

# THE IMPACT OF THE CLASSROOM ENVIRONMENT

Exploring how the classroom environment in secondary schools can enhance the student's learning experience

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Master Thesis  
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Architecture and  
the Built Environment



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MSc. Architecture, Urbanism and Building Sciences  
Track Management in the Built Environment

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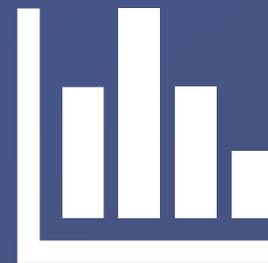
**1**  
**INTRODUCTION**



**2**  
**METHODOLOGY**



**3**  
**FINDINGS**



**4**  
**CONCLUSION  
& DISCUSSION**



**5**  
**LIMITATIONS &  
RECOMMENDATIONS**

# INTRODUCTION



ruimte en milieu / nieuws

## Gedateerde schoolgebouwen schreeuwen om aanpak

De komende jaren moet er 1,2 miljard euro per jaar worden uitgegeven om de schoolgebouwen op peil te houden. **August 29th 2024**

⌚ Koen Enneking 📅 29 augustus 2024



## Rethinking our school environments

### Wat is het effect van de inrichting van schoolgebouwen voor primair onderwijs op de ontwikkeling van leerlingen?

**June 22th 2021**

Published: 22 juni 2021

Kwaliteitskenmerken van schoolgebouwen, zoals de beheersing van luchtkwaliteit, (dag)licht, temperatuur en akoestiek hangen positief samen met leerprestaties van leerlingen. Hetzelfde geldt voor kleurgebruik en ruimtelijkheid. Of er een causale relatie is, is nog niet hard te maken. Overigens dragen de Arboret en het



NOS Nieuws • Zondag 25 maart 2018, 03:08

### 'Slechte ventilatie veroorzaakt hoofdpijn op tientallen scholen'

Leerlingen en misselijkheid door slechte ventilatie op tientallen scholen. NCRV-programma

## Classroom as backdrop

### Schoolgebouw in nood

### Hoe les krijgen in oude schoolgebouwen invloed heeft op de leerprestaties

**November 11th 2022**

11-11-2022 17:28



Twee kinderen helpen met hun huiswerk. Veel schoolgebouwen zijn verouderd en er wordt ervoor zorgen dat gemeenten en onderhouden van scholen.

Schimmel, lekkages, ramen die niet open kunnen: volgens Bouwend Nederland moet de helft van de scholen worden vernieuwd. Les krijgen in een verouderd gebouw heeft invloed op de leerprestaties, zeggen experts.

Minister Dennis Wiersma wil iets doen aan de oude schoolgebouwen. Hij hoopt geld los te krijgen bij energieminister Rob Jetten en minister Hugo de Jonge van Volkshuisvesting. In totaal wordt door brancheorganisaties en gemeenten gedacht dat er 730 miljoen euro nodig is.

### Inrichting van school heeft invloed op leerproces leerlingen

**June 5th 2019**

De redactie | bijgewerkt op 5 juni 2019

De inrichting van een school en de klaslokalen kan van grote invloed zijn op het leerproces van leerlingen. Volgens architect Herman Hertzberger moet een schoolgebouw aan twee tegenstrijdige voorwaarden voldoen: enerzijds moet het een veilige omgeving bieden maar anderzijds moet het spannend, uitdagend en prikkelend zijn.

### No longer fits the needs of modern education



INVESTING PRIMAIR ONDERWIJS | VOORTGEZET ONDERWIJS DOOR IRENE HEMELS

### Renovatie en vernieuwing zit muurvast

In goed schoolgebouw verbetert de leerprestaties en dringt ziekteverzuim terug. Het is in feite het fundament van goed én gezond onderwijs. Des te zorgelijker is het dat vrijwel alle scholen gebouwd voor 1980, toe zijn aan vernieuwing. Het gaat dan om de helft (!) van het aantal schoolgebouwen in Nederland. Toch ziet het er niet naar uit dat die scholen snel geknapt worden. Wat kun je dan als directeur doen?

... het goede nieuws. Echte bouwvallen met lekkende daken en schimmel op de muren ziet Marco van der Vliet zelden. Hij werkt voor Ruimte-OK, de kennisorganisatie voor scholen en gemeenten over huisvesting en onderwijs. "In het nieuws verschijnen soms schrijnende gevallen. Gelukkig komen wij ook met rampzalige situaties in de praktijk maar weinig tegen. We zien wel veel zaken die direct actie vereisen, zoals een slecht gebruik van ventilatiesystemen en slecht onderhoud. Dat gebeurt vaak bij gebouwen die 'in de wacht' zitten. Ze wachten op een grootschalige renovatie of nieuwbouw, maar dat is niet van de plicht om nu actie te ondernemen."

... van Nes, beleidsadviseur onderwijshuisvesting bij de PO-Baad en VO-raad, ziet 'gebouwen die met



Development of children is based on:

- 1) Interaction with Adults
- 2) Interaction with Peers
- 3) **Interaction with the physical learning environment**  
(The Third Teacher).

**Loris Malaguzzi**

# Main research question

---

*‘How does the design and use of classroom environments influence the learning experience of secondary school students?’*



