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Dynamic Lighting in Classrooms.

A mixed method study of light, behavior and sound.

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Dynamic Lighting in Classrooms

A mixed method study of light, behavior and sound.

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Content

A mixed method study of light, behavior and sound

1. Lighting Design Research Group Aalborg University, Cph.
2. Review of Literature – need for mixed methods
3. Case-study: combining light, sound and behavior
4. Analysing patterns from different parameters, mixing methods
5. Case study: Simulations
6. Future work



Lighting Design Research Group

A mixed method study of light, behavior and sound



This newly established research group (2015) with its center on the **Aalborg University** campus in Copenhagen has as its **mission to contribute to new and improved ways as to how we use and perceive light in our daily lives.**

Light.aau.dk



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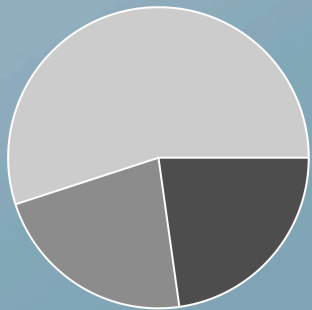




Dynamic Light in Classrooms

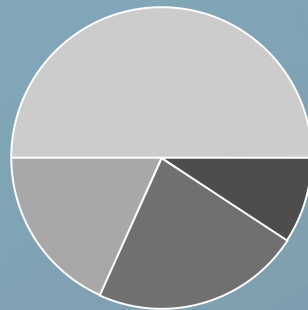
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Validating the impact of Dynamic light on the learning environment - A review on methods



■ Performance
■ Behaviour
■ Both

Field research on the effects of light on students' performance, behaviour, and on both.



■ Quantitative
■ Quasi-mixed
■ Mixed
■ Qualitative

Methodologies used in the selected field studies

A review of 22 papers studying the impact of lighting on learning environments.

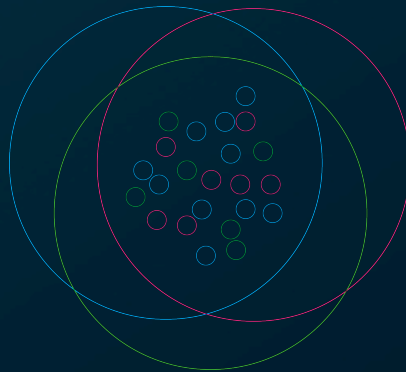
Above half of the papers apply only quantitative data and academic performance.

Only one third use mixed methods.

The Impact of Dynamic Light on The Learning Environment

A mixed method study of light, behavior and sound

DESIGN
ARCHITECTURAL
ANALYTICS



TECHNOLOGICAL
MEDIA BASED
ANALYTICS

HUMANISTIC
ANTHROPOLOGICAL
ANALYTICS

The review of the papers lead to the conclusion:

Lighting in the learning environment should be studied and designed **holistically** through a **transdisciplinary mixed method approach** involving the users



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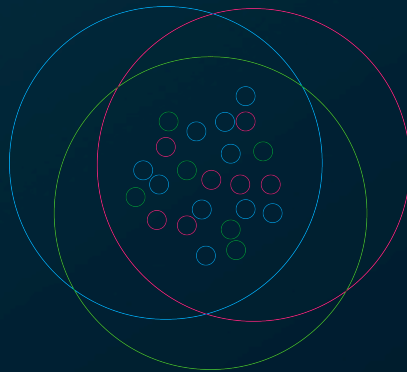




Case Study “Light & Learning”

A mixed method study of light, behavior and sound

DESIGN
ARCHITECTURAL
ANALYTICS



TECHNOLOGICAL
MEDIA BASED
ANALYTICS

HUMANISTIC
ANTHROPOLOGICAL
ANALYTICS

How can mixed methods be applied in lighting Design?

An initial case study was conducted in classrooms in a middle-school near Copenhagen.

The aim was to create holistic evidence-based knowledge on what parameters to integrate in the design of new dynamic lighting at the school.



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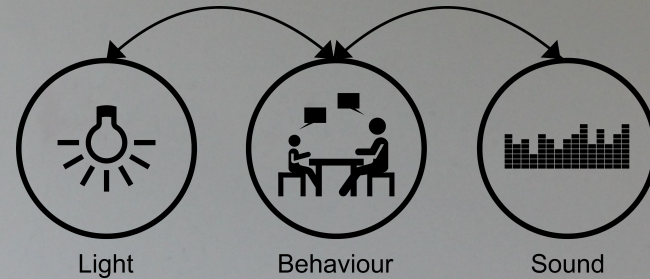


Case Study: Combining three parameters

A mixed method study of light, behavior and sound

To develop design parameters based on users needs, the case-study investigated the activities, behavior of students through sound, the use of space and the lighting.

