

# U

# O

# W

## Investigating the nexus between the classroom environment, sedentary time, movement, teaching and learning

Katharina Kariippanon

School of Health and Society  
Early Start  
Faculty of Social Sciences  
University of Wollongong



UNIVERSITY  
OF WOLLONGONG  
AUSTRALIA

# The issue

## THE PROBLEM WITH SITTING

- Adolescents are the 2<sup>nd</sup> most sedentary group after the elderly (Matthews 2008)
- Children and youth sit for 6-10 hours a day (Owen et al., 2014)
- Adolescents sit for 70% of the school day (Carson 2013)
- Longest bouts of uninterrupted sitting occur at school (Harrington 2011)
- Consequences for youth:
  - Poorer physical, mental, social & academic profiles (Carson 2016, Okely 2014)
- Consequences for adults:
  - Overweight, obesity, type 2 diabetes, CVD, some cancers (Owen 2014)



"He's very good at sit"

Too much sitting is distinct from too little activity

# What we don't know

## AND WHAT WE NEED TO DO

### Sedentary behaviour in the school setting

- Complex relationship between environmental factors and behaviour not well understood (Bauman 2002)
- Little information about the determinants of sedentary behaviour among youth in the classroom setting (Stierlin 2015)
- Evidence of the correlates of sedentary behaviour in the school setting is limited (Gomes 2014)

International guidelines recommend breaking up sitting  
as often as possible



# The setting

## POTENTIAL FOR CHANGE

- Schools are a health promotion setting
- Environment to fosters health and wellbeing
- Efforts to decrease sitting during class
  - Standing desks
  - Physical activity breaks
- Challenges in terms of:
  - Reliance on motivation of individual teachers
  - Scaling-up & long-term sustainability
- What about the learning environment itself?



Are there modifications that can be made to the physical, pedagogical & social environment that can enable decreased sitting and increased movement?

# The opportunity

## CHANGE OF LEARNING ENVIRONMENT

### Traditional Classroom



### Flexible Learning Space



# The evidence

## WHAT WE KNOW



## Modifications to the learning environment

- Activity-permissive environments are promising (Lanningham-Foster et al., 2009)
- Dearth of studies looking at the inter-relationship between the indoor school environment, pedagogy, sedentary behaviour and student movement (Ucci et al., 2015)
- Limited evidence on what occurs and with what effect in flexible learning spaces (Fisher 2016)

# Aims of the study

## WHAT WE WANTED TO KNOW

- Adolescents taught in FLS have reported opportunities for:
  - Increased autonomy to change posture frequently and move around the space (Kariippanon et al., 2017)
  - Increased collaboration, interaction and engagement with the lesson content (Kariippanon et al., 2017)
  
- It was unknown if this was perceived or real
  - If it results in less total and prolonged sitting
  - If there is an increase in collaboration, interaction or engagement
  
- The aim of this study was to objectively measure and compare between *traditional classrooms and flexible learning spaces*
  - Adolescent sitting and movement patterns
  - Adolescent academic behaviours



# Methods

## MEASURING SITTING & MOVEMENT

### Participants

- 191 students
- 9 schools, years 7-9
- Mean age 13.2 ( $\pm 1.0$  year)
- Even spread of females and males
- A range of socio-economic, cultural & ethnic backgrounds



### ActivPAL accelerometer

- Objective measure of different postures
  - Sitting, standing, stepping, length of sitting bouts, number of breaks in sitting
- Attached to the upper thigh

### A school-based cross-over trial

- Traditional classroom and a flexible learning space
- Students, teachers and content remained the same
- Duration of a double lesson - mean wear time 76min



# Results

## SIGNIFICANTLY LESS SITTING & MORE STANDING

Table 1: Changes in posture and sitting bouts and breaks, between TC and FLS

Outcome Variable	Traditional Classroom (M, 95% CI) (n = 171)	Flexible Learning Space (M, 95% CI) (n=177)	Mean difference in change between spaces (M, 95% CI)	Effect size (d)	p - value
<b>Posture</b>					
Sitting (%)	93.42 (89.95, 96.89)	75.51 (72.07, 78.96)	-17.90 (-20.79, -15.02)	-1.47	0.001
Standing (%)	5.00 (2.03, 7.98)	20.36 (17.40, 23.32)	15.36 (12.68, 18.03)	1.37	0.001
Stepping (%)	1.58 (0.78, 2.37)	4.13 (3.33, 4.92)	2.55 (2.02, 3.07)	0.99	0.001
<b>Number of bouts/breaks in sitting</b>					
≤9 min bouts (per hour)	6.86 (5.21, 8.51)	9.05 (7.42, 10.69)	2.20 (0.78, 3.60)	0.32	0.002
10-19 min bouts (per hour)	0.66 (0.46, 0.85)	0.81 (0.62, 0.99)	0.15 (-0.04, 0.34)	0.23	0.118
20-29 min bouts (per hour)	0.24 (0.14, 0.34)	0.23 (0.13, 0.33)	0.01 (-0.11, 0.09)	-0.04	0.860
≤30 minutes (per hour)	0.31 (0.23, 0.40)	0.11 (0.03, 0.19)	-0.20 (-0.29, -0.12)	-0.65	0.001
Breaks in sitting (per hour)	8.07 (6.45, 9.68)	10.20 (8.59, 11.80)	2.13 (0.75, 3.51)	0.26	0.003



