

SPACES FOR learning



**FINGRINGHOE
PRIMARY SCHOOL**
HOW A MODERN
MAKEOVER BREATHED
NEW LIFE AND
LEARNING INTO A
VICTORIAN SCHOOL





HELLO

Working for Essex County Council (ECC) and managing an in-house team of professionals (such as architects, engineers, town planners and clerks of works) means that quite a lot of my time is spent discussing technical matters. It's an interesting, challenging and rewarding job.

But what actually makes us all get out of bed in the morning is knowing that a well-designed and well-built school creates a great learning environment.

And when this is coupled with inspirational teaching, we know we are giving the young people of Essex the very best schooling experience we can.

Good acoustics, daylighting, artificial lighting, temperature, ventilation, etc are all key factors in creating the right environment for teaching and learning. Whilst these are relatively straightforward to incorporate in a new-build school project, the challenge is what can be achieved within an existing classroom, where budgets are tight and the school was built in a different era. Can we make worthwhile improvements?

Back in 2019, I was delighted when Professor Stephen Heppell accepted my invitation to speak at one of our ECF (Essex Construction Framework) 'Best Practice' sessions. These are held quarterly in the council with our contractors, designers, ECC staff and other stakeholders, with the simple aim of sharing knowledge, learning from others and improving outcomes for our customers (95% of which are schools). During that session, Stephen explained how incremental changes can make such a difference to a classroom environment, just as we've seen in sport – especially with the British cycling team in recent years. The changes ranged from small, low-cost and easy to implement ones, like

children each bringing a plant to school to improve oxygen levels, to more extensive changes requiring specialist contractors (such as upgrading lighting).

What was clear, however, was that the changes presented could be introduced individually and/or over a period of time. Many were both straightforward and affordable for schools, with some also offering ideal opportunities for PTA funding.

By the end of his excellent and animated presentation, we had a room of 70 eager attendees ready to implement his ideas. And so, the Fingringhoe Primary School project was born. With amazing help and support from headteacher Suzy Ryan, the staff and the children, a brief was developed with Stephen. It concluded that there was a need to improve the lighting, acoustics and CO₂ levels, in addition to replacing some furniture, introducing 'write-on' surfaces and making some decorative changes. The children were engaged and excited about the changes being discussed.

Key Essex County Council project objectives were agreed to deliver improvements that were cost-effective, attainable and proven, and which could then be promoted and emulated by other schools. They would also inform other work in our estate, help build reflective practice amongst colleagues and children, and promote physical activity, making learning better today.

As you read through this, you will gain an insight into the work undertaken by those who supported and drove the project: dedicated and passionate individuals working collaboratively to deliver change with one overriding goal – to improve the outcomes for young people. Without their goodwill, time and support, this project would never have started. And, of course, a very special thank-you to all the year 6 pupils for their contributions and suggestions.

Enjoy our story and hopefully you will be encouraged to try your own project and make a difference.

Greg Keeling

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Essex County Council

WHAT'S GOING ON IN HERE?

A Gratnells Learnometer measures all the relevant environmental conditions in a classroom to give you the data you need to make informed decisions about what changes will have the greatest impact on learning. And it was for this reason that Professor Stephen Heppell turned to it first when talking both to the school leadership team and students at Fingringhoe.

The seven critical factors monitored by the Gratnells Learnometer are:

Light Children don't learn as well when light levels are low, and behaviour suffers too. If light levels are uneven across a classroom there are equity issues too. High levels of natural light are ideal, and any electrical lighting should have suitable Kelvin values.

Temperature Levels are proven to influence the performance of children in the classroom. There is an optimal temperature range for learning; outside that range, performance suffers immediately.

Carbon dioxide Levels above 1,000 ppm increase sleepiness, hamper the ability to concentrate, and increase heart rate and feelings of nausea. The severity of symptoms increases as levels increase and varies from person to person.



Noise Noisy rooms obstruct children's ability to concentrate and perform, wherever they are. The type of sound matters too, and if background music is present then it should be below 80 beats per minute.

Humidity Humidity has an effect that is closely linked to temperature and raises similar concerns, as it also contributes to other health risks such as the growth of toxic mould spores. Dehydration reduces cognitive performance.

