Impact of noise in education

A research summary

Ecophon®
SAINT-GOBAIN
A SOUND EFFECT ON PEOPLE

Noise impact in education

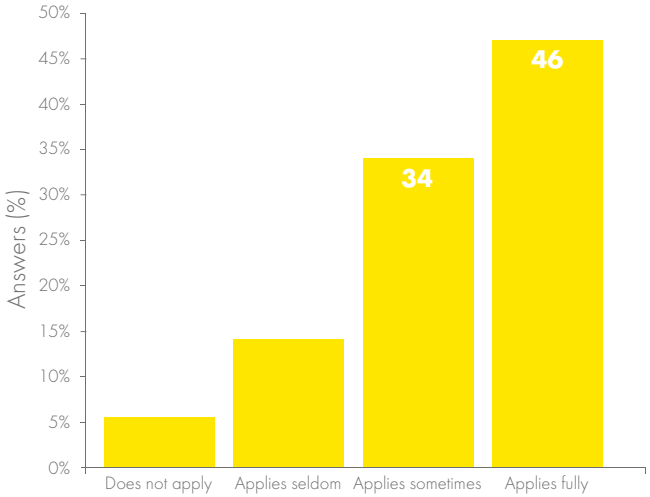
It's known that noise levels in schools can be loud enough to have a negative effect on those who occupy them, predominantly students and teachers. But by how much and to what extent? And furthermore, what's required to remedy it so that these learning spaces facilitate the sharing of knowledge instead of hindering it?

In this summary discover what research definitively reveals

- Recommended healthy noise levels and how it compares with today's average school environment levels
- What it takes to ensure good sound levels in schools
- How noise impacts students in their learning capacity and behaviour
- How noise affects teachers and the health risks involved, physically and mentally
- Perceived sound on concentration and annoyance levels in teachers and students
- Optimising acoustics for inclusive learning
- Noise levels and open plan classrooms
- How noise affects the vulnerable the most

This information is based on the comprehensive literature review process over many years by Prof. Bridget Shield, without whose work this summary would not be made possible. You can learn more about her research review in the conclusion.

80% of teachers are stressed by classroom noise[1]



Noise impact
on teachers and students

We know that good teaching* is the single largest influence on improving student learning. We all want to help talented teachers teach even better by providing the evidence that links good acoustics as part of a healthy indoor environment to be a key component in the overall pedagogical repertoire. For this, we have sourced evidence of the importance of reducing the negative influence of poor acoustics and its negative impact on teachers:

- Over 65% of surveyed teachers have experienced voice problems during their career[2]
- 32% of teachers stated that they had had voice problems, compared with 1% of non-teachers[3]

We must support students in more diversified activities which will help them best adapt in our rapidly changing societies. Students now need additional skills** including collaboration, communication, creativity and critical thinking skills.

These skills demand new ways for students to interact and engage in their learning process, meaning the acoustic environment has increased importance.

Students, with the benefit of good acoustics

- Increase tests scores by 5-7 %[4]
- Work more inclusively and better together[5]
- Reduce the sound level in collaborative group work by 13 dB[6]***
- Increased focus and decreased tiredness[7]

The 4 C's - 21st Century "high order" skills set out as a necessity for education outcomes**
Creativity
Critical thinking
Communication
Collaboration
This includes others which are essential for absorbing knowledge as well as for work performance.

*W.Imms University of Melbourne 2019 **OECD 21st Century Skills ***(Only 3db would be theoretically expected)

Sound and noise levels
common and recommended

Measuring sound
Noise is measured in decibels (dB)*. The decibel is a logarithmic unit which means that a doubling of sound energy, caused, for example, by doubling the number of speakers in a room, results in an increase in sound level of 3 dB.

Appropriate noise levels and typical school acoustic guidelines
Research backed guidelines provide a suitable acoustic range in classrooms for both the average listener and those with additional learning and hearing needs. Outlined below are maximum noise levels which ensure sufficient speech intelligibility and good communication. Levels include unoccupied background noise and the difference required to hear clear speech[8]:

- Maximum ambient noise levels, indoors 30-35 dB**
- For good speech communication there should be a clear difference in the signal to noise ratio (SNR) of at least 15-20 dB***
- Reverberation time (RT) depends on specific needs, the activity and classroom sizes. It should be approximately 0.5 seconds (can be a range of 0.3 - 0.6 s)****

Typical sound levels in decibels	
Four-engine jet aircraft at 100 m	120 dB
Riveting of steel plate at 10 m	105 dB
Pneumatic drill at 10 m	90 dB
Circular wood saw at 10 m	80 dB
Heavy road traffic at 10 m	75 dB
Telephone bell at 10 m	65 dB
Male speech, average, at 10 m	50 dB
Whisper at 10 m	25 dB

Sound vs. Noise

Sound is wanted.

Noise is unwanted.