# METHODOLOGY



## MIXED-METHODS APPROACH

Descriptive-exploratory focus



LITERATURE STUDY



SURVEYS  
with students



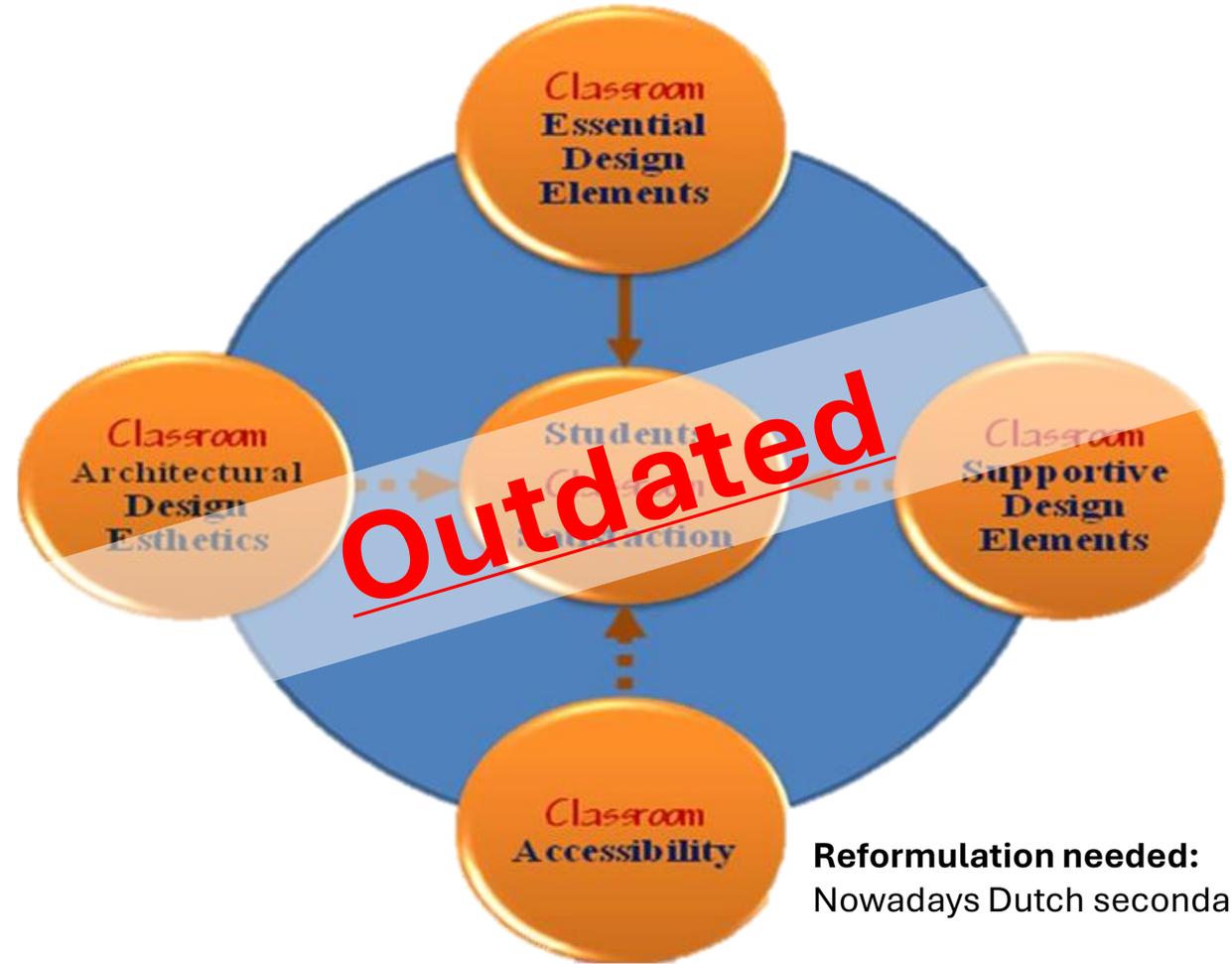
INTERVIEWS  
with teachers



# METHODOLOGY



Theoretical framework: design & use elements  
Technical aspects: Ergonomic furniture & IEQ  
Student perspective

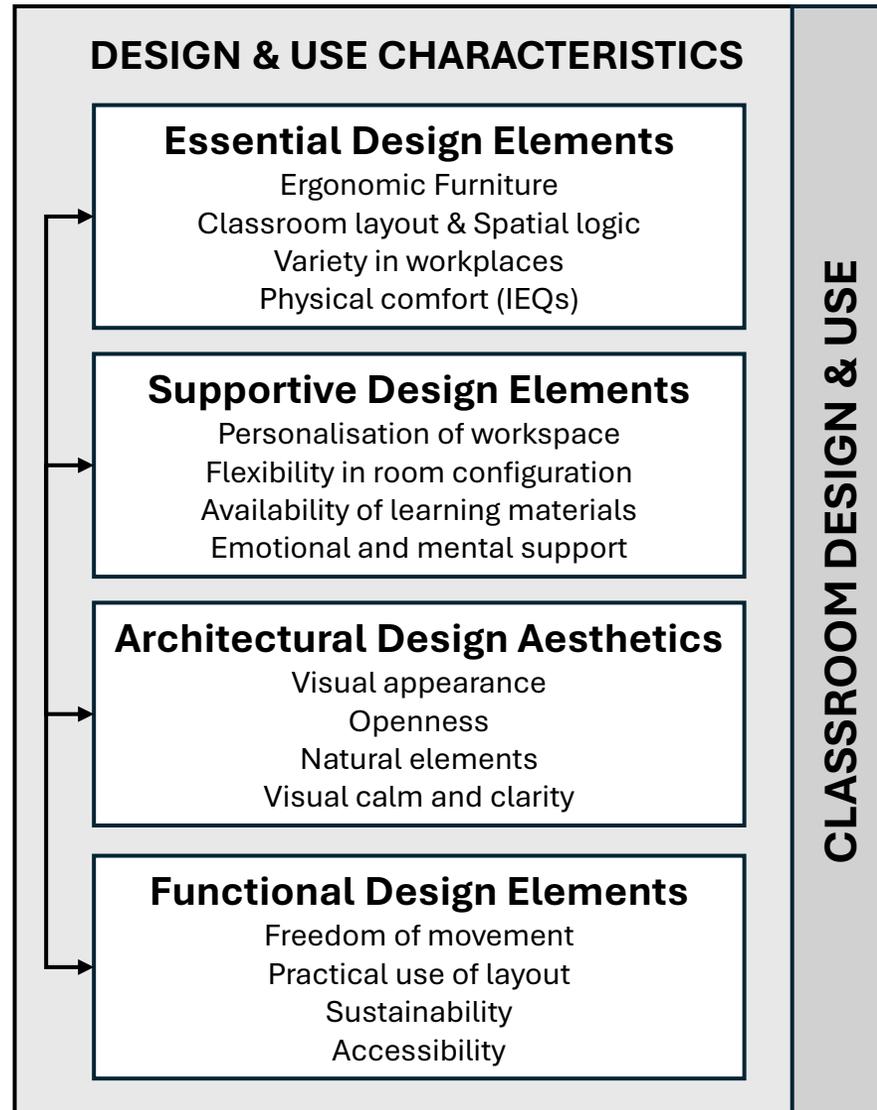


**Reformulation needed:**  
Nowadays Dutch secondary schools

Classroom environment study by Dahlan (2008; 2013)



# METHODOLOGY



Tangible elements vs subjective elements  
→ Framework to observe objectively  
→ Translate it to basis for student survey

Classroom observations & student input

Capture :  
→ the physical characteristics classroom  
→ lived experience students

