
# IMPROVING TANZANIAN CLASSROOMS: CONDUCTING SURVEYS IN TANZANIAN SCHOOLS – SECOND PILOT

Posted on 11th September 2023 by Björn Haßler, Xuzel Villavicencio Peralta and Oluyemi Toyinbo in blog

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Reading Time: 7 minutes
Funded by the UK Foreign, Commonwealth and Development Office, the Improving Learning Through Classroom Experience (ILCE) programme focuses on investigating whether modification of the built environment (temperature, light intensity, and acoustics) can positively impact the classroom experience to improve learning.

This blog post is about the second school visit, focused on testing the comfort survey with students, where we measured acoustics, lighting, temperature, and air quality with students in situ. We will also conduct the walk-through survey, which explores classroom conditions. Dr. Shelina Walli, Chief Executive Officer of Aga Khan Education Services in Tanzania, and her team facilitated OpenDevEd (ODE) to conduct this pilot study at Mzizima Secondary School in the city of Dar es Salaam. The study was conducted for a period of one week with students in Form 1, typically aged from 12 to 14 years of age. You can find out more about this here

# SECOND PILOT (20–27 JULY 2023)

In addition to testing the devices for a longer period, the purpose of the second pilot was to:

- Run a workshop with students to present the study and answer their questions
- Conduct a comfort survey with students in Form 1 (typically students aged 12–13 years)
- Conduct a walk-through survey with school personnel to understand the classroom conditions
- Assess the time that each activity of the data collection would take in the field.

## THE WORKSHOP

The team held a workshop with the students and gave a presentation on the causes of climate change and how it can affect indoor classroom environment quality (IEQ), including students' learning outcomes, wellbeing, and health. We explained the importance of the study, including how the results of the pilot could be used to implement changes and retrofits to improve classroom conditions and students' levels of comfort.

This space was also an opportunity for students to ask questions regarding the topic and to understand more details regarding the aim and approach of the study.


Figure 1. Presentation about climate change and the importance of indoor environment quality (IEQ) in classrooms at Mzizima Secondary School.

A comprehensive poster answering the main questions of the study was placed outside the classroom, so the school community could learn more about our project.


Figure 2. Poster placed next to the classroom

# COMFORT SURVEY

Forty-three students were asked to complete an online 'comfort survey' asking about their levels of comfort in their classrooms in terms of temperature, humidity, lighting, air quality, and noise.

As Figure 3 below shows, 65% of students indicated that they would prefer their classroom to be cooler. It is worth mentioning that July is one of the cooler months in Dar es Salaam. The students' answers seem to suggest that the need for cooler classrooms will only increase during the hotter months.

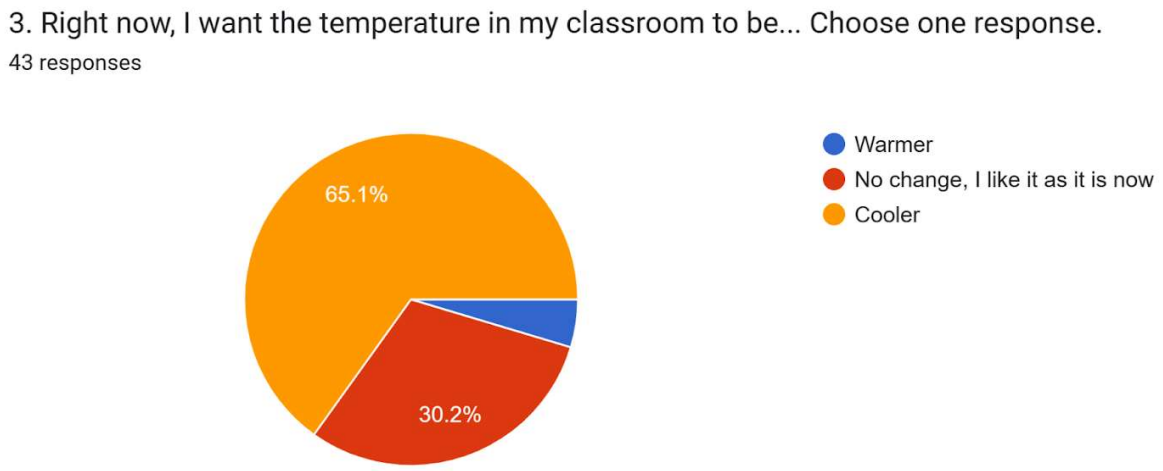


Figure 3. Results from comfort survey (temperature)

Another answer that caught our attention is that more than 75% of students would like the classroom to have better air circulation levels; this could be related to different things, such as the occupancy rate of the classroom, the orientation of the classroom related to airflow, reduced cross ventilation between opposing windows, etc.

