



Focused light in elementary learning environments

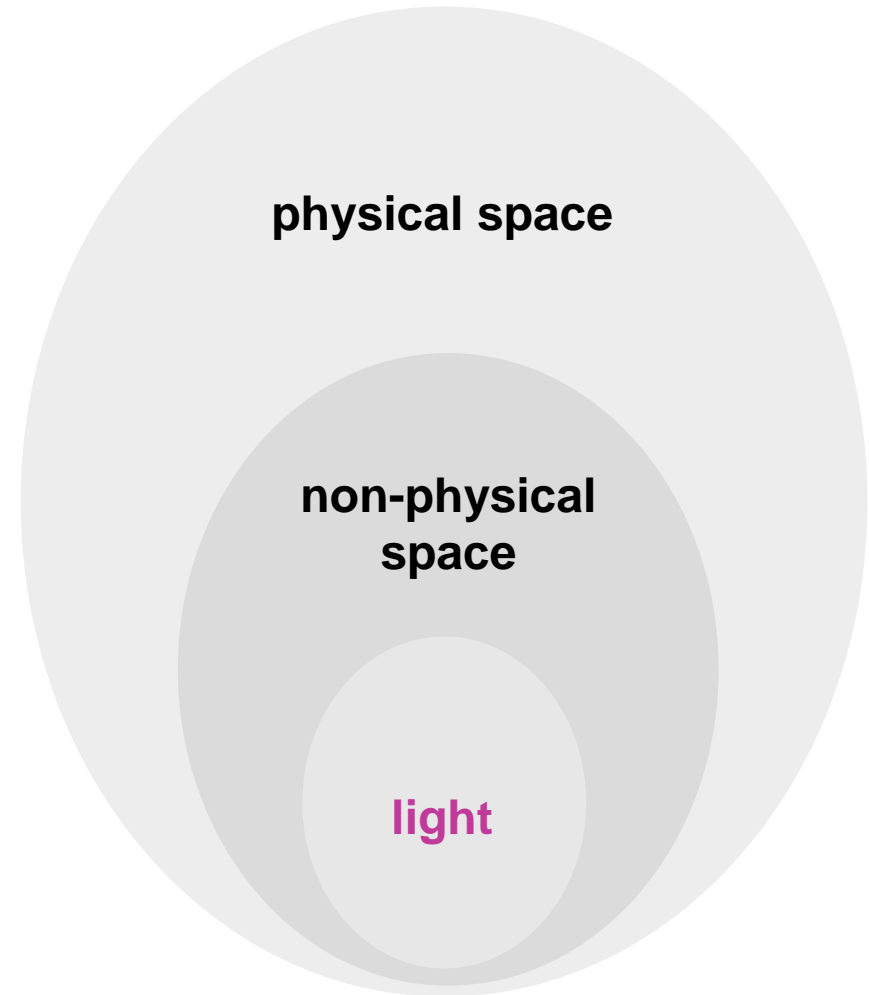
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Architectural Lighting Designer / Industrial PhD researcher

