Clever Classrooms

What aspects of infrastructure are important for learning outcomes?

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What is the problem?!

We all know buildings make a difference …

*Partial studies of factors involved* × *Complex interaction of issues*

**Physical environment**

Very low or no impact for low cost based on very limited evidence.
The HEAD Project
Holistic Evidence and Design – sensory impacts, practical outcomes

To explore if there is any evidence for demonstrable impacts of school building design on the learning rates of children in primary schools

Primary schools present a real opportunity as pupils mainly in one space and there are annual measures of academic progress – relatively simple

Pilot phase funded by Nightingales now IBI
HEAD Project funded by EPSRC 2012-15
How was a holistic view taken?
The SIN design principles

The opportunity of individualization

Natural Environment → the role of naturalness

Appropriate levels of stimulation

Personal Environment

How were confounding factors controlled out?

In nested situations (pupils in classroom) **multilevel modeling** presents the opportunity to separate out impacts from various levels.
Big / diverse study sample

Looked at 153 classrooms in 27 schools, 3766 pupils

- **Observation** – layout, display, lightings, floor covering, colour, view out, window (opening) size and position etc.
- **Measurement** – lighting level, temperature, noise level and CO₂ level, room height, window height, furniture and fixture size
- **Interview** – sensory comfort, e.g. temperature, glare, noise, smell, size and usage etc.
Headline results on impacts

The SIN principles explain 16% of the variation in learning achieved by the pupils over a year

(Using National Curriculum sublevels in Reading, Writing and Maths at the start and end of the year, and fixing all except built environment factors to their means)

Multilevel modelling factored out other influences
Extreme case - potential

Least effective classroom

Most effective classroom

+ 1.3 sublevels for “average pupil”
Which parameters are important?

Contribution from each classroom measures

Some parameters illustrated....
Naturalness: Air quality

- Large, varied openings good, especially at high level
- Can clash with roller blinds
- Large room volume can help

Average time for a class of pupils to “create” poor air quality ... ?

30 minutes
CO2 in one classroom over a week

An example

Significantly faster and more accurate responses for Picture Memory (by 8%) and Word Recognition (by 15%) at the higher ventilation rates

Bako-Biro et al, 2011
A range of factors were found to be important in two categories: aspects that helped pupils identify with “their” classroom; and aspects that are child-sensitive.

- Distinctive room design
- Pupils’ work is displayed on the walls. Other elements such as shared display tables.
- Elements that are personalized by the pupils: such as coat pegs, lockers and / or named drawers.
- Well-designed furniture that creates a learning space that is child centred.
- Desks and chairs that are comfortable, interesting and ergonomic to the pupils’ ages and sizes.

lots of class-made art work on display in varied formats and sizes.
Level of stimulation: Complexity

Which is good?

Appropriate level of stimulation is curvilinear for learning – not too exciting, not too boring
What surprises were there?
– The muted effect of “school” level factors

<table>
<thead>
<tr>
<th>School Level Factor</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Naturalness</td>
<td>Outside Learning zones, Playground Area</td>
</tr>
<tr>
<td>School Individualisation</td>
<td>Site area, Building floor area, Number of pupils</td>
</tr>
<tr>
<td>School Stimulation, Appropriate level of</td>
<td>Building Façade, Complexity of layout, Alternative learning rooms</td>
</tr>
</tbody>
</table>
First and foremost the individual classrooms must each be well designed – *argument for “inside-out design”*
The importance of the classroom

North facing on this side

South facing on this side
Differences by subject / pupils were found. Current analyses:

- **Reading** – “connection” becomes significant: “corridor libraries”, especially for FSM pupils. “Level of stimulation” has increased salience.
- **Writing** – “links to nature” becomes significant: relationship to creativity? “Level of stimulation” has increased salience.
- **Maths** – “individualisation” dominant: link to confidence issue in this subject?
- **SEN** – “light” (glare?) and “level of stimulation” (colour) dominant and overall impact rises to 19%.
Practical implications

• The HEAD results open up the possibility to:
  • Focus on the **key aspects** of school building design / use ...
  • So, maximising **positive** elements that support pupils’ **learning** ...
  • Many **don’t** have to cost lots of money and can be done **now**
  • And where it does cost money the results can inform the **optimal** allocation of resources.

• This is highly relevant for:
  • Teachers
  • Designers
  • Policy-makers
Outputs freely available:

- The “Clever Classrooms” illustrated report with practical suggestions for teachers and designers as a pdf at http://ow.ly/Jz2vV
- The underpinning *Building and Environment* journal paper at http://dx.doi.org/10.1016/j.buildenv.2015.02.013

Lot of interest – evidence helps!

- Schools conferences – teachers
- UK Department for Education; Welsh Constructing Excellence; Scottish Department of Education
- BBC Newsround
- Australian educational network (ACER)
- Norwegian Education Directorate
- US – ANFA (architecture and neuroscience network); USGBC; AIA
- OECD
- World Bank
I hope you find something of interest here that can have a positive impact on the educational experience of our children!