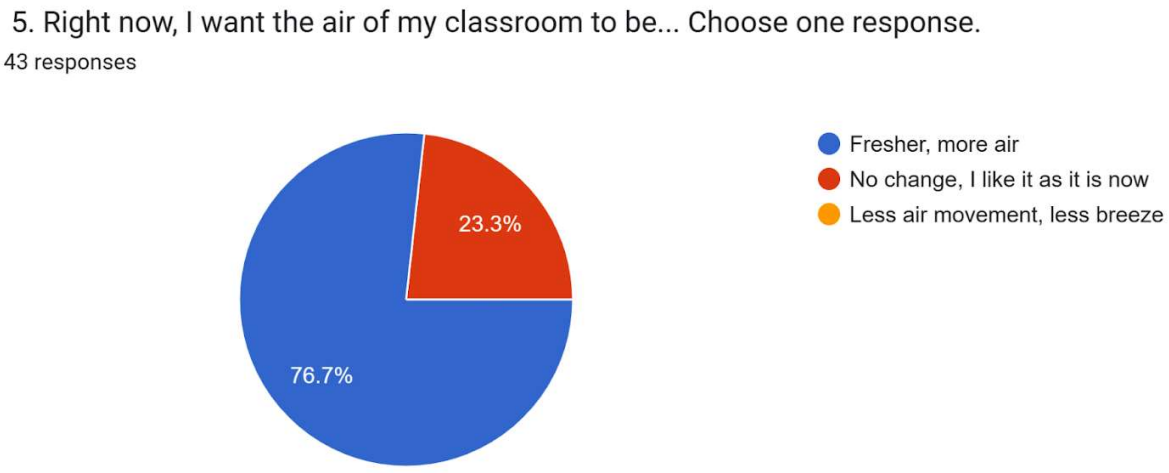


Figure 4. Results from comfort survey (air)

Of 43 students, 19 reported an unpleasant smell in the classroom. Of those 19 students, 15 attributed the smell to the manure being used on the football pitch near the classroom. While this could be something that only happens occasionally, it might be necessary to consider such instances more seriously to manage such occurrences and avoid students being negatively affected.