Pollution Exposure to Volatile Organic Compounds (VOCs) can cause headaches, dizziness and tiredness, nasal congestion, coughing, wheezing and sore throats. It can also trigger allergies, asthma, skin irritation and eczema. Long-term exposure makes it more difficult to concentrate, learn new things and remember.

Fine dust (PM2.5) Micro-particulates can travel into children's lungs and exacerbate asthma, plus impact levels of attendance. They have also been associated with cognitive impairment.

Taken individually, optimising each of these factors will only have a small impact on learning. But when addressed together, we see an aggregation of marginal gains: a measurable impact on learning and improvement in student outcomes.

As part of ongoing research, and its introduction across the education sector, Learnometers have been placed in over 100 schools around the world, where data is being monitored and collated to identify interventions that can positively impact the classroom environment and cognitive performance. Hundreds of staff and pupils across the globe have been experimenting with how to reduce noise, raise oxygen levels and improve lighting,

thereby finding their own local solutions to specific problems.

At Fingringhoe, what this identified was that in their existing classroom, none of these factors were ideal – light levels were typically between 200 and 300 lux (500 lux is a recommended minimum), CO₂ levels were up to 2,500ppm (anything over 1,000 will induce sleepiness) and the temperature was up to 25°C (above 21°C and concentration drops). This fascinated both staff and students. Hayley Rollings, Deputy Headteacher at Fingringhoe and the class's teacher the previous year, said, "Without this technology, we wouldn't necessarily notice these things in a teaching day. Previously you would just come in to the room and you might say 'it's a bit hot' or 'it's a bit cold'. But our awareness of different factors that affect learning has increased. We are starting to have a better understanding."

As a result of this initial survey, a programme of works was determined that included changing the lighting, the addition of acoustic treatments and replacing some of the furniture. And, even after these alterations were made, the Gratnells Learnometer remained as part of the normal school day.

"We've printed off some graphs," explained the Y6 teacher at Fingringhoe, "and the pupils have seen that when they're not here overnight the graphs change and they can work out when they've been out to play, for example." These visuals were then displayed in the school foyer to raise awareness across other year groups, as well as reminding them when to open windows to allow more fresh air in.

