CLIMATE, ENVIRONMENT AND EDUCATION

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DATA | RESEARCH | ANALYTICS

OpenDevEd
Development & Education

UKaid
from the British people

1910

Temperature change in Africa since 1901
Source: showyourstripes.info

2010

Climate change, the environment and education

1

There is a need to combine data science and community voices…

…to highlight the likely impacts of climate change on education systems and attainment in developing countries.

2

And take an intersectional approach

Support solutions based on the intersecting nature of climate change and education in relation to issues such as poverty, marginalisation, gender inequality, conflict, migration.

3

There will be impact at multiple levels

Our climate change response work focuses on policy and planning, infrastructure, and community responses to a changing climate, extreme weather events, and climate related crises.

4

And this is now and in the future

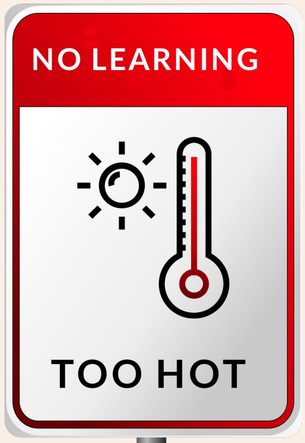
The aim is to improve conditions in the present, help governments and schools minimise the impacts of climate change, and support transformation in the education sector.

5

We need more impactful research

Underpinning this is a need for rigorous evidence on various aspects of the relationships between climate, extreme weather, climate change and education.

Disruption to schooling is likely to vary in intensity



CHILDREN/TEACHERS ARE PRESENT BUT CAN'T LEARN

- Children are hungry due to crop failures (drought)
- Classrooms are too hot to learn
- Classrooms are too noisy from rain to hear lessons
- Disease burden increases leading to illness and absence

SCHOOLS ARE OPEN BUT ACCESS IS RESTRICTED

- Rainy season means roads become inaccessible
- Drought/crop failure means children are pulled out of school

SCHOOLS DAMAGED

- Disasters mean that schools are closed
- Can be short term (while drying classrooms)
- Or long term – while rebuilding

> *"The aim is to minimise disruption and build resilience against climate change impacts."*

Examples of some work in this area

Children & teachers are present but can't learn

Research into Heat, light and sound and the impact on learning

Working to assess the impacts of climate extremes on education attainment.

Looking at extreme heat, light, rainfall, and flooding.

Understand impact the environment has on school attainment

Foreign, Commonwealth & Development Office

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Schools are open but access is restricted

Flooding and school access

Partners are using rainfall and school GIS data to highlight the impacts of flooding on school accessibility in Sierra Leone.

Fab Inc. and World Bank report supporting flood resilience in Sierra Leone.

Defining vulnerability to school closures and accessibility through floods

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THE WORLD BANK

Schools damaged

How can we get better at predicting this?

Fab Inc and IRC are working to develop an anticipatory action for education model

If we get better at anticipating, we can provide cost-effective support quickly.

Combining data mapping and community-based research.

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INTERNATIONAL RESCUE COMMITTEE

Cross-cutting elements

The Government of Sierra Leone have developed climate-smart education infrastructure planning policy guidelines.

Colin to add on Tz.

If GIS locations exist for schools, technological advances mean that a range of tools are available to improve climate-smart micro-planning

Where should we build new schools?

Catchment planning

1. What are our policy priorities? E.g. Accessibility commitments, maximising coverage.
2. There are free to use GIS tools to optimise locations
3. Integrate climate-hazard risk into analysis.

Where should we add new classrooms?

Micro-level planning

1. How can we identify over-crowding?

1. How can we model estimated needs in the future?

1. Within the broad need, where should we allocate funds to first?

How do we prioritise renovations?