# CASE STUDIES



## Casestudy A: School A



Classroom 2.04

**Traditional classroom**  
**Teacher-centred**



Classroom 2.07

**Traditional classroom**  
**Teacher-centred**



Classroom 2.15

**Traditional classroom**  
**Teacher-centred**

- Fixed layouts
- Limited flexibility

**Survey responses: 110 in 3 classrooms**

## Casestudy B: School B



Classroom 0.10

**Collaborative classroom**  
**Student-centred**

- Flexible layout
- Divers set-up alternatives

**Survey responses: 63 in 2 classrooms**



Classroom 2.01-2.02

**Dual-zone classroom**  
**Traditional & collaborative**

- Traditional lecture space
- Group work & collaboration

# RESEARCH FINDINGS



- 1A
- 1B
- 1C
- 2A
- 2B



Casestudy B:  
**Lyceum Kralingen**

Classroom 0.10

**Collaborative classroom**  
**Student-centred**



Category	Characteristics	Classroom 0.10
	Subject	Global Citizenship (WBS)
<b>Essential Design Elements</b>	Layout & spatial logic	Classroom size: 9.3m x 7.8m. Flexible and reconfigurable layout supports group work.  >2.5 m2/student
	(Ergonomic) furniture	Variation in furniture+ Offering ergonomic furniture and student preferences.
	Workspace variety / Zoning	Zoned into collaborative clusters within the same room. Divided by furniture types.
	Indoor Environmental Qualities (Light, acoustics, temperature and ventilation)	Good – High windows provide daylight access and controlled acoustic conditions. Students can open the windows and lower the sunscreen when necessary. They can't change the temperature.
<b>Supportive Design Elements</b>	Personalisation of workspace (autonomy)	Option to work in different areas and seating positions. Student work on the wall and displayed in the back.
	Flexibility in room configuration	Rearrangeable for activities. Most furniture on wheels.
	Availability of learning materials	No visible tools or materials.
	Emotional and mental support	Bright and open; Inviting atmosphere. Reported as emotionally supportive and cozy by students.
<b>Architectural Design Aesthetics</b>	Visual appearance	Neutral and calm colour palette with complementary tones; Modern and inviting aesthetic. Subject-specific design. Visually engaging.
	Openness	Open visual access and freedom.
	Natural elements & plants	No natural elements or plants.
	Visual calm and clarity	Clean and visually clear structured. Minimal clutter supports visual focus.
<b>Functional Design Elements</b>	Accessibility	Entrance & layout are functional with wide (>1,2m) walkways.
	Freedom of movement	Students can move freely between tables.
	Practical use and layout	Supports varied learning activities but a few chairs are faced with their backs to the front of the class.
	Sustainability	No visible implementations.



# RESEARCH FINDINGS



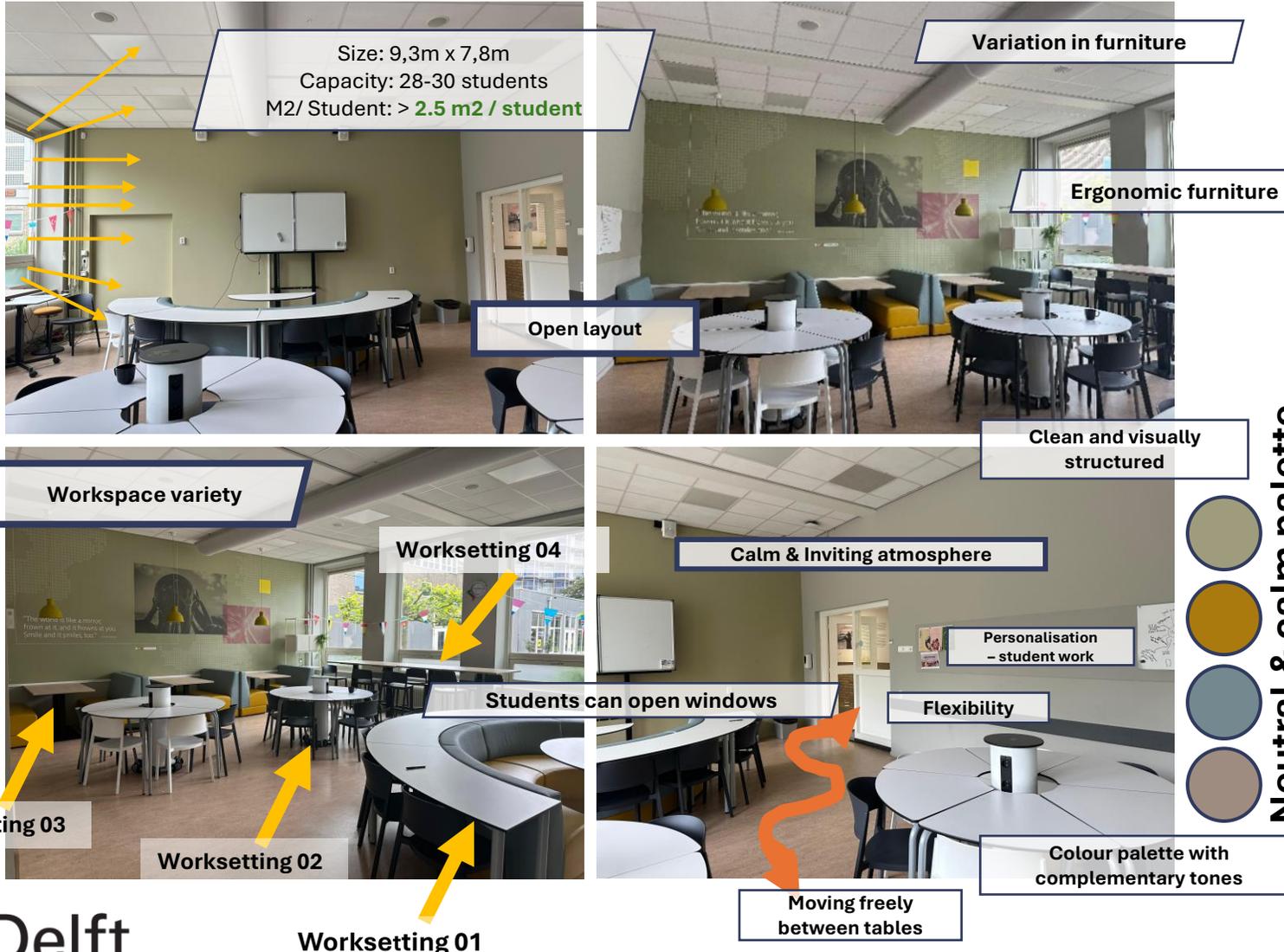
- 1A
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# METHODOLOGY