CREATING FIRM FOUNDATIONS

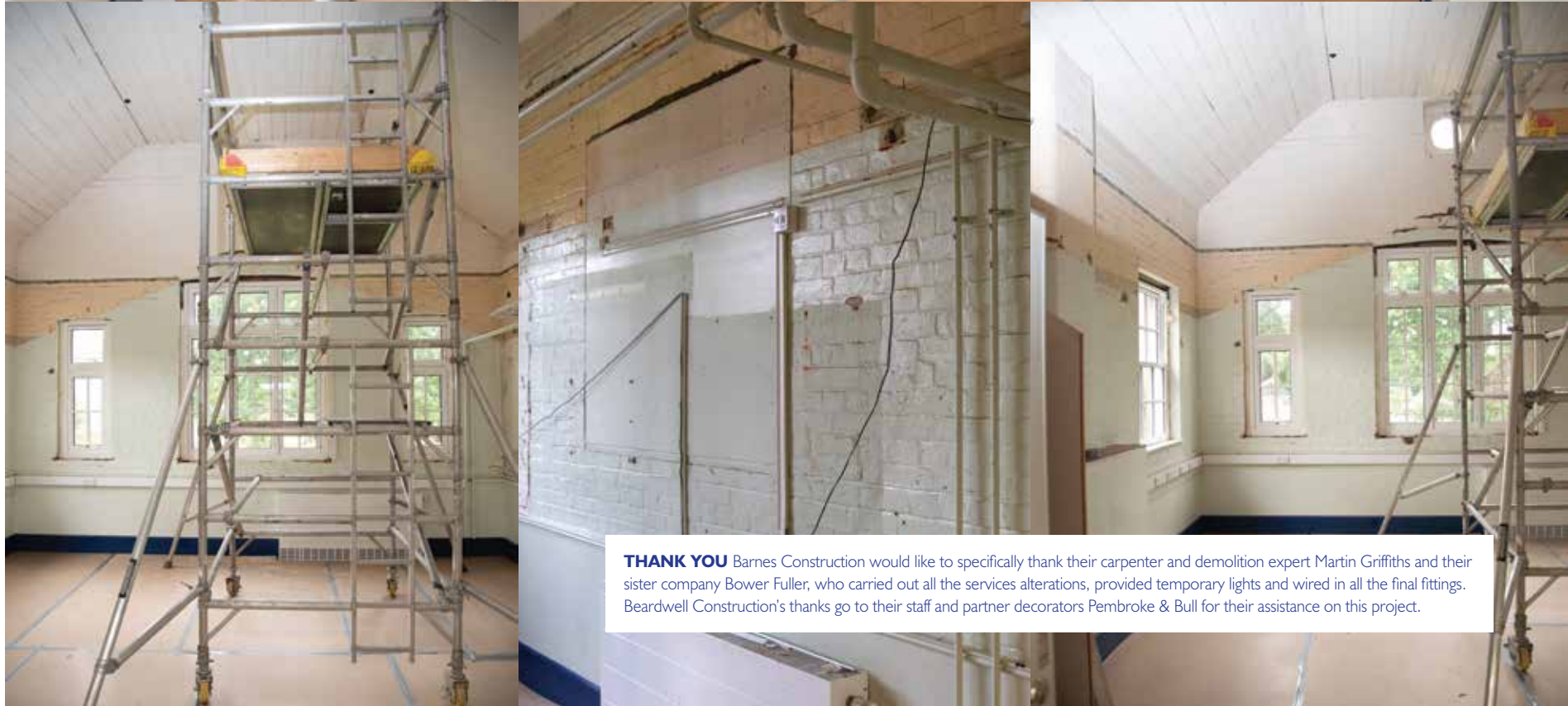
After a request was put to the Essex Construction Framework contractors for help to improve the learning space at Fingringhoe Primary School, surveyors from two contractors (Barnes Construction and Beardwell Construction), Essex County Technical Managers, the Headteacher and Professor Heppell met at the school to review the class space and decide upon the scope of works.

It was immediately apparent that the original ceiling had been lowered by introducing a series of timber trusses, the underside of which had hessian fixed taut, presumably to provide some degree of sound absorption, but which unfortunately created a low and dark ceiling. Within minutes a set of steps and a Stanley knife appeared and the 'survey' of the space above commenced. There was no going back now! Cutting back the hessian revealed the original, timber-lined, vaulted ceiling, along with numerous hidden services [such as radiator pipes and electrical cables]. But it was clear that the existing dark and confined space could be significantly transformed.

In the true spirit of co-operation and collaboration, Barnes and Beardwell soon worked out a split of the works. One contractor would complete all the strip-out and services alterations, whilst the other would complete the refurbishment. The two companies jointly set about the task of making significant improvements to the teaching area.

Dulux Light + Space paint in Brilliant White was used on the walls – its light-reflective particles reflect up to twice as much light back into a room, compared with Dulux's conventional emulsion paints.

Both companies were delighted to help Essex County Council and Fingringhoe Primary School re-develop their tired Victorian classroom and see the wealth of improved learning features incorporated into the project. They were excited to hear of positive outcomes in terms of learning and the fact that a clear link to the quality of learning environment could be established.



THANK YOU Barnes Construction would like to specifically thank their carpenter and demolition expert Martin Griffiths and their sister company Bower Fuller, who carried out all the services alterations, provided temporary lights and wired in all the final fittings. Beardwell Construction's thanks go to their staff and partner decorators Pembroke & Bull for their assistance on this project.