Prioritisation and D4D

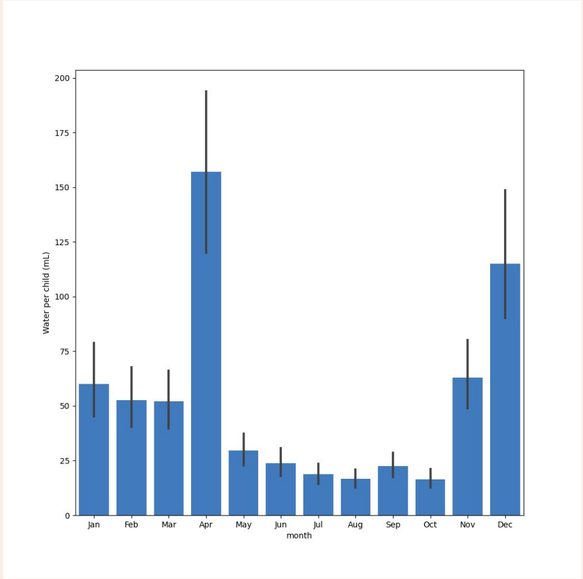
1. How allocate funds based on our priorities?

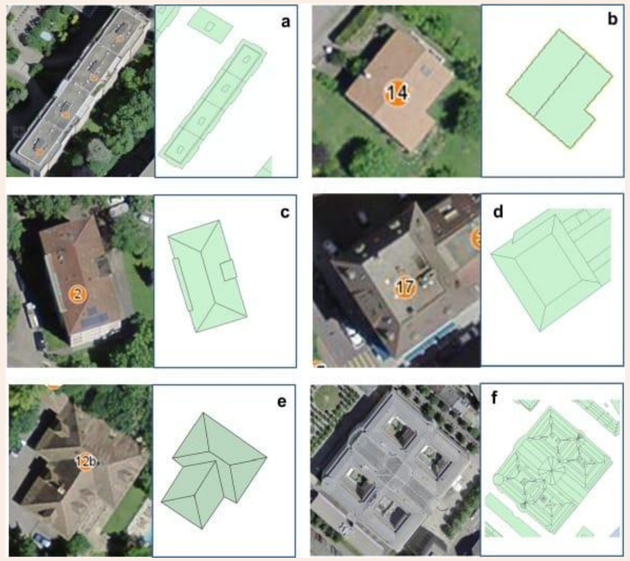
Technology and cross sectoral working can also help with climate-smart education planning

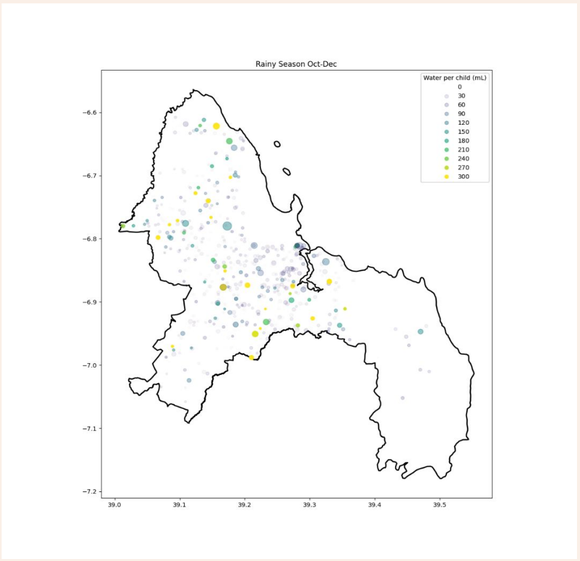
1 Can link drought forecasting for pre-positioning of school feeding support