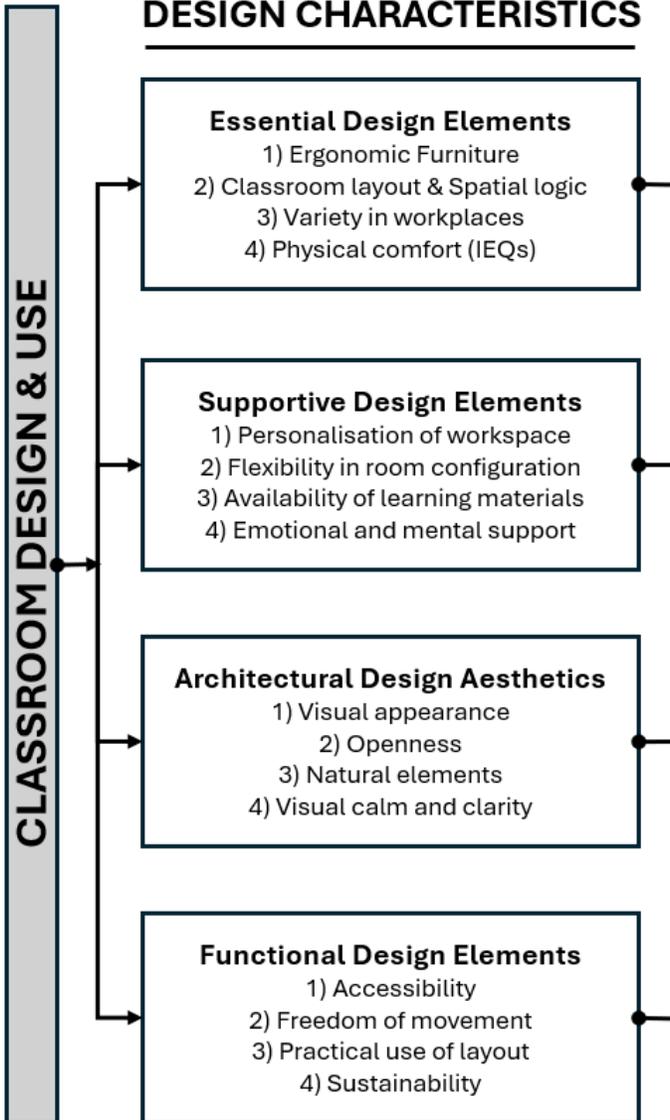


SURVEY

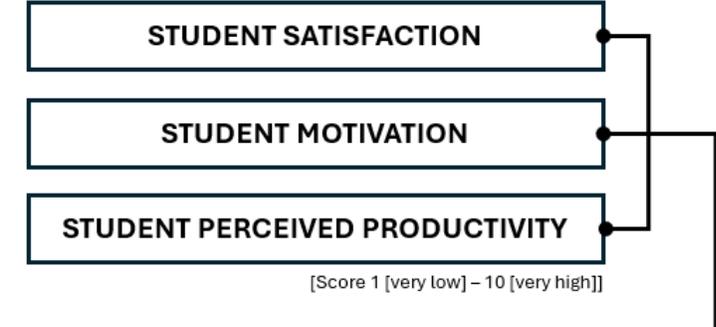
## DESIGN CHARACTERISTICS

## STUDENT SURVEY

Main goal: "Experience with their classrooms"



Overall...



# METHODOLOGY



N= 173 students in 2 schools and 5 different classrooms  
 Covering physical and experiential aspects → affect on learning experience



## DESIGN CHARACTERISTICS

## STUDENT SURVEY

CLASSROOM DESIGN & USE

**Essential Design Elements**

- 1) Ergonomic Furniture
- 2) Classroom layout & Spatial logic
- 3) Variety in workspaces
- 4) Physical comfort (IEQs)

Main goal: "Experience with their classrooms"

#	Essential Design Elements	
1	Furniture satisfaction	Satisfaction
1	Furniture support for productivity	Productivity
2	Variety of workspaces	Satisfaction
3	Layout alignment with subject & learning	Satisfaction
3	Layout support for productivity	Productivity
4	Indoor Environmental Quality (IEQ)	Satisfaction

**Supportive Design Elements**

- 1) Personalisation of workspace
- 2) Flexibility in room configuration
- 3) Availability of learning materials
- 4) Emotional and mental support

#	Supportive Design Elements	
1	Motivation through workplace personalisation	Motivation
2	Flexibility of classroom layout	Satisfaction
2	Classroom flexibility supports collaboration	Satisfaction
3	Availability of learning materials	Satisfaction
4	Emotional comfort in the classroom	Motivation
4	Ability to be productive in the classroom	Productivity

**Architectural Design Aesthetics**

- 1) Visual appearance
- 2) Openness
- 3) Natural elements
- 4) Visual calm and clarity

#	Architectural Design Aesthetics	
1	Visual appearance	Satisfaction
2	Perceived openness	Satisfaction
3	Natural elements for satisfaction	Satisfaction
3	Natural elements for productivity	Productivity
4	Visual calm and clarity	Satisfaction
4	Aesthetic support for productivity	Productivity

**Functional Design Elements**

- 1) Accessibility
- 2) Freedom of movement
- 3) Practical use of layout
- 4) Sustainability

#	Design Elements	
1	Accessibility for workflow	Productivity
2	Freedom of movement	Satisfaction
3	Layout visibility and acoustics	Satisfaction
3	Layout support for task focus	Motivation
4	Sustainable design	Satisfaction

[Likert scale 1 [Strongly disagree] – 5 [strongly agree]]

Overall...

**STUDENT SATISFACTION**

**STUDENT MOTIVATION**

**STUDENT PERCEIVED PRODUCTIVITY**

[Score 1 [very low] – 10 [very high]]

## CLASSROOM ENVIRONMENTS

**CLASSROOM 2.04**

**CLASSROOM 2.07**

**CLASSROOM 2.15**

**CASE A**

**CLASSROOM 0.10**

**CLASSROOM 2.01-2.02**

**CASE B**

Individual options & identification of patterns

# METHODOLOGY



INTERVIEW

- **Confirm or nuance the patterns**
- **Methodological triangulation:** classroom environment from multiple perspectives
- **In practice:** differences → know for who you are building & what you try to accomplish



“This classroom is really flexible – we can move things around easily.”