**Henning
Larsen** —

DESIGN WITH KNOWLEDGE

New research in sustainable building
Published by Henning Larsen Architects





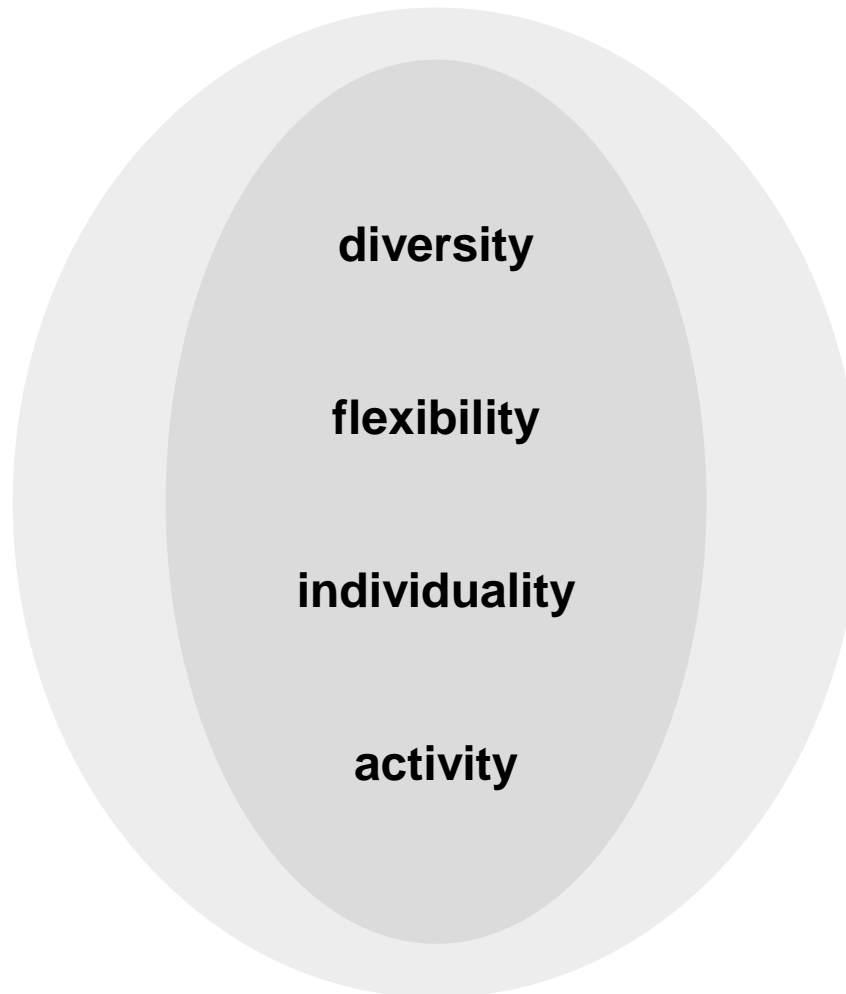
Improving the Public School

- overview of reform of standards in the Danish public school (primary and lower secondary education)

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diversity

flexibility

individuality

activity



artificial light

natural light



What kind of artificial lighting is present in learning environments?

TPOLOGY

Natural light

Uniform (vision)

Architectural integration

Building standards

What kind of artificial lighting is present in learning environments?

How does artificial light influence user's of learning environments?

TPOLOGY

PUPILS

Natural light

Cognitive functioning

Uniform (vision)

Social behaviour

Architectural integration

Communication

Building standards

Motivation

What kind of artificial lighting is present in learning environments?

How does artificial light influence user's of learning environments?

What characteristics of artificial light are responsible for this?

TPOLOGY

PUPILS

CHARACTERISTICS

Natural light

Cognitive functioning

Amount

Uniform (vision)

Social behaviour

Colour

Architectural integration

Communication

Spectrum

Building standards

Motivation

Pattern



“... The ceiling lighting does not do much, but I use my own lights such as candles to promote quietness and concentration”

Teacher, Ørestad Skole



“I use small IKEA lights to create a more intimate atmosphere so that pupils work more quietly in small groups within the same room” Teacher, Lyngby Skole



“I used different light typologies to support the different activities and needs such as comfort, excitement or concentration”

Designer, Mathildelund Preskole

Can focussed light promote a quieter atmosphere and support pupil concentration?



... is about creating localities
“Spaces within Space”



Frederiksbjerg Skole, Aarhus (DK)

