Noise in Classrooms

Presented by:
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Why are noisy classrooms a problem?

Starting primary school sees a **huge rise in language exposure** and demands

**Learn basic literacy and numeracy skills** that are the building blocks for the rest of their education

**Children spend 45-75% of their time listening and comprehending** so they need to be able to discriminate speech from irrelevant classroom noise
Who is affected by poor classroom acoustics?

Young children
• Neurologically immature (Boothroyd, 1997; Wilson, 2002)

Children who have:
• Any degree of permanent or fluctuating hearing loss
• A history of otitis media
• Auditory processing disorder
• Attention deficits
• Learning disabilities
Effects of high noise levels

Children

Affect speech perception

Affect cognition & concentration

Affects reading
- word recall
- auditory discrimination
- comprehension

Children ‘tune out’ (learned helplessness, fatigue, poor behaviour)

Shield et al. 2010, Anderson 2001
**Effects of high noise levels** → *Need to keep noise levels to a minimum*

<table>
<thead>
<tr>
<th>Children</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affect speech perception</td>
<td>Increase stress levels</td>
</tr>
<tr>
<td>Affect cognition &amp; concentration</td>
<td>Increase blood pressure</td>
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<tr>
<td>Affects reading</td>
<td>Cause fatigue and headaches</td>
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<tr>
<td>- word recall</td>
<td></td>
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<tr>
<td>- auditory discrimination</td>
<td></td>
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<tr>
<td>- comprehension</td>
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<tr>
<td>Children ‘tune out’ (learned helplessness, fatigue, poor behaviour)</td>
<td>Puts them at risk of pathological voice conditions</td>
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</table>

Shield et al. 2010, Anderson 2001
Open plan classrooms – why are they becoming popular?

<table>
<thead>
<tr>
<th>Why?</th>
<th>But…</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Child-centred approach, teacher the facilitator <em>not instructor</em></td>
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<tr>
<td>• Broader range of activities and technology used</td>
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<tr>
<td>• Group work, stage-based learning, and team teaching</td>
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</table>

What about the noise?!!
Workshop Outline

Thursday 19th October

Introduction to classroom acoustics, speech intelligibility, and the effects of noise

Introduction to open plan classrooms and my PhD research
- 4 case study classrooms
  - acoustics
  - speech perception
  - children’s & teachers’ perceptions

Practical activities on designing classrooms and measuring noise and reverberation
Workshop Outline

Introduction to classroom acoustics, speech intelligibility, and the effects of noise

Introduction to open plan classrooms and my PhD research

- 4 case study classrooms
  - acoustics
  - speech perception
  - children's & teachers' perceptions

Practical activities on designing classrooms and measuring noise and reverberation
Enclosed Classroom (25 children)

- Floor Teaching Area
- Concertina Wall
- Shared Store Room
- Windows
- K1
- K2

Purpose - Built K-6 Classroom (205 children)
<table>
<thead>
<tr>
<th>Enclosed Classroom (25 children)</th>
<th>Double Classroom (44 children)</th>
</tr>
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<tbody>
<tr>
<td>Floor Teaching Area</td>
<td>Floor Teaching Area</td>
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<tr>
<td>Concertina Wall</td>
<td></td>
</tr>
<tr>
<td>Shared Store Room</td>
<td>Windows</td>
</tr>
<tr>
<td>K1</td>
<td>Shared Store Room</td>
</tr>
<tr>
<td>K2</td>
<td></td>
</tr>
<tr>
<td>Windows</td>
<td>Windows</td>
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**Enclosed Classroom (25 children)**

- Windows
- Floor Teaching Area
- Concertina Wall
- Shared Store Room

**Double Classroom (44 children)**

- Windows
- Floor Teaching Area
- Utility Area

**Untreated Triple Classroom (91 children)**

- Year 2 Entry
- Windows
- Year 1 Entry
- Corridor
- Floor Teaching Area
- Windows
Enclosed Classroom (25 children)

Double Classroom (44 children)

Untreated Triple Classroom (91 children)

Purpose-Built K-6 Classroom (205 children)
Live speech perception testing

Other classes engaged in quiet vs. noisy activities

Mealings et al. (2015b,c)
Noise levels

Average Noise Level

Noise Level (dBA)

Enclosed | Double | Triple | K-6

Quiet Activities

Noisy Activities

Mealings et al. (2015c)
Higher noise levels = lower speech perception scores

Average Noise Level

Classroom Average Noise Level

Speech Perception Accuracy

Mealings et al. (2015c)
Distance effect – other classes engaged in quiet activities

<table>
<thead>
<tr>
<th>Classroom</th>
<th>Other Classes Quiet Activities</th>
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<tbody>
<tr>
<td></td>
<td>Noise Level</td>
</tr>
<tr>
<td>Enclosed</td>
<td>48 dBA</td>
</tr>
<tr>
<td>Double</td>
<td>44 dBA</td>
</tr>
<tr>
<td>Triple</td>
<td>57 dBA</td>
</tr>
<tr>
<td>K-6</td>
<td>61 dBA</td>
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</table>

Mealings et al. (2015c)
# Distance effect – other classes engaged in noisy activities

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<th>Other Classes Quiet Activities</th>
<th>Other Classes Noisy Activities</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Noise Level</td>
<td>Front Score</td>
</tr>
<tr>
<td>Enclosed</td>
<td>48 dBA</td>
<td>82%</td>
</tr>
<tr>
<td>Double</td>
<td>44 dBA</td>
<td>79%</td>
</tr>
<tr>
<td>Triple</td>
<td>57 dBA</td>
<td>82%</td>
</tr>
<tr>
<td>K-6</td>
<td>61 dBA</td>
<td>83%</td>
</tr>
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</table>

Speech Level for +15 dB SNR = 80-90 dBA

Mealings et al. (2015c)
Frequency of voice elevation & vocal problems

Mealings et al. (2015e)

Always

Often

Sometimes

Never

Elevate Voice

Voice Problems

- Enclosed
- Double
- Triple
- K-6
Response times

Mealings et al. (2015c)
Considerations when designing classrooms

Noise significantly affects:
- Children’s ability to hear and process what their teacher is saying
- Teacher’s vocal health

If open plan innovative learning environments are desired they need to be:
- Purpose-built, acoustically treated, with learning spaces for different activities
- Closed areas, quiet rooms
- Consider age of the children

Teachers need to be trained about how to teach effectively in these environments
Future work

How can we ensure classrooms have good acoustic conditions?

Educate teaching professionals, architects, designers, parents, children etc. about appropriate acoustic conditions and classroom designs for:

- Children at different ages
- Children with special educational needs
Acknowledgements

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