2 Integrate education planning into Anticipatory Action and Disaster Risk Reduction

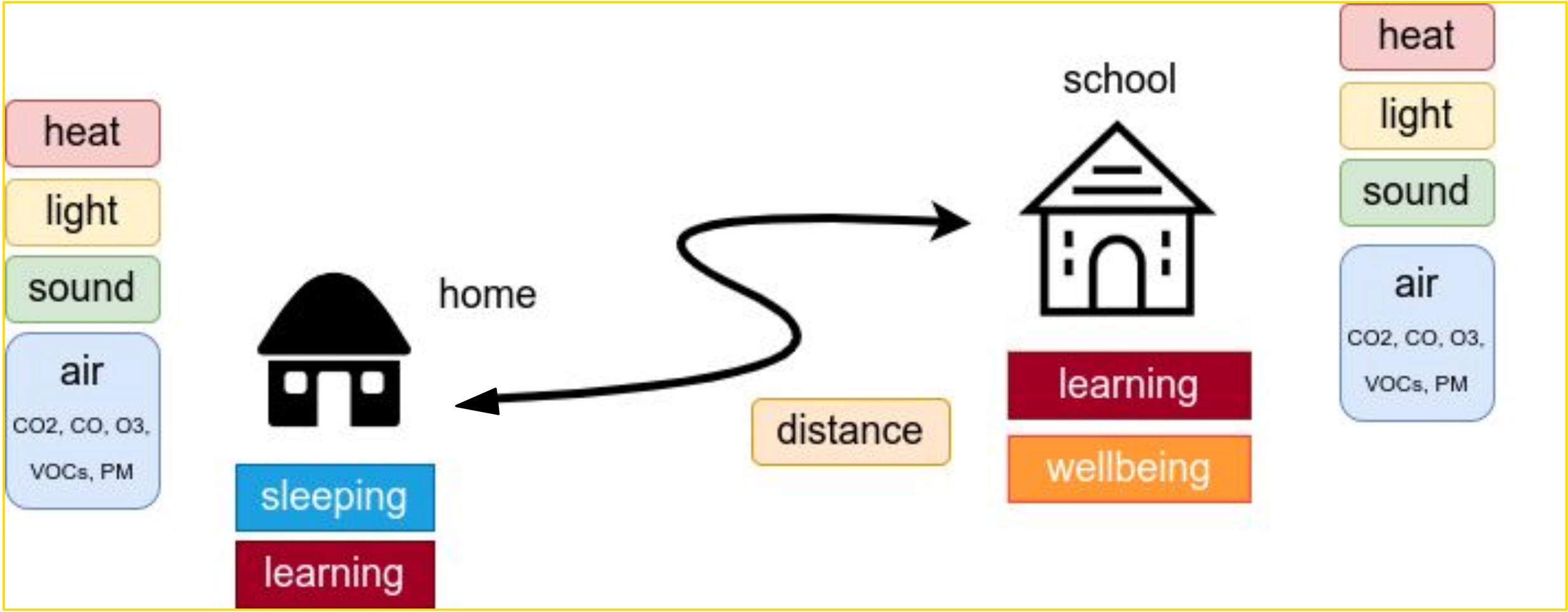
3 Combine satellite images and rainfall data to model where extra support is needed for sustainable WASH







What can be done to improve comfort in students, including thermal comfort?



What can be done to improve comfort in students in schools?