“True, but during lessons it can still be difficult to actually adapt the space in practice.”



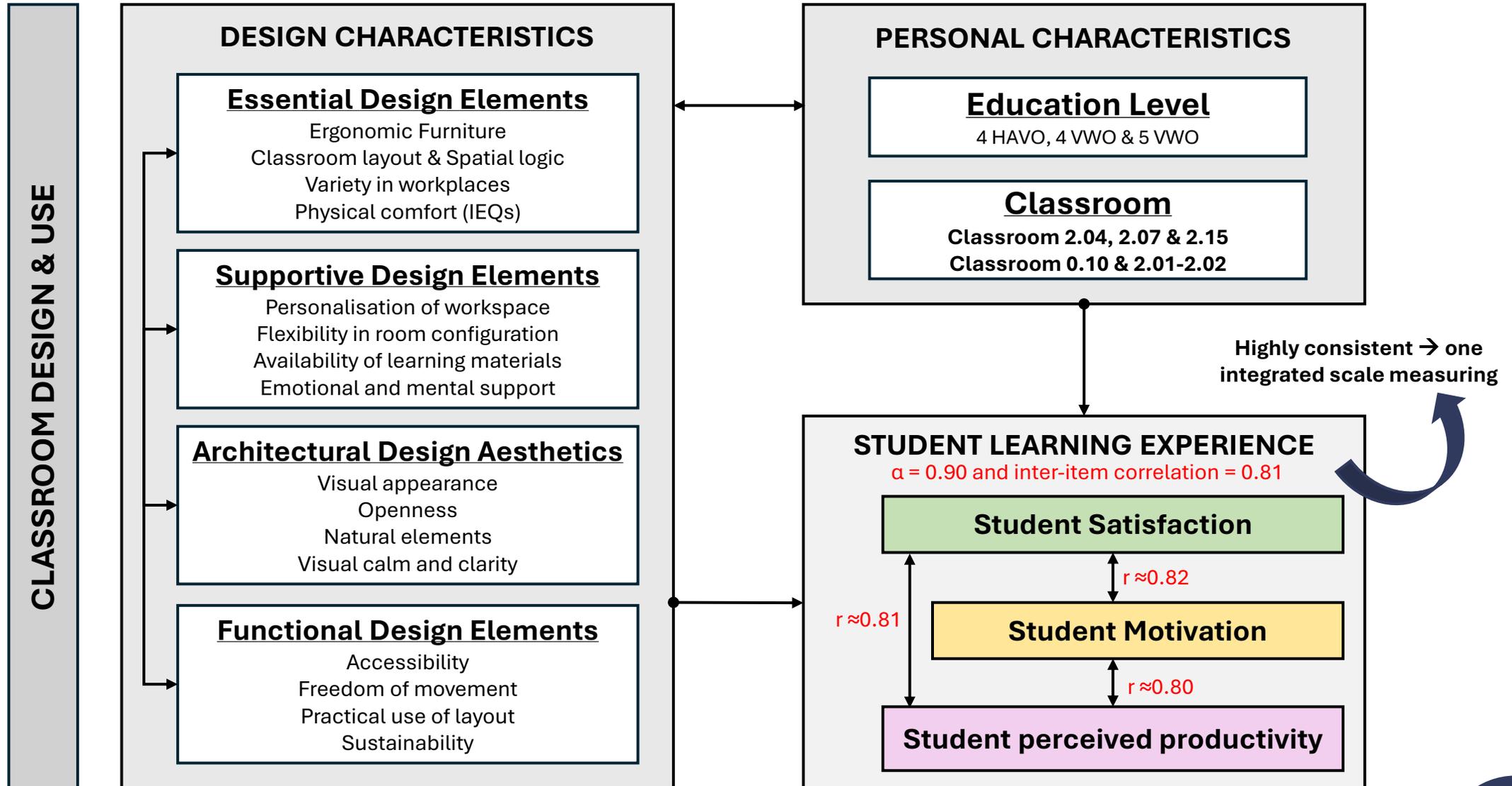
“I really like that the classroom is bright and colourful, it feels more engaging.”

“I see that, but sometimes the colours distract students and make it harder to keep them focused.”

