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Climate Change - All Change

Children and designers

take on the greatest challenge of our time

Report on the primary school pilot for architecture

December 2019 – March 2020

If we don't learn about it, if we don't know, we can't help. We're the future of this planet.

(R, age 9)

Kimberly Safford, The Open University

for

DaeWha Kang Design

David Lloyd Jones Associates

and

The Museum of Childhood, London



The *Climate Change – All Change* pilot for architecture was to culminate in an exhibition at the Museum of Childhood in London. Sadly, the Covid-19 pandemic forced the Museum to close before the opening. The pilot will be displayed when the Museum re-opens.



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Introduction

The climate crisis is the biggest challenge to children's futures, and there is abundant evidence that children are experiencing anxiety, depression and anger about the state of the world they will inherit¹. Children who are 10 years old in 2020 are likely to live in a very different environment in 2050. The widespread school climate strikes illustrate that children are not only aware of the crisis, they want to do something about it. It is therefore urgent that schools equip children with knowledge about climate change, and with the creative and interdisciplinary skills to imagine and innovate solutions to it. Yet climate change is not in the primary school curriculum in England², and creative subjects such as art and design are not seen as integral aspects of the 'core curriculum'. In an address to the V&A Museum, the head of the schools inspection service Ofsted said that primary school pupils have very limited experiences of the iterative design process, working creatively to solve design problems, and that design processes and principles were 'getting left behind' in primary schools.³ *Climate Change – All Change* aims to redress this imbalance of educational need and provision.

Climate Change – All Change is a co-design programme, where school children work with professional designers to co-create responses to the climate crisis. The starting point of *Climate Change – All Change* is that design – for architecture, transportation, clothing, food, communications, and all aspects of our lives – will address the ways in which we must adapt and respond to climate change. The programme focuses on the impact that design can have on climate change, so that children can feel empowered to find solutions for life in the future.

¹ See for example 3rd March 2020 "Climate anxiety: Survey for BBC Newsround shows children losing sleep over climate change and the environment" <https://www.bbc.co.uk/newsround/51451737>

² The notable exception in the UK nations is Scotland's Curriculum for Excellence, which explicitly refers to children's learning about the climate crisis.

³ 10 July 2019 <https://www.gov.uk/government/speeches/amanda-spielman-speaking-at-the-victoria-and-albert-museum>

Climate Change – All Change Primary school pilot for architecture

Aims, timetable and participants

The pilot for *Climate Change – All Change* aimed to test components of the co-design project in a primary school, where children and their teachers worked with a professional architect to develop building designs for a climate changed world in 2050. Outcomes and learning from the pilot will inform the proposal for a large-scale co-design programme of creative partnerships, in the UK and internationally, between designers from a range of disciplines and primary school children.

The architecture pilot was undertaken in two Year 5 classes, which we will call Class 1 and Class 2. Participants were: 60 children aged 9-10, three classroom teachers, four teaching assistants, the lead architect DaeWha Kang and his staff, and a second architect, David Lloyd Jones. The deputy headteacher monitored and supported the pilot throughout its implementation.

The pilot ran from December 2019 to March 2020. Classroom activities took place over a half-term, comprising:

- Weeks 1-2: teaching about climate change, led by the class teacher. Children also wrote stories about themselves in the year 2050, describing their lives in a climate changed world.
- Week 3: introduction to building materials and energy sources, led by architect.
- Week 4: Linking architecture and climate change, and imagining future materials and energy sources to address climate change, led by the architect.
- Weeks 5-6: Children in teams of three designed a school building in 2050, based on their stories and applying their learning about materials and energy sources. The groups presented their designs to a 'jury' of the two architects, the HEI lecturer, and a Museum of Childhood curator. All the groups were awarded certificates of merit. Two groups in each class were selected as finalists for further design development by the architect's studio, and two additional groups in each class were awarded high commendations for their designs.

School profile

William Tyndale primary school is a high-performing, highly diverse, larger-than-average size primary school in central London. The proportion of disabled pupils and those with special educational needs is above average, and the proportion of pupils who speak English as an additional language is above average, and the proportion of pupils eligible for support through Pupil Premium is above average.

The identification of William Tyndale school as the site for the pilot was, in part, opportunistic, because one of the architects has a child in Key Stage 1 (not in the Key Stage 2 project classrooms) and was known to the school. More importantly, William Tyndale takes a creative and flexible approach to the curriculum, frequently ‘collapsing the curriculum’ in order to undertake sustained creative partnerships with arts organisations and businesses. Additionally, William Tyndale has achieved a Gold mark as a UN Rights Respecting School, an award granted by Unicef UK to schools which explicitly embed the UN Convention on the Rights of the Child in policy, practice and culture; William Tyndale is the only school in its local education authority to achieve this award. Within this remit, children have learned about sustainability, recycling, and the impact of climate emergencies such as Amazonian deforestation and resulting fires. The Year 5 classes for the *Climate Change – All Change* pilot had also recently taken part in a team-building activity with a marketing company to design a new perfume; at the time of the pilot, both classes were participating in the redesign of Exchange Square in Moorgate by a large civil engineering company.

Pilot learning outcomes for children

The pilot developed two sets of learning outcomes for children, covering climate literacy and design.

