(Adapting to the) **Impacts of climate** (change): Temperature, Light, Sound, Air

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https://opendeved.net

Utafiti Elimu 2023

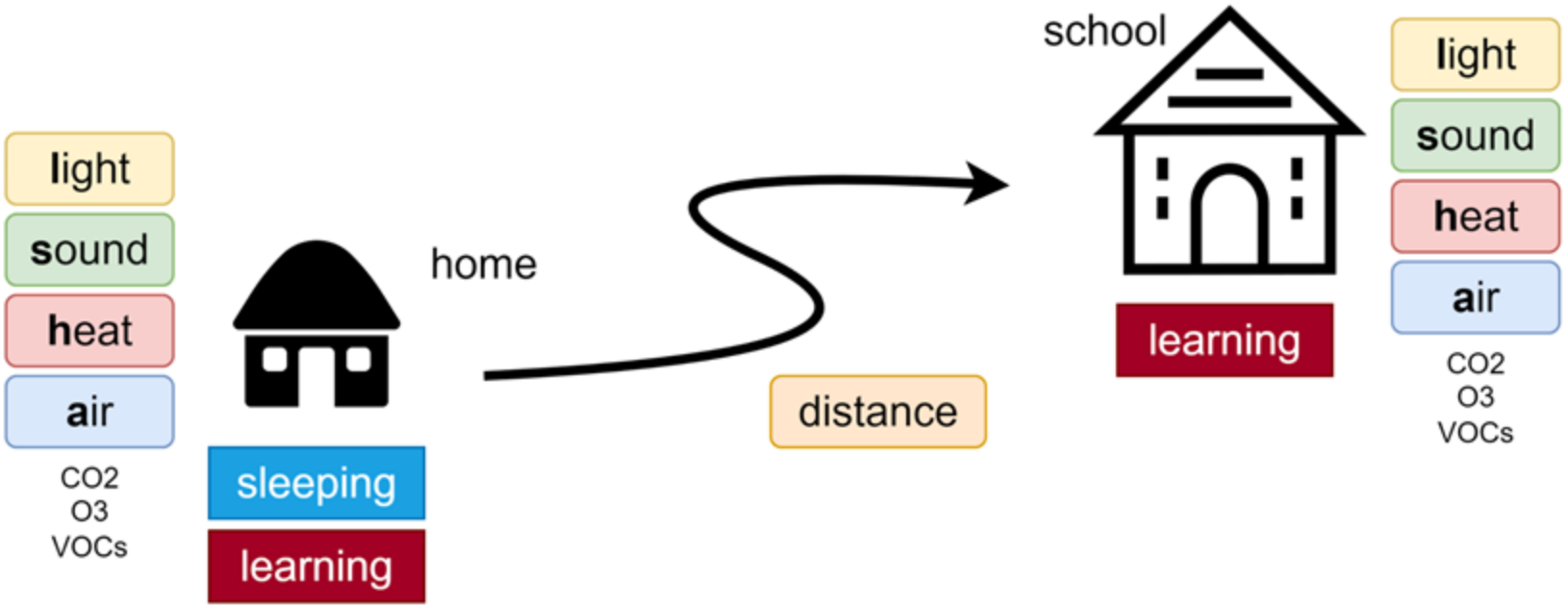
Stating the obvious

The built environment of a school affects student well-being.

Does classroom indoor temperature matter?

Yes!

Issues that matter



Some ideas for improving the indoor environmental quality of classrooms

What can we learn from elsewhere?