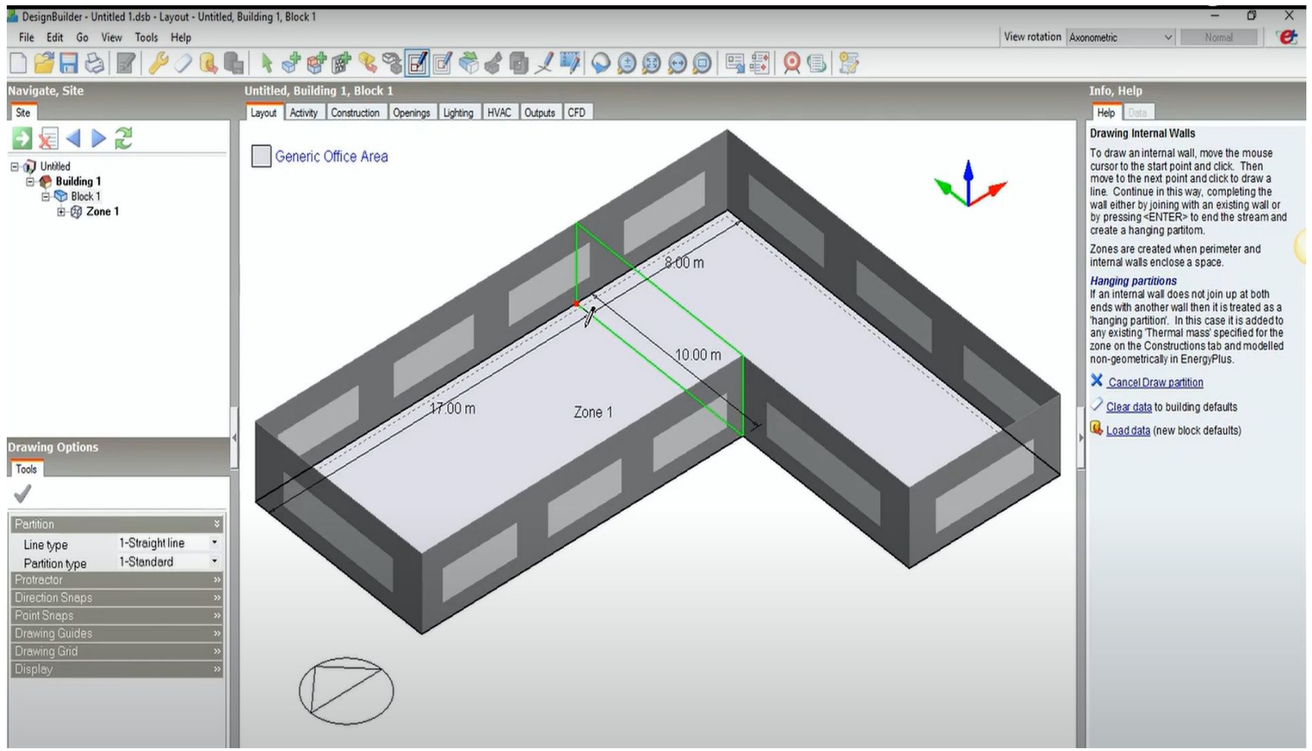
Analysing different schools infrastructures and characteristics

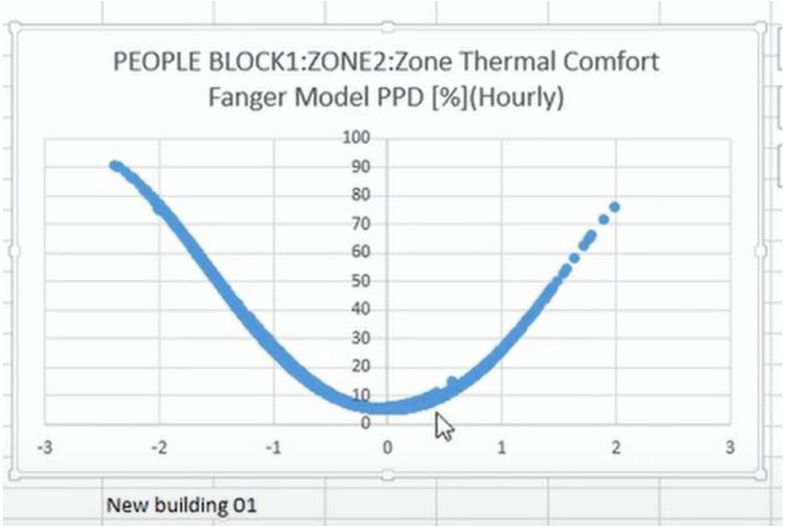
- *Roof material and colour*
- *Light conditions*
- *Ventilation*
- *Number of students per class*

