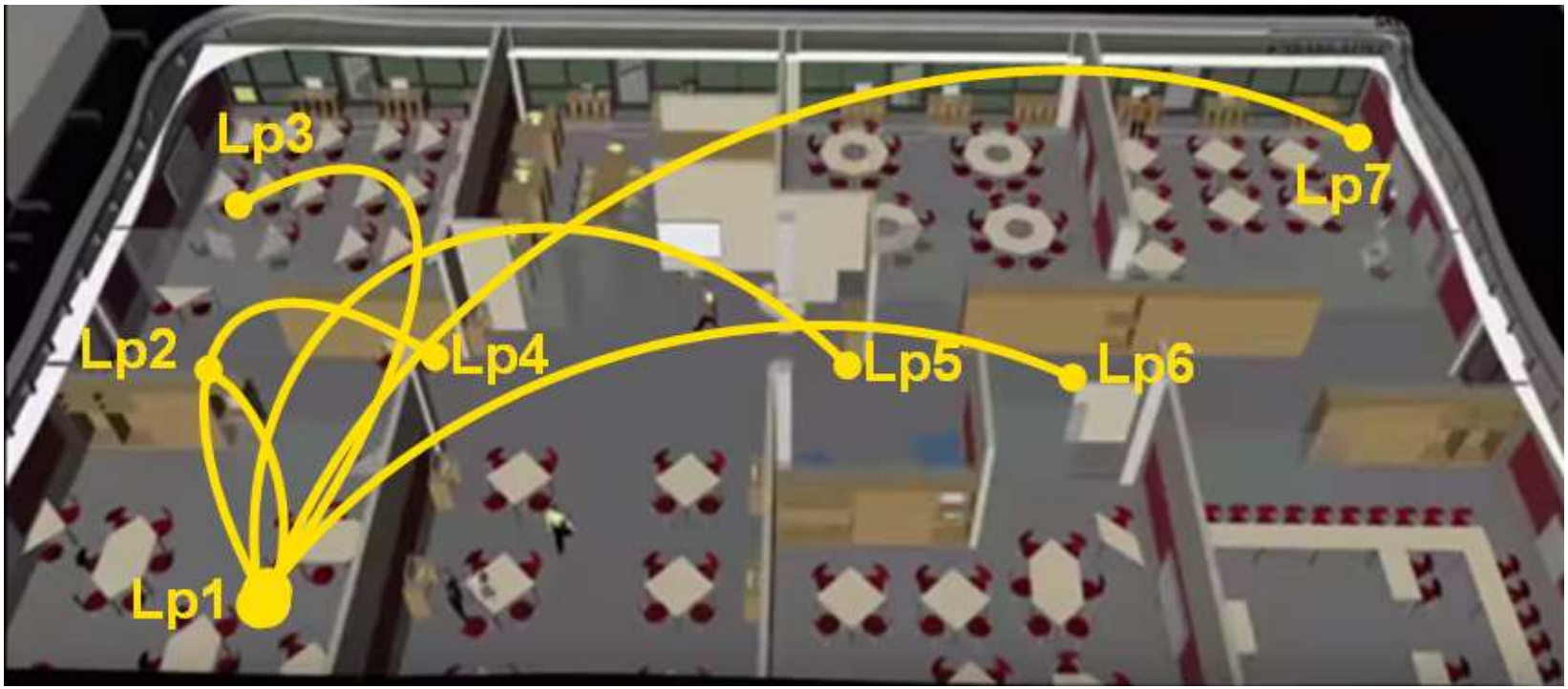
Witzenhausen semi-open school

-Pedagogically open but acoustically closed

Ecophon SAINT-GOBAIN

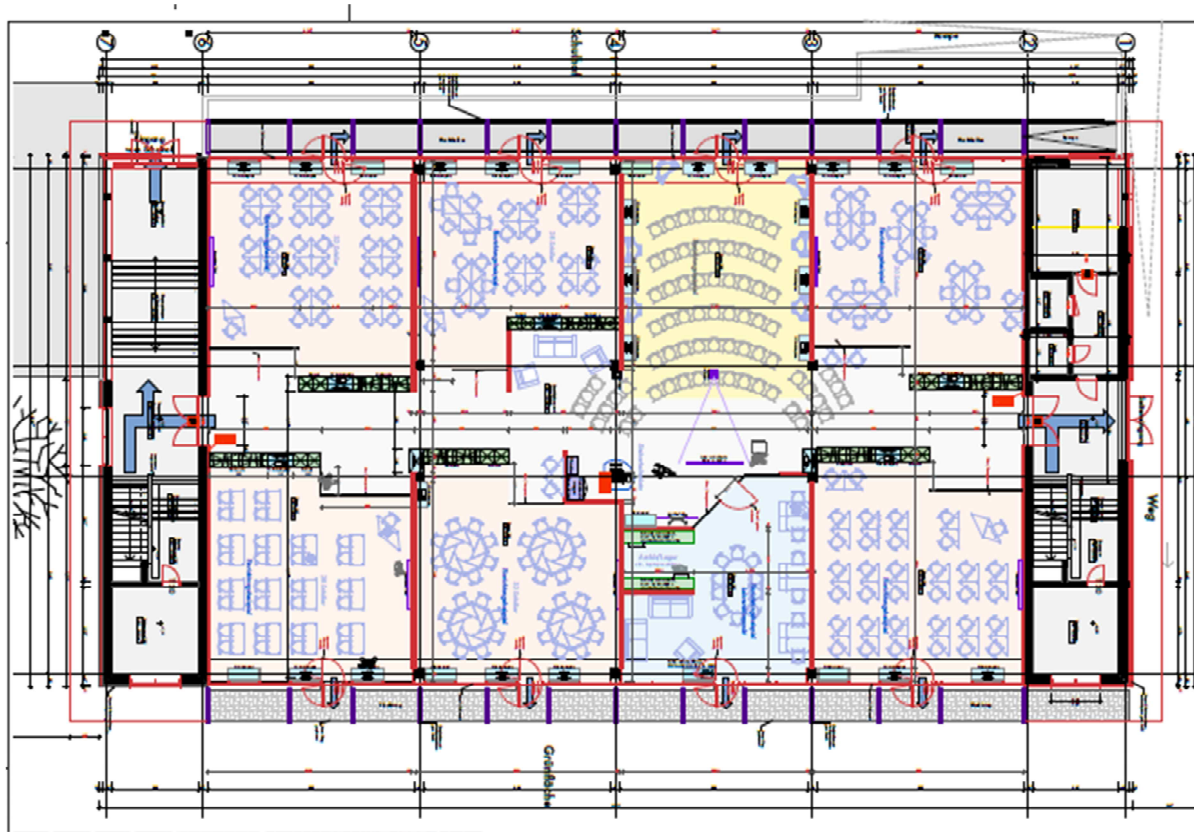
A SOUND EFFECT ON PEOPLE

Sound mapping across the spaces



Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