Linear luminaires by Thorlux

Dulux Light + Space

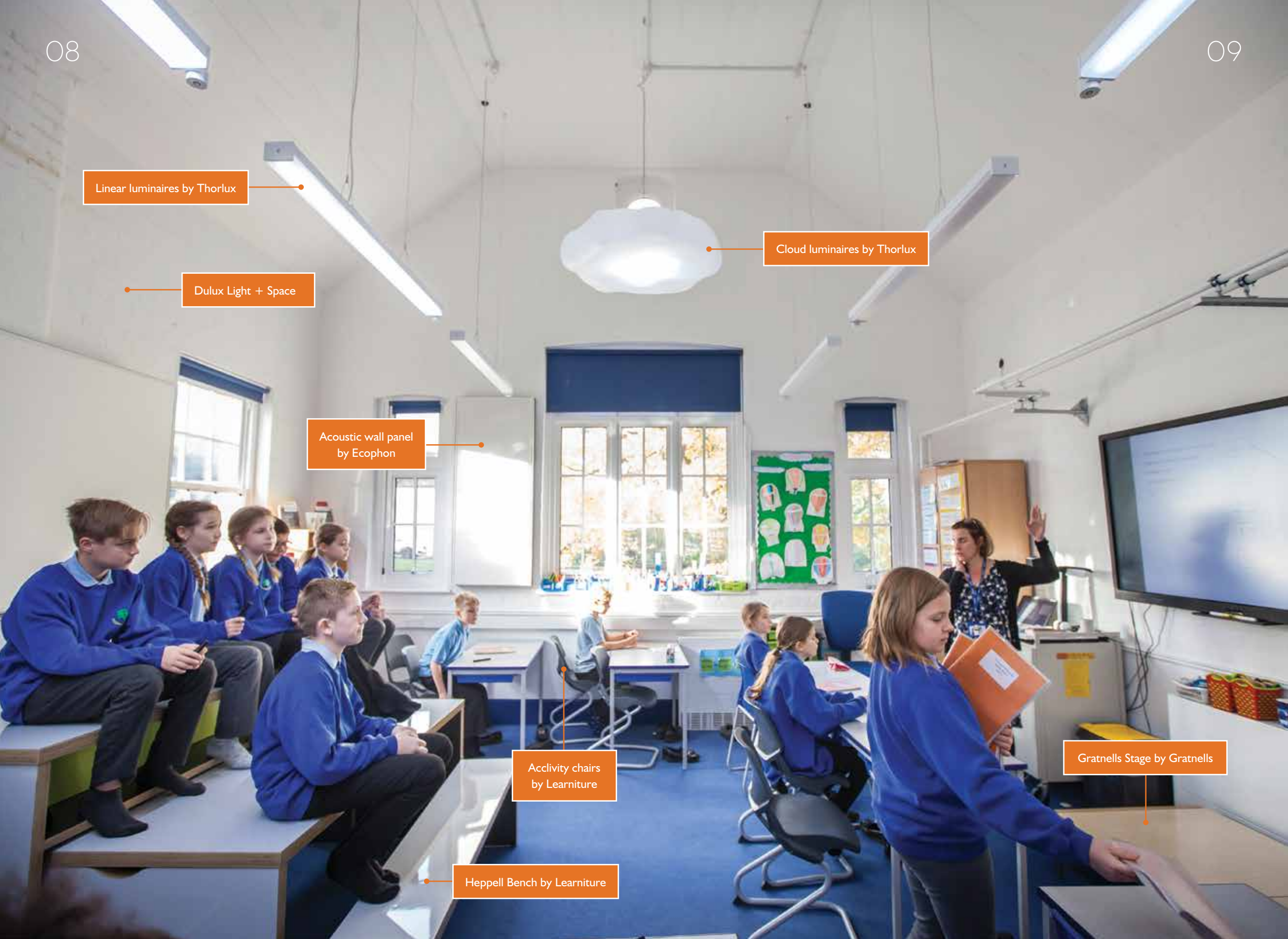
Acoustic wall panel by Ecophon

Cloud luminaires by Thorlux

Acclivity chairs by Learniture

Heppell Bench by Learniture

Gratnells Stage by Gratnells





‘I LIKE TESTING THE DIFFERENT COLOURS OF LIGHTS FOR DIFFERENT TASKS.’

BEA

Good lighting of any learning space is vital to ensure students are engaged and stimulated. The challenge is to ensure that work surfaces are lit sufficiently which, for a classroom, can be the tables, chairs, walls, floors, whiteboards, or anything else that’s used to educate.