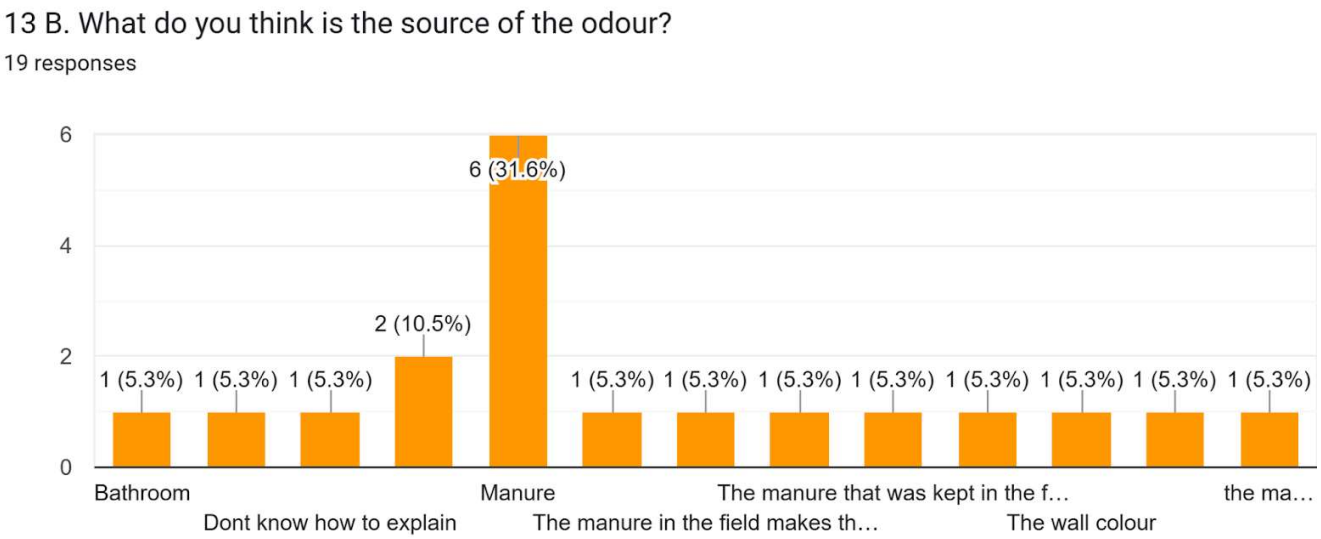


Figure 5. Results from comfort survey (source of the odour)

# WALKTHROUGH SURVEY

This survey consisted of different sections that aimed to cover aspects such as roof material, number of windows, wall colours, occupancy, and the frequency with which maintenance plans are implemented. While most of the questions could be answered by the OpenDevEd (ODE) team, the completion of certain sections required the collaboration of school personnel.

The results of the data collected from this survey will be analysed in a future report when we begin analysing different options for retrofits.

# ENVIRONMENTAL DATA

The team set up different IEQ parameter-measuring sensors in the classroom to collect data for a week. All dataloggers/sensors worked as expected with little to no interference from the students or the teaching staff. The data from the dataloggers was safely retrieved and stored in the ODE data repository. Extensive data analysis and reporting will be undertaken and shared with Aga Khan Mzizima Secondary School at a later date.

The preliminary results of our pilot study are shown below.

## TEMPERATURE

Temperatures each day vary by about 2 °C, with the coolest temperature record being 27 °C from 5 a.m. to 8 a.m. and the hottest being 29 °C from midday to 3 p.m. The increase in temperature within the classroom during midday can be attributed to a combination of factors. The heat generated by the students themselves, along with the radiant heat from sunlight during that time.