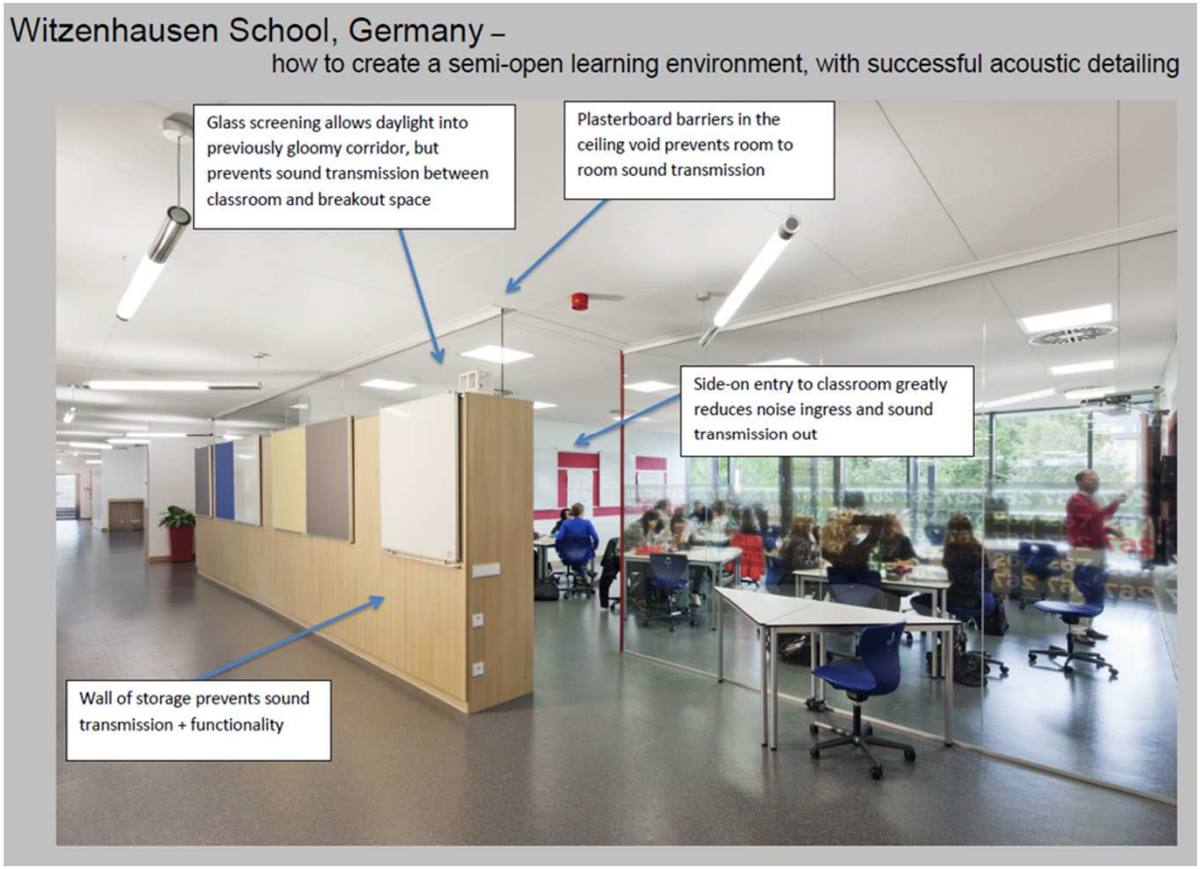
Witzenhausen Semi-open school case study



Ecophon SAINT-GOBAIN

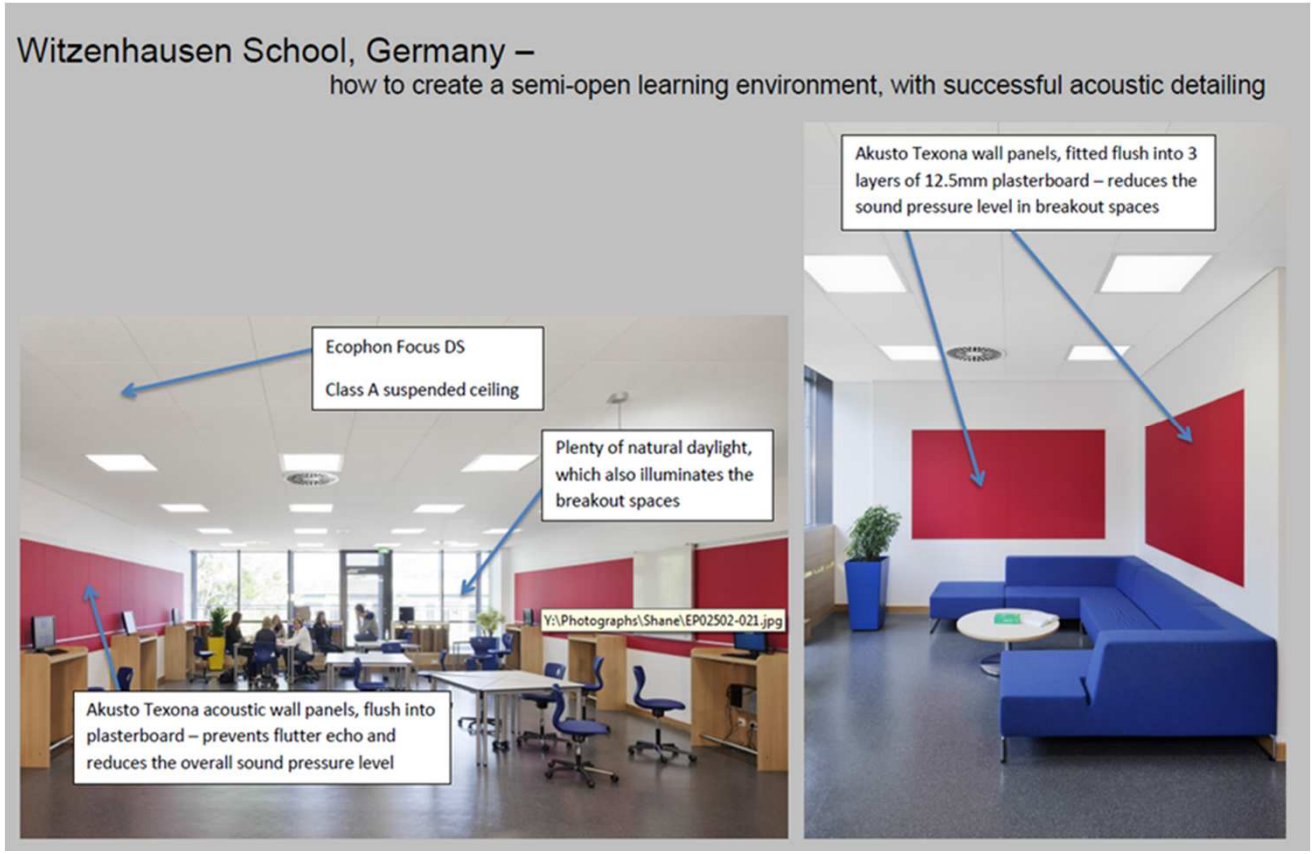
A SOUND EFFECT ON PEOPLE

Typical classroom space



Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Breakout and multi-purpose spaces



