

Engineering Empathy: How Student Innovators Built a Smart Walking Stick for the Visually Impaired in Lagos, Nigeria

Global STEAM & Leadership Challenges – Case Study



“Equipping students with hands-on STEAM education transforms them into leaders and problem solvers who design empathetic, meaningful solutions to real-world challenges.”

—[Hannah Edubi](#), STEAM educator and [Teach For Nigeria](#) fellow

The Catalyst for Change

Growing up and working in a low-income community in Lagos, Nigeria, I have witnessed firsthand the daily realities faced by vulnerable groups, especially students living with visual impairment. In our neighborhood, a simple walk down the street is filled with serious mobility challenges due to poor infrastructure, including open gutters, uneven roads, and unmarked staircases. These conditions significantly increase the risk of accidents and severely limit personal independence. Traditional walking canes rely mainly on physical contact, which fails to provide early warning of upcoming hazards. This pressing local reality guided my students and I to take on an applied STEAM project designed to restore safe mobility for our visually impaired neighbors. .

The Journey: Transforming Empathy into Engineering

To create awareness, my students and I introduced empathy-driven activities where they had to imagine navigating our environment without sight. This immersive exercise helped them deeply understand both the physical and emotional challenges faced by visually impaired individuals. Through this process, students developed a deeper sense of social awareness, identity, and purpose, recognizing that they had a responsibility to create inclusive solutions for their community.

With a shared purpose ignited, the classroom transformed into a collaborative design lab. Students worked together to explore solutions, demonstrating strong teamwork, mutual respect for diverse perspectives, and a shared responsibility toward a common goal.

Rather than sitting back as passive learners, they acted as true innovators. They were actively involved in every stage—from identifying the problem to designing and building the solution. Through collective brainstorming and critical thinking, they proposed a brilliant idea: a Smart Walking Stick that could detect obstacles and ground-level changes before making physical contact. Their ability to take initiative and make decisions reflected a massive leap in student agency.

The Engineering Breakthrough: Iteration and Mastery

The physical development of the Smart Walking Stick required students to synthesize knowledge from science, technology, engineering, and mathematics. They chose an affordable PVC pipe to serve as the lightweight frame of the stick. To give the stick its "eyes," they integrated two ultrasonic sensors. One sensor was positioned horizontally to manage positive obstacle detection (spotting hazards directly ahead), while the other was angled downward for negative obstacle detection (spotting sudden drops like steps or potholes). To provide the user with clear feedback, they added two buzzers programmed to produce distinct sound alerts, alongside an LED light for nighttime visibility to oncoming traffic.

However, the path to innovation is rarely smooth. During initial testing, the students hit a major technical hurdle: the sensors generated inconsistent readings. When parallel echo signals from both positive and negative obstacle fields flooded the system, the single microcontroller suffered from processing bottlenecks. Instead of seeing this as a failure, our classroom culture embraced risk-taking without fear of mistakes. Students applied critical thinking and technical problem-solving to overhaul the system architecture. They discovered that by integrating two separate Arduino boards to isolate and decouple the data processing streams, they could completely eliminate data latency and maximize detection accuracy. This breakthrough was a moment of true learning mastery.

Real-World Impact: Co-Design and Wellbeing

We extended our collaboration beyond the classroom by inviting members of the visually impaired community to test the prototype. Their feedback was vital, shaping the final design and ensuring that the solution truly addressed real user needs rather than our assumptions. This collective effort created a profound sense of community belonging. The final device prioritized physical and emotional wellbeing on both sides:

- **For the Users:** Features like early hazard detection, tailored audio alerts, and improved visibility reduced transit fear and boosted their confidence to move independently. The students even added a foam-padded handle to ensure comfort during prolonged use.
- **For the Students:** The project fostered a supportive environment where curiosity flourished. Seeing their ideas come to life boosted their academic confidence and emotional development, proving they could be active agents of change.

Key Project Takeaways & Reflections

- **Developing Students as Leaders:** This project completely redefined leadership for our students. By transitioning from passive learners to primary innovators, they took full ownership of the design cycle. Their leadership manifested not in commanding others, but in developing deep social responsibility, initiating critical system architectures, and learning to manage technical setbacks without fear.
- **The Power of Stakeholder Collaboration:** True innovation cannot happen in a silo. Collaborating with members of the local visually impaired community directly shifted our designs. By validating our prototypes through actual user testing, the students learned that

impactful engineering requires humility, active listening, and co-designing with a community, rather than simply designing for them.

Future Roadmap and Scalability

To transition the Smart Walking Stick from a successful classroom prototype into a mass-producible, life-changing tool for thousands of visually impaired individuals across Nigeria, we have established a clear three-phase technical roadmap. We are actively seeking strategic partnerships, grants, and funding to execute the following upgrades:

Phase 1: Sustainable Power Infrastructure (Timeline: 3 Months): We aim to eliminate the financial burden of disposable batteries on low-income users by integrating a rechargeable lithium-ion battery system compatible with standard, widespread mobile phone chargers.

Phase 2: Haptic Feedback Integration for High-Noise Environments (Timeline: 6 Months): To ensure user safety on loud, crowded metropolitan streets where audio buzzers might be drowned out, we will embed micro-vibration haptic motors into the handle to deliver intuitive, tactile proximity alerts.

Phase 3: IoT Geolocation & Safety Network (Timeline: 12 Months): To mitigate transit fear and provide peace of mind to families, we plan to architect and integrate a low-power micro-GPS and GSM module into the stick that transmits real-time location data and triggers automated SOS alerts if a fall is detected.

For more information about the **Future of Work initiative**, visit the official [website](#).
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