ÅRETS BYGGERI 2016





August 2016

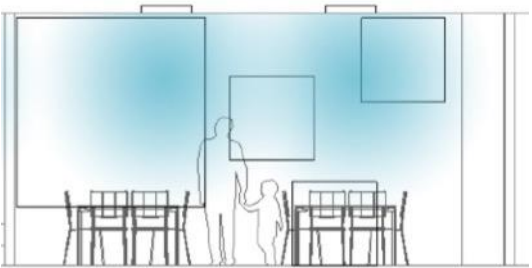


February 2017

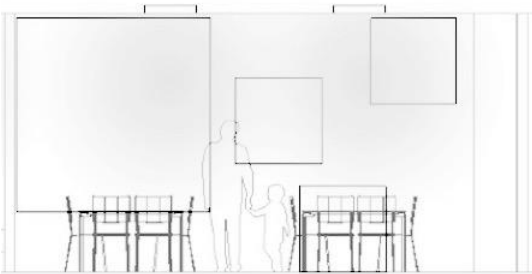


A

Default situation



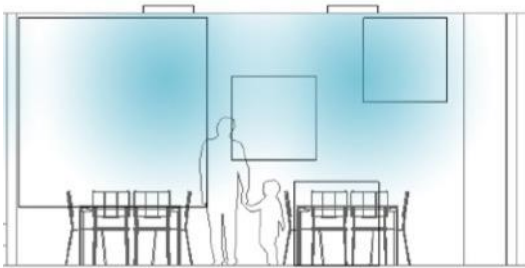
A Ambient ceiling lighting (± 300 lux)



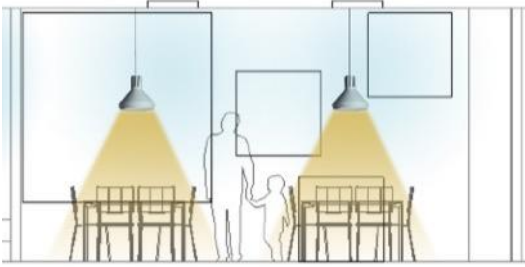
D No lighting

B

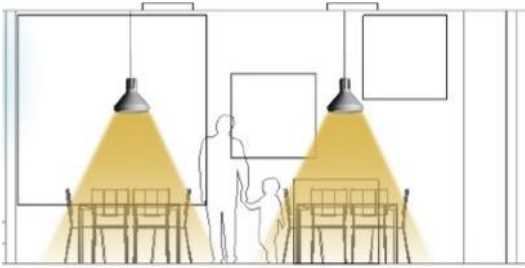
Experimental situation



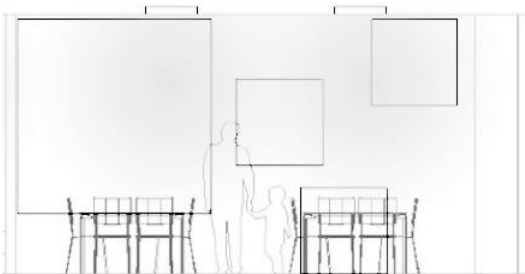
A Ambient ceiling lighting only (± 200 lux)



B Ambient CL + Focused pendants



C Focused pendants only (± 500 lux)