Ecophon® SAINT-GOBAIN

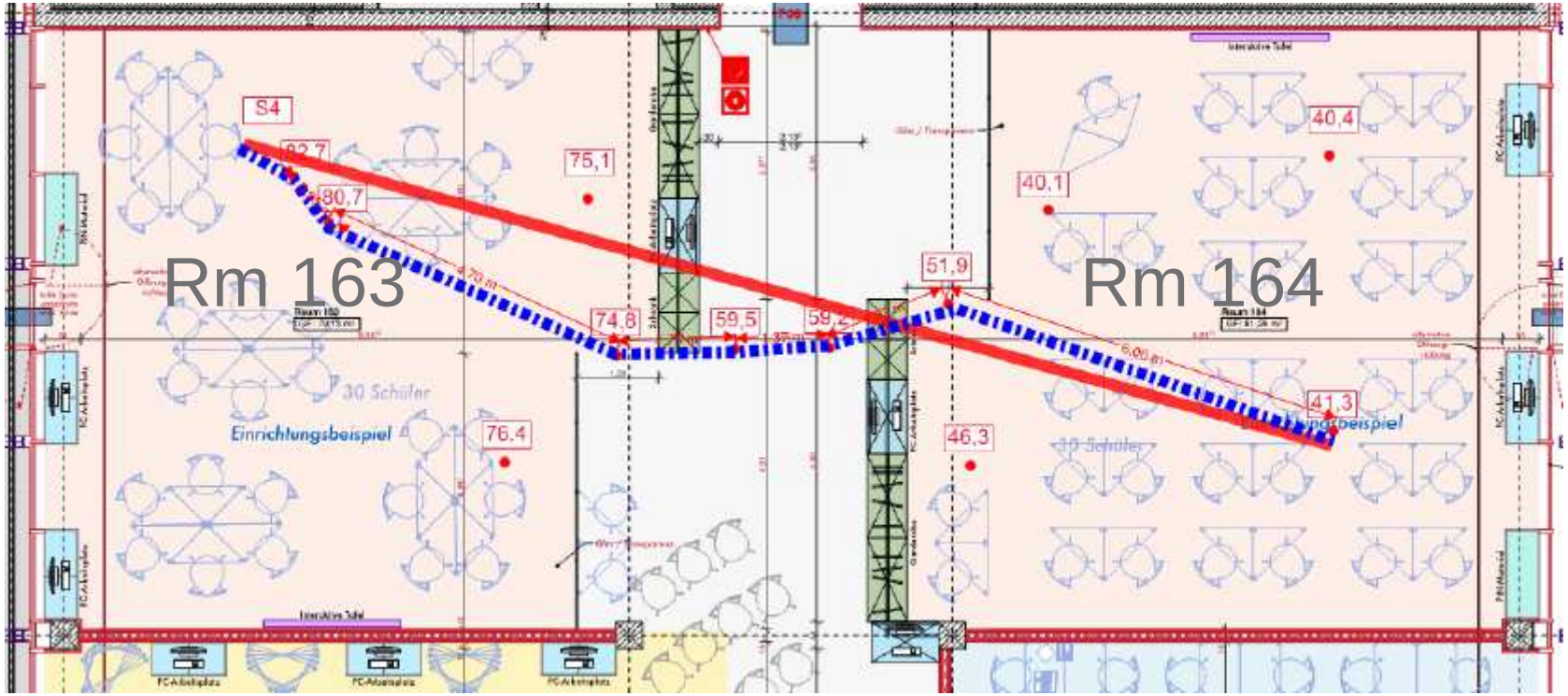
A SOUND EFFECT ON PEOPLE

Balancing transparency & acoustic control

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

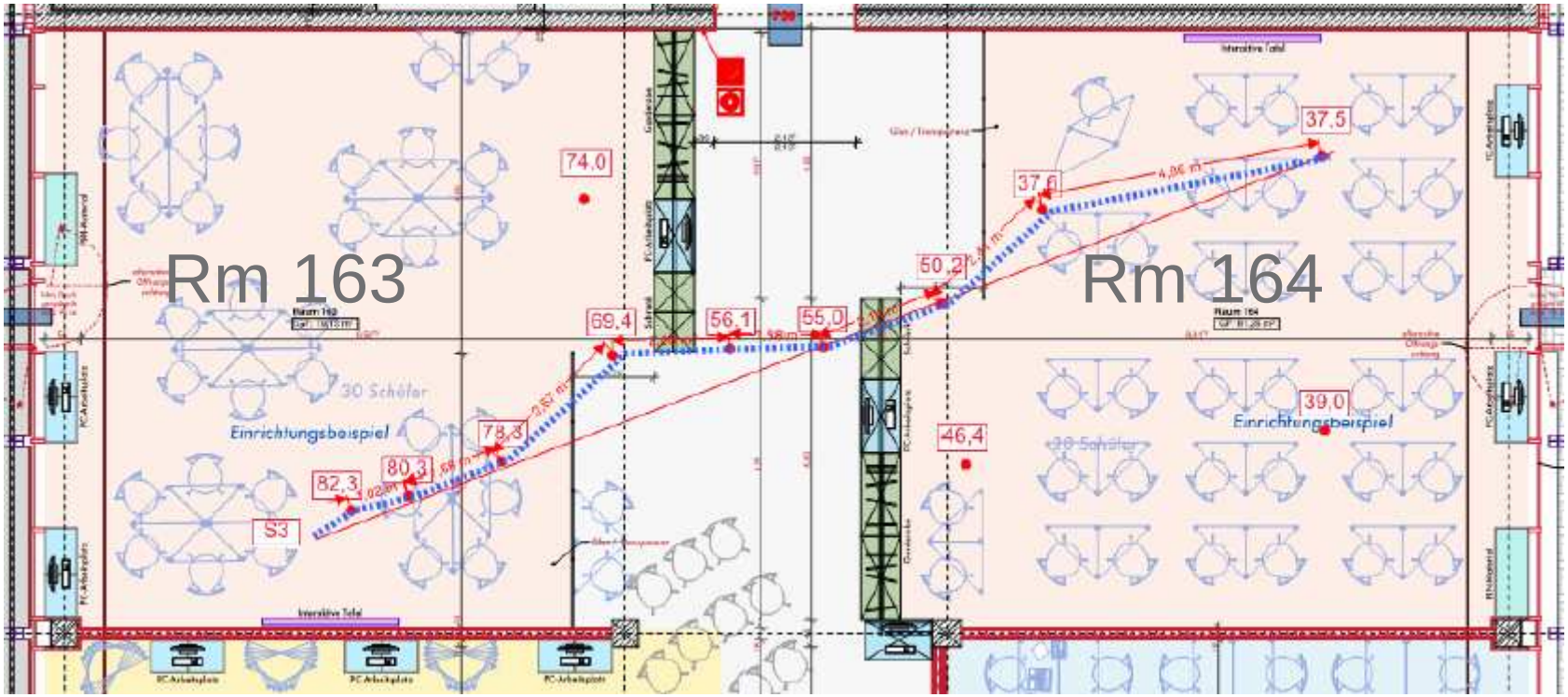
Sound reduction over distance



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

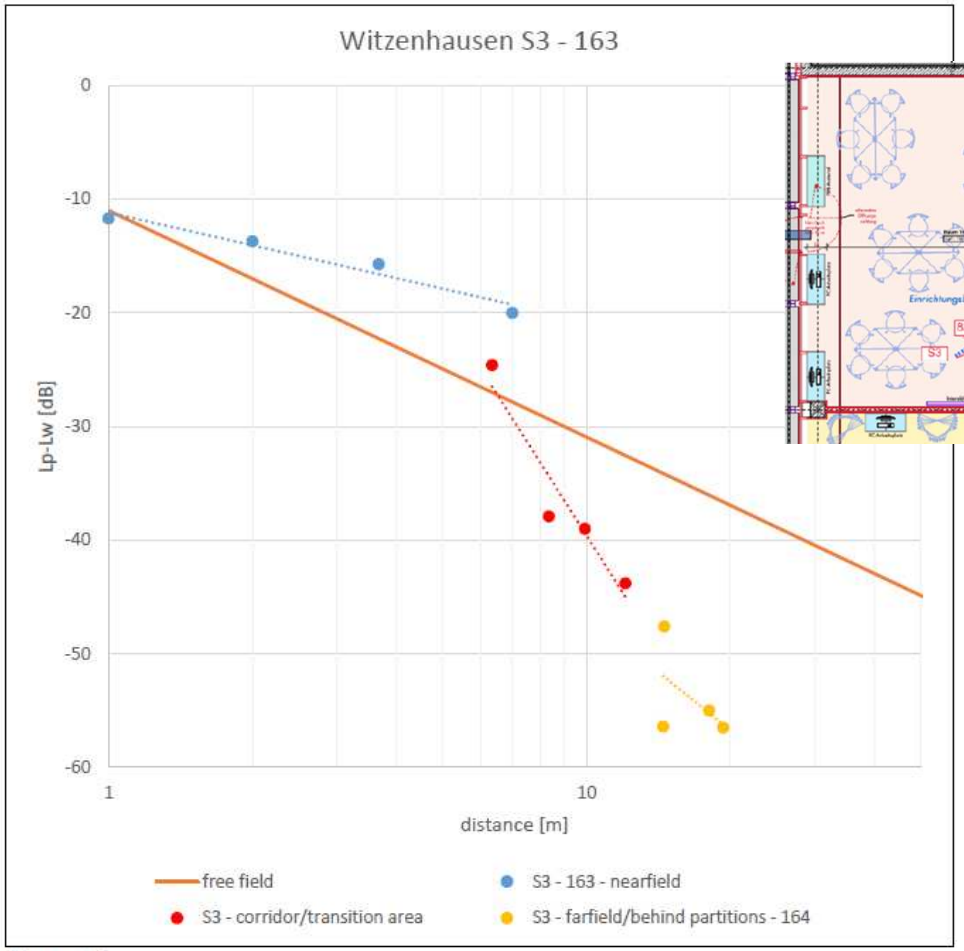
Line of sight vs line of sound



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Sound reduction from classroom to classroom