To investigate behavior, sound was identified as a measurable parameter.



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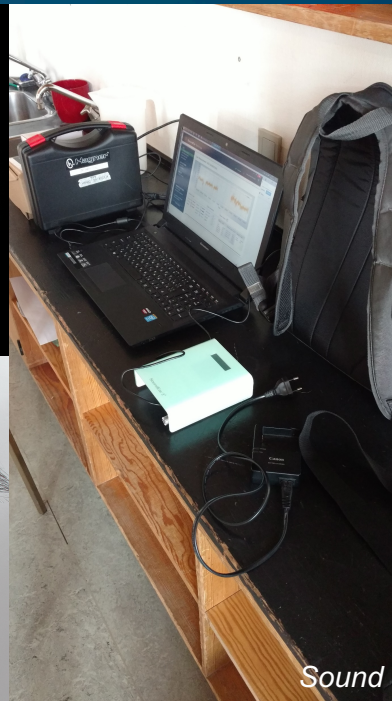


Case Study: Methods

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Light



Sound

The data collected, was structured into three categories:

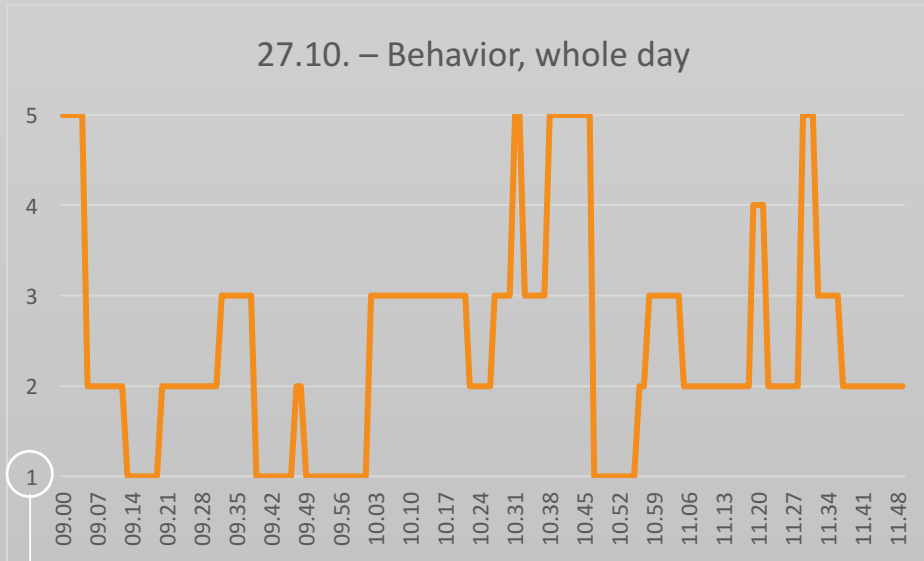
- Light: photos, measurements structured observations, interviews.
- Behavior: structured observations, interviews, sound and photos
- Activities: structured observations, interviews



Case Study: Development of analysis method

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27.10. – Behavior, whole day



● Rating scale: 1 calm behavior and 5 noisy and disruptive behavior

To correlate the parameters a **quantification of observations, brightness and behavior** took place. Interviews were used to support the statistical analysis.