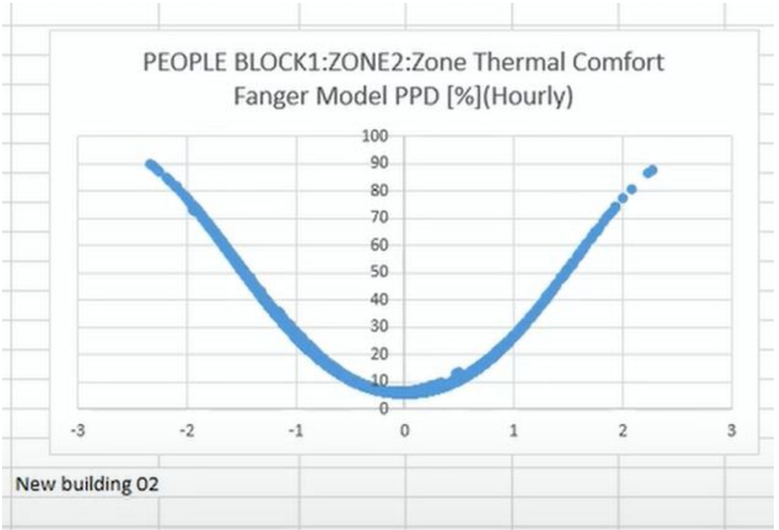
and many more…

Modelling

Once data is collected, modelling for simulating possible retrofits might be necessary







Asking students

Exploring how students feel in their current school

A badly placed or sized aperture, louvre angles that are inefficient, incorrectly specified materials, and improper colour are just a few examples of issues that might reduce the comfort of students in their learning environment.

Catriona Forbes (2022) Carbon-smart schools mitigate climate change and improve learning

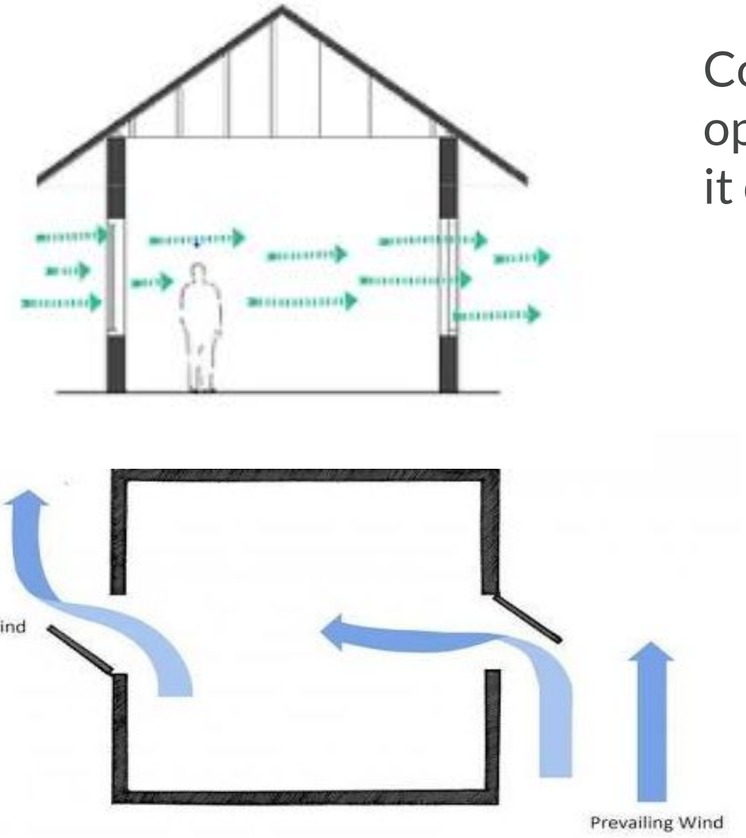
Hyunjun Yun, Insick Nam, Jinman Kim, Jinho Yang, Kyoungho Lee, Jongryeul Sohn, A field study of thermal comfort for kindergarten children in Korea: An assessment of existing models and preferences of children

'Knowing' is important, but once we know, what do we do?

Possible approaches for retrofitting schools for better indoor environmental quality

Option 1: Cross ventilation

Only natural ventilation is unlikely to be sufficient to bring thermal comfort to students



Consist of a building designed with **openings**, such as windows, on opposite sides or facades. When wind blows against the building, it creates areas of high and low pressure.

The **pressure** difference created by wind causes air to flow through the building, facilitating natural ventilation.

The **effectiveness** of cross ventilation depends on factors such as the size and placement of openings, building orientation, local wind patterns, and the presence of obstructions.

A proper design can maximize the **benefits** of cross ventilation and enhance natural ventilation within the building.