# Practical implications

## THE “SO WHAT”?

- Total and prolonged sitting was significantly reduced in flexible learning spaces
- Students accumulated more bouts of intermittent sitting and more breaks in sitting
- The effects were larger for females than males
  - Significant because females are typically more sedentary than males during adolescence
- Students can maintain light-intensity physical activity (LPA) throughout the day in flexible learning spaces, particularly females
  - Significant because sedentary behavior during adolescence predominantly replaces LPA



# Methods

## MEASURING ACADEMIC BEHAVIOURS

### Participants

- 54 students
- 9 schools, years 7-9
- Mean age 13.2 ( $\pm 1.0$  year)
- Even spread of females and males
- A range of socio-economic, cultural & ethnic backgrounds

### Observational checklist

- Used direct momentary time sampling to measure frequency of academic behaviours
  - Time on task, interaction, child level setting, technology use, mode of learning
- Attached to the upper thigh

### A school-based cross-over trial

- Traditional classroom and a flexible learning space
- Students, teachers and content remained the same
- 6 students per class, observed on a rotational basis, 30 min



# Results

## SIGNIFICANTLY MORE COLLABORATION AND ENGAGEMENT

Table 1: Changes in academic behaviour between TC and FLS

Outcomes as a proportion of lesson time (%)	Traditional Classroom (M, 95% CI) (n = 54)	Flexible Learning Space (M, 95% CI) (n=54)	Mean difference in change between spaces (M, 95% CI)	Effect size (d)	p - value
<b>Lesson time spent in different <i>learning settings</i></b>					
Groups of ≤ 6	53.52 (41.06, 65.98)	77.78 (65.32 – 90.24)	24.26 (9.98, 38.53)	0.61	<b>0.001</b>
<b>Lesson time spent in different <i>modes of learning</i></b>					
Teacher-led instruction	30.74 (18.55, 42.93 )	14.26 (2.07, 26.45)	-16.48 (-21.06, -11.90)	-0.75	<b>0.001</b>
Collaborating	12.59 (-2.74, 27.92)	49.44 (34.11, 64.77)	36.85 (31.00, 42.70)	1.33	<b>0.001</b>
<b>Lesson time and type of <i>engagement</i></b>					
Actively engaged	56.93 (48.69, 65.18)	68.98 (60.73, 77.22)	12.05 (5.15, 18.94)	0.50	<b>0.001</b>
Off-task - verbal	12.26 (8.55, 15.96)	6.50 (2.79, 10.20)	-5.76 (-10.46, -1.07)	-0.44	<b>0.016</b>
<b>Lesson time and type of <i>interaction with other students</i></b>					
Positive interaction	35.47 – (26.07, 44.87)	58.34 (48.95, 67.74)	22.87 (14.97, 30.77)	0.88	<b>0.001</b>

# Practical implications

## THE “SO WHAT”?

In flexible learning spaces compared to traditional classrooms

- Students spent significantly more time:
  - Working in group settings
  - Collaborating
  - Interacting with peers
  - Actively engaged
  
- Students spent significantly less time:
  - Being taught in a whole class setting
  - Engaged in teacher-led instruction
  - Working individually
  - Verbally off-task



# Mechanisms

## HOW IS THIS HAPPENING?

- Democratization of space achieved by de-emphasizing hierarchy
- Affordances of FLS can allow students to capitalize on opportunities for frequent interruptions in sedentary time
  - Increasing the variety of furniture and resources to include standing workstations, group tables, writeable walls
  - Structuring lessons that facilitate student autonomy and engagement with the space and its users
  - The interplay between the physical environment and pedagogical approach encourages and enables collaboration and engagement



# Summary

## WHAT NEXT

“Win-win” situation where:

- Schools obtain the outcomes they are pursuing in terms of teaching and learning
- As an unintended consequence, there are potential cardio-metabolic health benefits to be gained from interrupting prolonged sitting