SEEING THE LIGHT

This means lighting different types of surface, reflections and colours. These surfaces can have different orientations and heights, so we need to ensure light falls on the vertical as well as horizontal planes. The lighting of vertical surfaces is important to read other people’s facial expressions to better understand each other, whether student to student, or teacher to student.

The existing lighting was dark, dull and outdated. During the design process, Thorlux proposed a solution that replaced the existing fluorescent fittings with new LED luminaires that brightened the space as well as saving energy. A lighting control system was introduced to allow flexibility of the environment through brightness, colour appearance and lighting scenes.

The Thorlux SmartScan wireless control system incorporates integral sensors within each luminaire, providing both automatic and manual lighting control, energy usage monitoring and luminaire status reporting, alongside Thorlux ColourActive.

Thorlux worked with Professor Stephen Heppell and Essex County Council to deliver a dynamic and flexible environment to cater for all sorts of activities. They selected suspended linear LED luminaires for the main usable light and enhanced this with Thorlux Cloud luminaires in the centre to give a different level of interest to the ceiling void. The simulated clouds give a sense of the outdoors and are a fun addition to the scheme.

The users can change the lighting to increase light levels and colour appearance via the ColourActive touch plate on the wall, or via the app. The lighting automatically changes colour throughout the day, from a warm white in the morning (yellow hue), through to cool white in the middle of the day (blue hue), to a warm white in late afternoon to simulate changes in natural daylight. Users can override this to create their own unique feel at any time of the day.

SmartScan controls can also recall pre-configured lighting scenes which allows luminaires to be individually controlled. The teaching staff commented that the whiteboard scene is used regularly and is of great benefit to the class. This scene allows the whiteboard to be seen clearly by dimming the luminaires closest to it during operation of the display screen.

The Learnometer research has shown that below 500 lux, students have a shorter attention span, engagement and recall. Their behaviour and performance are noticeably worse. The lighting was therefore designed to achieve higher light levels than recommended in lighting guidance at around 700 lux, which could be dimmed to suit requirements. The design used a mixture of luminaires to give interest and to ensure light to all corners of the room, leaving no child left working under poor lighting levels.

Following feedback, the teaching staff reported that the new lighting encourages student engagement. Students enjoy being able to change the lighting and are often the ones initiating the change.

The new lighting installation has been used by two year-groups so far and the teacher has already noticed that the different groups favour different lighting conditions. She has found she can control the mood of the students using the lighting, with warm light having a calming effect and the cool light giving them a lift, focusing them almost instantly. The cool light is most used in the afternoon when attention spans start to struggle.

Thorlux were delighted to be part of such a pioneering project investigating the environmental effects on student learning. This new approach to classroom lighting indicates that it can have a significant impact on behaviour and, therefore, learning experiences, and demonstrates the need to look beyond the current regulations and standards.

RIGHT HEAR, RIGHT NOW

At Ecophon, we're used to working in every conceivable school type around the world. Being Swedish, we have a long tradition of reflecting the sound environment we find in nature, inside the classroom, for optimal learning.

We were pleased to be invited to improve the acoustics in the reverberant (echoey) Victorian primary school at Fingringhoe.

Victorian schools in Britain originate from the 1870 Elementary Education Act, which made primary school education compulsory. This required the quick construction of a large number of schools in large, industrialised cities through to leafy green villages. They were built to last, and today England and Wales still utilise some 3,000 of them.

Characteristics of the Victorian school include the height of windows from the floor, to minimise distraction to the children, and high rooflines with their cupolas. Whilst the build quality is widely acknowledged to be skilfully executed, especially the brickwork, Victorian schools can be challenging to adapt to modern teaching methods.

We know that conditions in the classroom can have a huge impact on children's ability to learn, especially the acoustics, second only in importance to daylighting. A false ceiling had been installed in the 1970s which was, quite rightly, removed to open up the space for improved air quality and to allow more natural daylight

in. This, however, resulted in an increased acoustic challenge.