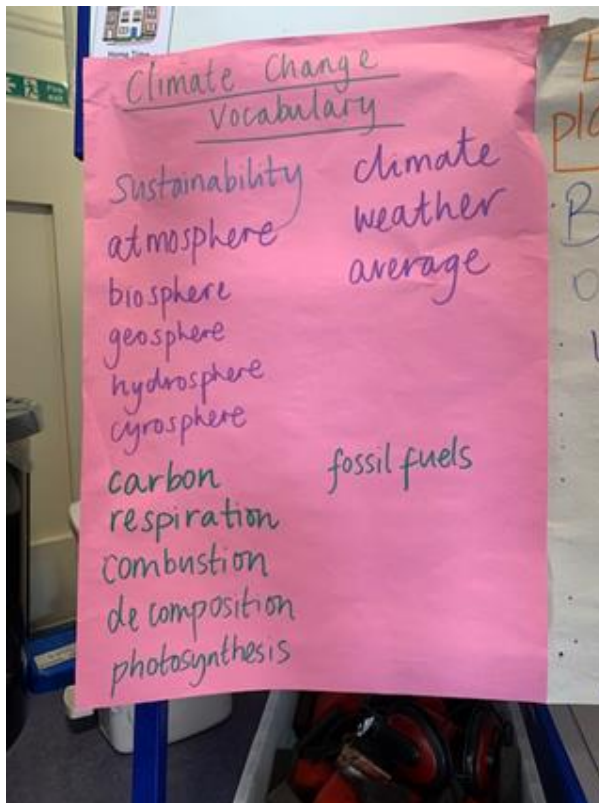
According to NOAA⁴, a ‘climate-literate’ person understands the essential principles of Earth’s climate system, knows how to gather scientifically credible information about climate, communicates about climate and climate change in a meaningful way, and is able to make informed and responsible decisions with regard to actions that may affect climate. In the pilot

⁴ The US National Oceanic and Atmospheric Administration

learning outcomes for this strand, children would learn the basics of global evolution and the way the planet works.

The UK Design and Technology Association believes that it is vital to nurture children's creativity and innovation through design, by exploring the designed and made world in which we all live, work, play and study. Design learning fosters children's creative, analytical, problem-solving and 'blue skies' thinking skills, and the climate crisis makes the development of such skills an urgent priority. As Alvin Toffler wrote in 'Future Shock', "*The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn.*" In the pilot learning outcomes for this strand, children would learn the process of design workflow, anticipate and understand architectural transformation as a result of climate change impacts, and apply learning about materials and energy sources to building design.

Learning outcomes for climate literacy



In *Climate Change – All Change*, children will learn:

1. the difference between weather and climate
2. how the climate works and what causes it to change
3. the functions of the carbon cycle and carbon's global pathways
4. what greenhouse gasses are, their importance and how they work
5. why the earth's temperature is getting warmer in recent history, and how human activity is causing climate change
6. why we are suffering extreme weather conditions
7. the consequences of global heating and its impacts on society

Learning outcomes for design (architecture)



In *Climate Change – All Change*, children will

1. Understand the process of a collaborative design workflow, from research and site investigation to brief development and creating a design result
2. Understand the impact of building design on climate change
3. Identify sources of energy in a familiar building: where they come from, how they are made, and how much carbon they use
4. Identify construction materials in a familiar building: where they come from, how they are made, and how much carbon they use
5. Apply knowledge of climate change, energy sources and construction materials to their own building designs
6. Work collaboratively, respectfully and productively in teams; develop and practice presentation skills

Additionally, *Climate Change – All Change* was designed to meet some of the science learning outcomes in Scotland’s Curriculum for Excellence and some of the learning outcomes in England’s National Curriculum Programme of Study for Design and Technology in Key Stage 2 (see Appendix 1).

Pilot activities and outcomes

Children focus group

Before classroom activities began, the project team held an informal focus group discussion with five children aged 9 and 10. The discussion aimed to elicit what children knew generally about climate change and about architecture, in order to plan classroom activities at the appropriate level.

It was evident from the start of the conversation that children knew quite a lot about climate change, as these comments illustrate:

We hear about it in assemblies, in class, on the news, at home. A lot. Everywhere.

[Climate change is] the atmosphere being heated up, and the rainforests being cut down, and the icecaps being melted, yeah, basically, the climate is changing, the air is getting hotter, and if it gets too hot, well, obviously, we’re all gonna die.

There’s been lots of deforestation and lots of animals are losing their habitats.... Animals won’t be able to adapt back from it, so they’ll definitely die... Sea levels are rising, so there are floods.

Airplanes are causing climate change, but not only airplanes, it’s factories and smoke.... palm trees being cut down for palm oil, and people using cars.