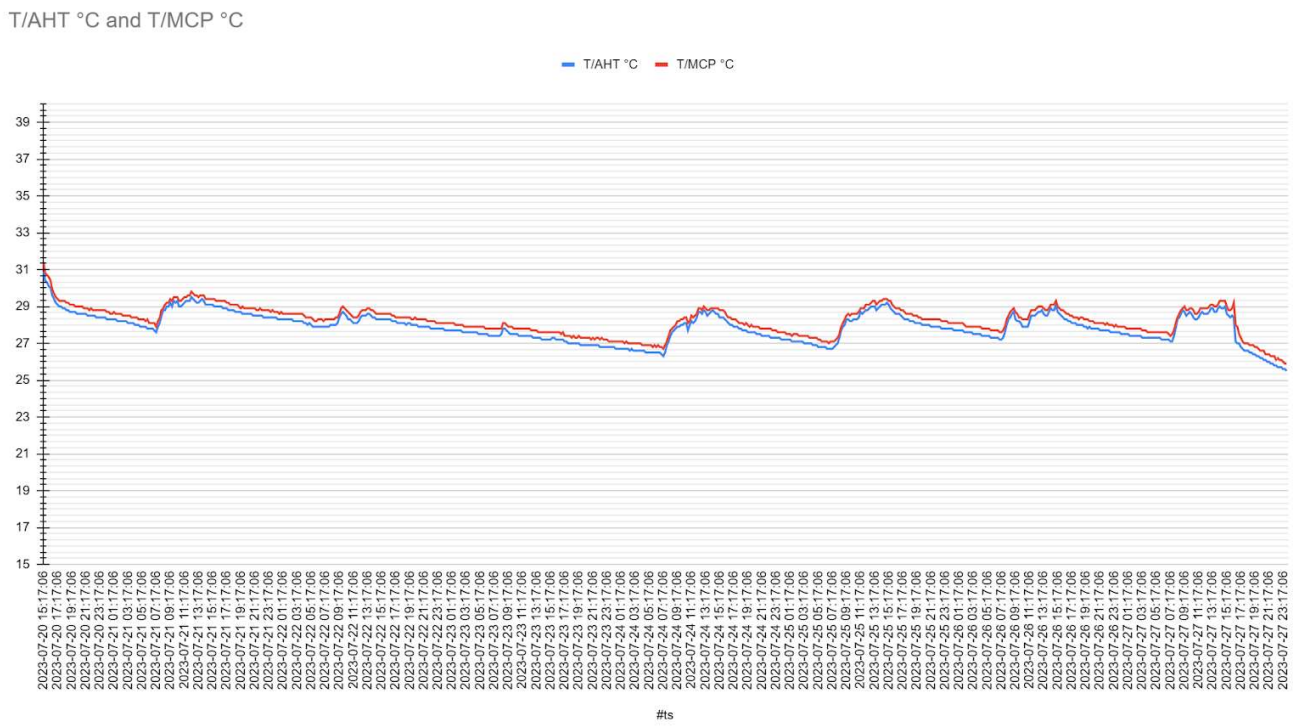


Figure 6. Temperature readings for the week of 20–27 July, using two different sensors

## $CO_2$

As a preliminary analysis, $CO_2$ shows 400 ppm (parts per million) as the lowest level, and it peaks at over 1000 ppm from 8 a.m. to 9 a.m. During the school day, from 9 a.m. to 4 p.m., levels of $CO_2$ vary from 400 to 900 ppm. $CO_2$ measurements are commonly employed to gauge the sufficiency of ventilation within indoor spaces. In the context of classrooms, maintaining a $CO_2$ concentration below 1000 ppm is the recommended criterion for ensuring satisfactory ventilation. The utilisation of $CO_2$ measurements to assess ventilation adequacy stems from the fact that $CO_2$ is a reliable indicator of indoor air quality (IAQ) and circulation. As students exhale $CO_2$, its concentration within a closed space increases over time. Therefore, monitoring classroom $CO_2$ levels provides valuable insights into the effectiveness of ventilation systems in replenishing indoor air with fresh, oxygen-rich air from the outside.

By measuring $CO_2$ concentrations, it is possible to infer whether a space is experiencing sufficient air exchange and proper circulation. Elevated $CO_2$ levels, especially when over 1000 ppm , often indicate inadequate ventilation, suggesting that the build-up of other potential pollutants and decreased oxygen levels might also be present. Thus, $CO_2$ measurements offer a practical and indirect means of evaluating ventilation performance and ensuring healthier indoor environments.