Before work commenced, Ecophon worked with Adrian James Acoustics, known for their work on the ground-breaking Essex Study into school acoustics*, to provide test data before- and post-refurbishment. As expected, once the old ceiling was removed, the classroom provided a very unsatisfactory 1.2 secs Tmf (125Hz – 4000Hz). Having even a subtle echo in learning spaces can cause a range of challenges for the teacher and pupils:

- 1 **Poor speech intelligibility** – students (especially under 8s) can't always understand what their teacher is saying
- 2 **High background noise levels** – the greater the echo, the more loudly pupils speak and so the noise level increases (Lombard Effect)
- 3 **Poor memory skills**
- 4 **Lower attainment**
- 5 **Poor behaviour**
- 6 **Lack of focus**
- 7 **Vocal strain and headaches for the teacher**

We know that, on average, 70% of teaching still happens vocally from teacher to student. The teacher needs, ideally, to be heard at 15-20 dB(A) above the background noise level to teach effectively. Adrian James Acoustics measured this 'speech intelligibility' at just 40%-50% before the Ecophon intervention, moving to 80% (very good) afterwards!

*<https://www.ecophon.com/en/articles/knowledge/essex-study---good-acoustics-enable-effective-group-work-in-classrooms/>

"We took measurements of the room before and after installation of acoustic panels. It was important to establish the veracity of our readings, so that the true benefits of the treatments could be measured. Using WinMLS software, we assessed reverberation time (T20 and T30), Clarity, Definition, Strength/Gain and Early Decay Time. Before treatment, the mid-frequency reverberation time level (TMF) was measured at 1.2 seconds. However, once the acoustic products had been installed our readings revealed a huge improvement, down to a level of 0.6 seconds. These results put the new acoustic performance well above the BB93 standard and close to the rigorous standards specified for SEN pupils. I sincerely hope that this research, supported by Ecophon, encourages other education authorities to start providing the acoustic conditions that pupils and teachers deserve."

Adrian James, Director, Adrian James Acoustics



BACK TO BASS-ICS

Acoustic rafts come in a range of shapes and sizes, including clouds, and can easily be installed to work around existing services and light fittings. Acoustic wall panels are usually necessary with a high ceiling and are essential when catering for students with special education needs, e.g. autism or hearing impairment.

Low sound frequencies have more energy than higher frequencies and can be challenging to absorb; you may have experienced these phenomena if you have noisy neighbours playing music too loudly. It will be the bass frequencies that you hear coming through the wall or from inside a vehicle. At Fingringhoe we utilised our inexpensive bass pads behind the wall panels to provide a low frequency-absorbing boost.

BRINGING NEW IDEAS TO THE TABLE...

One of the things that furniture can do for a classroom is to provide options. The options available when you have 15 rectangular tables and 30 chairs, together with a teacher's desk, are limited. Of course, you can arrange them in rows, a horseshoe or groups (as long as the groups are of even numbers) but, from the learner's perspective, their only option is to sit on a plastic chair, next to someone else, at a double table.

At Fingringhoe we removed some of the tables and replaced them with a Heppell Bench. Designed in association with Professor Stephen Heppell, and manufactured by Learniture, a Heppell Bench is a set of four benches – two low, one mid and one high. Pushed together they form a quasi-tiered seat. Separated and you have a big 'family table' with learners sitting either side, as well as a separate standing-height table. And all the surfaces are dry-wipe LearningSurface® – one (or four!) enormous white boards.

"I feel less restricted when I work there," one child commented about the Heppell Bench, whilst another added that it was his favourite "because I can show my workings-out and it's fun". Professor Heppell explained that writeable surfaces work so well "because when you write publicly, it's a social activity and people remember the moment".

The large folding doors that separated the classroom from the adjacent hall were covered in LearningFilm – a magnetic, dry-wipe, self-adhesive film – so, if a student wasn't sitting at the Heppell Bench, they still had access to enormous whiteboard surfaces.

In an unused corner, a member of the Essex team constructed shelving in a recess from upcycled timber, so the students had somewhere to put plants – one each, cared for by individual learners. In addition to instilling a sense of responsibility (at another school, one student's attendance record improved markedly because they were so keen to look after their plant!), plants also convert CO₂ into oxygen.