*Whenever dB is mentioned in this brochure, it refers to dB(A) **BB93: acoustic design of schools - performance standards, BATOD: Classroom Acoustics - recommended standard ***The intelligibility of speech in elementary school classrooms Bradley 2008 ****Nordic Countries Classroom acoustic performance standard examples

Average classroom noise levels

Noise in schools is dominated by two factors
- External environmental noise (planes, trains and automobiles)
- Student generated noise in their learning activities

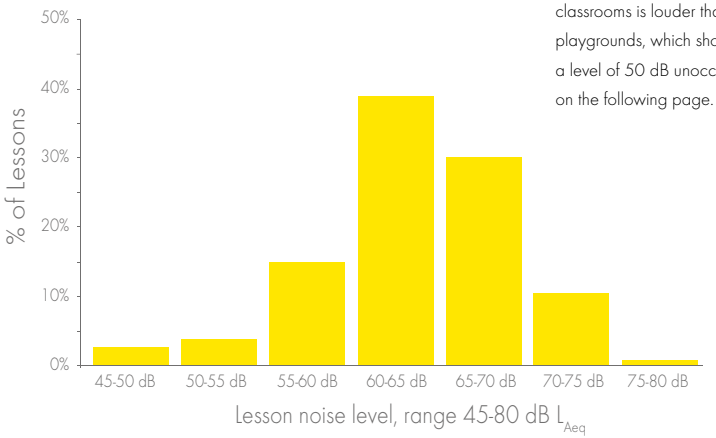
This study (referenced below) documented existing noise levels in schools by measuring spaces both occupied and unoccupied. The results show that the acoustic quality affects noise levels impacting on both student learning and behaviour.

Room acoustics impact lesson levels: Results of the research revealed that a number of classrooms had exceedingly high noise levels and required additional acoustic treatment to achieve suitable levels for teaching and learning.

Applying building legislation makes improvements: When legislation was introduced relating to school acoustics, it almost doubled the number of school spaces complying with the current guidelines at the time.

Acoustic design can affect student behaviour: Disruption time in the lessons was also recorded in the study (e.g., students talking or shouting), showing that less than ideal room acoustics can negatively impact student behaviour. Negative impact started around the average noise levels and another study[4] on page 8 showed these levels negatively impacted fundamental verbal learning tasks.

Noise survey of 274 lessons[10]



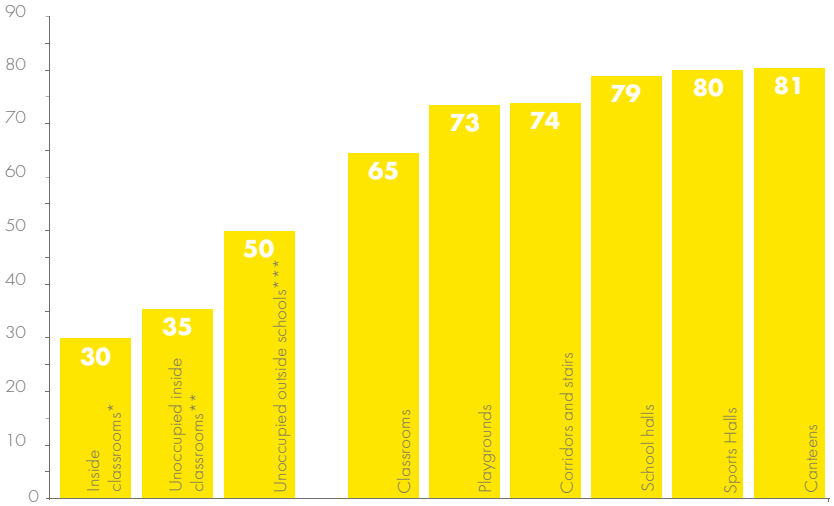
The majority of average noise levels in classrooms is louder than even outdoor playgrounds, which should not exceed a level of 50 dB unoccupied, as seen on the following page.

School noise levels
vs recommended levels

When looking at actual school noise levels, we see the typical magnitude of the difference between recommended noise levels and the reality. Both students and staff are exposed to noise in a variety of school spaces, beyond the classroom, where volumes can often be quite high. Halls and canteens are approaching the levels (over 80 dB) where actions should be considered to mitigate and control noise regarding occupational health legislation.

The summary below shows noise levels in comparison to the WHO recommendations outside the school (50 dB) and levels expected inside typical classrooms, refurbished classrooms (35 dB), new classrooms or those used by students with additional learning needs (30 dB).

Average sound level (dB)[8]



*Bradley, BB93 New build & SEN, additional learning needs **WHO, Bradley, BB93 refurb
***WHO recommendations

Achieving good acoustics
for good speech communication

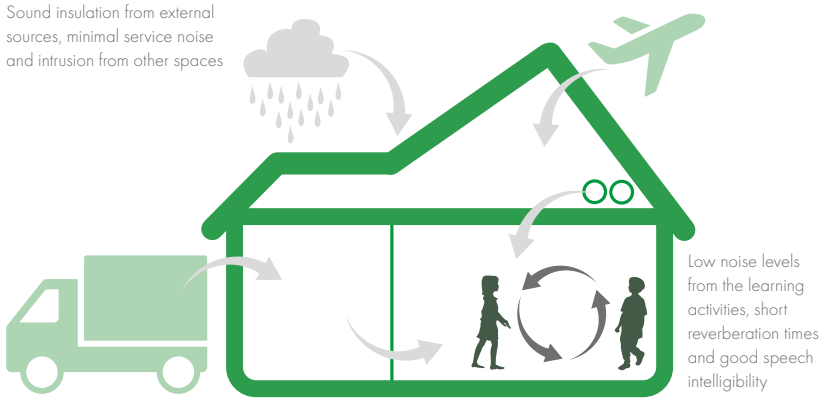
To achieve good acoustics which support all facets of communication; speaking, hearing and listening for one way and multi-way dialogue, it's necessary to look at building and acoustic design from various perspectives to ensure the following[8]:

Sufficient insulation from internal and external sources
- Low noise levels internally from installations and activities
- Short reverberation times* to minimise unwanted sound reflections
- Good speech intelligibility depending on the reverb time and SNR

There are two clearly identified aspects that influence a school's acoustic environment: noise and reverberation. In classrooms, noise may have many sources: from outside, building services (heating, lighting, ventilation systems), technology aids (projectors, computers) and increasingly – noise from the students themselves.