Further research is needed:

- To unpack how to leverage the opportunities created by FLS
- To ensure that decision making around the:
  - Design and fit-out of school refurbishments and new builds
  - Environmental competency of teaching staff
  - Pedagogical approaches used;
- Maximize the potential health gains that can be obtained from these innovative learning environments



# What about the tertiary setting?

## USER EXPERIENCES OF UOW SPACES

Survey participants

- 197 students and 19 teaching staff

Common Teaching Area (CTA)

Space	19.1002 & 19.G024	24.G02	43.G01 & 43.G02
Description	Traditional - old	Traditional - new	Best-practice
Layout	2 person tables in rows facing the front	2 person tables in rows facing the front	Grouped tables
Technology	One projector/screen	One projector/screen	Multiple projectors/screens, COWs

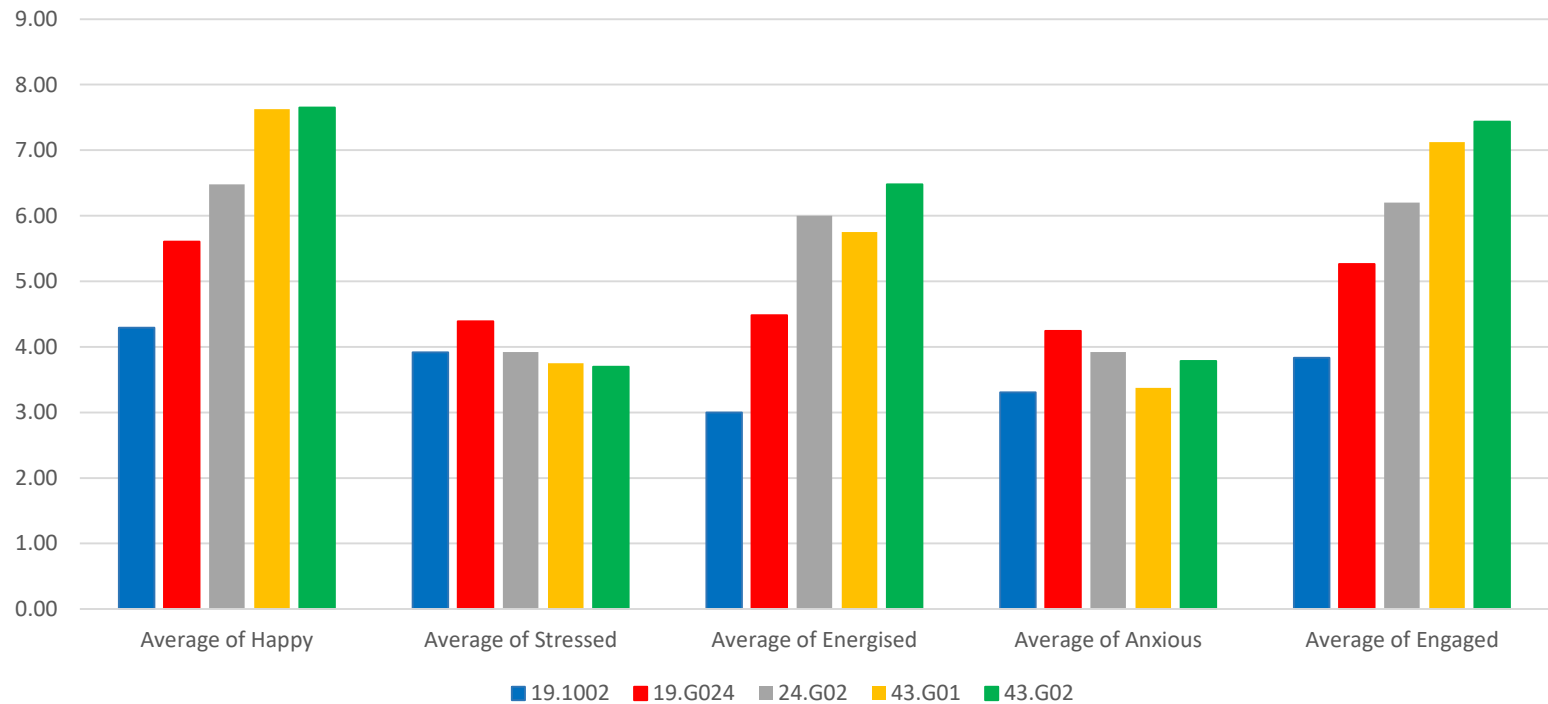




# Student survey results

## HOW STUDENTS FELT IN THE SPACE

How... do you feel in this space



# Student survey results

## STUDENTS PERCEPTIONS OF FUNCTIONALITY