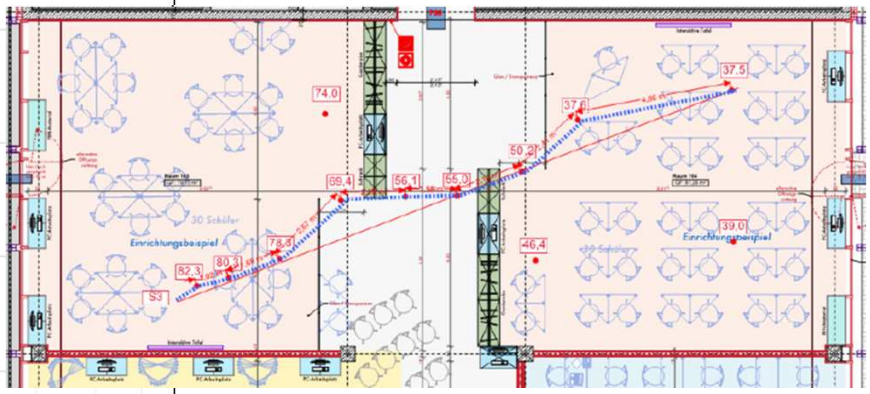


Figure 4.8
Sound propagation along measurement path S3.

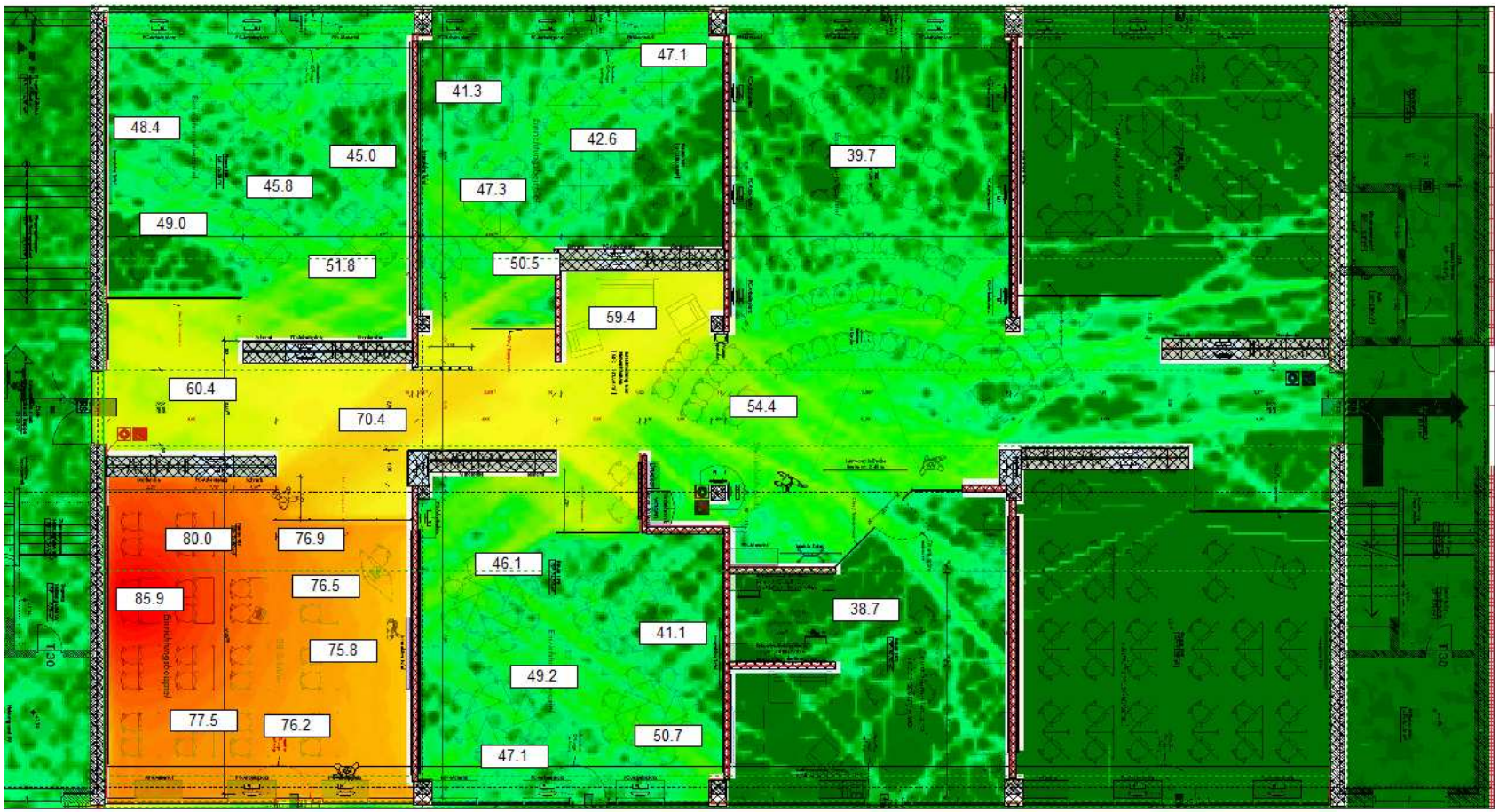
RT: 0.48s (Reverberence)
C50: 8dB (Speech clarity)
STI values >0.7 (Good – Excellent)
(Speech Transmission Index)

Corridor:
STI values around 0.5 (Poor – Fair)

Adjacent / neighbouring classrooms:
STI values <0.2 (Bad)

Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

2D sound mapping – speech perception

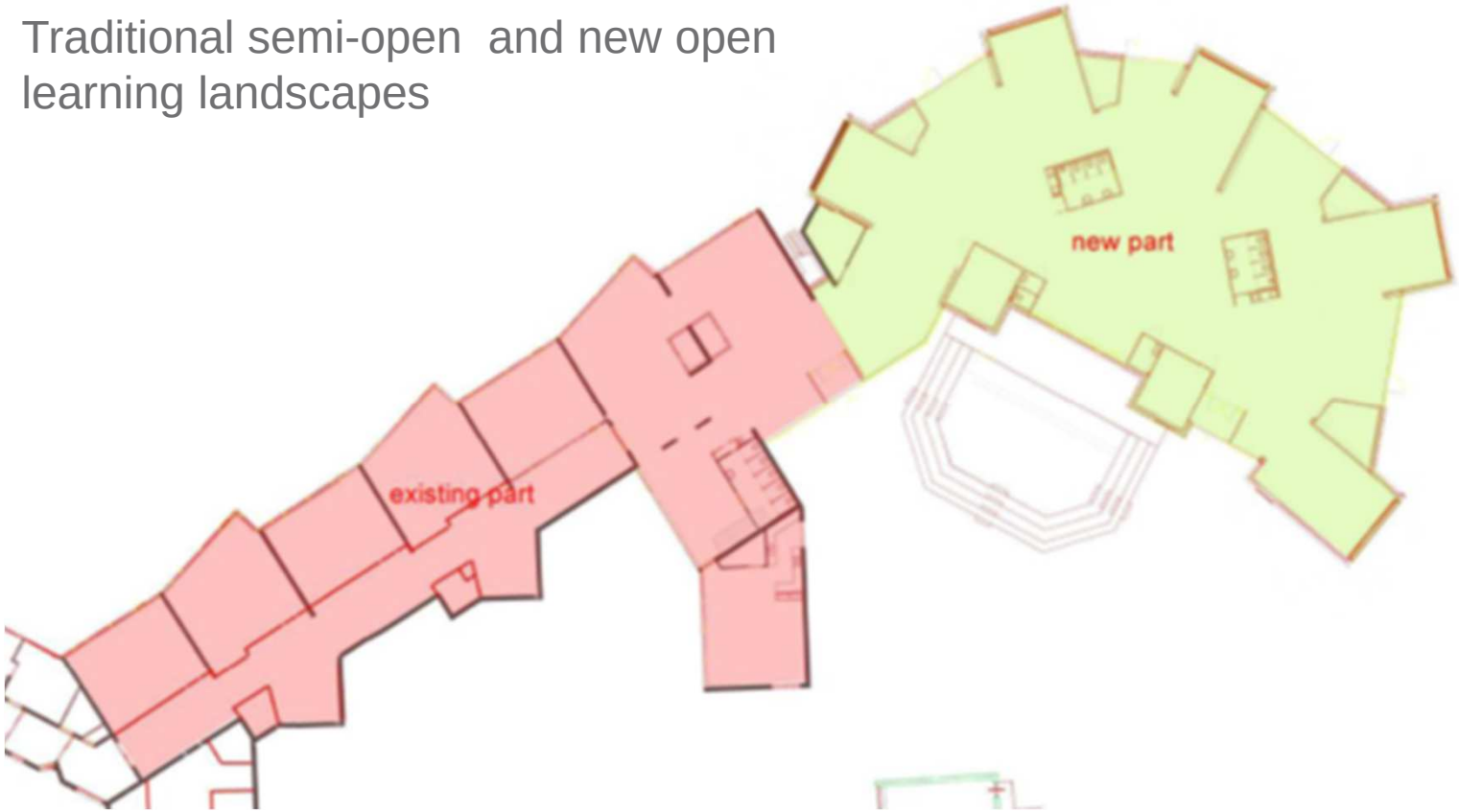


Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Werkplaats existing & extension building

Traditional semi-open and new open learning landscapes



Ecophon SAINT-GOBAIN

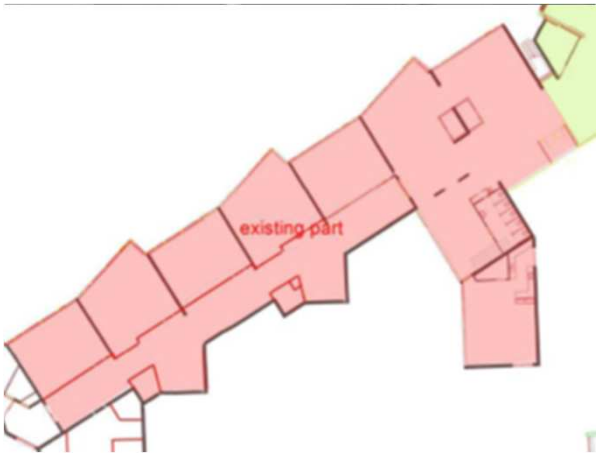
A SOUND EFFECT ON PEOPLE

Existing classroom - sliding door

Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

De Werkplaats School in the Netherlands



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Sound mapping across the spaces

Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Sound Source S 1	To Class breakout	To Adjacent class breakout	To Adjacent classroom
Rm1 door open & Rm2 door open	10dB	20-25dB	27-33dB
Rm1 door closed & Rm2 door open	23dB	30-35dB	38-42dB
Rm1 door closed & Rm2 door closed	23dB	30-35dB	37-43dB*
Recommended standard for attenuation	20dB		
Recommended standard for sound insulation between rooms			40-45dB
Recommended standard for sound insulation for doorsets		30-35dB	