The quality and intelligibility of speech depends both on the level of noise and on the amount of reflected sound. Sound reflects off, and is potentially amplified from surfaces in the room; including walls, ceilings, floors, tables and whiteboards. Too much reflected sound from hard and flat reflecting surfaces degrades the quality of speech by increasing the noise level with late reflections, masking speech.

Key acoustic design aspects



*Sound reflections are quantified by the 'reverberation time' (RT) in the room. The time in seconds for a sound to decay by 60 dB. RT for speech should be short; around 0.5 seconds in classrooms, whereas for music, longer times of around 2 seconds are desirable. The RT can be reduced by increasing the amount of acoustic absorption in the room.

Effects on learner performance

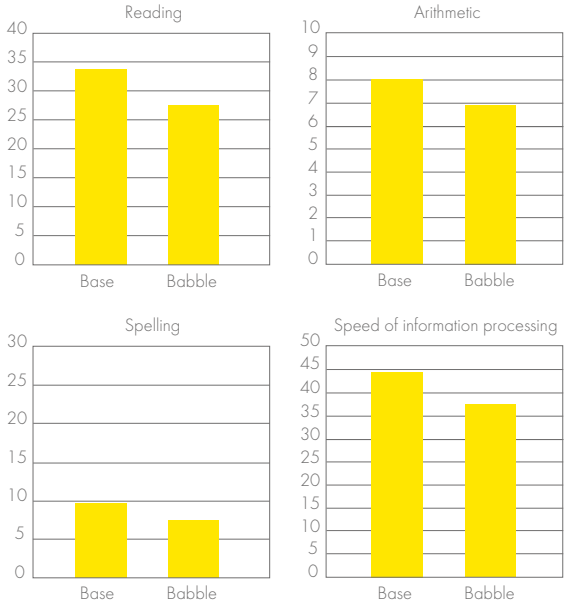
This study[4] compared different levels of background noise to understand their degrees of impact on student learning tasks. These two levels were comparing “quiet” background noise and “average” activity babble noise on learner performance.

Lower noise levels provide students with the opportunity for longer processing time, which results in greater accuracy. This study demonstrates that adolescents’ reading comprehension is vulnerable to the challenges created by unfavourable levels of classroom noise.

Typical classroom babble at an average of 65 dB has a significant impact on verbal tasks, arithmetic and speed of answering.

Children who had a cold, hadn’t slept well or were otherwise not optimally functioning were much more severely affected by the babble.

Experimental testing scores:
Effects of classroom babble on performance of primary school children



Noise interferes with the **processing of language**

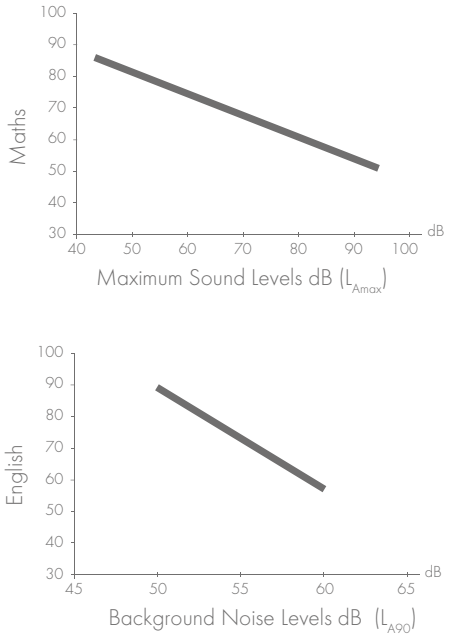
This study[4] demonstrates the impact of noise on standardised tests is detrimental to student results. Noise affects scores in language testing the most.

Comparing school standardised assessment test scores of young students with internal noise levels found significant negative relationships between the ambient background sound levels in classrooms and test scores for several subjects.

The test which showed the strongest association with noise was the language test. The results showed that background noise in the classroom interferes with general processing of language.

Increasing the noise levels clearly lowers the scores in two fundamental subjects, with a more dramatic impact in English.

Effects of noise on children’s scores in standardised tests



Good acoustics improve student

accuracy by more than 35%

Researchers made groundbreaking findings[11] that most noise in school classrooms was not caused by the assumed noise from planes, trains and automobiles, but by the students themselves during learning activities.

By Introducing a high performing "Class A" absorption ceiling

- Student accuracy improved by 35%
- Perceived sound level was reduced by half

Reducing noise levels has a physical and behavioural impact

The predicted theoretical effect of installing a Class A sound absorbing ceiling was a 3 dB sound level reduction for an unoccupied classroom. However, the real change is in the behaviour of the people in the classroom. Since everyone can be heard and understood without raised voices, students and teachers immediately spoke more quietly, in fact 7 dB more quietly, with a reduction of 10 dB overall.