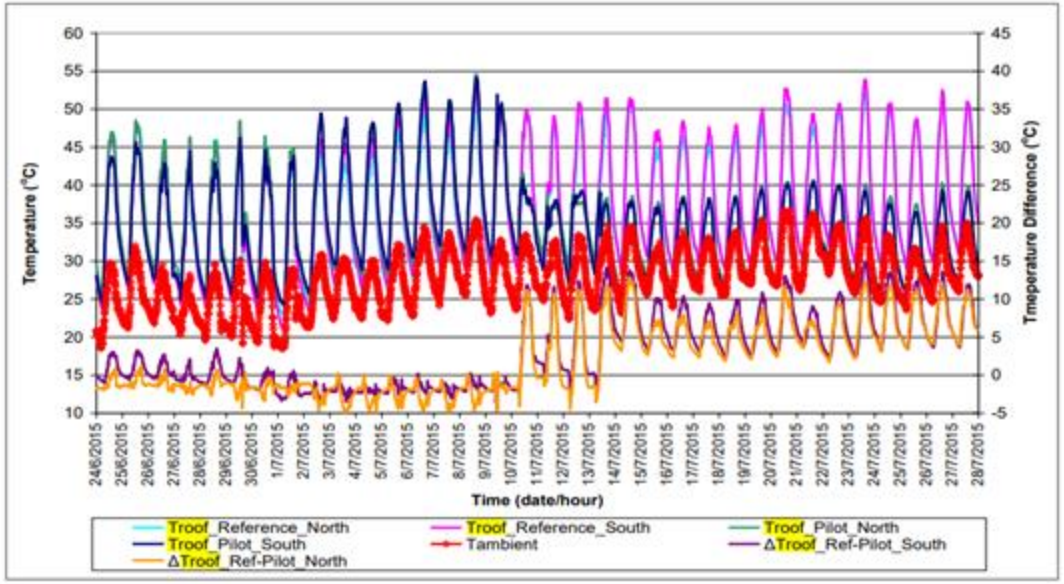


Fig. 4. Classrooms' roof temperature distribution and temperature difference before and after the cool roof.

Cool Roof Impacts on a School-Building Thermal and Energy Performance in Athens, Greece

Androutsopoulos, A. V., Stavrakakis, G. M., & Damasiotis, M. (2017). *Cool Roof Impacts on a School-Building Thermal and Energy Performance in Athens, Greece*. International Conference on Sustainable synergies from buildings to the urban scale. https://www.sciencedirect.com/science/article/pii/S187802961730107X

But …

While there is some, research in Tanzania (and Africa) is sparse.

Possible approaches for retrofitting

Idea 1: Natural ventilation

Encouraging natural ventilation to improve indoor environmental conditions at schools. Case studies in the north of Spain before and during COVID-10

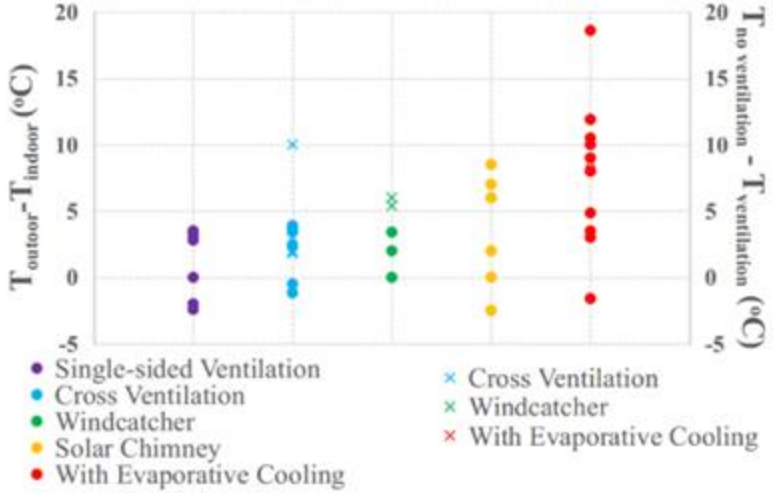
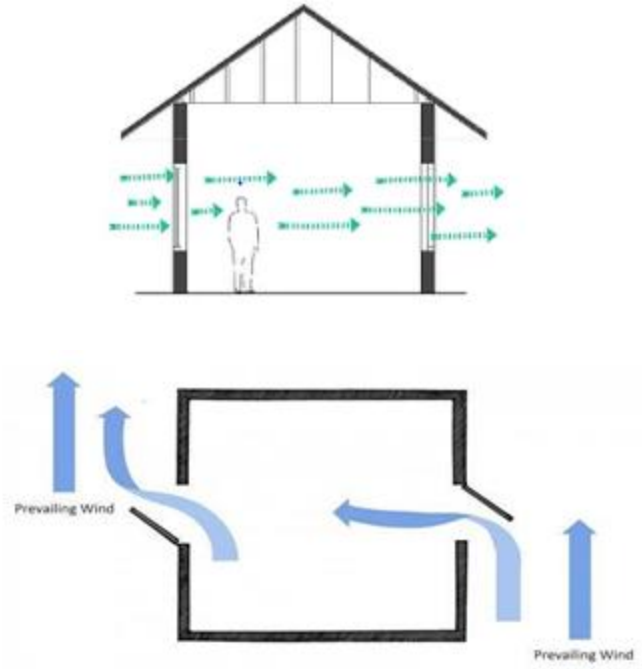


Fig. 11. Indoor temperature reduction compared to outdoor temperature (left y-axis; circle markers) and compared to non-ventilated scenarios (right y-axis; cross markers) for different natural ventilation systems using data reported from Table 6 to Table 9.