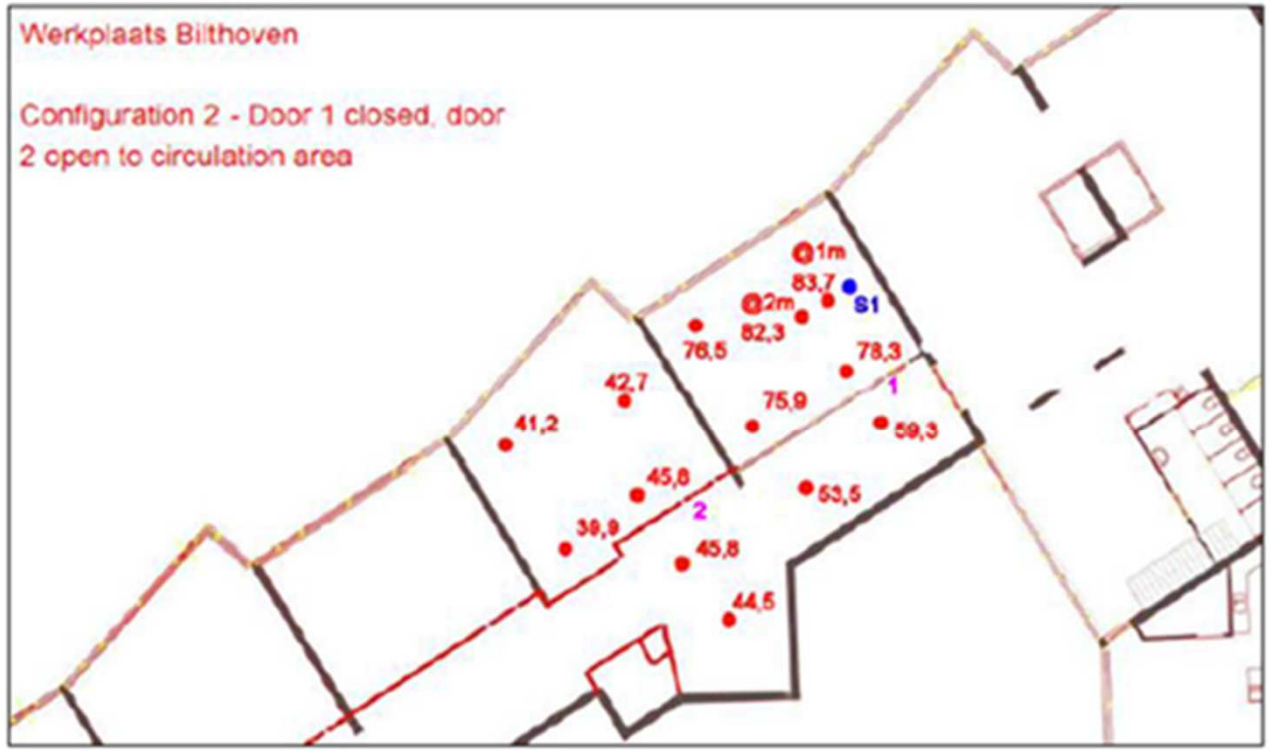


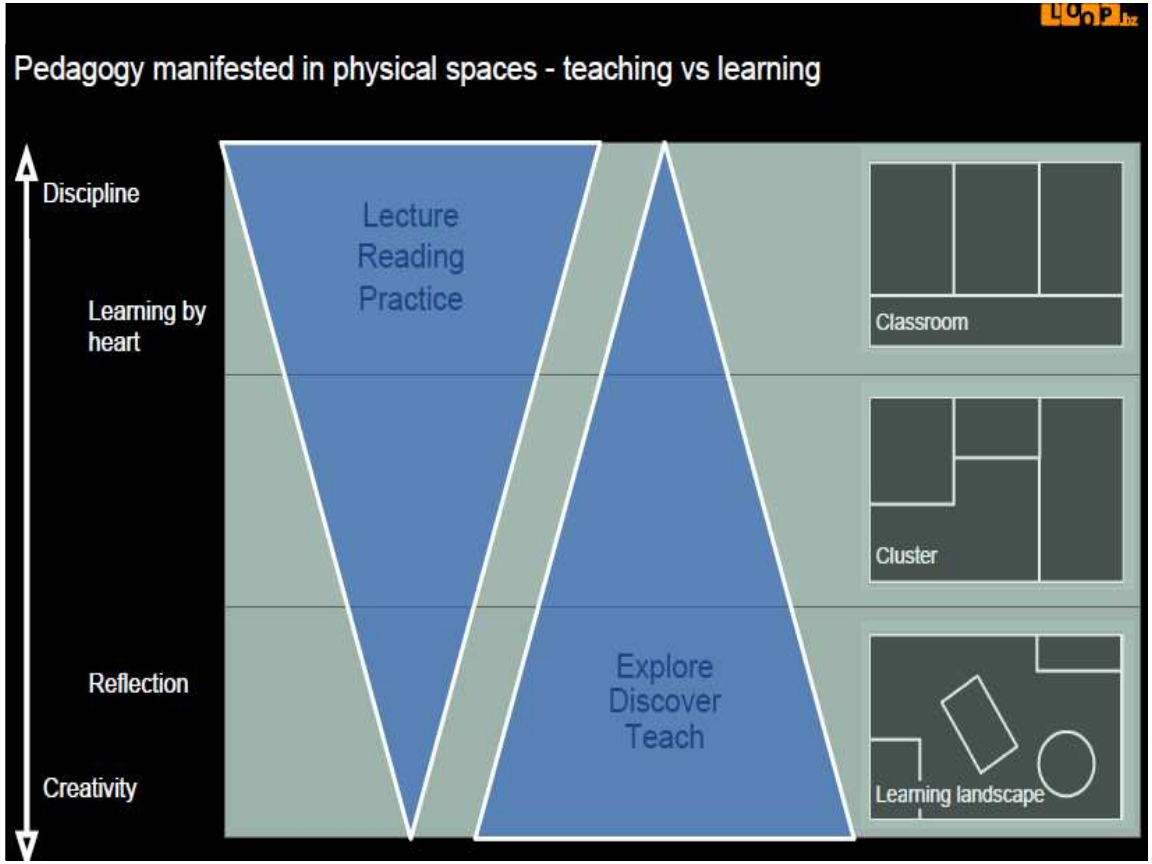
Figure 3

Measured sound pressure levels (L_{Aeq}) as a result of the reference sound source in position S1. Sliding door 1 is closed, sliding door 2 is open.

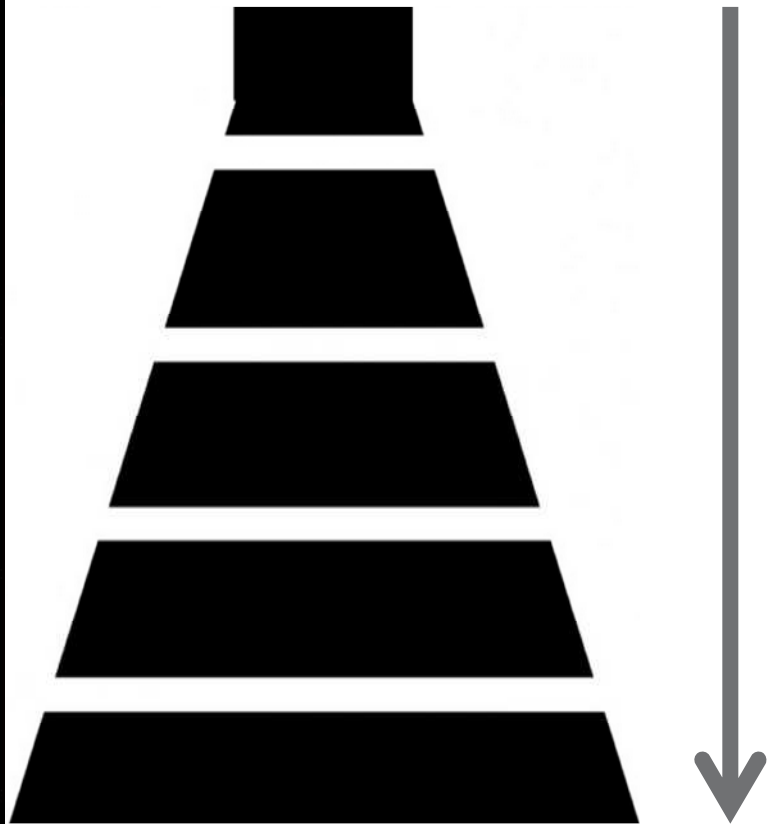
Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Age appropriate spaces - acclimatisation

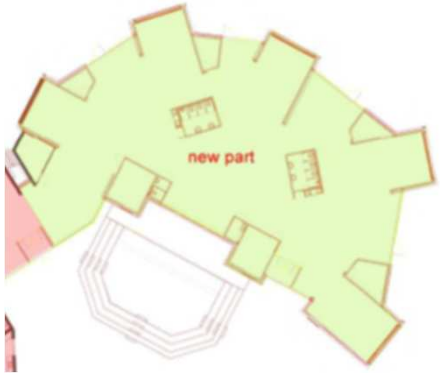


Age Funnel



Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

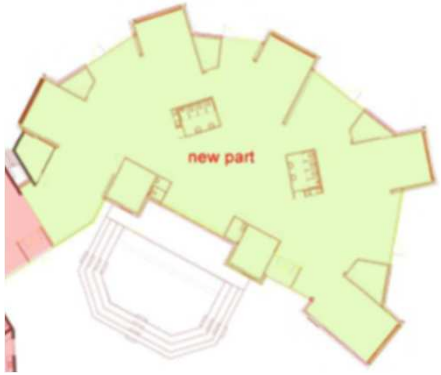
Werkplaats - New Extension



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Sound level reduction mapping



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Data: word doc/upcoming LBPSight report & ppt