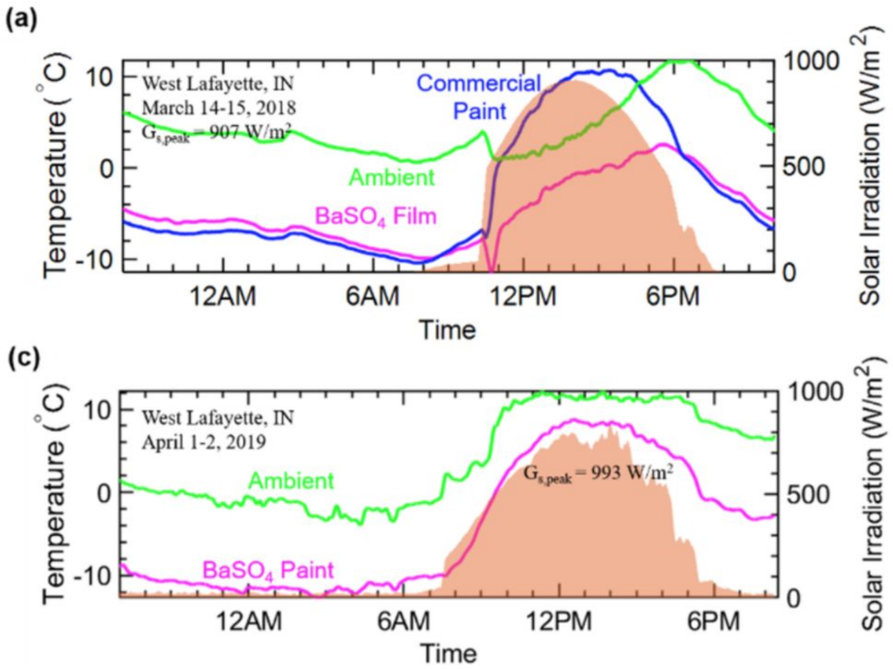
Monge-Barrio, A., Bes-Rastrollo, M., Dorregaray-Oyaregui, S., González-Martínez, P., Martin-Calvo, N., López-Hernández, D., Arriazu-Ramos, A., & Sánchez-Ostiz, A. (2021). *Encouraging natural ventilation to improve indoor environmental conditions at schools. Case studies in the north of Spain before and during COVID.* https://doi.org/10.1016/j.enbuild.2021.111567

Option 2: Roof colour

White Paint intervention (WPI) could be improved, by adding **Barium Sulphate.**

This **paint** is effective at reflecting the solar radiation hitting buildings back into space.

Painting buildings with white barium sulphate paint can reduce temperatures inside the buildings by 4.5°C compared to the outside air temperature



Proctor, J. (2022). *Should we paint all classroom roofs white to improve learning in Tanzania?* EdTech Hub. https://doi.org/10.53832/edtechhub.0122

Li, X., Peoples, J., Yao, P., & Ruan, X. (2021). Ultrawhite BaSO4 Paints and Films for Remarkable Daytime Subambient Radiative Cooling. *ACS Applied Materials & Interfaces*, *13*(18), 21733–21739. https://doi.org/10.1021/acsami.1c02368

Option 3: Sun shading techniques

To **prevent** windows and walls from passive solar heating, when it is not desired, it must always be protected from direct solar components.

Ishaq, M., & Alibaba, H. (2017). Effects Of Shading Device On Thermal Comfort Of Residential Building In Northern Nigeria. *International Journal of Scientific and Engineering Research*, *8*.

Decision on integration of shading elements can have an effect on the thermal comfort level of a closed space.