Children also expressed worries about the future:

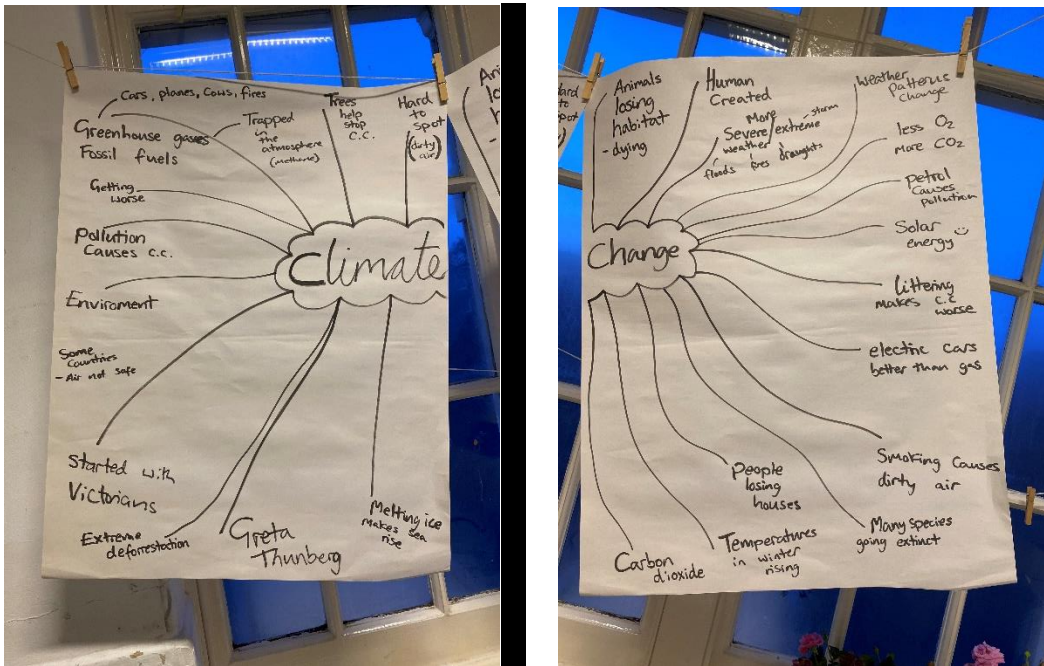
If we put enough effort in now, we’ll have high hopes that in the future they won’t make it worse again... That is the most high hope. The low hope is what’s happening now. If it carries on for 50 years, it’s gonna be worse than today. ... If the earth gets too hot, and we haven’t found a Planet B, we don’t know what we’re gonna do.

I don't want the earth to overheat. I don't want to die.

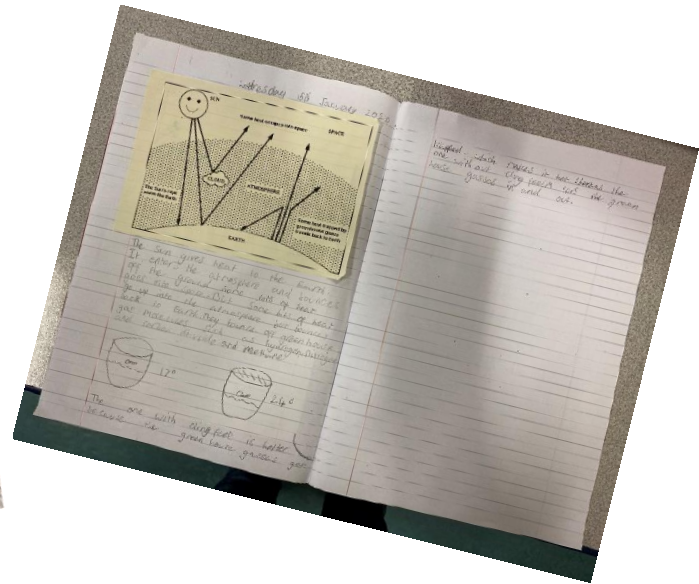
It worries me because animals are losing their homes. We will lose their homes.

Children were asked about design, architecture, and design work they do or have done in school. They were aware that the discipline involves 'Basically, designing things' such as 'Buildings, sometimes furniture'...'Roads and areas'...and that 'Sometimes they [designers] do it on a computer in 3D'. At the time of the pilot, both Year 5 classes were exploring a range of building materials and design features such as glass, light, water and green spaces, as part of a community outreach programme by a large civil engineering company leading the redesign of Exchange Square in Moorgate. The children also recalled work they had done in previous years in the school, such as designing vehicles using plastic bottles and sellotape, and dollhouses from cardboard and paper. They were enthusiastic about art and craft, and they welcomed any opportunities to draw and make. The school has a recently-opened studio dedicated to art and design, although the focus group children reported that they had few opportunities to do art, design or craft, or to use tools and materials, since they entered Key Stage 2; their teachers confirmed this was the case, and said that art activities usually involved drawing.

Teaching climate literacy

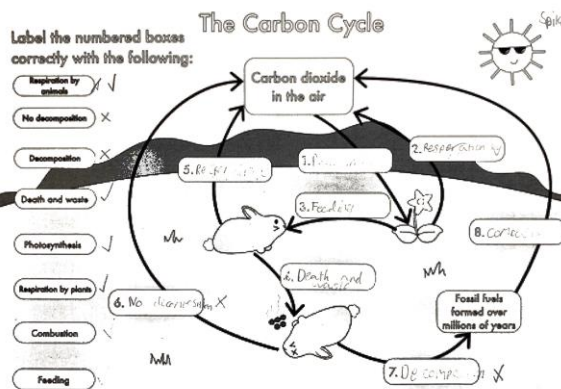
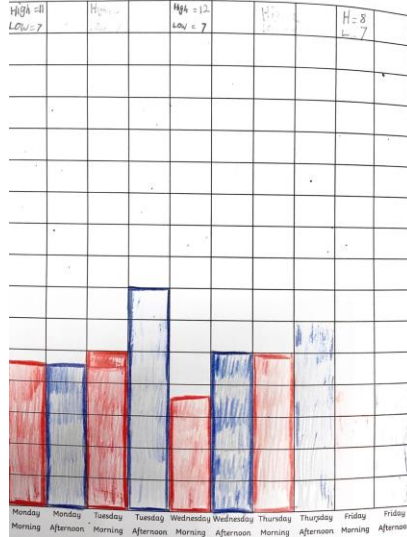