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

But natural ventilation

… is unlikely to be sufficient.

Idea 2A: Roof colour

White Paint intervention (WPI) and Blue Paint Intervention (BPI)

Tanzania

Should we paint all classroom roofs white to improve learning in Tanzania?
(standard paint)

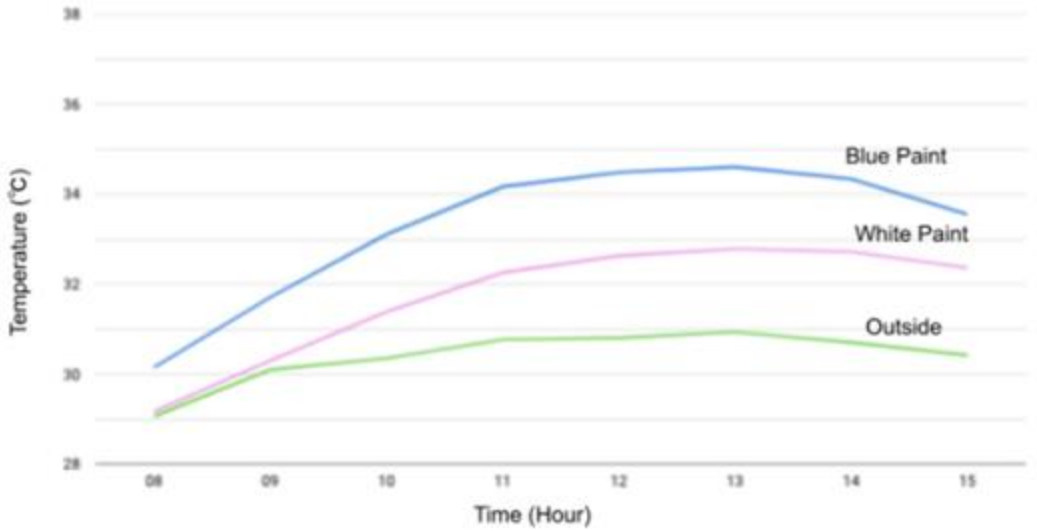
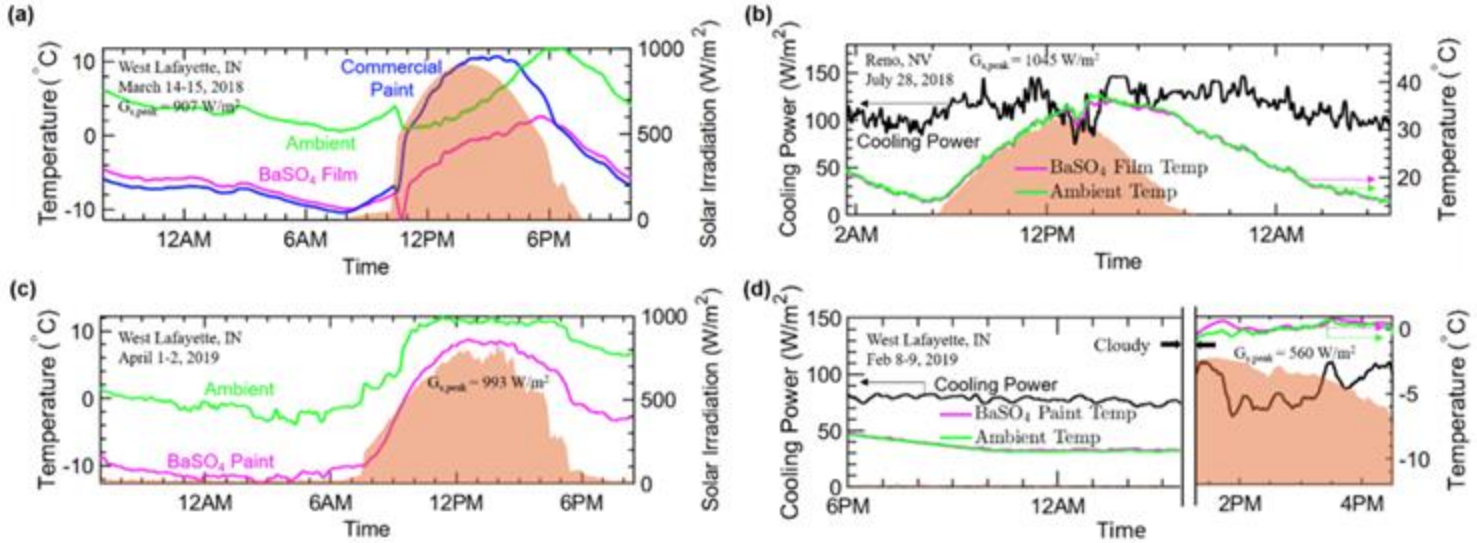