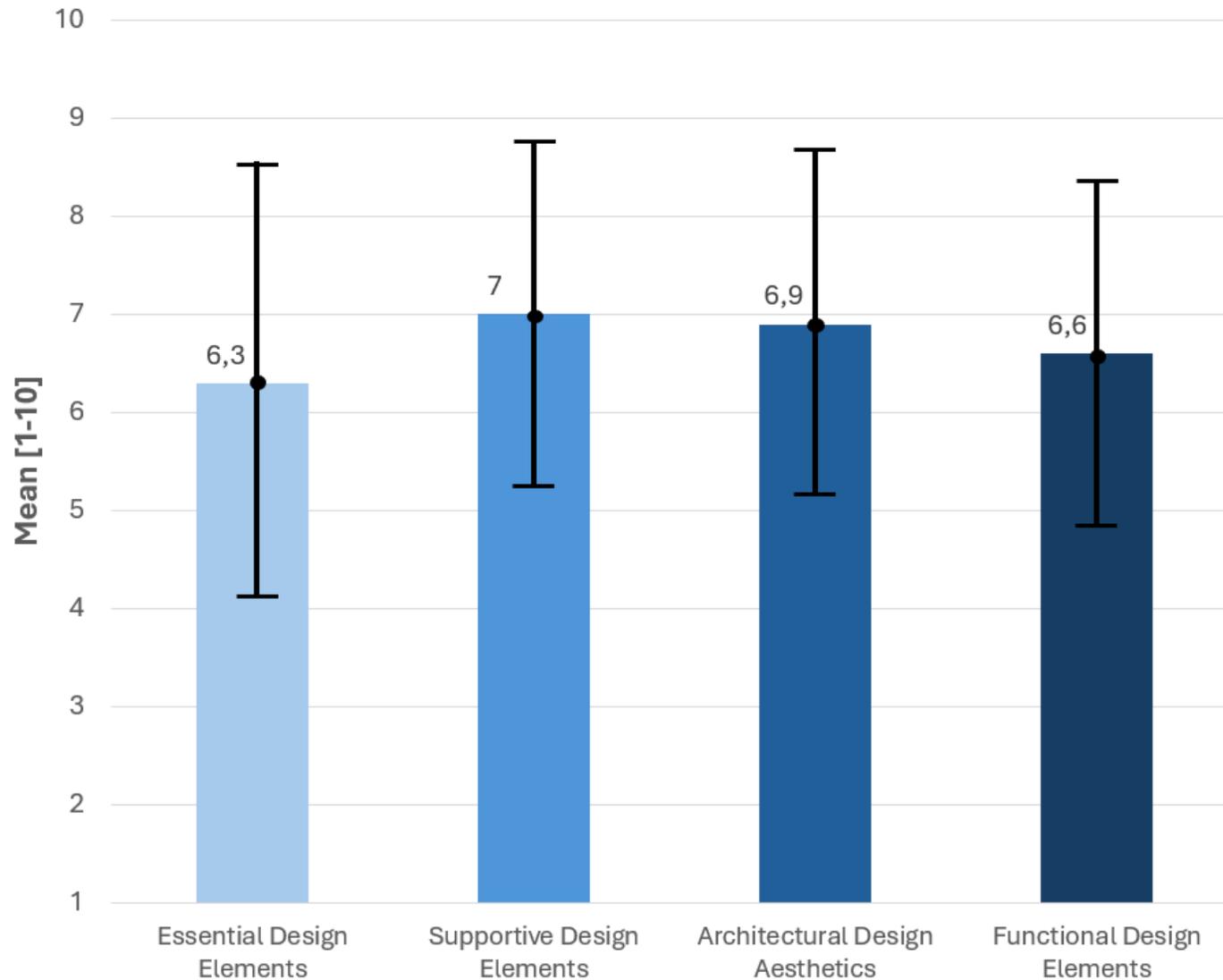
# RESEARCH FINDINGS



## ERE - Secondary schools



# RESEARCH FINDINGS



- Valued in a relatively balanced way
- None of them dominant on its own
- They all contribute, the interplay between that matters

Category	Mean [1-10]	Standard deviation (SD)
Essential Design Elements	6.3	2.2
Supportive Design Elements	7.0	1.8
Architectural Design Aesthetics	6.9	1.8
Functional Design Elements	6.6	1.9





# RESEARCH FINDINGS



**Confirmed in prior research:** *relevance empirically substantiated*

- *Physical comfort & autonomy are threshold conditions*
- *Lacking = ↓motivation, ↓satisfaction, ↓productivity*
- *Regardless other classroom qualities*

	C101 <i>Ergonomic furniture</i>	C102 <i>Variety of workspace</i>
<i>Satisfaction</i>	0.62**	0.57**
<i>Productivity</i>	0.60**	0.56**
<i>Motivation</i>	0.61**	0.55**
<b><i>Student learning experience</i></b>	<b>0.64**</b>	<b>0.61**</b>

**Assumptions in literature – empirical validation was limited:**

- *Not just theoretically plausible but also measurably significant*

	C103 <i>Layout &amp; spatial logic</i>	C204 <i>Emotional and mental support</i>	C301 <i>Visual appearance</i>	C403 <i>Practical use of layout</i>
<i>Satisfaction</i>	0.63**	0.69**	0.66**	0.63**
<i>Productivity</i>	0.65**	0.68**	0.63**	0.65**
<i>Motivation</i>	0.63**	0.69**	0.66**	0.62**
<b><i>Student learning experience</i></b>	<b>0.71**</b>	<b>0.74**</b>	<b>0.70**</b>	<b>0.66**</b>



# RESEARCH FINDINGS



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		Classroom		
		Classr. 2.04	Classr. 0.10	
		07	10	
Constructs	Mediators	12. Satisfaction	-0.26**	0.37**
		13. Productivity	-0.20**	0.39**
		14. Motivation	-0.21**	0.38**
		15. Student Learning Experience (construct)	-0.24**	0.39**
Design and Use Categories	Essential Design	16. Ergonomic Furniture (C101)	0.19*	0.57**
		17. Variety of workplace (C102)	0.13**	0.52**
		18. Layout & Spatial logic (C103)	0.18*	0.37**
		19. IEQ (C104)	-0.49**	0.41**
	Supportive Design	20. Personalisation of workspace (C201)	0.22**	0.36**
		21. Flexibility in room configuration (C202)	0.29**	0.40**
		22. Availability of learning materials (C203)	0.24**	0.28**
		23. Emotional and mental support (C204)	0.30**	0.51**
	Architectural	24. Visual appearance (C301)	0.20**	0.50**
		25. Openness (C302)	0.31**	0.36**
		26. Natural elements (C303)	0.18**	0.28**
		27. Visual calm and clarity (C304)	0.24**	0.42**
	Functional Design	28. Accessibility (C401)	0.29**	0.34**
		29. Freedom of movement (C402)	0.18*	0.31**
		30. Practical use of layout (C403)	0.20**	0.38**
		31. Sustainability (C404)	0.17*	0.35**