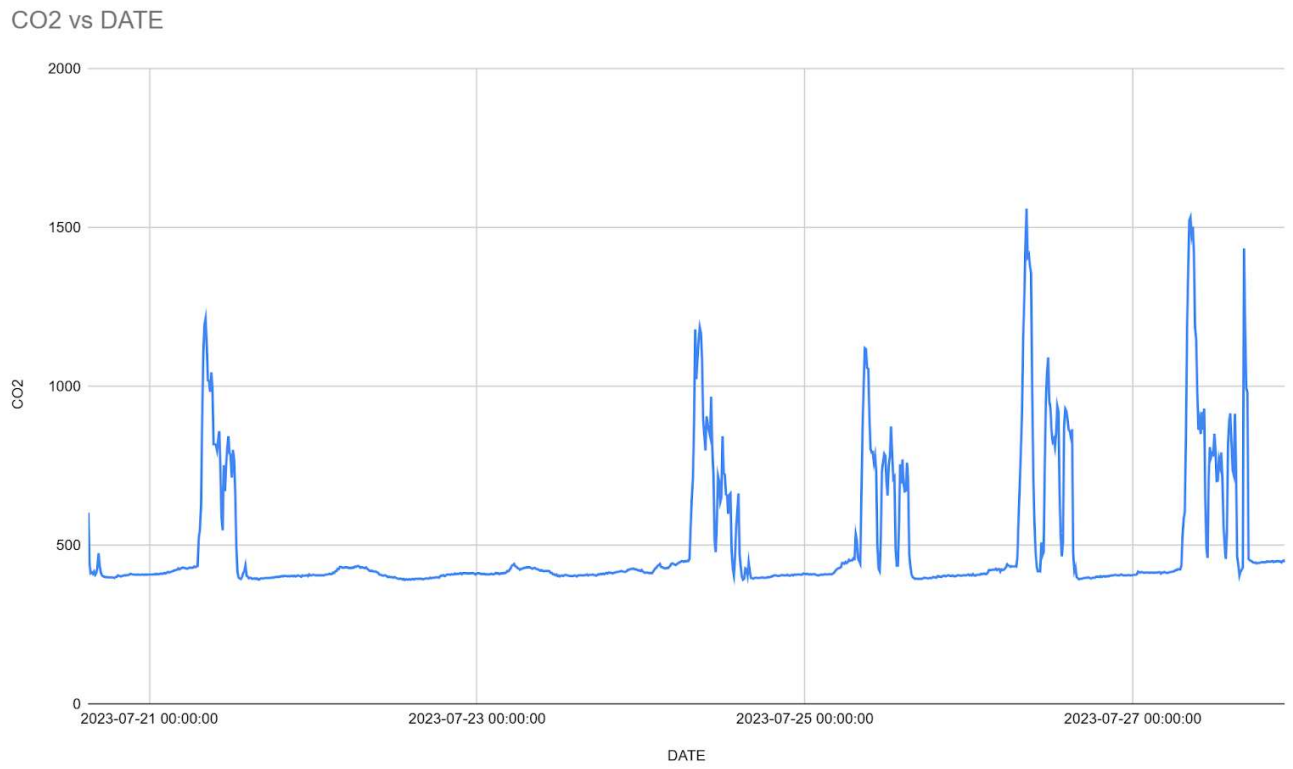


Figure 7. $CO_2$ readings for the week of 20–27 July

## PM2.5 AND PM10

In the context of regulating air quality, particle size is a critical factor. Particles with a diameter of 10 microns or smaller (PM10) are considered inhalable and can pose health risks. Particularly concerning are particles with a diameter of 2.5 microns or smaller, known as fine particulate matter (PM2.5). It's important to note that PM2.5 particles can penetrate even deeper into the respiratory system, potentially causing more severe health issues. Consequently, a portion of PM10 particles consists of PM2.5 particles.

The World Health Organization recommends that the yearly mean levels of PM2.5 should remain below 5 $\mu g/m^3$ on average. Additionally, there should be no more than 3 to 4 instances per year when the 24-hour average exposure surpasses 15 $\mu g/m^3$. For PM10, the annual average should be limited to 15 $\mu g/m^3$, while the 24-hour average should not exceed 45 $\mu g/m^3$ for more than 3 to 4 instances per year.

