



ABDULLAH BIN SALAM SCHOOL

مدرسة عبدالله بن سلام للتعليم الأساسي (5-8)

Using recorded student feedback as a guide to choosing more sustainable school flooring

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Discussion of results

The discussion of the findings of this research focuses on linking field data, community awareness, and engineering perspectives to answer the research questions and achieve the study's objectives of promoting school sustainability, as follows:

First: The role of GLOBE program observations in understanding local climate change (answering the first question)

The results show that daily observations of surface temperature are a crucial tool for scientists and students to understand the phenomenon of local warming.

• Thermal Gap: The data revealed a sharp contrast between surface and air temperatures. In May 2024, concrete surfaces (interlocking pavers) recorded a maximum temperature of 71.1°C, while the air temperature at the same time was 40.2°C. This difference of 30.9°C proves that the current flooring acts as a heat collector, increasing the temperature of the school's surroundings.

• Material Behavior: Measurements showed that non-vegetated surfaces made of concrete exhibit a significant increase in heat compared to other materials, justifying the need to transition to more sustainable materials. Second: The Impact of High Temperatures on the Use of Outdoor Spaces (Answer to Question 2)

An analysis of a questionnaire with 42 participants revealed that the intense heat from rooftops directly and negatively impacts the learning environment and physical activity:

• Restrictions on Activities: Participants agreed that the heat emitted from exposed rooftops is "annoying" and limits their ability to engage in activities or play in the playground, especially during the midday sun.

• Environmental Preferences: The results showed a high awareness of thermal contrast; there is a strong sense of a comfortable temperature difference between planted areas and concrete areas, which reinforces the desire for greenery.

• Impact on Classrooms: There is a widespread understanding that the heat from outdoor areas negatively affects the cooling of classrooms overlooking them, increasing the strain on cooling systems.

Third: The Contribution of Long-Term Data to the Sustainability Strategic Plan (Answer to Question 3)

According to the interview with Engineer Ehab Al-Hatli, GLOBE data spanning from 2019 to 2025 provides the school with a "roadmap" towards sustainability. • Scientific Persuasion: This data transforms casual observations into a rigorous engineering study, persuading decision-makers to focus on the lifetime cost of construction (LCCA) rather than solely on the initial construction cost.

• Improved Learning Environment: The data supports proposals to modify flooring using materials with a high Solar Reflectance Index (SRI) to reduce heat absorption, thus achieving thermal comfort for students.

• Pilot Area Initiative: The study proposes to begin by converting small sections of the school as a pilot project, aligning with Oman Vision 2040's commitment to environmental sustainability.

Overall Conclusion: The research objective is achieved by demonstrating that reliable scientific data bridges the gap between students' field observations and practical engineering and financial implementation. The shift towards more sustainable school flooring is not merely an aesthetic choice, but an environmental and health imperative to ensure a safer school environment for future generations.

Conclusions

- The study demonstrated a critical thermal gap between air temperature and solid (concrete) surfaces, exceeding 30°C. This confirms that traditional building materials in schools act as "heat reservoirs," exacerbating the phenomenon of small island heat.
- The results revealed a direct correlation between increased surface temperatures and restricted use of outdoor spaces, as the emitted heat reduces thermal comfort levels, hindering students' physical activities.
- The research concluded that long-term GLOBE data (2019-2025) provides a reliable benchmark for supporting engineering decision-making. The shift towards materials with a high Solar Reflectance Index (SRI) and the expansion of vegetation cover are technological necessities for achieving the sustainability standards outlined in Oman Vision 2040.

The research underscores the importance of moving from assessing "initial construction costs" to "life-cycle costs of materials," as investing in sustainable materials reduces long-term energy consumption and provides a healthier and safer learning environment.

the reviewer

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Show results

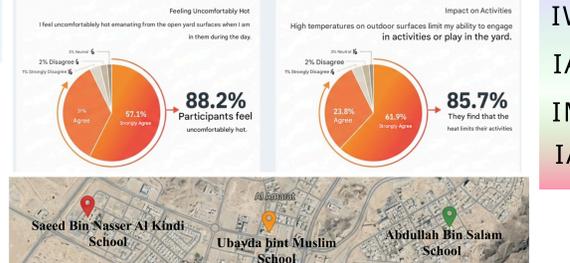
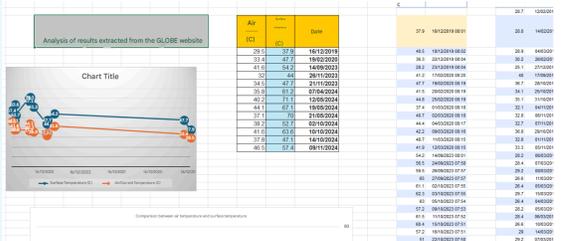
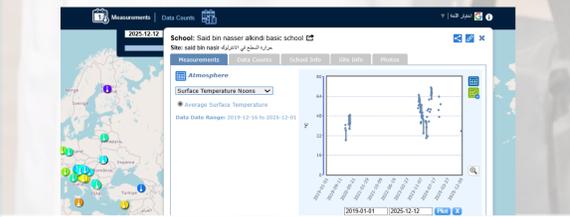
1. Heat Gap (Digital Results): Field measurements using GLOBE protocols revealed a sharp thermal contrast; concrete (interlock) surfaces recorded a maximum temperature of 71.1°C, while the air temperature at the same time was 40.2°C. This difference, exceeding 30.9°C, scientifically proves that traditional flooring acts as a "heat sink," raising the temperature of the school's surroundings and exacerbating local warming.