# RESEARCH FINDINGS



Classroom 2.04  
Traditional classroom  
Teacher-centred



Classroom 2.07  
Traditional classroom  
Teacher-centred



Classroom 2.15  
Traditional classroom  
Teacher-centred

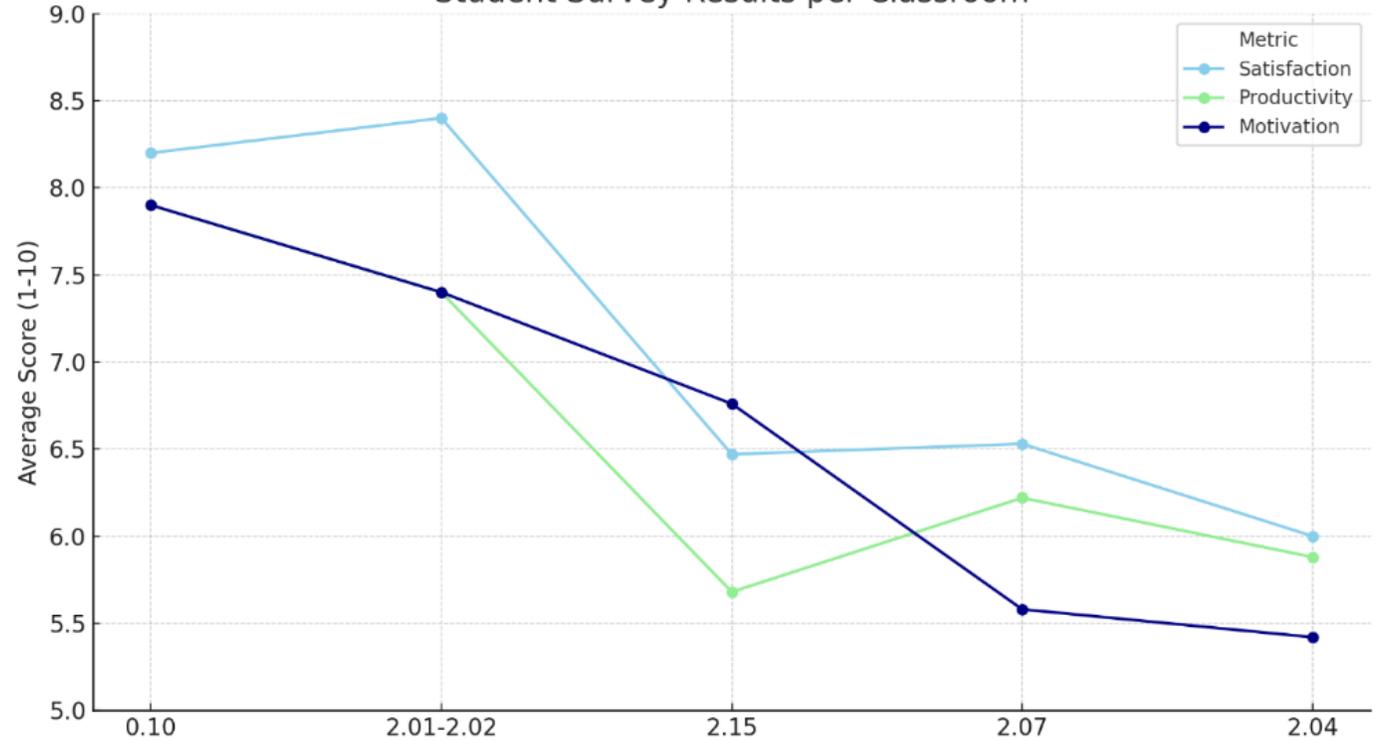


Classroom 0.10  
Collaborative classroom  
Student-centred



Classroom 2.01-2.02  
Dual-zone classroom  
Traditional & collaborative

Student Survey Results per Classroom



Constructs	N=173	Classroom						Classrooms				
		Case A: School A			Case B: School B			2.04	2.07	2.15	0.10	2.01-2.02
		4	4	5	4	4	5					
		HAVO	VWO	VWO	HAVO	VWO	VWO					
Satisfaction		0.10*	0.17*	0.12	0.24*	0.26*	0.19*	-0.26**	-0.11*	-0.13*	0.37**	0.21**
Productivity		0.07	0.15	0.16*	0.08*	0.12*	0.19	-0.20**	-0.11*	-0.22**	0.39**	0.22**
Motivation		0.11	0.17*	0.15	0.14	0.20*	0.20*	-0.21**	-0.17*	-0.12*	0.38**	0.27**
Student learning experience		0.07	0.18*	0.15	0.15	0.18*	0.20*	-0.24**	-0.14*	-0.17**	0.39**	0.18*

# RESEARCH FINDINGS

Most positive impact on student learning experience



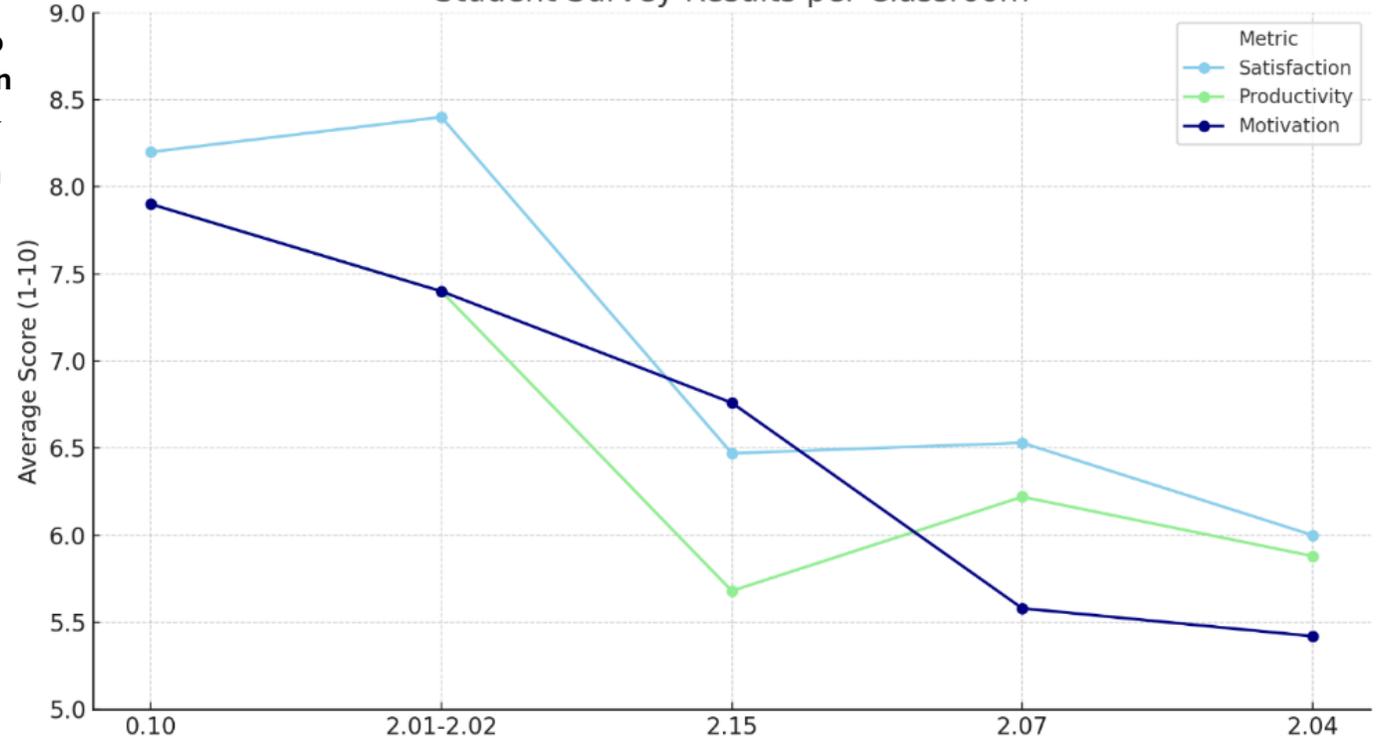
Exploratory nature of the study  
**Not 'ideal' classroom, but refer to as an example & recommendation**