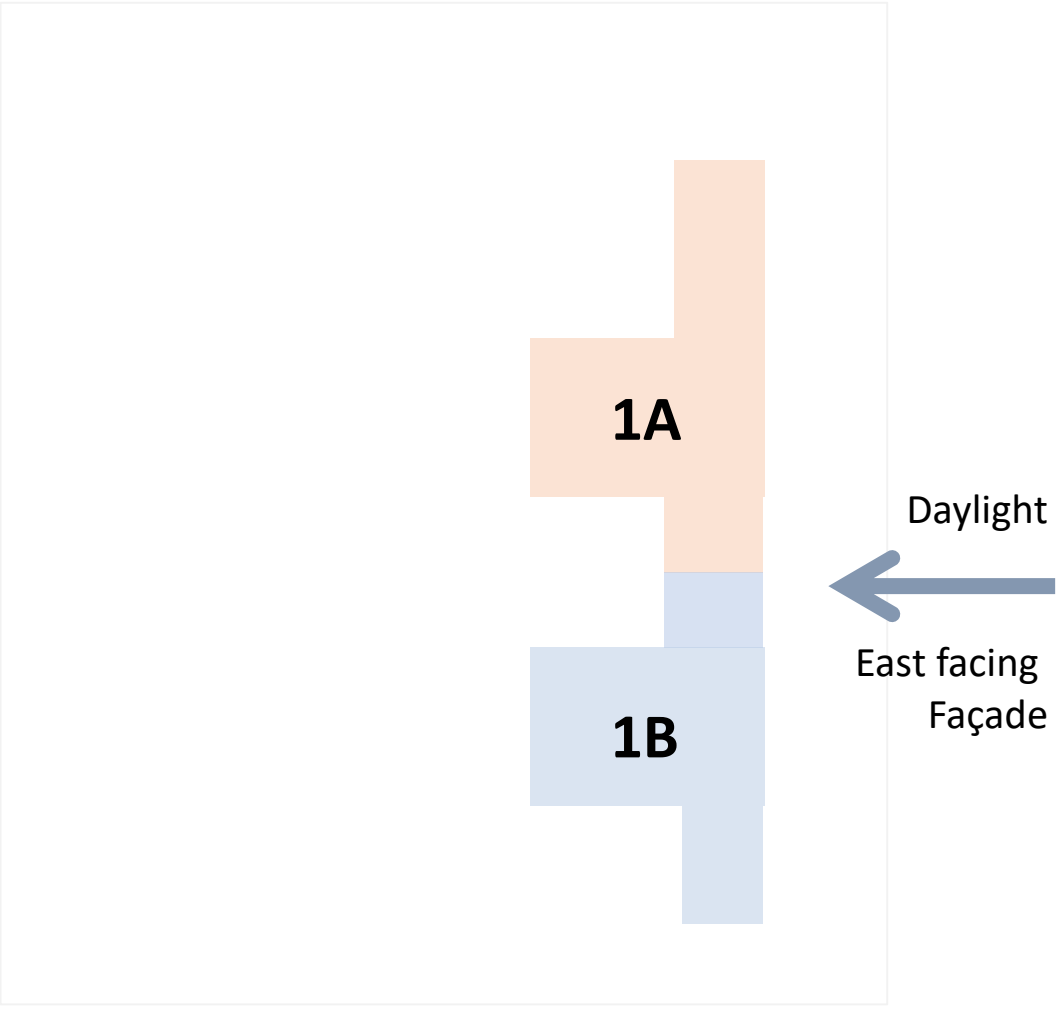


D No lighting



A

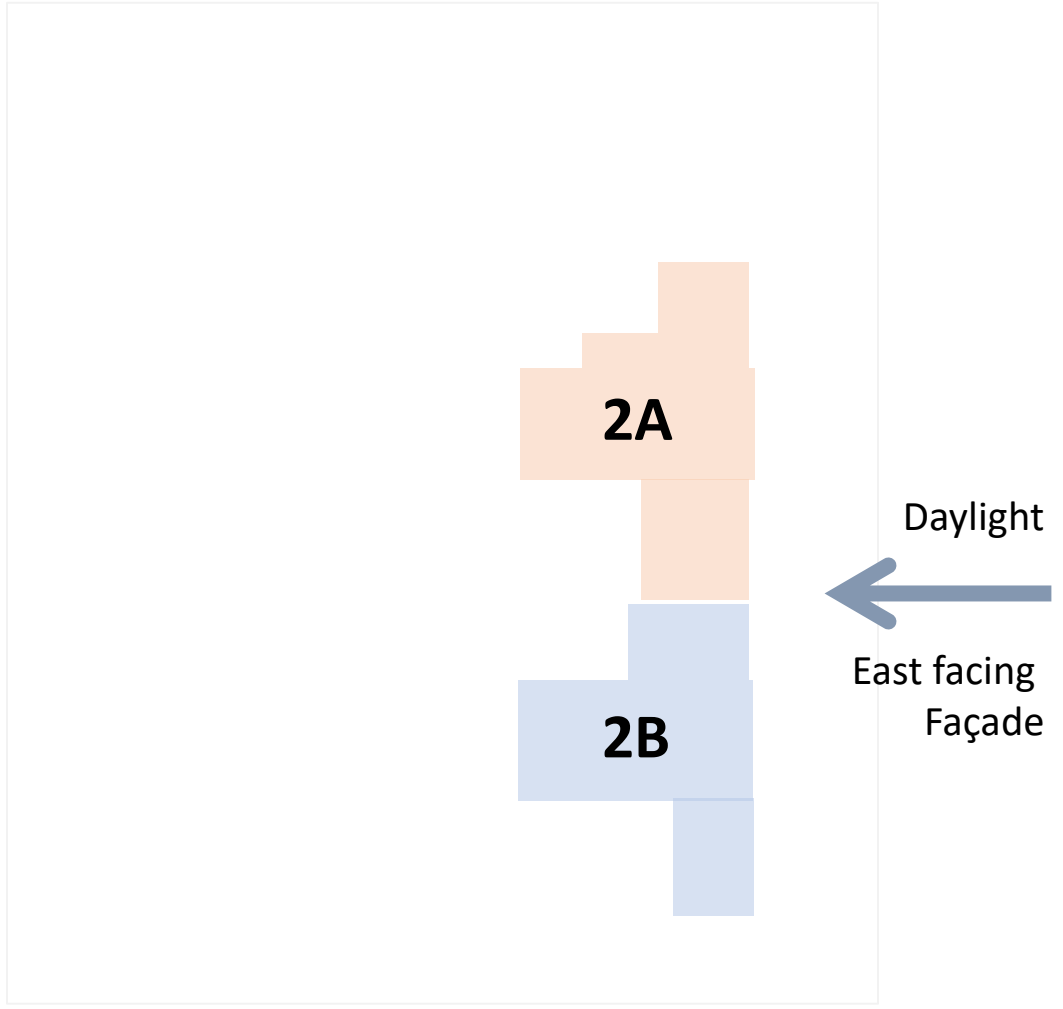
Default situation



Level 01 LOWER ELEMENTARY (1-3)

B

Experimental situation



Level 02 – MIDDLE ELEMENTARY (4-6)

Mixed Method Approach

Quantitative Data

Qualitative Data

Light levels (horizontal) Light distribution

Lux measurements
HDR photography
(day + night time)



Points in time
(2x2 days)

Indoor climate data

Temperature
Humidity+ CO2
Int/ext daylight levels



Continuous
(2x3 weeks)

Demographic Curricular Spatial

Make-up each group
Teaching style+topic
(fixed room design)



Each session
(2x2 days)

Perceived behavioral impact

Interviews
Observations
(real-time video)



Presence days
(2x2 days)

Classroom noise evaluation

Sound recordings



Presence days
(2x2 days)