Figure 31: Minute by minute temperature recordings averaged across the four days and averaged hourly, from 30th December 2021 - 2nd January 2022 for the Blue Paint Intervention Classroom, White Paint Intervention and Outside under a tree.

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

Idea 2A: Roof colour/paint

We can do better… add Barium Sulphate



Li, X., Peoples, J., Yao, P., & Ruan, X. (2021). Ultrawhite $BaSO_4$ Paints and Films for Remarkable Daytime Subambient Radiative Cooling. *ACS Applied Materials & Interfaces*, *13*(18), 21733–21739. https://doi.org/10.1021/acsami.1c02368

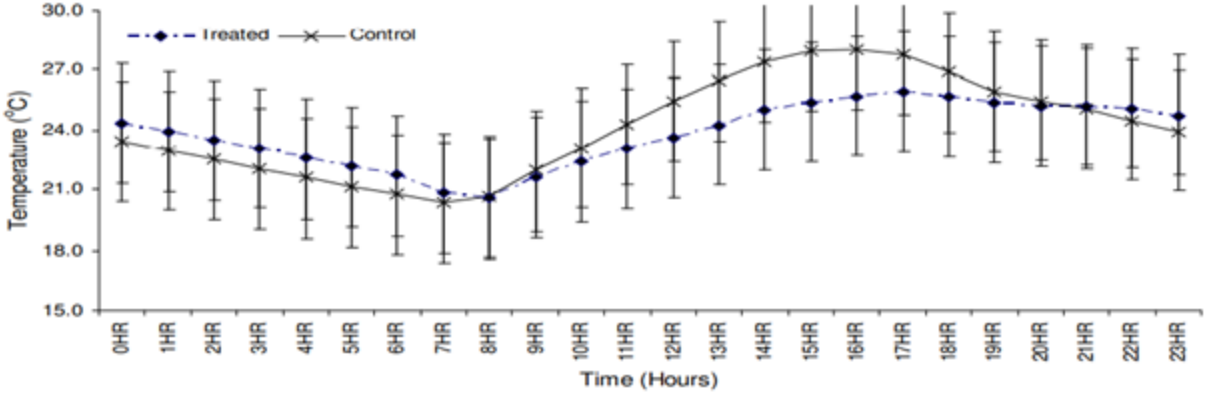
Idea 2B: Papyrus mats as roof insulation

Atieli, H., Menya, D., & Scott, T. (2009). House design modifications reduce indoor resting malaria vector densities in rice irrigation scheme area in w estern Kenya. *Malaria Journal*, *8*, 108. https://doi.org/10.1186/1475-2875-8-108

Idea 2B: Papyrus mats as roof insulation

House design modifications reduce indoor resting malaria vector densities in rice irrigation scheme area in western Kenya

Atieli, H., Menya, D., & Scott, T. (2009). House design modifications reduce indoor resting malaria vector densities in rice irrigation scheme area in w estern Kenya. *Malaria Journal*, *8*, 108. https://doi.org/10.1186/1475-2875-8-108



Idea 2C: Radiant barrier on the roof

Propst, D. (2019). *Creating temperate indoor environments in the schools, hospitals, and ministry buildings we design*. https://emiw orld.org/emi-tech/rd-radiant-heat-and-indoor-environments

Idea 3: Interlocking Stabilized Soil Blocks (ISSB)

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

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

Properties

ISSBs have favourable properties

… at favourable cost.