Finally, to create additional learning space, the traditional teacher's desk was removed (teachers can always sit at the Heppell Bench when they're planning, after school) and replaced with a simple Dash teacher console – a standing-height lectern. Teacher desks typically constitute "a frighteningly large (usually around 20%) loss of the learning space available," explains Professor Heppell on his website. "Amongst other things, they provide a literal barrier to effective team teaching and collaboration and impose an unnecessary inefficiency of movement around children's learning." Adding to the democratisation of the space, a section of Gratnells Stage was added to the traditional presentation area at the front of the classroom.

Together, these interventions have created opportunities to do different things in the classroom. And students now have a choice in where, and how they learn. Moreover, teachers can now change the classroom dynamic simply by altering where key items of furniture are located, and how.

'I FIND IT EASIER TO CONCENTRATE BECAUSE I CAN CHOOSE HOW AND WHERE I SIT.'

BEN

ARE YOU SITTING COMFORTABLY?

Ergonomists have proved that the concept of sitting bolt upright with thighs horizontal and lower legs vertical, creating two neat right-angles (remember those diagrams?), is fundamentally flawed when you look at how the muscular-skeletal and cardio-vascular parts of the body work. Most of the vital organs are located in the lower abdomen and have arteries running through them carrying oxygenated blood to the brain. Creating a 90-degree angle between the thorax and lower limbs constrains these organs and restricts blood flow. Research carried out in Germany has proved a direct link to cognition.

So where rectangular tables were retained at Fingringhoe, the seats were changed to Acclivity chairs, slightly higher and slightly shallower than those they replaced, meaning the angle between the back and the thigh opens to nearer 110 to 120 degrees. The 'waterfall' edge on the front of the seat, meanwhile, ensures that the popliteal artery (that runs down the back of the knee) isn't trapped.

I love using the Heppell bench because it is better to do workings out or writing on. This is because if you get it wrong you can just rub it out more easily which means we are less frightened of making mistakes.



HEADTEACHER'S REPORT



We learnt a lot working on this project with Professor Heppell, Greg's team from Essex County Council and the various specialist companies they brought in.

Three years earlier, the staff had wanted to take action to address demotivated and disengaged older pupils. Seeing children start school in the early years – motivated, excited and curious – they were keen to harness this love of learning and instil it further up the school. So, between 2016 and 2018, a school ethos underpinned by a growth mindset was introduced and embedded. Many people may have heard of a 'growth mindset', many schools may say they 'do it'; however, at Fingringhoe we wanted to ensure that it permeated everything we did.

Now, we, the staff, believe in it. It is part of our core values: Courage, Care & Compassion. Courage is taught explicitly through assemblies and the curriculum. It is modelled by staff. Behaviours for Learning skills (based on a growth mindset) are assessed. Pupils are encouraged and praised for demonstrating it.

However, although situated in an idyllic setting, next to a village pond and historic oak tree, the school has its fair share of challenges. Ensuring we are as inclusive as possible, within a 150-year-old building, requires a good deal of creativity – particularly when there are no spare spaces for supporting children who find classroom environments cognitively overloading. So, when we were approached with an exciting project to improve learning spaces, we were intrigued.

We had spent time developing pupils' attitudes to learning but we hadn't given much thought to the physical learning environment. Together with the Professor, Essex County Council, pupils, parents and many generous volunteers, we decided to start a journey of making our Year 6 classroom a better learning space...

Fingringhoe School was built in 1863 and is perhaps the smallest school premises in Essex, accommodating just four classes. The primary schools I had taught in for over 22 years had barely changed their classroom designs, layouts, way of working or displays – let alone given thought to acoustics, lighting, air quality and classroom management. We were sure this could have a positive impact, not only on pupils' attitudes to learning, but also for pupils with more complex needs.

The Year 6 pupils agreed that they felt that they had more ownership of their learning because:

- they are allowed to make choices about how they sit, where they sit, where they write;
- they have been involved in the design of the classroom from the start;
- they have been involved in testing out which environments help them to concentrate and focus better – such as changes to lighting and furniture;
- they feel the staff treat them as 'grown ups' and feel listened to.