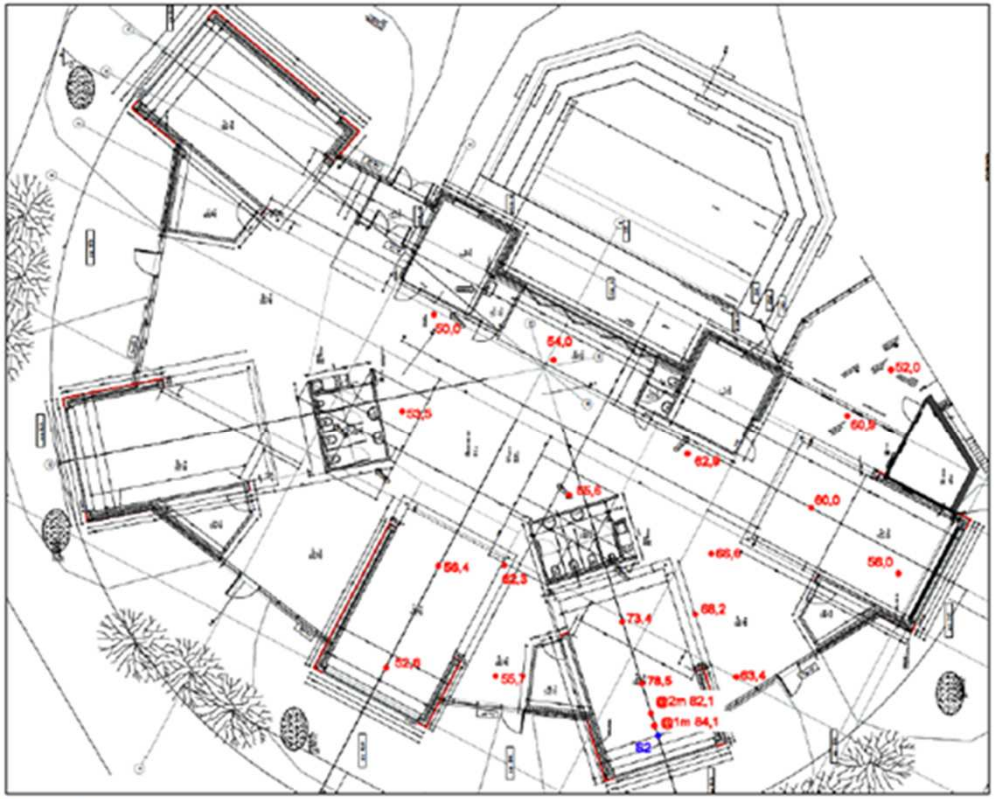
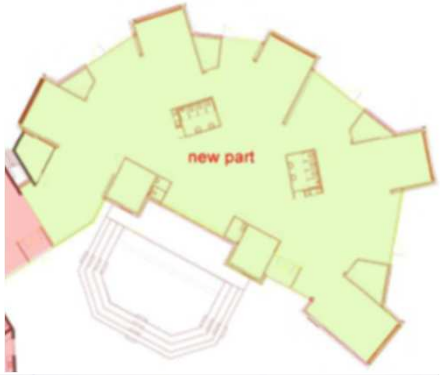


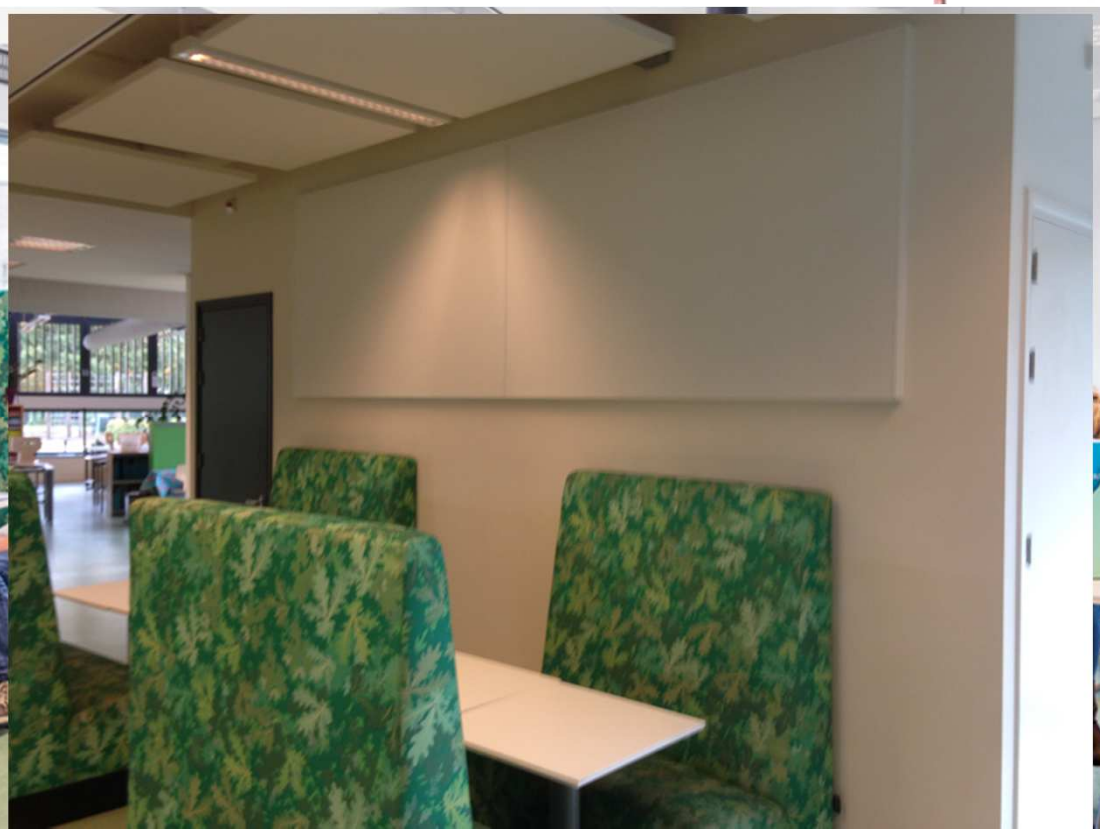
Figure 5
Measured sound pressure levels (L_{Aeq}) as a result of the reference sound source in position S2.

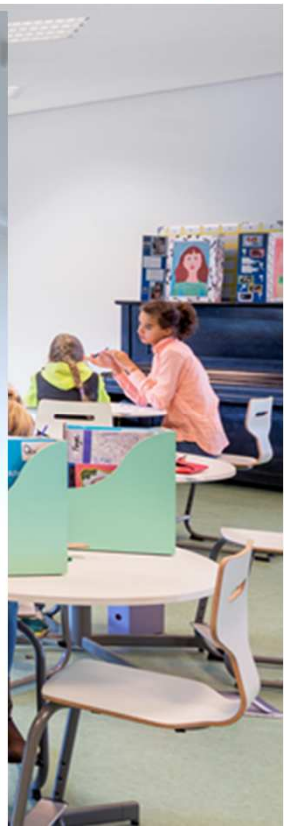
Ecophon SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Werkplaats - New Extension