The project team provided teachers with briefing notes and a set of online resources for teaching climate change to primary school children, drawn from reputable organisations such as Young People’s Trust for the Environment (YPTE), Oxfam, NASA, Climate Change Live, and Centre for Climate and Energy Solutions (C2ES, successor to the Pew Center on Global Climate Change) (see Appendix 2). Teachers selected from these and located additional resources from the TES and the BBC, to develop lessons focused on the science and impact of climate change. Teachers introduced children to key concepts of climate science such as the carbon cycle and the functions of greenhouse gasses. Children carried out research on local and global climate trends and they carried out practical experiments (see below for some examples of the range of work and Appendix 3 for a weekly teaching plan).



Day Temperature Recording Graph

Use the space below to record the temperatures for this week.



London changed a lot. Now
for my child ~~and~~ it is
harder to go to school,
I should drop her on
a boat on Monday
and pick her up on
the other boat
on ~~Tu~~ Friday. ~~Over~~ ^{During} the
first few weeks it
was really confusing.
Now William Tyndale
is a boarding school.
It is really cold and it
is flooded.

Based on their research into climate change, children began writing stories imagining themselves in 2050 as adults, with children of their own, in a climate changed world, and the impact of climate change on their local area.

Teaching design, linking climate change and design

The architect developed a set of bespoke lesson resources (some examples are below) that guided children through iterative exploration and design activities and prepared them for designing their own buildings:

1. Energy sources in buildings, and uses of energy in the school building
2. Materials used for building and materials used in the school building
3. New sources of energy and materials, and imaginary materials and energy sources of the future

Fieldwork: Children Finding Energy Use In their School

Energy Found in my School and its Sources
 Names: Yaqeen Zayeb Lola

Draw some of the things you find in school that use energy.

laptop	light	electric equipment	phone	microwave	kettle	cooler	spotlight
computer	speakers	stove	clock	air conditioner	grill	buttons	speaker
white board	fire alarm	sinks	teaster	elevator	lantern	keyboard	water pump
printer	raid heater	fan	fridge	toilet	handker	projector	clock
		airmanus	coffee maker				

Describe the things that use energy in your school

There are lots of devices in our school, such as laptops, pads, pens, keyboards, PCs, posters and white boards, handball, lots of electronics use heat and keep us warm or to cool or heat up food. We many people like there are candles.

Explain different energy sources and their greenhouse gas impact

Doesn't use heat for the incandescent. Due to the plants it causes on the other hand solar panels are good because it doesn't create any electricity.

Energy Found in my School and its Sources
 Name: Zayeb

Draw some of the things you find in school that use energy.

Describe the things that use energy in your school:

There are lots of things that use energy in our school, such as laptops, pads, pens, keyboards, PCs, posters and white boards, handball, lots of electronics use heat and keep us warm or to cool or heat up food. We many people like there are candles.

Explain different energy sources and their greenhouse gas impact:

Doesn't use heat for the incandescent. Due to the plants it causes on the other hand solar panels are good because it doesn't create any electricity.

David Lloyd Jones / DaeWha Kang / Kimberly Safford / Jan 2020

The process was designed to familiarise children with the entire process of design: from planning a work flow to doing field research and desk research, to exploring and developing the project brief, and ultimately to designing and presenting proposals. The activities aimed to help children learn how design work could positively impact on the climate crisis. Fundamental to this was knowing how energy is generated in the UK, and the impact of that energy generation on greenhouse gas emissions. The children learned about how energy is consumed by buildings, and they were encouraged to think about how that energy use could be reduced. The other key element of design and its impact on climate change is material use in buildings, and the energy used to extract and transport those materials to the building site. Children studied their own school and analysed the materials found in its construction for embodied carbon.

Children at Work



David Lloyd Jones / DaeWha Kang / Kimberly Safford / Jan 2020



Finally, the children were asked to imagine and describe new materials in the future that might help them deal with the challenges of climate change. They were shown examples of such materials that architects and designers are working with now, such as bamboo, cellulose, mushroom bricks, and construction materials made from organic waste. As children continued to write their stories, they incorporated these and imaginary ideas for materials in their school designs, e.g. *'The whole building is made from Glysikle, for us to view the rising of the floods...Glysikle tubes full of algae run through the building, with glowing fish for lights...'*

William Tyndale School 2050 Title of your design Bridge Town!

Names: Iggylee Spike Scarlett

Draw your vision for William Tyndale School in 2050. Include your characters from your scenario story as part of the design.

1. Draw the context: How has Islington changed? What does the environment look like around you? What are the challenges to overcome?
2. Draw the school: How does it overcome the difficult challenges? What is it like in class, at playtime, and on the way to the school?
3. What materials is it made from? What energy does it use and where does the energy come from? What kind of technology does it have?
4. Label your drawing and include notes on the right hand column to really explain your design.