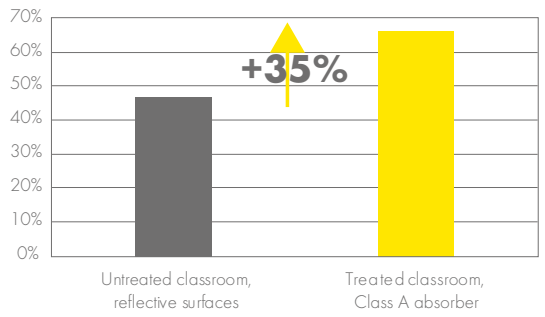
Better for group learning

The acoustic treatment reduced the background noise levels and shortened the reverberation time, resulting in better student performance in word intelligibility tests. The improvement was particularly positive when many students were talking simultaneously in the classrooms.

"Staff working in the treated classrooms say there's an enormous difference. Not only do they not have to shout to be heard, but there's generally a calmer, quieter and more relaxed atmosphere in the classroom. We're all delighted."

- Head teacher Miss Catherine Douglas of Balgreen Primary School

Percentage of correctly identified words

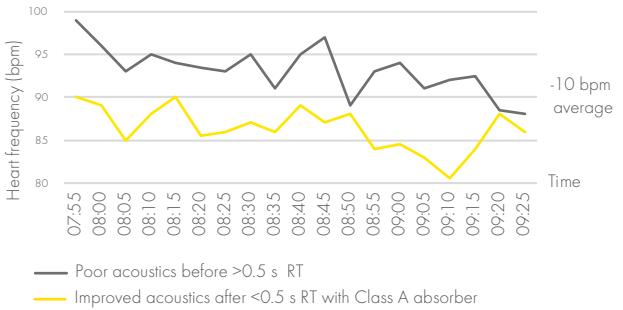


Good acoustics lower heart rates

When it was realised that 80% of teachers were stressed by noise[1], researchers decided to find out if these stress levels could be reduced by improving the sound environment. They also sought to discover how classroom noise actually affects teachers and students during activities[6].

With the Class A absorbing acoustic treatment, teacher heart rates calm down by 10 beats per minute (bpm)

Teachers' pulse in good and poor sound environments



How it's possible

If a classroom has poor acoustics, sound is amplified as it bounces off the reflective ceiling and walls. This creates background noise which distorts speech. Sound levels then escalate because instructors and learners have to raise their voices to be heard. This environment will often feel progressively more stressful as the class (or day) continues. (We refer to the study on page 14 about concentration and the Lombard effect.)

"Heart rate is a medically recognised stressor."

– Dr Gerhart Tiesler

Reducing noise and reverb reduces stress

Acoustically treated classrooms transform the space into more relaxed environment where everyone feels calmer, resulting in lowered teacher heart rates. Teachers experience considerably less stress in classrooms when reverberation time is less than 0.5 seconds.

Voice problems
are a health threat to teachers

Sadly, it has been consistently shown that teachers develop more voice problems than other occupations.

Threats to teacher vocal health

- Over 65% of teachers surveyed have experienced voice problems during their career[2]
- Teachers represent 16.4% of those diagnosed with voice disorders while being only 2% of the overall working population[12]
- Voice problems reported in teachers were 15% compared with 6% of the other (non-teacher) group[12]
- 32% of teachers stated that they've had voice problems, compared with 1% of non-teachers[3]

Based on numerous studies on teacher vocal health, teachers are at least twice as likely to have voice related problems versus other occupations.

Consequences of voice problems
on teachers' working life

This large study[13] compared voice related work problems and work absence between two groups: teachers and non-teacher occupations. It spanned a one year period (preceding the survey), featuring 2,400 participants. The findings show that teachers are more likely than non-teachers to restrict work activities and miss more days of work due to voice related problems.

	Prevalence (%)	
	Teachers	Non-teachers
Reduced activities on at least one day	43	16
Missed at least one day of work	18,3	7,2
Missed more than 5 days of work	3	1,3
Voice not functioning as usual for more than 5 days	35	22
May need to change job because of voice	2.0	0.78

Comparison of work related problems in previous year among teachers and non-teachers

Teachers miss more than twice as many days of work as those in other occupations.

Noise impact on student
concentration and behaviour

Contrasting acoustic conditions have implications on the number of dysfunctional activities

Less widely reported but still meaningful, this study [1, 6, 7, 14] shows that classroom noise level changes have a direct relation to student behaviour. During five morning lessons, 'dysfunctional' activities increased in classrooms with worse acoustics (RT 0.6 to 0.75 s), while in the rooms with 'better' acoustics (RT 0.4 to 0.5 s), dysfunctional activities remained approximately the same throughout the morning.

Lombard effect

As the day progresses, classrooms with poor acoustics result in more dysfunctional and disruptive behaviour following the progressive rise in noise levels.

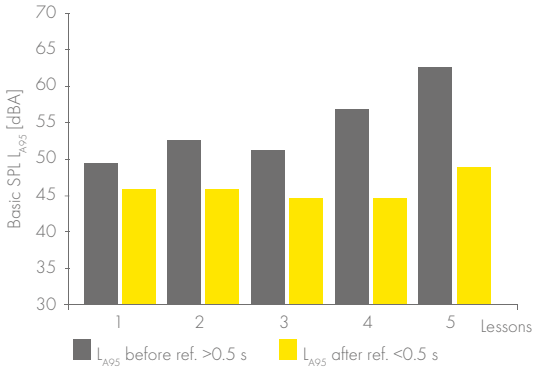
The improvement changes student behaviour

A sound absorbing ceiling reduces the overall sound level in the classroom and reduces the activity noise which alters the behaviour of students in a very positive way.