Properties	Interlocking Stabilised Soil Block	Sun-dried Mud Block	Burned Clay Brick	Stabilised Soil Blockb	Concrete Masonry Unit
GENERAL INFO					
Block Apperance					
Wall Apperance (not rendered)					
Dimension (L x W x H) (cm)	26.5 x 14 x 10 cm	25 x 15 x 7 cm to 40 x 20 x 15	20 x 10 x 10 cm	29 x 14 x 11.5 cm	40 x 20 x 20 cm
Weight (kg)	8-10 kg	5-18 kg	4-5 kg	8-10 kg	12-14 kg
Texture	Smooth and flat	rough and powdery	rough and powdery	smooth and flat	coarse and flat
Blocks needed to make up a sq.m.	35	10 to 30	30	21	10
PERFORMANCE					
Wet Compressive Strength (mps)	1 - 4	0 - 5	0.5 - 6	1 - 4	0.7 - 5
Thermal Insulation (W/m C)	0.8 - 1.4	0.4 - 0.8	0.7 - 1.3	0.8 - 1.4	1 - 1.7
Density (kg/m3)	1700 - 2200	1200 - 1700	1400 - 2400	1700 - 2200	1700 - 2200
AVG. PRICE (2009)					
Per Block (UgS)	350	50	150	400	3000
Per Sq Meter	35000	10000	55000	45000	75000

Nambatya, M. M. (2015). Investigating the Rationale for Material Selection in Tropical Housing Projects in Uganda – a Case for Interlocking Stabilised Soil Blocks (ISSB) Technology. University of Cambridge.

Idea 3: Tree cover

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

Propst, D. (2019). *Creating temperate indoor environments in the schools, hospitals, and ministry buildings we design*. https://emiw orld.org/emi-tech/rd-radiant-heat-and-indoor-environments

However…

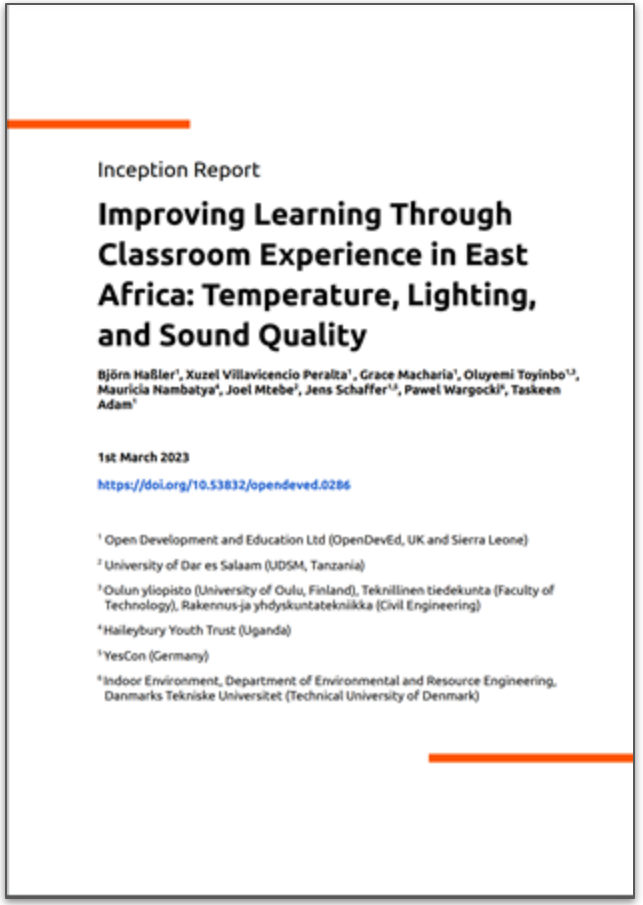
Trees very close to classrooms can have adverse effects.

- Roots of trees near a classroom could affect the infrastructure over time
- Certain trees attract bugs, which could create discomfort in the school community
- Watering trees could present a challenge in certain areas
- Community beliefs present resistance to certain types of trees

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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1st March 2023

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If you have any questions, contact us ↓

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