Classroom placement mapping

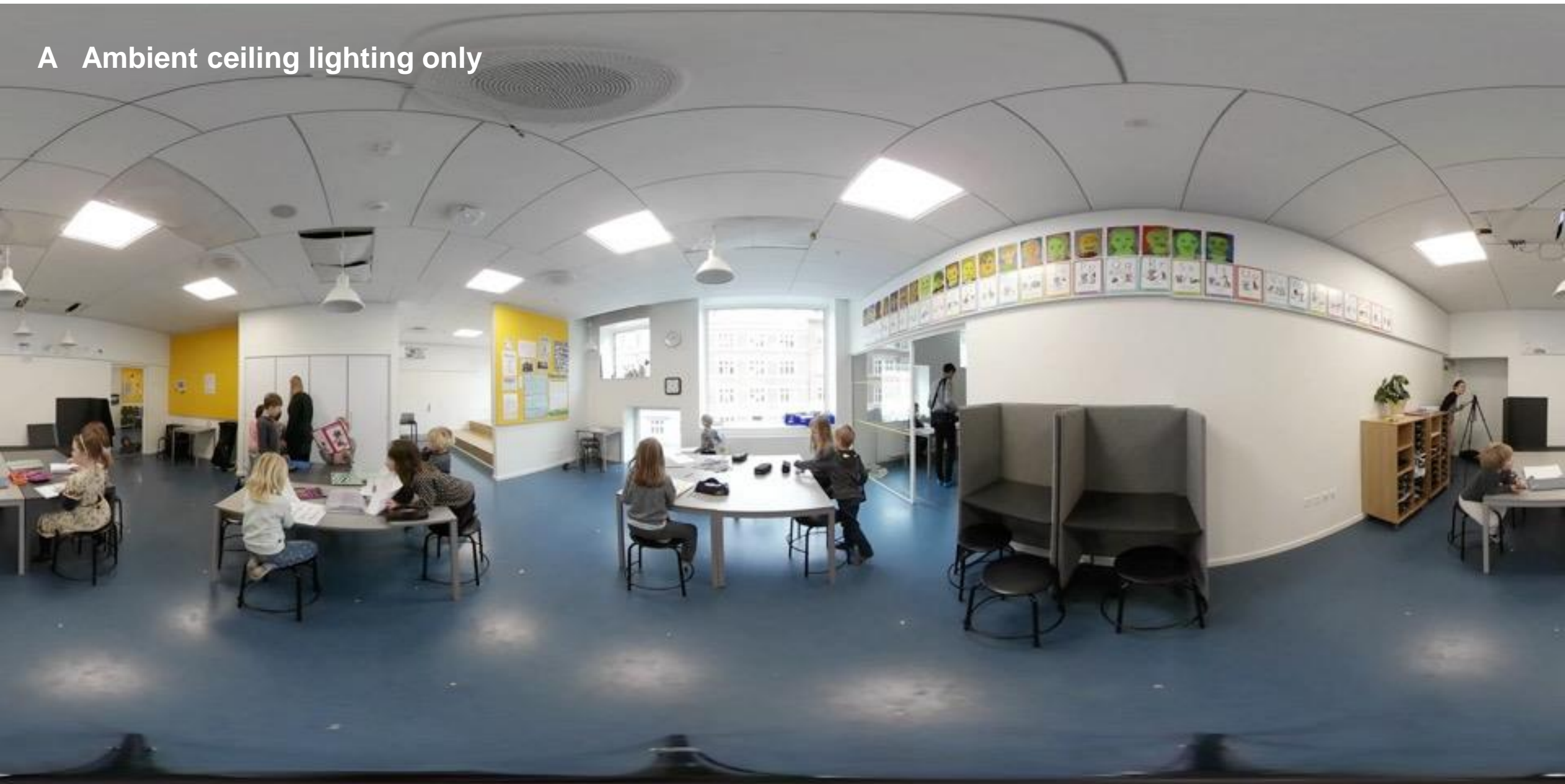
Time-lapse video



Presence days
(2x2 days)