Your Character
 Hero Survivor

Your Scenario
 Hot, tropical, flooded Hot, dry forest
 Cold, flooded Hot, dry desert

Hi my name is Charlie I live in London 2050. My daughter is Ivy. She feels climate change is OK because she has known only when it is bad but not the difference and impact I have sponge walls in the building is powered by solar panels. Since it is also flooding you get kayaks from the school so you can ride a boat to school. There is a slot where you can put your boat. It is also powered by a water wheel which takes lots of water for fuel so we don't run out by a drier. John are picking aviator strong drones also making roads for climate change.

My daughter feels is OK because she has known only when it is bad but not the difference and impact The by S

Kayak Parking

William Tyndale School 2050 Title of your design William Tyndale Desert School

Names: Elvira Tomy Ella

Draw your vision for William Tyndale School in 2050. Include your characters from your scenario story as part of the design.

1. Draw the context: How has Islington changed? What does the environment look like around you? What are the challenges to overcome?
2. Draw the school: How does it overcome the difficult challenges? What is it like in class, at playtime, and on the way to the school?
3. What materials is it made from? What energy does it use and where does the energy come from? What kind of technology does it have?
4. Label your drawing and include notes on the right hand column to really explain your design.

Your Character
 Hero Survivor

Your Scenario
 Hot, tropical, flooded Hot, dry forest
 Cold, flooded Hot, dry desert


The UK has turned into a desert. There has been a big sand storm. But luckily we discovered a plant that's juice is poison. But it is bad for children's skin so this school will protect them from the desert by building a large wall. They have canals and take the water from their homes they also gather the juice and eat a treat. They have two sand storm safety walls. That fit up to 70 people. The school has 120 children and 20 teachers.

Solar panel

The designs incorporated many current forms of renewable energy, such as wind and solar power. The children also designed imaginary forms of energy and materials, such as sponge walls to absorb water, and organic materials that could be grown, harvested to make buildings, and grow back again.

William Tyndale School 2050 Title of your design Future Life!
 Names: Sophia Ardil Henry 7A

Draw your vision for William Tyndale School in 2050. Include your characters from your scenario story as part of the design.
 1. Draw the context: How has Islington changed? What does the environment look like around you? What are the challenges to overcome?
 2. Draw the school: How does it overcome the difficult challenges? What is it like in class, at playtime, and on the way to the school?
 3. What materials is it made from? What energy does it use and where does the energy come from? What kind of technology does it have?
 4. Draw your drawings and include notes on the right hand column to really explain your design.



Your Character
 Hero Survivor

Your Scenario
 Hot, tropical forest Hot, dry forest
 Cold, flooded Hot, dry desert

Hi my name is Ardil and my age is 7 years. I'm a child in class and they are 9 years old. I know I'm going to speak to you because all know London is a cool place but busy it's been really hot the lowest is 37 but we have made new materials like a house that can be up where to stop floods.



Enhancing and re-presenting children's designs



Children's designs were taken into the architect's studio, where architects produced computer generated models of children's drawings.

These models, sadly, could not be presented to the children before schools were closed because of the Covid-19 pandemic.



This element of the co-design pilot aimed to expand children’s frames of reference and encourage them to think beyond their present material contexts. The architects’ renderings aimed to show children how their ideas and designs could spark innovation and ignite real-life design solutions.

We were sorry that children could not see their designs re-imagined in this way.

Impact and Learning

Children’s interviews

26 children from both classes were informally interviewed as the pilot was in progress. It was evident that the pilot was improving their knowledge, for instance, children said that they knew that climate change was happening, but they didn’t know the scientific details of it.

I did know about climate change, but now we’re learning about it in more detail, and I didn’t know stuff that I know now. ... This is definitely educating me!

The five spheres of the earth, I didn't know about those: atmosphere, geosphere, biosphere, lithosphere, hydrosphere, cryosphere ... land, water, snow and ice, animals, the scientific side of it.

I liked writing out explanations, how the heat gets in, how it gets trapped, researching the different greenhouse gasses and how they're all different.... thinking about the difference between climate and weather...we also learned about the carbon cycle, all the parts of that.

The pilot activities also helped children to see how familiar buildings, such as their school, were a part of the climate change scenario, and how designers were creating innovative materials that could make a difference:

We learned how power plants and electricity release greenhouse gasses into the air and what it does to the environment. ... Then we walked around the school, looking at all the different uses of electricity.

We found materials and learned how much pollution they make, how much carbon dioxide they release. Bricks and stone, glass, lots of materials used to build buildings, cause pollution.

We learned about sustainable materials and what we can use to build our future school in 2050. ... I liked learning about new materials, like mushroom bricks.

Children were articulate about the importance of linking their knowledge with action.

I didn't know that it was happening so quickly. I thought it was happening slowly. But it's happening badly now.

Climate change is happening to us, and we need to know what's happening. If we don't know, how can we stop it?... we should know about it, and stop it if we can.

Following their team presentations to the 'jury' and their classmates, children were asked what they enjoyed most about the project. They appreciated each other's work, noting that 'Every design was unique', and said that their design work and the creation of imaginative scenarios had caused them to reflect on innovative possibilities for the future:

I loved hearing about all the made-up materials, some were very far out!

People added unusual things you wouldn't imagine they would come up with.

It could happen later in life.