Achieving **shading** from solar radiation can be done in different ways. Some examples are:

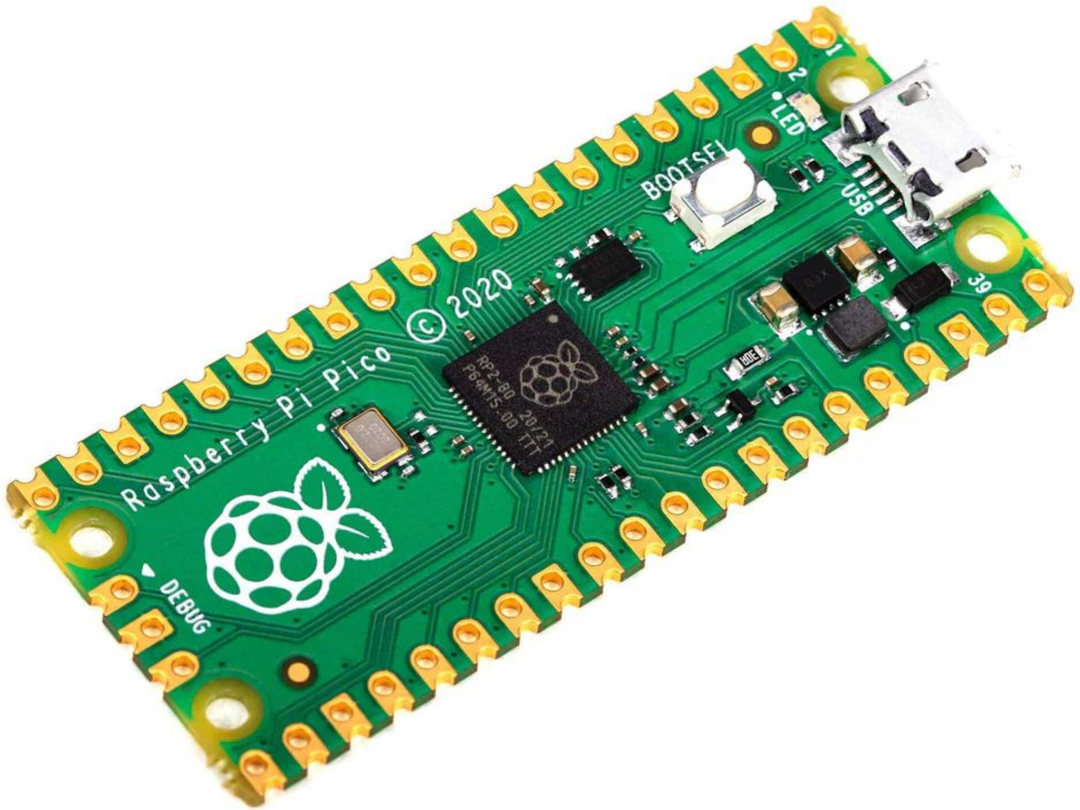
- Recessing the external envelope of the building
- Integration of fixed or automated external blinds or louvers.
- Permanent shading provided by vegetation or existing buildings.
- Integrating reflective canvas, earthen pot, vegetation on the roof.

Determining success

Measuring relevant properties for improved indoor environmental quality is not simple:

- Sensors need to measure temperature, light, sound, indoor air quality and other properties.
- Schools do not have power → Sensors have to have very long battery life and/or solar backup.
- Schools do not have internet connectivity → Sensors need to use mobile connectivity to report data.
- Sensors need to be safe for use in primary school classrooms, which infrastructures are often not very robust.
- Sensors need to be resilient to environmental conditions, e.g., dust and high temperatures.

A single device satisfying these constraints is ***not readily available;*** *some properties could be measured separately, but devices would be very expensive and hard to maintain.*



We're building our own devices, with the sensors we need.

Our device is based on the Raspberry Pi Pico – designed in the UK.

We're working with developers in Morocco, Pakistan, Germany, and UDSM/CoICT.

What could be put in place for the future of building design?

Interlocking Stabilized Soil Blocks (ISSB)

ISSBs have **favourable properties at favourable cost.**

- ISSB is a compressed earth block, mixed with a little cement and air-cured.
- These blocks are made without removing any trees.
- Buildings can be constructed more quickly thanks to the interlocking characteristic, which requires significantly less mortar between courses.
- ISSBs replace the need for burnt bricks and require no firewood, which is one of the environmental benefits

Haileybury Youth Trust Uganda. (2021). https://hytuganda.com/

Carbon smart schools

Without the use of mechanical systems, interior spaces that are more pleasant than the surrounding environment have been built using **locally accessible tools** and **renewable materials.**