“PUPILS ARE NOW STARTING TO UNDERSTAND HOW ENVIRONMENTAL FACTORS CAN AFFECT THEIR LEARNING”

Pupils are now starting to understand how environmental factors can affect their learning: they seem to be more aware of when they are focused and when they are not and the factors that may contribute to this. Staff have developed an assessment tool to track pupils' behaviours for learning: they carried out a teacher assessment and pupils audit in September and December 2019 to monitor impact. Case studies have been collated to show the effect on individual pupils. And environmentally, we know we're providing the best conditions for learning – logging onto our Learnometer dashboard, for example, we can see light levels are consistently above 500 lux, CO₂ between 500 and 800 ppm, and the temperature between 16°C and 20°C.

Suzy Ryan Headteacher

LAST WORDS

Schools lie at the heart of their communities. Children within them are central to those communities' futures. For many small, often very stable, communities around the world, ensuring that their children can be the very best that they can be is an obvious goal.

Today, we know so much about optimising learning environments. It was hugely satisfying at the beginning of this project to be introducing and exploring those many details with the children, parents and teachers.

As the various contributors to the project have already outlined, together we looked at all the factors that research tells us impacts learning and it was quickly apparent that there was an impact from each of these variables. "No wonder they struggle, sitting in that hot gloomy corner!" or "I understand now why I go home with a headache every Friday." But we saw how quickly small changes could impact: opening doors and windows, stripping paper off the glass, adding plants.

There were moments of surprise too. Looking up at the suspended ceiling it was apparent that the roof was a lot higher than the ceiling panels.

Beyond the children's delight at dead birds raining down on me when I pushed up one of the panels, was the excitement of a whole undiscovered vertical dimension to the learning space. It had the most delightful barrel roof, as you'll see from the 'after' pictures in this report. We saw pipes, skylights, space, opportunity!

As the project progressed, the language changed from 'me' and 'my' to 'us' and 'our'. The room became a focus, a learning object in its own right. The children had a view on everything, but not a view that was merely an opinion, their views were built on data from their Learnometer, on science, on inquisitiveness and on problem-solving. As they introduced me to the many plants and chatted about the impact on CO₂ through photosynthesis, it was clear, above and beyond the dramatically improved light quality, transformation of sound quality, the new teaching approaches ushered in by some featured furniture and more, that the real change was in the children themselves.

The research literature speaks of 'student agency', of 'meta cognition' and of 'reflective learners', but beyond the terminology it was enough to see the children looking around their learning space, noticing, wondering, discussing. As one teacher said, "If the names hadn't been the same in the register, I wouldn't have believed they were the same children."

This was a collaborative effort by many. Professional knowledge ran deep and is all too often anonymously contributed, but here we were all learning from and with each other as the project progressed. Modelling and managing the sound quality, or setting lights with adjustable Kelvin values, is complex science. Our experts knew their stuff.

Also, it was a local authority project. Local authority professional officers have years of experience, reaching back decades. Many Essex LA employees put themselves forward freely to help a bit, with painting, with details, even with the dead birds...

Sometimes, policymakers forget the value of this body of local expertise with their passion for learning. This project didn't.

The ripples of change spread out through the community too - into homes, the church, outdoors, everywhere. The Aggregation of Marginal Gains model says that many tiny changes together can make a substantial difference. But tiny changes are not expensive. Probably our most expensive changes were to transform the bi-fold doors into (still folding) writeable surfaces, or to add a unit of tiered seating - also with writeable surfaces. However, the change of orientation they brought, the new options for teaching and learning, and the sense of audience for children's work were dramatic; demonstrably value for money.

If you want to do all this in your own community, in one of your own learning spaces, remember: start with observing detail and monitoring data; do it with the learners; involve everyone and keep a narrative to pass on. Looking back through, this has been a joy and I would like to thank every person, large and small, involved in everything you read about here.

Now go and do it yourselves!

Professor Stephen Heppell is CEO of Heppell.net and holds the Felipe Segovia Chair of Learning Innovation at Universidad Camilo José Cela, Madrid.



I am writing to say thank you for the new writeable bench and the whiteboard foldable walls. These new things have helped me want to learn a bit more!