Easier listening encourages better behaviour

This study also monitored "dysfunctional activity" throughout lessons. This included interjections or disruptions by physical activities not relating to the lesson. As the sound levels were reduced, so were the dysfunctional activities, which related to increased concentration during the lesson.

Increase of activity sound levels (L_{A95}) before and after refurbishment



When noise levels are controlled, the levels of student concentration remain the same. This consistency with improved acoustics negates a large source of fatigue and stress.

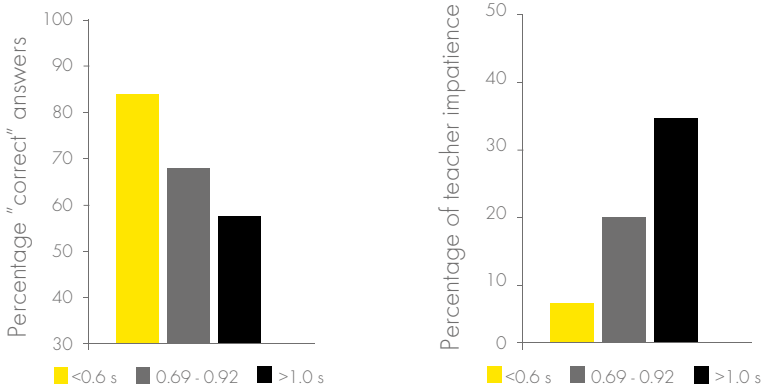
Poor acoustics lead to
perceived annoyance from noise

This study[15] analysed the effects of classroom reverberation on children's learning at school. It shows there's a direct correlation between classroom reverb and annoyance for both teachers and students.

The least amount of annoyance occurred in rooms with the least amount of reverb (the treated rooms). The majority of parents agreed with this statement: "My child suffers from the noise produced by his or her classmates in school."

Classroom acoustics (RT)	% annoyance
<0.6 s	44%
0.7-0.9 s	51%
>1.0 s	61%

Lowering the reverberation time (RT) improves students' ability when working in silence



Excessive reverb lowers motivation & reduces student rapport with teachers

Children from the most reverberant classrooms gave lower ratings in their motivation, and in their relations with peers and teachers. Typical classroom acoustic recommendations are for reverberation times to be around 0.5 s.

Noise sources,
acoustic conditions and speech clarity

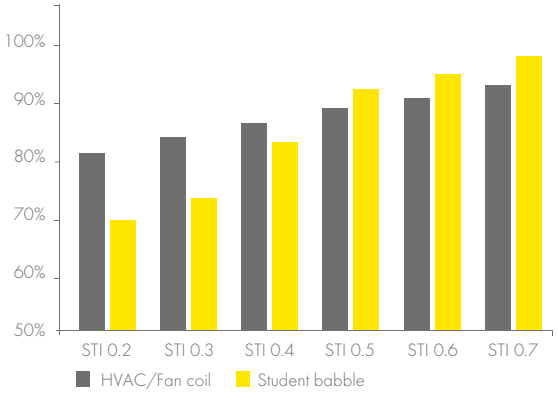
This study[16] researched speech intelligibility* in classrooms through objective and subjective surveys in order to understand the effect noise from different sources and varying acoustic conditions had upon student intelligibility scores.

Noise levels and reverberation affect the quality of speech for listeners. Lowering both improves speech intelligibility*. Speech intelligibility is measured by the Speech Transmission Index (STI**).

The higher the speech intelligibility, the better the quality of speech communication for all students. However the impact was more significant in younger children. In addition to comparing the negative effects of lower speech intelligibility, it was also clear that intelligibility scores were much more affected by classroom babble noise than HVAC ventilation noise.

STI descriptor	STI
Bad - poor	0,30
Poor - fair	0,45
Fair - good	0,60
Good - excellent	0,75

When looking at the impact of classroom babble (ie. group work), we see intelligibility scores increase from 70% to 98% (+28%). This is opposed to the impact of fan noise which went from 82% to 93% (+11%) with respect to the same improvement in acoustic conditions.



Excellent intelligibility of speech is important for all students and even more so for younger students. Particularly for classes engaged in group learning activities, where speech conversation is fundamental.

*Speech intelligibility is also related to the signal to noise (S/N) ratio, which is the difference between the signal (in this case, speech) and background noise in a room. STI** – Speech Transmission Index is a measurement method which indicates the level of speech intelligibility.

Speech must be heard clearly
above background noise

To hear and understand what is said in classrooms requires good speech intelligibility at an audible level. The speech needs to be heard above the ambient background noise. This is the signal to noise ratio (SNR) and the younger the listener, the greater their needs.

In a speech intelligibility study[17] it was found that while 15 dB could be considered a satisfactory SNR for the older children (age 11), the youngest children (age 6) required an SNR of 20 dB to provide adequate speech intelligibility.

Younger learners have increased hearing needs[18]

SNR requirements increase for younger children	SNR required for 75% to achieve 90% intelligibility score
6 year olds	+20 dB
8 year olds	+18 dB
11 year olds	+15 dB

In a later study, Bradley analysed speech in noise tests for children ages 6-11 in classrooms to determine maximum acceptable levels of ambient classroom noise. In order for 75% of the students to achieve a speech intelligibility score of 95%, younger children needed a higher SNR over a maximum ambient level of 35 dB. This allowed 80% of the youngest students to understand at least 95% of familiar and simple words.

Optimising acoustics
for inclusion of all students

For every upgrade in the acoustic treatment[5], both teachers and students became quieter and calmer. Learners generated less noise and instructors did not have to speak as loudly or strain their voice.