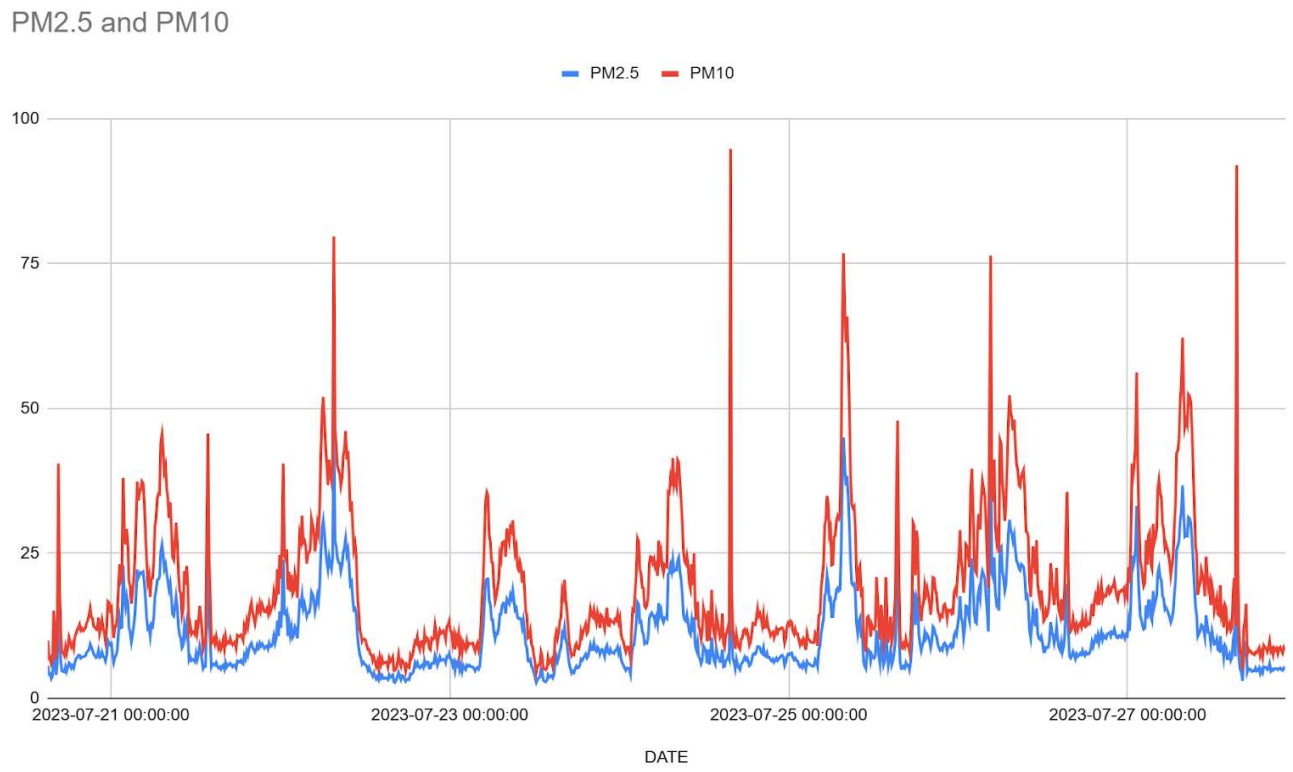


Figure 8. PM2.5 (μg/$m^3$) and PM10 (μg/$m^3$) readings for the week 20–27 July

As can be seen from Figure 8, there were many days when the recommended values for PM2.5 and PM10 were exceeded

## TABLE 1. DESCRIPTIVE STATISTIC FOR MEASURED PM2.5 (MG/$M^3$)

**PM 2.5**

| Mean | Median | Max | Min |
|---|---|---|---|
| 11.32 | 9 | 50.2 | 2.7 |

## TABLE 2. DESCRIPTIVE STATISTIC FOR MEASURED PM10 (MG/$M^3$)

PM 10

| Mean | Median | Max | Min |
|---|---|---|---|
| 19.16 | 15.2 | 94.8 | 4.5 |

### ILLUMINANCE

The descriptive statistics for the measured light intensity during the workshop with students are shown In Table 1 above.

#### TABLE 3. DESCRIPTIVE STATISTICS FOR MEASURED LIGHT INTENSITY IN THE CLASSROOM (LUX) DURING OCCUPIED HOURS OF THE WORKSHOP (~2 P.M. TO ~3 P.M.)

| Mean | Median | Max | Min |
|---|---|---|---|
| 36.35 | 35 | 53 | 10 |

The mean, median, maximum, and minimum light intensity values measured showed that the light intensity in the classroom was below recommended levels for classrooms, which should be around 300 lux or more. This could be related to the classroom windows being covered with curtains during classes when the teacher uses a projector. However, we noticed that the students still preferred the dark classroom even after the presentations. It's likely that they have become accustomed to the classroom being dark, or they might be using the curtains to prevent sun glare.

Lighting is a crucial factor in creating an optimal learning environment in a classroom. It plays a significant role in shaping students' concentration, mood, and overall wellbeing. The quality and design of classroom lighting can greatly influence students' ability to engage in lessons, retain information, and foster a positive educational experience.

## 1.5. NEXT STEPS

An in-depth analysis of the readings collected from the devices, comfort survey, and walkthrough survey will be carried out to learn more about the classroom conditions. After this, our team will provide recommendations for retrofits to improve IEQ in the classroom where the second pilot was conducted.

- Students displayed a high level of interest and asked questions in the workshop about how climate change could impact them. More activities to engage the school community on this topic might be necessary.
- Students in the schools where the study will be conducted are mostly Swahili speakers. For the fieldwork, the presentation, poster, and comfort survey will be translated into Swahili.

- The comfort survey will be printed for the fieldwork because internet connectivity and computer labs might not exist or be available in the schools selected for the larger intervention.
- OpenDevEd has built a second version of the environmental sensor that includes readings of temperature, humidity, luminance, sound, and $CO_2$ parameters. In the upcoming months, this second version will be tested again at Mzizima Secondary School, with and without the presence of students.

Overall, the first and second pilots enabled us to fine-tune our approach and prepare for the larger intervention programme. We are excited to see the positive impact our research could have on improving indoor environmental quality and learning conditions for students in Tanzania.

**PREVIOUS POST**
IMPROVING TANZANIAN CLASSROOMS: Trialling environmental sensors in Tanzanian Schools – First pilot

**NEXT POST**
Education and climate change – What retrofits could make classroom environments more conducive to learning?

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