Future of Work Initiative

Turning Scarcity into Solution — The Pejuola Water Purification Project

Global STEAM & Leadership Challenges – Case Study

> *"When we allow children to step out of the role of passive victims of an environmental crisis and into the role of active research scientists, the entire purpose of school shifts. True education does not simply prepare a child for the future—it convinces them that they have the power to change it right now."*

Salimot Akande, STEAM educator and Teach For Nigeria Fellow

The Human Element & Community Context

Water is the fundamental spark for human survival, biological hygiene, and academic performance. Yet across peri-urban networks in Ogun State Nigeria, accessing a reliable drop of clean water turns into a grueling daily battle when the dry season sets in.

In the Pejuola Community Development Area (CDA)—spanning five sub-CDAs along Elite Road in Abeokuta, Ogun state , Nigeria—residents are tied to seasonal hand-dug wells. When the rains stop, these critical water lines undergo an alarming transformation: they dry up to a muddy trickle or yield thick, turbid water choked with visible particulates and invisible microbial pathogens.

For the students attending Lantoro High School Junior, this infrastructure gap is an immediate threat to their education. Walking into the classroom during these months,I instantly noticed a troubling pattern: empty desks at the morning bell, exhausted faces, and children nodding off over their notebooks. When asked why they are struggling, the students' explanations reveal a painful reality:

- "I woke up early to fetch water before my neighbours woke up."
- "I went to fetch water, that is why I am late."

This is not a simple case of poor time management. It is a structural crisis where 80% of my students face chronic school lateness because they are carrying heavy jerrycans through the dawn hours. Furthermore, the reliance on raw, contaminated well water triggers public health issues, leaving students to battle painful skin infections like ringworm and rashes. The water scarcity was not simply an infrastructure problem; it was quietly dismantling student health, dignity, and learning.

To address this environmental hazard, my classroom teaching pivoted from static textbook definitions to live action research. 50 students across basic secondary levels were organized to map the community's water architecture and run quantitative field assessments.

The data gathering confirmed that local systemic reliance on unsafe water sources was widespread: Faced with proof that 70% of their peers rely on contaminated wells and 80% miss critical morning instructional time , our first school's student-led Change Maker Club stepped up. They set out to engineer an immediate, affordable, and hyper-local solution to purify the water right at the source.

Engineering Design & The Iterative Prototyping Process

The Change Maker Club approached the problem through the lens of environmental engineering and separation chemistry. The core objective was clear: design a multi-layer filtration column using cheap, locally sourced materials that could reduce turbidity and filter out suspended matter. Students selected materials based on distinct physical and chemical separation behaviors:

- Gravel & Sand (Physical Screening): Arranged from coarse to fine grades to act as mechanical sieves. Coarse layers trap large debris (twigs, leaves), while fine sand beds capture micro-particulates and suspended silt.
- Activated Charcoal (Chemical Adsorption): Included to handle what physical screens cannot. Activated charcoal features a highly porous surface area that drives chemical adsorption. Instead of just trapping particles mechanically, it chemically binds to volatile organic compounds, neutralizes foul odors, and strips out foul tastes and dissolved organic toxins.
- Sieve Membrane Barrier: Placed at the base to retain fine charcoal sediment and capture any lingering microscopic particles.

The Prototyping Phase

The young engineers built three distinct experimental configurations (Models A, B, and C) using plastic variables to identify the ideal final sieve membrane:

Model	Sieve Material Tested	Experimental Outcome & Water Clarity
Model A	Serviette paper	**Highest clarity** — produced a visibly clean, particle-free output.
Model B	Cotton wool	**Moderate clarity** — minor turbidity and faint cloudiness remained.
Model C	Foam	**Lowest clarity** — water stayed largely turbid and unchanged.

Critical Thinking Pause: Why must turbid water pass through the coarse gravel and sand layers before reaching the charcoal and serviette paper? Predict how the system's filtration efficiency and operational lifespan would change if raw, muddy well water hit the fine serviette paper first.

Backed by their experimental data, the club scaled up the design into a dual-chamber, gravity-fed filtration system. They mounted a transparent filtration chamber directly over a clear collection vessel, linking them with localized piping.

The final operational blueprint was assembled in a precise, top-to-bottom sequence designed to balance flow rate with maximum particle entrapment:

- **Step 1:** Inflow Container - Raw, turbid well water is introduced at the top.
- **Step 2:** Coarse & Fine Gravel -Primary Separation Zone. Traps large twigs, stones, and heavy organic matter.
- **Step 3:** Coarse & Fine Sand -*Secondary Polishing Zone.* Captures fine suspended soil particles and cloudiness. .
- **Step 4:** Activated Charcoal Layer—Adsorption zone neutralizes volatile contaminants, bad odor, and organic discoloration.
- **Step 5:** Serviette Paper Matrix - Micro-filtration barrier catches fine particulates and prevents charcoal dust from washing through.
- **Step 6:** Collection Outflow Container -Purified, clear water is collected and checked visually for domestic use.

Scaling our design from small classroom containers into a heavy, dual-chamber gravity system brought unexpected engineering hurdles. During our first trial run, the high hydrostatic pressure of the water column caused the delicate serviette paper matrix to rupture at the base, resulting in a cloud of fine charcoal dust flooding our collection vessel. Instead of getting discouraged, the Change Maker Club huddled together to troubleshoot. The students engineered a structural fix by reinforcing the base sieve membrane with a porous layer of mesh fabric, perfectly balancing the water flow rate with maximum particle entrapment. The system performed exceptionally well. The heavy, yellowish tint of the dry-season well water cleared up completely, yielding water fit for handwashing, sanitation facilities, cooking, and agricultural school projects.

Educational Transformation & Leadership Mapping

The impact of this action research extended far beyond physical water quality. By stepping into the roles of analytical researchers and environmental designers, the students experienced a profound shift in agency. They stopped seeing themselves as passive victims of an infrastructure gap and began acting as civic leaders.

This achievement was not built in a vacuum. True community-led change requires deep collaboration, and our school's Parent-Teacher Association (PTA) alongside local Pejuola CDA leaders stepped up to source the heavy-duty plastic barrels and excess gravel needed for our scaled prototype. This collaborative dynamic establishes a sustainable, community-led governance blueprint. By actively involving the PTA and local CDA leaders in sourcing materials, the project bypasses reliance on external municipal funding and ensures that the local community takes long-term operational ownership of the filtration infrastructure. When parents and civic leaders see their children acting as primary researchers, school and community boundaries dissolve, creating a shared responsibility to maintain and protect local water resources.

The Sustainability & Replication Blueprint

To scale this local success into a regional model, the Change Maker Club has formalized a concise three-part replication blueprint:

- **Geographic Shortage Mapping (3 Months)**: Student leaders will deploy quantitative field assessments to survey neighboring schools and identify where chronic lateness correlates with water-fetching burdens.
- **Peer-to-Peer Training Workshops (6 Months):** Our students will host weekend workshops to train external student networks in filtration chemistry, system prototyping, and mechanical troubleshooting.
- **Community Asset Mapping (12 Months):** We will guide new student hubs to audit local resources, empowering them to source affordable, site-specific sand, gravel, and agricultural charcoal.

Reflection

My students looked past standard lab kits and turned everyday serviette paper and charcoal into life-altering tools. Audit your school grounds today: what local, low-cost raw materials are hiding in plain sight that your students can use to combat an environmental or public health hazard?

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