Results of acoustic improvement

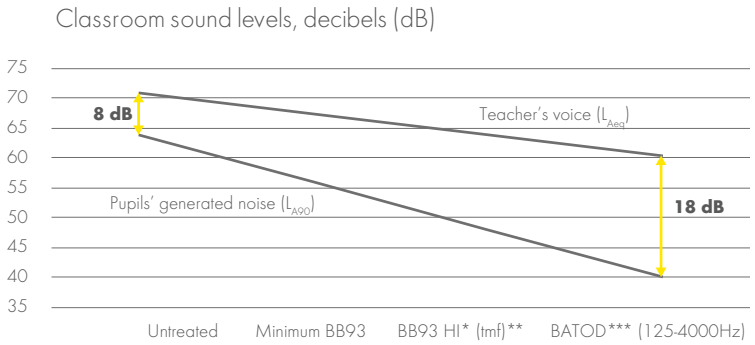
- More classroom discussions and group work
- More effective teaching and fewer repetitions
- Reduced teacher stress level

Untreated classrooms with poor acoustics

Background noise distorts speech and amplifies sound as it bounces off the reflective ceiling and walls. Sound levels then escalate because occupants must raise their voices to be heard.

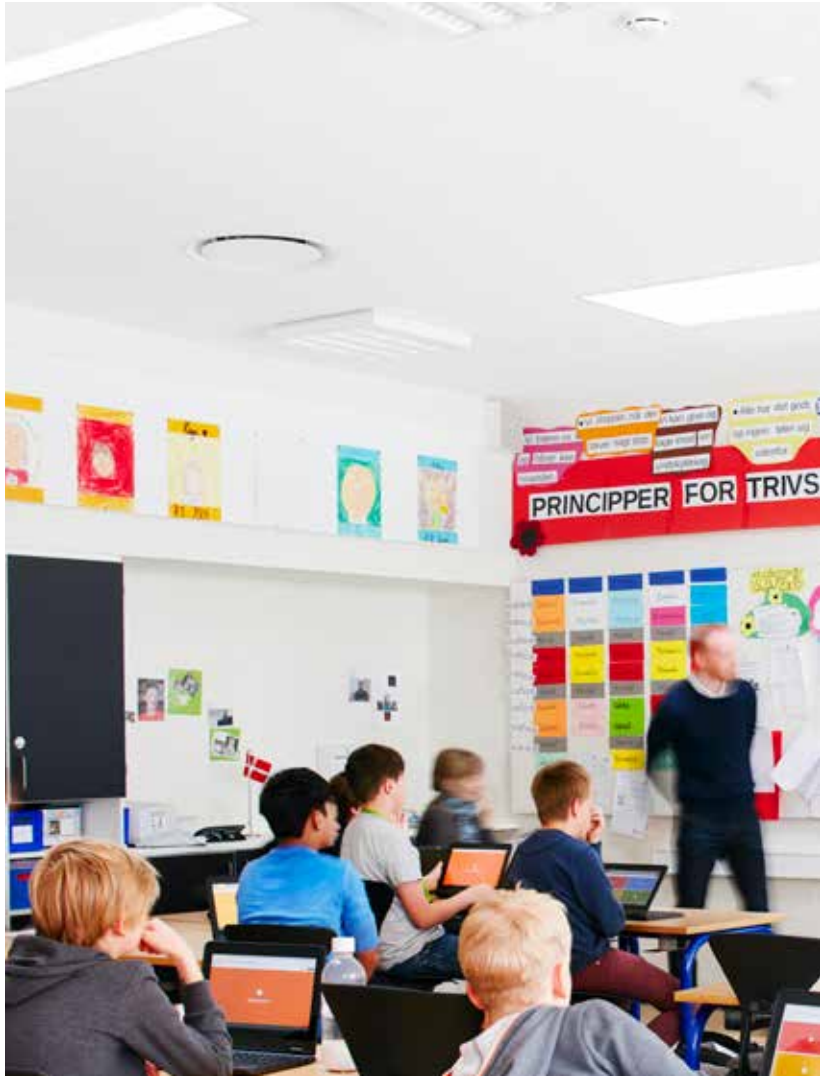
Increasing levels of sound absorption lowered occupied sound levels

A sound absorbing ceiling reduces the overall sound level. Adding additional low frequency absorbers reduces background noise and improves speech clarity, giving a better harmony across all frequencies.



*Higher performance for Hearing impaired. **(tmf) total mid frequencies; 500,1000,2000Hz.
***BATOD as recommended by the British Association of Teachers of the Deaf.

Theoretically a 3 dB sound level reduction would be expected per halving of RT. In fact, the reduction of sound level dominated by the teachers' voice was 5 dB and the underlying noise generated by the students by an even more significant 9 dB per halving of RT. Signal to noise levels increase from a mere 8 dB to 18 dB as shown above.



As the acoustic treatment improves, the signal to noise ratio increases and the pupils were found to require less effort to understand the teacher, and the vocal effort and stress of the teacher were also reduced.

The classroom with the highest performing acoustic treatment including additional low frequency absorption was consistently rated as providing the best conditions for both speaking and listening.