Main Challenge

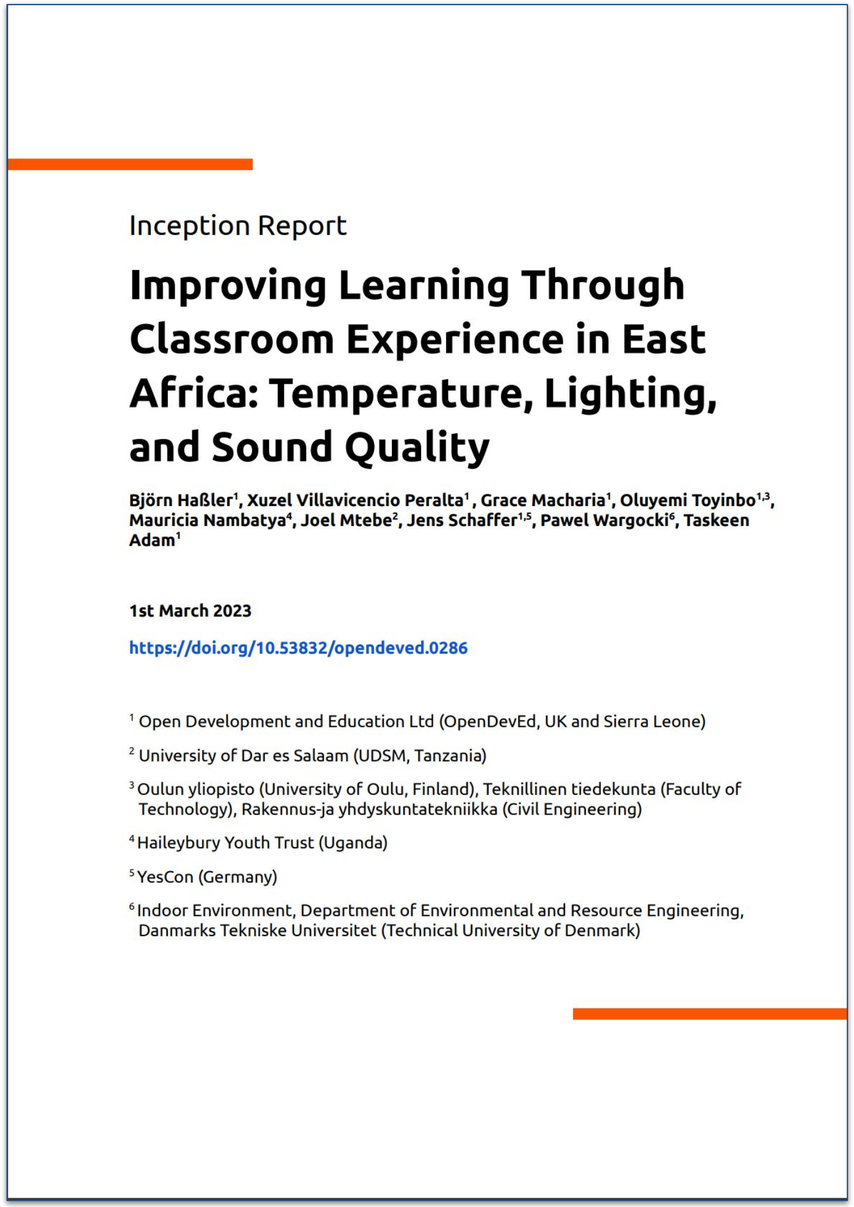
Most governments in low-income countries have standard, approved school designs, which makes it difficult to encourage stakeholders to see traditional construction techniques and low-cost, locally sourced materials as valuable.

Catriona Forbes (2022) Carbon-smart schools mitigate climate change and improve learning

Conclusion

Much remains to be investigated.

Improving learning through classroom experience in East Africa: Temperature, Lighting, and Sound Quality



Inception Report

Improving Learning Through Classroom Experience in East Africa: Temperature, Lighting, and Sound Quality

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If you have any questions, contact us ⬇️

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