Children's survey responses

Class 2 was asked to complete a short baseline survey, before pilot activities began, and to answer the same questions in an endline survey when pilot classroom activities were completed. The baseline questions asked children to self-rate their understanding of climate change and building design, and whether they would like to learn more about these topics through story-telling and designing. The endline questions asked children to self-rate themselves at the end of the pilot. 28 children completed the baseline survey, and 26 children completed the endline survey.

The endline survey data show consistent evidence of children's learning through their participation in the pilot. On all ten questions, children's endline responses shifted from the 'Disagree' categories into the 'Agree' categories, and for some questions there was dramatic movement into the 'Strongly Agree' categories, for instance, on understanding the causes of climate change, understanding the impact of building design on climate change, and enjoying designing a school of the future: see Table 1 and Table 2 below.

Table 1. Class 2 Baseline Survey

Q	Class 2 Baseline n = 28	1-2	3-4	5-6	7
	1 Strongly Disagree 7 Strongly Agree				
1	I understand what climate change is and what causes it	3%	11%	61%	25%
2	I understand how the design of our buildings can affect climate change	18%	25%	39%	18%
3	I enjoy learning about energy sources	30%	14%	31%	25%
4	I enjoy learning about building materials	8%	21%	39%	32%
5	I would enjoy writing about my future life affected by climate change	29%	29%	21%	21%
6	I would enjoy designing a school of the future	11%	0	14%	75%
7	I would like to tell a story about the future and how we have to deal with climate change	21%	32%	36%	11%
8	I would like to design good solutions to prevent climate change from getting worse	14%	18%	29%	39%
9	I think design is important for solving the climate crisis	10%	18%	43%	29%
10	I would like to learn design skills	11%	3%	32%	54%

Table 2. Class 2 Endline Survey

Q	Class 2 Endline n = 26	1-2	3-4	5-6	7	Percentage points change at 7
	1 Strongly Disagree 7 Strongly Agree					
1	I understand what climate change is and what causes it	0	4%	31%	65%	+ 40
2	I understand how the design of our buildings can affect climate change	4%	0	46%	50%	+ 32
3	I enjoyed learning about energy sources	4%	19%	43%	34%	+ 18
4	I enjoyed learning about building materials (n =25)	4%	4%	52%	40%	+ 8
5	I enjoyed writing about my future life affected by climate change	0	26%	12%	62%	+ 41
6	I enjoyed designing a school of the future (n=25)	4%	0	0	96%	+21
7	I enjoyed telling a story about the future and how we have to deal with climate change	4%	12%	42%	42%	+ 31
8	I would like to design good solutions to prevent climate change from getting worse	4%	11%	31%	54%	+ 15
9	I think design is important for solving the climate crisis	0	12%	23%	65%	+ 36
10	I would like to learn more design skills in the future (N=23)	4%	13%	13%	70%	+ 16

Class 1 and Class 2 were also asked to respond in writing to two questions: what they enjoyed most about the pilot and what they would suggest to improve it. 51 children wrote answers to these questions, and their favourite activity, virtually unanimously, was *'designing the school in 2050'*:

I loved designing the school itself as I loved the thinking in a world where anything was possible.

Everyone's designs should be turned into proper architectural designs.

I love designing.

Making a school for the future.

Children also enjoyed imagining and designing future materials for a climate changed world, and presenting their team's building designs to the jury and the class:

My favourite thing was designing new materials because at first I thought it was hard.

I loved designing new futuristic materials.

Showing the houses/schools to everybody.

Designing and presenting – I can't choose.

My favourite activity was our final picture.

A small number of children reported that they enjoyed being physically active in the pilot, going around the school to look at energy sources and building materials. In general (and this is supported by the survey data) children were slightly more interested to learn about building materials than about energy sources:

I think we could see some more samples of building materials.

Maybe we could see more future materials.

I would like to do more on what buildings look like.

In terms of making improvements to the pilot, a majority of children commented that the time allocated for it was too short: *'I would change the fact that it is spent over such a short period of time.'*

A dozen children (just over 6% of those who answered the two questions) wrote that they would improve the pilot by making 3-D models of their design drawings, expressing a wish to work hands-on with materials and tools. Not every child enjoyed the story-writing element of the pilot, and some children lacked confidence in their drawing skills:

I would like it more if we made a project out of materials.

I'd like it more if we could build our own model.

I'd like it more if we could build the model instead of drawing it.

If we made a model of the school, if we had more time, and if we did less writing.

I would like it more if we built a model, not draw one, because I am not a good drawer.

Teachers' responses

The teachers and teaching support staff were asked to reflect on their experiences of the pilot. Teachers initially had expressed some personal unease about teaching climate to change to children. They were aware of the anxiety, anger and frustration felt by children around this pressing issue, and they did not want to make this worse. Teachers were pleased to see children's enthusiasm for learning about climate science. Teachers were also positive about the creative work undertaken by children, and the opportunity for children to work alongside a professional designer.

[This work] gives them a sense of agency and ability to affect change in the future... They see how, through different disciplines, such as architecture and design, they can have a positive effect on the future.... The learning intentions are cross-curricular: problem solving creatively, researching independently, and we've done work in maths by designing an area and buildings, and it's very engaging and very purposeful for the children. The project has captured their imaginations in quite an exciting way. ... and it's been inspiring for me to see how they have become quite hopeful in thinking about a positive future for themselves and for others.