Improved acoustics support

collaborative group work

A study[1, 6, 7, 14] in Germany compared two classrooms of varying reverb times. They found a significant reduction in noise levels between them when the classrooms were occupied and the students were engaged in different learning activities. In the treated rooms, the sound levels were reduced dramatically with shorter reverb times, enabling:

- collaborative group work, because learning activities can be carried out with much lower sound levels – even below the level of one teacher speaking
- the teacher to speak at a lower level, reducing voice strain
- workload stress reduction due to the noise reduction

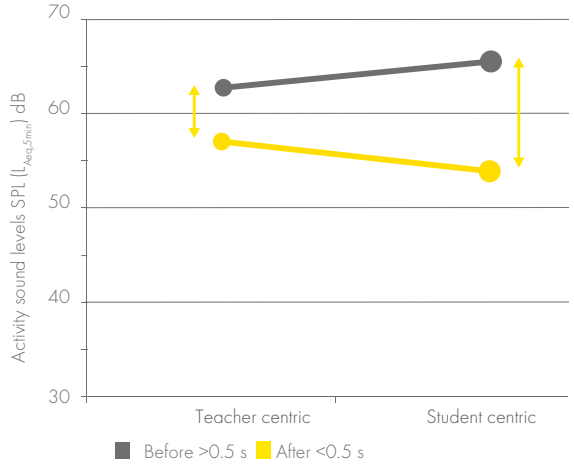
The treated rooms reduced noise levels 6 dB for traditional teaching and 13 dB for group work

A room that's acoustically treated is especially beneficial for group work because a number of people can speak at the same time, but more quietly, and without the need to compete in volume of speech.

"You buy a 3 dB sound reduction and you get 10 for free!"

- Dr G. Tiesler

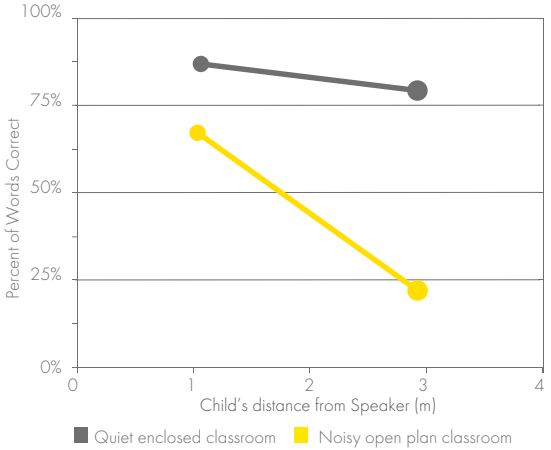
Activity sound levels before and after refurbishment



Open Plan Classrooms

This Australian study[19] looked into four kindergarten comparison groups: one enclosed and three open plan of different types and sizes.

Intrusive noise was measured for quiet activities (whole class teaching) and noisy ones (group work) in all the classrooms. Intrusive noise levels increased with the size of classroom and number of class bases, both for adjacent quiet activities and for noisy activities.



In open plan classrooms the further away the listeners are from the speaker the greater number of incorrect answers given.

Even when surrounding open classes were engaged in quiet activities, children at the back of the large open classrooms were disadvantaged due to higher noise levels. The above diagram shows that in a quiet, enclosed classroom, with an absence of outside noise distraction and disturbance, it's possible to hear to the back of the class. In open plan spaces, which were found to be much less quiet, as the listener is further from the speaker, the listening quality is considerably reduced.

In short, It is always good to cluster the listeners closer to the speaker in more open spaces as noise from adjacent spaces is more intrusive and distracting.

Perception and response
to noise in open plan classrooms

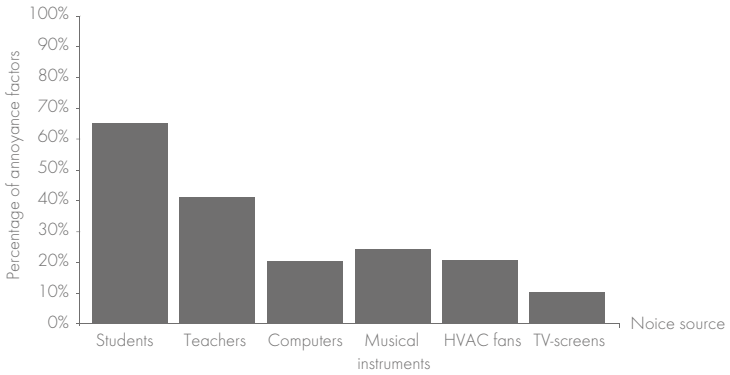
Looking at extensive studies[21], researchers have determined sound levels during activities are comparable between open plan and enclosed classrooms.

Despite the common perception that noise levels are higher in open plan spaces, noise levels appear to be quite similar to closed classrooms. In some, levels were higher in an open plan, however, in some cases they were lower. This is possibly due to low reverb times as a result of increased absorption and / or appropriate classroom management.

Noise, however, from other students outside the classroom is frequently cited as a source of annoyance and disturbance for them in both open primary and secondary schools. Children being taught in open plan classrooms are particularly susceptible to hearing irrelevant speech and, indeed, in surveys of open plan schools, speech from adjacent teaching areas has been cited as the most common form of disturbance. (Greenland, 2009)[20].

When asked to rate sounds that were the most annoying in open plan classrooms, 65% were fellow students from other classes, followed by teachers from other classrooms.

Sounds which annoy students in open plan primary school classes (n=408)



The vulnerable suffer the most

In any classroom there's likely to be a number of learners with special hearing and communication needs (SHCN) and special education needs (SEN). This not only includes hearing loss but also those with attention problems and those learning in a second language. Interestingly, it applies to anyone who is not in optimal condition, for example being under slept or under the weather.