Georgieva D., Schledermann K. M 2016



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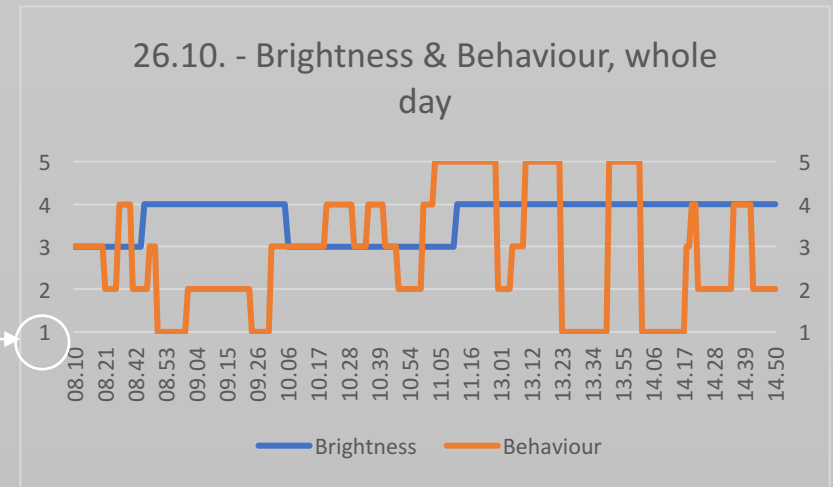
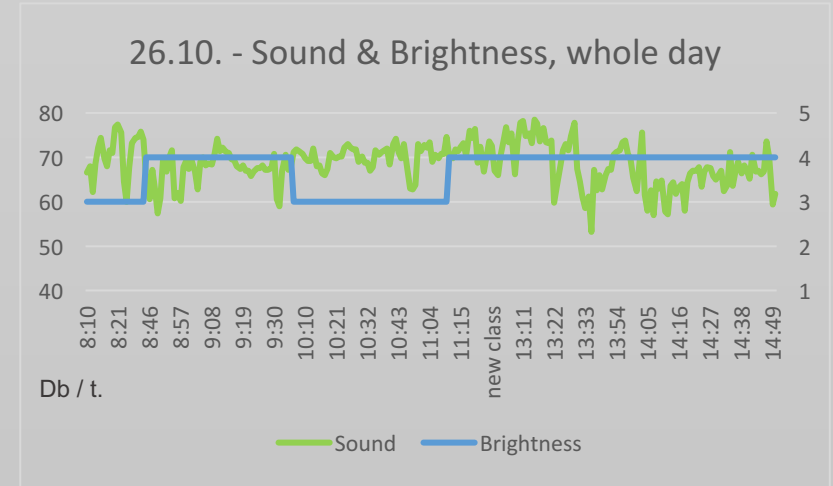
Case Study: Analysis

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Correlations were analysed by comparing patterns of brightness, sound and behavior over time.

This demonstrates a methodology that can be used to define holistic design scenarios crossing boundaries between qualitative and quantitative design criteria and research methods.

Rating scale: 1 calm behavior and disruptive behavior



Georgieva D., Schledermann K. M 2016

Case Study “Light & Learning”



Studying two classrooms facing east and west



The **users needs** were translated into **design parameters** and used to develop dynamic lighting design solution.



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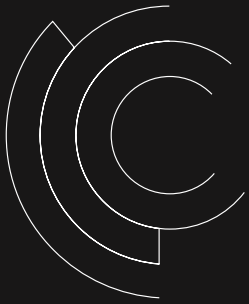
Case Study: From analysis to design criteria

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Criteria groups	Criteria	Methods for measuring
Activities and behavior	Reduced sound levels → to a maximum of 60 dB during class - SoundEar recommendations (1)	Sound measurements
	The students are less distracted (especially in the afternoon) → not going above 3 on the scale → the students and teachers express feeling more focused in the afternoon	Observations Interviews
Comfort and Visibility	Reduced discomfort glare and eye strain issues caused by sunlight → not being mentioned as a problem in interviews	Interviews with students
	Improved visibility of the smartboard → not being mentioned as a problem in the interviews	Interviews with students
	Improved visibility at desk level → illuminance levels and uniformity are up to the standard DS/EN 12464	Light measurements
Interaction with light	Conscious use of the lighting as a tool to influence the learning activities → the teachers change the scenarios at least 3 times per hour → they are aware of how the lighting is influencing the classroom activities	Observations Interviews with teachers

(1) SoundEar (2015) *SoundEar@3 UK Manual ver.2 26.05.2015*

https://dl.dropboxusercontent.com/u/59214245/Manualer/SoundEar3/SoundEar3_UK_manual%20ver.2%2026.05.15.pdf



Case Study: Simulations of Three Lighting Scenarios

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Task by tables



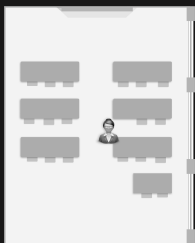
Visibility on Smartboard



Focus on teacher



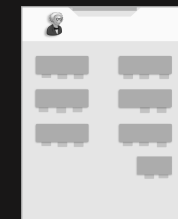
Rendering: Georgieva D.,



1. High illuminance
2. Even distributed light
3. Neutral CCT



1. Low illuminance
2. Warmer CCT



1. Wallwashers
2. Cooler CCT
3. High illuminance

Three lighting scenarios based on the design criteria



Future Work

Currently an evaluation is running investigating how the implemented dynamic lighting scenes effect the learning and teaching environment.

Combining sound, observations of behavior and activates, tracking the teachers use of light scenarios, and focus groups will be used to study the relationship between the light and learning.

Expected publication: Spring 2018



Photos: Classroom before (above) and after renovation (below)





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