(Teacher Class 1)

The best thing is their being able to put their knowledge into practical use and straightaway. They've really enjoyed learning about climate change – they knew a little bit about it, and they have definitely built on their knowledge. ... this project has been fantastic for being so open-ended, there were no limitations ... It's made them have to think hard about different shapes of buildings and what to include, and think about how a building could be completely different to what they know. ... And it's given me an opportunity to see different skills in different children that don't come to light in other work that we do in school. ... Its inspiring to work with [the architect] and for children to see the kinds of jobs that are open to them in the future.

(Teacher Class 2)

Teaching assistants were likewise positive about the pilot. One TA told the pilot team: '*I have been informed [about climate change] – everyone was learning*'. Another TA said that '*the children's teamwork was amazing...[climate change] is something they really want to know about*'.

Designer's responses

The lead architect, DaeWha Kang, was asked to reflect on the pilot:

One of the great challenges of architectural design is effectively communicating very complex ideas and designs in a simple and understandable way. Tackling climate change through architecture is even more challenging in this regard. Engaging with children and teaching them about climate change and architecture was an opportunity to clarify and distil some of the key principles.

We learned a great deal about the pedagogical aspect throughout the pilot process. After teaching Class 1 we gained a better sense of pacing and structure for the work and found ways to set foundations for later stages of the process earlier on. For

instance, for Class 2, when the children were drawing energy uses in the school, we taught them how to draw architectural sections. This meant that they were already familiar with that mode of representation when they began their designs for the schools of the future later in the process.

Children have incredible imaginations and are less bounded by practical constraints. Co-design with the children has opened up territories and possibilities of design that we might not have otherwise explored. Working from children's sketches also gives us license to propose more fantastical or ambitious ideas about architecture that might otherwise seem fanciful without the children's involvement.

The designer carried a great deal of responsibility for the pilot outcomes, both in the classroom and in the design studio. As a professional who is external to the school, it was observable that his presence animated the classroom sessions and brought real-world ways of thinking and working to children's school learning.

Going forward with *Climate Change – All Change*

Vision for large scale collaboration

Cultural institutions have a responsibility to engage audiences on what is the most urgent issue of our generation. Museums and galleries have started to explore climate change, with more intending to do so. Exhibitions to date have typically relegated the creative potential of children to a minor layer of interpretation, a handful of activities or a parallel learning programme. The proposal to scale-up *Climate Change – All Change* would challenge this and present the creative disciplines, climate change and young people as a cohesive experience.

A large-scale *Climate Change – All Change* exhibition would anticipate life in 2050 by working with seven primary schools and practitioners from seven design and creative disciplines: architecture, urbanism, fashion, transport, product/industrial design, graphics/communication and digital/service design. There would also be a programme of international outreach and collaboration, with schools and designers. The exhibition would be innovative in promoting child-professional co-design, bringing children and professionals together to respond creatively to the climate crisis.

Teacher-designer creative partnerships: issues to consider for scaling-up

A larger programme involving multiple schools and designers must have a longer preparation period for teachers and designers, and extended teaching-learning time for teachers, children and designers. The following additional aspects would need to be carefully planned:

Recruiting schools: schools involved in a co-design programme need to have a commitment to creativity and design, a flexible approach to the curriculum, and a willingness to work with a designer over time. Should schools be identified and directly recruited, or should there be an

advertising and application process for schools, where a panel would set criteria and make a selection from applicants?

Recruiting designers: designers working in schools must be able to interact sympathetically with teachers and children, be able to undertake some teaching, and be willing to co-design resources and activities with teachers and the project team. The time demand on designers is likely to be considerable. Therefore, all of the designers in a larger co-design project should be recognised, world-class designers, with capacity to set the standard and have the resources and imagination to make a scalable programme as relevant, exciting and interesting as the pilot. Ultimately, the project can evolve and be scaled across different national and international curricula and, at that stage, designers more local to schools could follow the project framework.

Recruiting international partners: in addition to the points above for UK schools and designers, international schools and designers must have capacity to interact online with UK partners.

The programme would need resource to develop a teacher education pack, a designer support pack, and to organise a series of induction and training events for teachers and designers. There could be a public-facing website showcasing the ongoing work of the programme. The programme might also benefit from an external evaluation and/or research strand.

Children and design work: issues to consider

Children in Key Stage 2 primary school have few opportunities to design and make. Their practical drawing, making and crafting skills are, in general, poor – through no fault of their own. They have limited opportunities to handle materials and tools in school. Should the programme aim specifically to ameliorate this by introducing hands-on materials and construction with children? This would require substantially more time and resourcing. Children in the pilot were also keenly interested in computer-assisted design, and there may be some scope to resource this for schools that join the larger project.

How far should the children be directed or prompted into developing their creative ideas? For instance, if the element of a 2050 story setting is retained in programme design, how open or prescriptive should these settings be? It was evident in the pilot, and confirmed by teachers in their comments, that children thrived when they could experiment with open-ended ideas in a bounded framework.

In the pilot, some children received higher commendation awards than others. It should be anticipated that some schools, parents and children may be unhappy with a competitive element in what is meant to be an inclusive programme for school children. Professional designers are important role models in this regard, because they can demonstrate to children the real-life frustrations, aspirations and learning that arise from competition. Children in the pilot were visibly attentive and impressed by the architect's personal account of his experiences of competition as a professional designer: he makes presentations to juries – just as the Year 5 children had done – and he wins some competitions and loses others. He was honest with the

children, telling them that he hates being in competitions because he doesn't enjoy losing, and that in competitions where he doesn't win, he believes that the most important thing is to participate and learn from the process. Messages such as these from professionals can be highly motivating to children's attitudes for learning and inspirational to their ambitions for the future.