2. Material and Color Comparison (Performance Efficiency): The results showed that material and color determine the thermal behavior of the surface. White ceramic tiles recorded the lowest readings (between 18.6 and 19.9°C) in the shade, while colored cement floors recorded very high readings when exposed to sunlight [42, 44]. This justifies the need to switch to materials with a high solar reflectance index.

3. Societal and Educational Impact (Questions): Qualitative analysis of the responses of 42 participants confirmed a widespread awareness of the problem. Students and teachers overwhelmingly agreed that the heat emanating from schoolyards hinders physical activity and play, and negatively impacts the cooling of classrooms overlooking them.

4. Strategic Feasibility (Engineering Perspective): Interviews with specialists demonstrated that relying on long-term GLOBE data (2019-2025) transforms casual observations into a "sound engineering study." The results concluded that sustainability is a smart investment that reduces operating costs by applying the "life-cycle costing" concept, rather than focusing solely on initial construction costs.

*These integrated findings prove that improving school flooring is not merely an aesthetic choice, but a technical and environmental necessity to ensure "thermal comfort" that supports academic achievement and aligns with the sustainability goals of Oman Vision 2040.



Search procedures

First: Saeed bin Nasser Al Kindi School, from which observations were collected over a period of six years (2019-2025). This data is useful for monitoring surface and air temperatures for most months of the year. The recorded data was extracted from the GLOBE website using the Visualize Data tool.

- The school is located in the Muscat Governorate, Al Amerat, at an altitude of 124 meters, at longitude 23.5111 North and latitude 58.4516 South.

- There is no vegetation on the studied surfaces; instead, they are paved with interlocking tiles made of heat-treated cement.

- Surface temperatures are measured daily near an atmospheric shelter, with measurements taken almost daily around midday.

Second: Abdullah bin Salam School also extracted recorded data from the Visualize Data platform during the first two months of the study. Because the school is new, the data relies on recorded observations of surface temperature and air temperature over several months for comparison with data from Saeed bin Nasser Al Kindi School and Ubaidah bint Muslim School.

- The school is located in the Muscat Governorate, Al Amerat Wilayat, at an altitude of 108 meters, at longitude 23.490°N and latitude 58.504°S.

- There is no vegetation in the area where the surface temperature was studied, but the area is covered with soil next to the air shelter.

- Surface temperature readings of the interlocking pavers were also taken in another area of the school to obtain diverse data for the research.

Third: Ubaidah bint Muslim School had surface temperature measurements taken because the school has various flooring materials, including painted interlocking pavers, cement, and ceramic tiles, in two different locations (in the shade and in the sun). This allows for a scientific comparison of surface temperature readings across the three schools. - The school is also located in the same governorate and is 4 kilometers away from the study site at longitude (23.465) and latitude (58.477) south.



Research summary:

This research investigates the integration of daily GLOBE program observations to comprehend climate change and safeguard the school environment. The study addresses the critical impact of extreme surface temperatures on student outdoor activities during peak sun hours. It aims to provide a robust scientific justification for transitioning to sustainable school flooring through field evidence, blending expert engineering insights with student-led data to enhance educational quality.

The methodology employed a "Citizen Science" approach across three tracks: field measurements of surface and air temperatures following GLOBE protocols, scientific questionnaires distributed to 42 participants to assess physical heat impact, and a specialized interview with a project engineer. Furthermore, Artificial Intelligence (AI) techniques were utilized to analyze historical climatic records.

The results revealed a significant "heat gap" exceeding 30.9°C. While ambient air temperature recorded 40.2°C in May 2024, concrete surfaces surged to a staggering 71.1°C. This confirms that conventional flooring acts as a "heat collector," severely restricting schoolyard activities.

The findings indicate that sustainability is a strategic investment that reduces long-term operational costs via "Life-Cycle Costing" methodologies. The study recommends replacing existing surfaces with materials possessing a high Solar Reflectance Index (SRI), such as white ceramic tiles, and expanding green spaces. Finally, it suggests implementing "miniature application models" as an initial step toward comprehensive development aligned with Oman Vision 2040, ensuring a safer and more resilient learning environment.

Research questions

1. How do our daily GLOBE observations of surface temperature help scientists understand climate change and protect our school and community environment?
2. How does a significant increase in surface temperature affect students' and teachers' use of outdoor spaces at school during peak temperatures (typically around midday)?
3. How can long-term GLOBE data (2019–2025) contribute to a school strategic plan to promote environmental sustainability and mitigate the negative impacts of local climate change?

the introduction

This research is based on the methodological framework of the GLOBE program, a global initiative that empowers students and citizen scientists to understand the Earth as a holistic system. Using the pedosphere protocol, the study recorded extreme surface temperatures—reaching 71.1°C on concrete surfaces—within a longitudinal dataset spanning from 2019 to 2025.

To ensure the overall scientific validity of the research, four distinct data collection pathways were employed:

Field measurements: Analysis of surface and air temperature data recorded over six years.

Public opinion: Scientific surveys to assess the impact of surface temperature on the biosphere and student activity.

Expert consultation: Interviews with structural engineers to link technical data to practical architectural solutions.

Case study: Field measurements at Ubaidah Bin Salam School to evaluate the adaptability of canopy materials for use in other educational facilities.

By analyzing this data through the GLOBE information system, the research provides a scientific justification for the transition to sustainable schoolyards. This evidence-based strategic plan promotes environmental stewardship and directly contributes to improving community well-being. Furthermore, it highlights the vital role of student-generated data in addressing local climate challenges and encourages the next generation to conduct regular observations. Ultimately, these findings guide engineering decisions toward the use of high-efficiency materials, ensuring a safer and more resilient learning environment, in line with the Sustainable Development Goals.



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