- B2 – Classroom 0.10
- B1 – Classroom 2.01-2.02
- A3 – Classroom 2.15
- A2 – Classroom 2.07
- A1 – Classroom 2.04

SCHOOL B  
  
  
  
  
  
  
SCHOOL A

Most negative impact on student learning experience

Student Survey Results per Classroom



Constructs	Case A: School A			Case B: School B			Classrooms				
	4	4	5	4	4	5	2.04	2.07	2.15	0.10	2.01-2.02
Satisfaction	0.10*	0.17*	0.12	0.24*	0.26*	0.19*	-0.26**	-0.11*	-0.13*	0.37**	0.21**
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# CONCLUSION & DISCUSSION



- **Not a passive background, but an active determinant**
- One integrated construct: learning experience
- No single category is prioritised
- The classroom as a balanced whole →

## Baseline Essentials (non-negotiable):

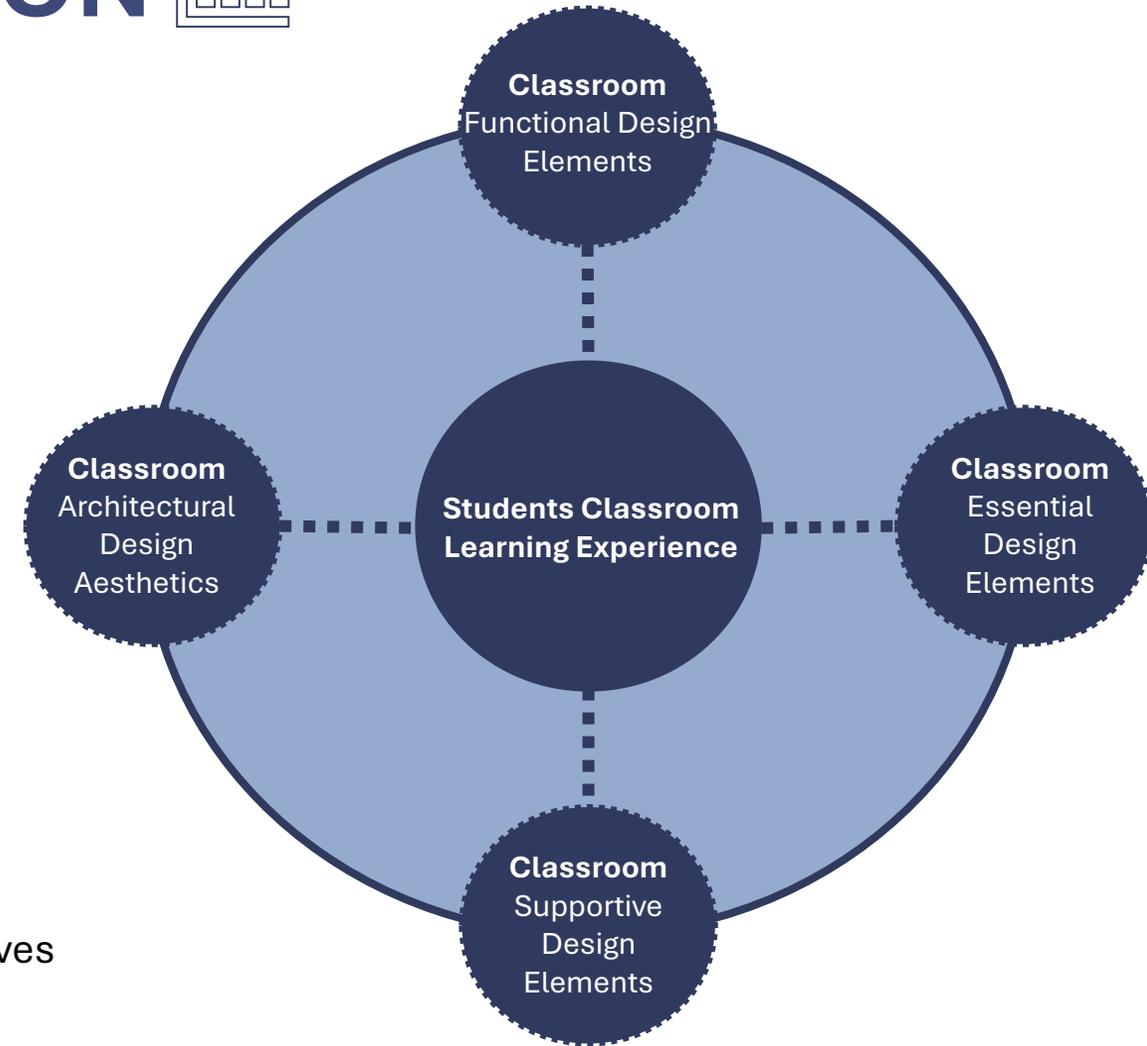
- *IEQ, Ergonomic furniture & Comfort*

## Enhancing factors (lifting the student experience up):

- *Workspace variety*
- *Emotional support*
- *Visual appearance*
- *Layout*

The classroom design as a **strategic tool**

**A third teacher**, alongside educational and pedagogical perspectives



For schools, architects & policy-makers:

***Secure the baseline essentials of comfort and autonomy first and then build on them with targeted enhancements that address aesthetics, clarity, and support.***

# LIMITATIONS



1

## Sample size and generalisability

173 students from two schools; limited scale reduces generalisability.

2

## Self-reported data

Surveys capture perceptions, but may include bias or response fatigue

3

## Situational factors

One-time measurement due to time constraints; seasonal or long-term dynamics not reflected.

4

## Conceptual categorisation

Categorisation of 16 elements is partly driven by researcher's own interpretation of the literature and observed data patterns. This requires further validations in future work.



# RECOMMENDATIONS

For future research



**EXPAND SAMPLE SIZE &  
BROADEN THE SCOPE**



**LONGITUDINAL  
APPROACH**



**COMBINE SUBJECTIVE AND  
OBJECTIVE MEASURES**



# RECOMMENDATIONS

For practice



**DESIGN FOR BOTH  
PHYSICAL & EMOTIONAL  
COMFORT**



**ADAPTIVE DESIGN &  
STRENGTHENING  
COLLABORATION**



**EDUCATIONAL POLICY  
AND INDICATORS OF  
CLASSROOM QUALITY**

*Classroom quality becomes a continuous, evidence-based part of school policy —  
not just a technical or one-time design task*



# THESIS

---

## The Impact of the Classroom Environment on Enhancing Academic Performance

Exploring how secondary schools can foster better learning outcomes

**THANK YOU FOR LISTENING**



*B Tokyay*