Appendices

Appendix 1 from Scotland Curriculum for Excellence and England National Primary Curriculum for Design and Technology

***Climate Change – All Change* reflects elements of Scotland’s Curriculum for Excellence, that learning in the sciences will enable children to:**

- develop curiosity and understanding of the environment and their place in the living, material and physical world
- demonstrate a secure knowledge and understanding of the big ideas and concepts of the sciences
- recognise the impact the sciences make on their lives, the lives of others, the environment and on society
- develop an understanding of the Earth’s resources and the need for responsible use of them
- express opinions and make decisions on social, moral, ethical, economic and environmental issues based upon sound understanding
- develop as a scientifically-literate citizen with a lifelong interest in the sciences

***Climate Change – All Change* addresses some of the learning outcomes of the programme of study for Design Technology in Key Stage 2 in England:**

DT2/1.1 Design

DT2/1.1a use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups

DT2/1.1b generate, develop, model and communicate their ideas through discussion, annotated sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces and computer-aided design

DT2/1.3 Evaluate

DT2/1.3b evaluate their ideas and products against their own design criteria and consider the views of others to improve their work

DT2/1.3c understand how key events and individuals in design and technology have helped shape the world

Appendix 2 Teaching Resources

YPTE lesson resources for KS2 <https://yppte.org.uk/lesson-plans/climate-change>

OXFAM climate challenge resources for 7-11 year olds

<https://www.oxfam.org.uk/education/resources/climate-challenge-7-11>

Climate Generation (founded by polar explorer Will Steger)

<https://www.climategen.org/our-core-programs/climate-change-education/curriculum/>

Climate Change Live Educators' Toolkit

<https://climatechangelive.org/index.php?pid=179>

Climate basics for kids <https://www.c2es.org/content/climate-basics-for-kids/>

BBC Climate change for children

<https://www.bbc.co.uk/teach/live-lessons/climate-change-for-children/z77wvk7>

NASA climate change for kids <https://climatekids.nasa.gov/climate-change-meaning/>

Videos

Message from Antarctica video <https://www.youtube.com/watch?v=931drXJDqT4>

Climate change according to a child <https://www.youtube.com/watch?v=Sv7OHfpIRfU>

(note: the ending is dated by referring to the past international meeting in Paris)

CAFOD video climate change for children

<https://www.youtube.com/watch?v=v8unGCTWUWI>

(note: this video refers to earth as 'a gift from God')

Appendix 3 Week 1 teaching plan

Day	Learning	Outcomes
Monday	<p>Introduce the project, who are we working with and what is the purpose? Highlight transferable skills/knowledge.</p> <p>Knowledge harvest, what do we already know? AfL to inform rest of week.</p> <p>What is the climate? How does it differ from weather. Nasa Climate change video https://www.youtube.com/watch?v=vH298zSCQzY</p> <p>Look at Climate zones BBC bitesize - how does the climate work - what distinct zones are there and how are these created and maintained by different interactions of terrains.</p> <p>Discuss recording data this week of temperatures and comparing against the historic data for London in January.</p>	<p>Whole class reference sheets about prior climate knowledge.</p> <p>Chn colour map of different climate zones.</p> <p>Chn to start their own bar graph of the temperature to be continued over the week.</p>

<p>Tuesday - Short session</p>	<p>Recap climate and weather definitions from yesterday.</p> <p>Look at the example of the Great ocean conveyor belt. How does this keep Britain warmer than Canada despite being on similar latitudes.</p>	<p>Chn to write a paragraph explaining how the Ocean regulates temperatures and affects climate zones.</p>
<p>Wednesday</p>	<p>Explain that Carbon is an element which means that it (along with other elements) makes up everything in the universe, including humans, animals and plants.</p> <p>Carbon in on the move - look at diagram from national center for atmospheric research. The Carbon Cycle</p> <p>Greenhouse gasses - using diagram to explain, children get from one side of the room to the other without touching a table, if they do they head back.</p> <p>Practical demonstration of how heat is trapped by greenhouse gasses. If we increase the amount of tables it makes it more likely that they will hit one.</p>	<p>Chn to fill in their own similar carbon cycle.</p> <p>Practical demonstration</p> <p>Set up experiment for testing greenhouse gasses.</p> <p>Diagram labelled for green house gasses and carbon cycle.</p>

<p>Thursday</p>	<p>Review - ideas from earlier this week. Look at the experiments children set up earlier this week. Compare as class, what is the difference in the temperature from the week against the projection based on the climate. Why might this be happening?</p> <p>Look at the greenhouse gas experiment. Which bowl of soil is warmer? Covered or uncovered?</p> <p>How humans impact on the climate. Sorting activity. What do we think are the positive or negative actions that impact on climate.</p>	<p>Review temperature grid</p> <p>Write an explanation of greenhouse gas experiment</p> <p>Sorting activity.</p> <p>Research and video an explanation of main question over climate change from this week.</p>
<p>Friday</p>	<p>The consequences of climate change.</p>	<p>Looking at / discussing photos of famine, flood, fire and drought.</p>