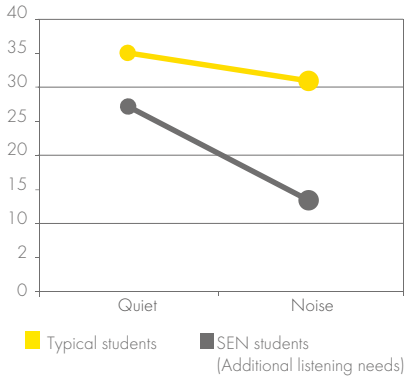
Hearing impairment increases the risk of fatigue and required listening effort and stress, which may jeopardise a child's ability to learn in a noisy environment and thus compromise their performance.

This study[4] explores the effects of typical classroom noise on the performance of primary school children in a series of literacy and speed of processing tasks, between regular and SHCN/SEN learners. Noise conditions were made to reflect levels and sources of exposure found in urban classrooms.

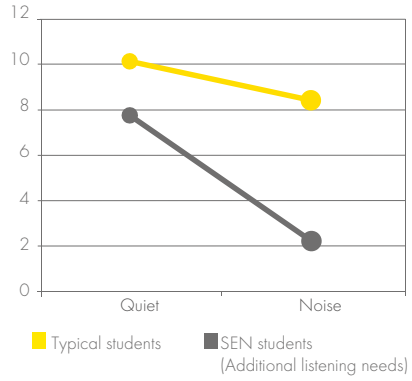
The two conditions were as follows:
"Quiet" base - that is, normal classroom conditions when the children are working quietly, with no talking and no additional noise. "Babble"- noise consisting of children's babble artificially introduced at a level 65 dB.

The results show children with special educational needs were most negatively affected, especially in the typical babble condition. They also reveal that test scores from learners with additional needs plummet when the environment became noisy, whereas typical listeners were much less impacted.

Maths scores in different conditions



English scores in different conditions



Hearing impaired standards set
criteria for inclusion

Students with SHCN or SEN are known to be vulnerable listeners but also attend mainstream schools, so any inclusion policies must support their additional needs.

Students who fall into the SHCN groups[8] are clearly students with hearing loss, auditory and attention problems and those learning in a second language. More comprehensively this includes students with:

- Permanent Hearing Impairment (HI)
- Severe or complex needs including:
  - Speech, language and communication difficulties
  - Visual impairments
  - Fluctuating HI caused by conductive hearing loss (colds, ear infections)
  - Attention Deficit Hyperactivity Disorders (ADHD)
  - Auditory Processing Disorder (APD) or difficulty
  - Being on the autistic spectrum

Increased background noise in classrooms affects the behaviour of students with autism, leading to more instances of disturbing behaviour. A correlation between noise levels and frequency of target behaviours was found; that is, as decibel levels increased, so did consequential behaviours[22].

Below, a standards summary from the UK (BB93 & BATOD) for noise and reverberation in classrooms for SHCN

In addition to SHCN requirements mentioned, it has been found that younger students also require the same signal to noise ratio (SNR) of up to 20 dB, that is the signal to be heard should be 20 dB over and above the background noise. (Bradley 2008)[17] All recommendations for SHCN students with vulnerable listening also apply to students who do not have these issues. So these more stringent conditions can only benefit all students.

Acoustic Criteria[8] - SCHN students	BB93 (2015)* BATOD**	
	New build	Refurbishment
Indoor ambient noise level*	≤ 30 dBA	≤ 35 dBA
Reverberation time*	≤ 0.4s, average 125 Hz to 4000 Hz octave bands	
	≤ 0.6s in each octave band 125 Hz to 4000 Hz	
Signal to Noise ratio** SNR	>20 dB, 125 Hz to 750 Hz	
	>15 dB, 750 Hz to 4000 Hz	

To enable an inclusive learning environment, students should have increased speech intelligibility and standards which recognise the importance of controlling reverberation at low frequencies* for sensitive listeners.**

***Low frequencies at 125Hz

Conclusion

In order to provide suitable working and learning environments that support the development of education- including newly critical 21st century skills- a good sound environment is a fundamental necessity.

We believe this research summary can provide much needed knowledge and awareness of the positive impact of improving acoustic environments. We believe it's a key component for teachers and students, in their overall health and wellbeing during teaching and learning activities. Good acoustics can support critical aspects of a positive culture in education. The result is enhanced participation and engagement for all.

As noted on page 18 in the study[5] comparing untreated with acoustically treated classrooms, a positive domino effect occurs: as the reverb time is reduced, students generate less noise, which affects better behaviour and more attentive listening.

When schools are designed with good acoustics, everyone can communicate more easily. The practice of sharing knowledge and ideas becomes a more productive experience. Imagine the exponential impact if teachers were able to remain focused on teaching and not controlling noise and disruptions, while students could spend longer periods engaged in a deeper state of learning.

Teacher testimonials from studies[5,14] with improved acoustics reveal

- Significant improvement in working conditions for both staff and students, describing the improvements to be both quieter and calmer
- Improved working environment and better classroom behaviour and comprehension
- Less experienced teachers reported the most reduction in stress levels
- Hearing impaired students can participate in classes more equally with other children

Stress and heart rates go down
Productivity and engagement go up
Reduced noise levels = greater concentration and better student performance

For a deeper look into the impact of noise in education, read the comprehensive "Classroom acoustics – a research review" 2019, by Professor Bridget Shield and Dr Nicola Shiers.

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