More wall absorption added to reduce class to class disturbance

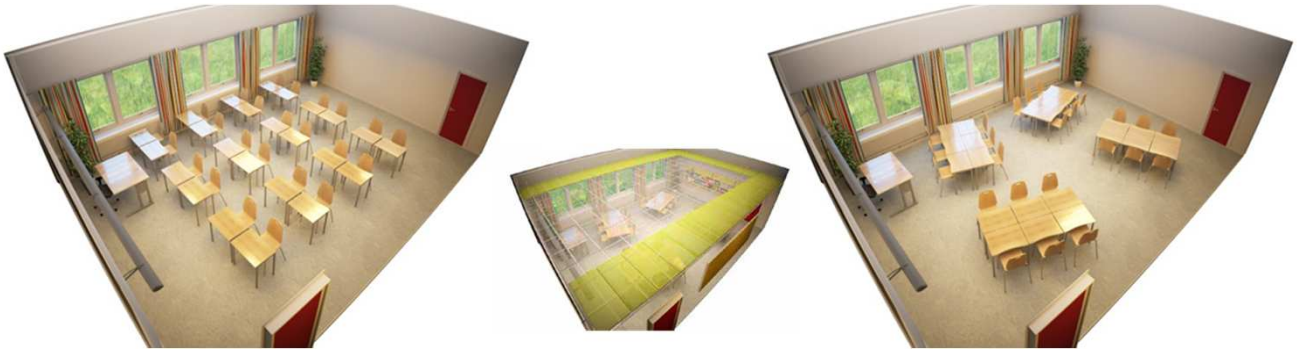




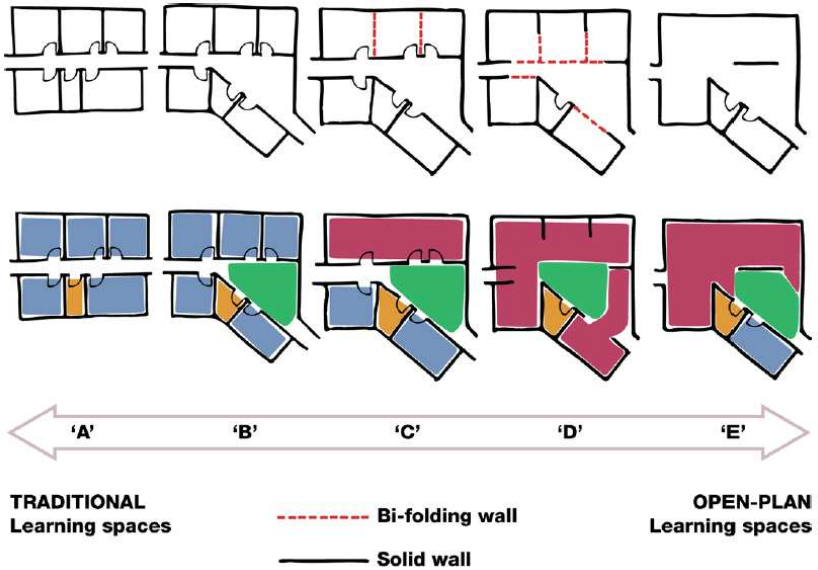
Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Good acoustics not just for traditional classrooms



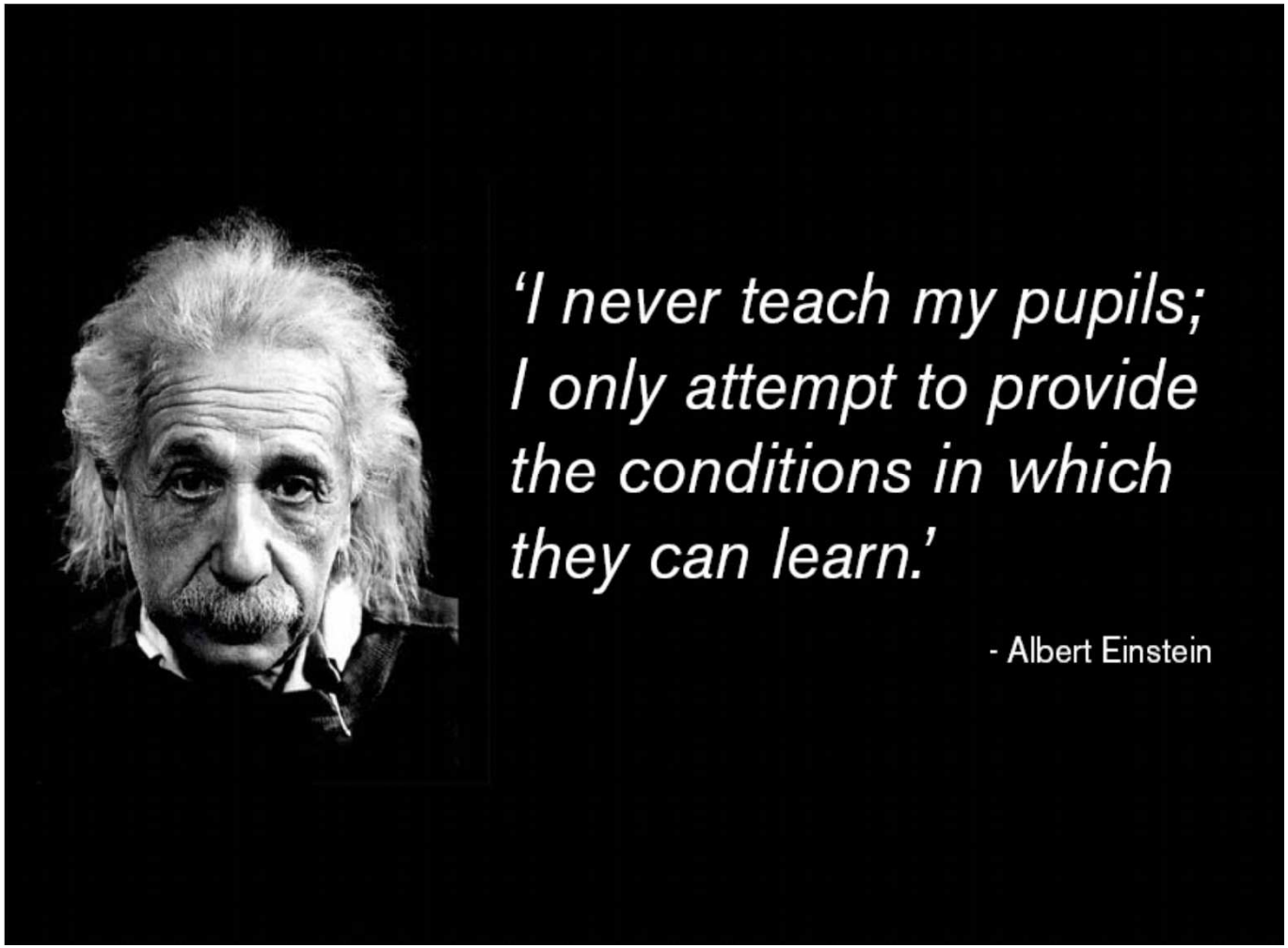
- **Starting with the key teaching and learning activities in the classroom**
- **Good acoustics is a necessity for all learning activity spaces**



Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Spaces where we can hear ourselves think!

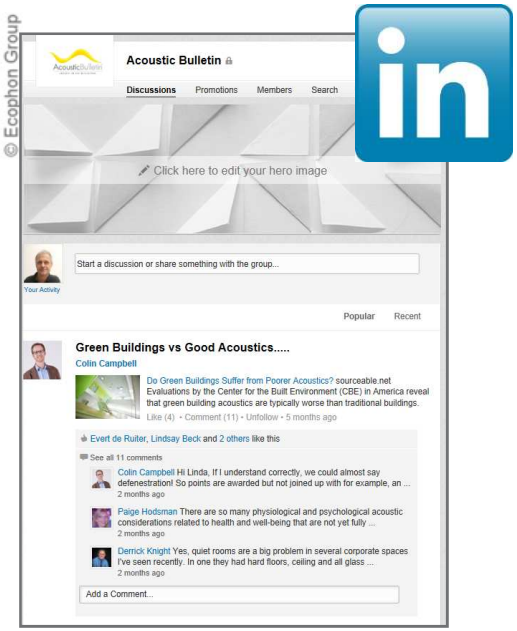


Ecophon SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE

Thank you for listening

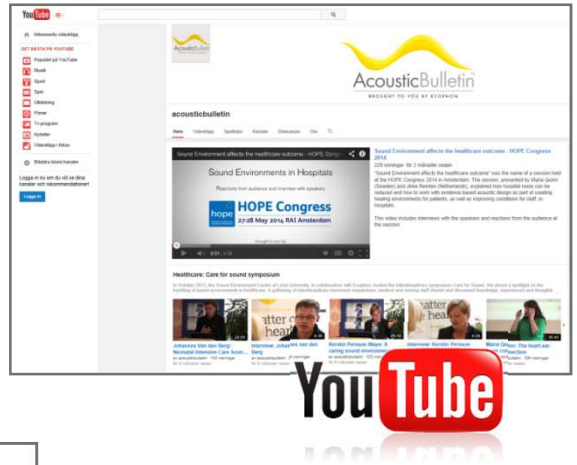
Ecophon®
SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE



AcousticBulletin™

BROUGHT TO YOU BY ECOPHON

Online news service
about room acoustics



http://www.acousticbulletin.com/

Ecophon®
SAINT-GOBAIN

A SOUND EFFECT ON PEOPLE