Spring 2017 | February - April

A Ambient ceiling lighting only



B Ambient ceiling lighting + Focused pendants

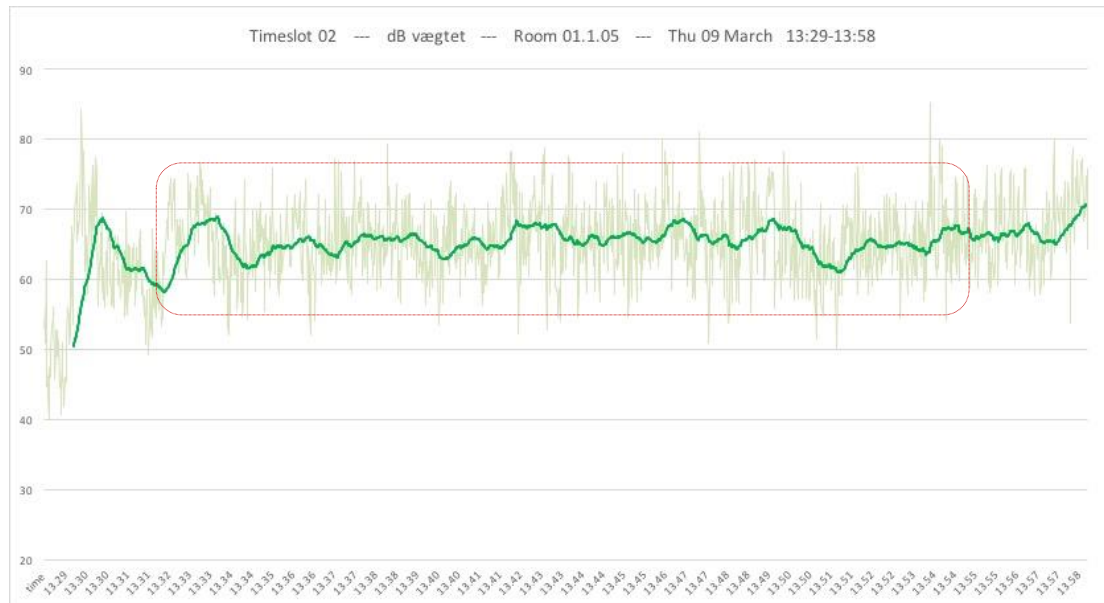


C Focused pendants only

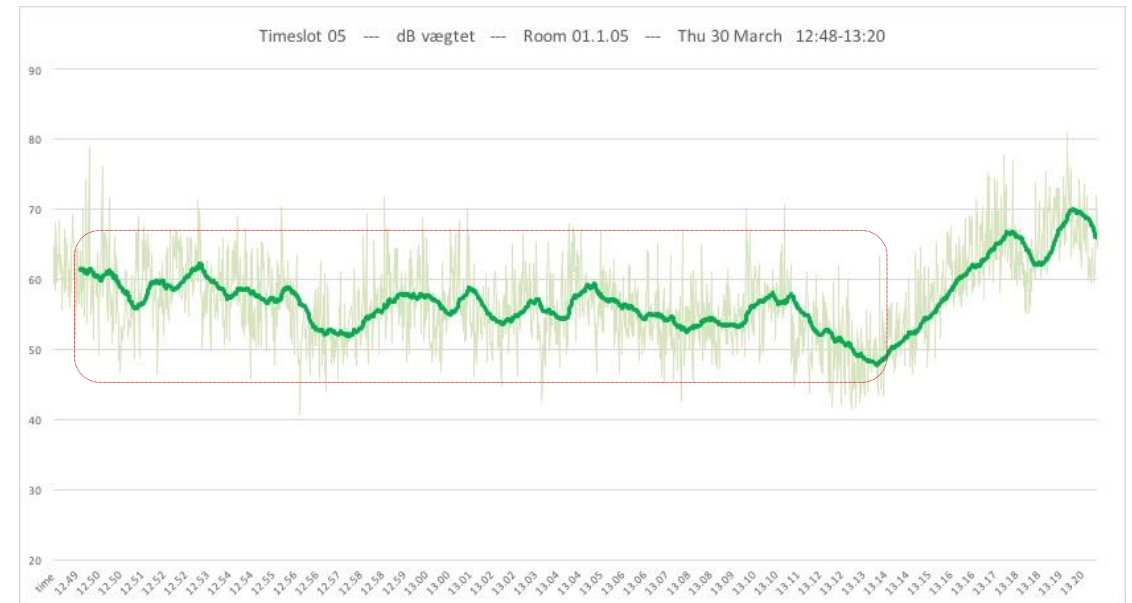


Can focussed light promote a quieter atmosphere and support pupil concentration?

Can focussed light promote a quieter atmosphere and support pupil concentration?



dB average	65,1
dB min	40,2
dB max	85,0



dB average	57,2
dB min	40,8
dB max	80,9

Can focussed light promote a quieter atmosphere and support pupil concentration?

*“.. The pupils really like to read close to the lights.
They ask me if I can switch them on”*

Heidi, Teacher indskoling

*“.. I am not sure if the new lights have improved the
concentration of the pupils, but I did notice they focus more on
themselves and local neighbors instead of the rest of the room”*

Mathias, Teacher Matematik

*“.. I like that we do not have the lighting on all the time. I or the
pupils can make some changes, that work best for the weather
and mood that day”*

Christian, Teacher Matematik

*“.. I think the concentration is better in my room now.
I feel that I do not have to walk around so much”*

Ulla, Teacher Matematik

*“.. I think is it really nice that there is not so much light
everywhere. Now I can choose where I like to sit”*

Pupil, Matematik

“.. I do not feel blinded by the light, it makes me feel relaxed”

Pupil, Matematik

Permanent Installation - Autumn 2017



Thank you

**Henning
Larsen —**



The Royal Danish Academy of Fine Arts
Schools of Architecture, Design and Conservation
School of Design

Frederiksbjerg Skole



 **AARHUS
UNIVERSITET**

FAGERHULT

DTU Danmarks Tekniske Universitet

