<AI & Equality> African Toolbox | Case study

Bridging Language Barriers: AI for Kenyan Sign Language and Digital Inclusion

Watch the video

This case study is part of the **African <AI & Equality> Toolbox**, which builds upon the methodology of the global <AI & Equality> Human Rights Toolbox—an initiative of Women At The Table in collaboration with the United Nations Office of the High Commissioner for Human Rights (OHCHR). The African Toolbox is a collaboration between the <AI & Equality> initiative and the African Centre for Technology Studies (ACTS).
To learn more visit **aiequalitytoolbox.com**

The challenge: When silence becomes exclusion

In a bustling university classroom in Nairobi, Sarah sits in the front row, her eyes fixed on the professor's lips as he delivers a complex computer science lecture. Her learning partner, James, frantically scribbles notes, knowing that Sarah will depend on his interpretation of concepts she cannot hear. When the professor turns to write on the board, Sarah loses all connection to the lesson. When students laugh at a joke, she wonders what she's missing. When the professor asks a question, she cannot respond in her native language—Kenyan Sign Language (KSL)—because no one in the room can understand her.

This scene plays out daily across Kenya's higher education institutions. While the country has established special schools for deaf students from primary through secondary levels, these young people face a brutal transition when they enter universities and colleges. Suddenly, the carefully constructed support systems vanish, leaving them isolated in hearing-dominant environments with no sign language interpreters, no accessible materials, and often, no understanding of their communication needs.

Sarah's story reflects a broader challenge: language barriers that exclude entire communities from educational opportunities and social participation. In Kenya, over one million people experience hearing impairments, yet their language—KSL—remains largely invisible in the digital age. This invisibility perpetuates cycles of exclusion that begin in hearing families where 90% of deaf children are born, continue through educational systems that abandon them at higher levels, and extend into workplaces that cannot accommodate their communication needs.

The genesis: From personal encounter to community-driven innovation

Dr. Lilian Wanzare's journey into sign language AI began not with a research proposal, but with a moment of recognition in her own classroom. As a computational linguist at Maseno University, she was confronted with deaf students who had been "dropped" into her computer science courses with no support system beyond learning partners—hearing students who would take notes and attempt to interpret complex technical concepts.

"I realized I was supposed to teach them computer science, but I had no clue how to handle a deaf student," Dr. Wanzare recalls. "We were failing them systematically. They were forced to learn with their hearing counterparts, but we had no way to include them actively in class."

This personal encounter revealed a fundamental injustice: educational systems that provided specialized support through secondary school but abandoned students at the crucial

transition to higher education. The problem wasn't just about individual accommodation—it was about the systematic exclusion of an entire linguistic community from digital innovation and technological advancement.

What began as a search for classroom solutions evolved into a recognition that the challenge was much deeper. The issue wasn't just about interpreters or note-takers; it was about the complete absence of Kenyan Sign Language from the digital ecosystem. While other languages could access spell-checkers, translation tools, and digital content, KSL remained locked out of the technological revolution.

Building trust through community-centered design

Entry Through Educational Champions

Unlike many AI projects that begin with technical possibilities, the KSL initiative started with educational reality. Dr. Wanzare's team began by identifying what they call "educational champions"—sign language teachers, deaf students, and deaf community leaders who could bridge the gap between technical development and lived experience.

The Kenya Institute of Curriculum Development (KICD) had already established a standardized KSL curriculum for schools, providing a crucial foundation. But the real champions were the teachers and students in specialized schools across Kenya—from primary schools for the deaf to secondary institutions like Kaimosi School for the Deaf and Meru School for the Deaf.

These champions didn't just provide access to the deaf community; they fundamentally shaped the project's understanding of what needed to be built. Teachers explained that their students didn't just need translation tools—they needed technology that could help them participate fully in hearing-dominated environments. Students expressed frustration not just with communication barriers, but with the broader invisibility of their language and culture.

Participatory Language Mapping

The breakthrough came through what the team calls "participatory language mapping"—sessions where deaf community members, teachers, and students collaborated to identify the specific vocabulary, contexts, and communication needs that AI systems would need to address.

These sessions revealed nuanced insights that technical experts would never have discovered independently. Deaf students explained that they didn't just need word-by-word translation; they needed systems that could capture the grammatical structure of KSL, which places

objects before subjects and uses facial expressions as integral parts of meaning. Teachers highlighted that different regions had signing variations, even within the standardized curriculum. Community members emphasized that effective sign language includes not just hand movements but facial expressions, body posture, and spatial relationships. "When you see a deaf student explaining how a sign changes meaning based on the speed of movement or the direction of the palm, you understand that building AI for sign language isn't just about recognizing gestures—it's about understanding an entire linguistic system," Dr. Wanzare explains.

Redefining the Technical Challenge

The participatory approach revealed that the "sign language problem" was actually multiple interconnected challenges:

- **Educational access:** Deaf students needed ways to participate in hearing-dominated classrooms.
- **Communication barriers:** Families and communities needed tools to communicate with deaf members.
- **Cultural preservation:** KSL needed digital representation to prevent language loss.
- **Economic inclusion:** Deaf individuals needed access to digital technologies for employment.
- **Social participation:** Deaf community members needed ways to engage with broader society.

This comprehensive understanding shaped the technical approach, ensuring that AI development would address systemic exclusion rather than just individual accommodation.

Technical innovation driven by linguistic justice

The text-to-avatar pipeline

The technical architecture of the KSL translation system reflects both the linguistic complexity of sign language and the realities of resource-constrained environments. The system operates through a three-stage pipeline that transforms spoken English into animated sign language through an avatar representation.

- **Stage 1 -Text to Gloss Translation:** The system first converts English text into "gloss"—a linguistic representation that captures how concepts are structured in KSL. This isn't simple word-for-word translation; it involves understanding that KSL grammar places objects first, then subjects, then verbs. So "A bee stings" becomes "bee sting" in gloss representation.
- **Stage 2 - Pose Extraction and Representation:** The system then converts the gloss into pose representations—mathematical descriptions of hand movements, facial expressions, and body positions that capture the essential elements of signs. This step abstracts away from individual signers while preserving the linguistic content of signs.

- **Stage 3 - Avatar Animation:** Finally, the system uses the pose representations to animate a virtual avatar that performs the signs. This avatar isn't just a technical convenience—it's designed to be culturally appropriate, customizable, and accessible to users with different preferences and needs.

Community-driven technical requirements

Every technical decision emerged from community input rather than engineering convenience. The development team learned that effective sign language AI required attention to details that might seem trivial to hearing people but were fundamental to the deaf community:

- **Facial Expression Integration:** Signs aren't just hand movements—facial expressions are grammatically significant. The system had to capture and reproduce subtle facial movements that change meaning.
- **Regional Variation Support:** While Kenya has standardized KSL, regional dialects and individual variations exist. The system needed to accommodate these differences while maintaining comprehensibility.
- **Cultural Authenticity:** The avatar's appearance, clothing, and behavior needed to reflect Kenyan culture and be acceptable to the deaf community. Early feedback rejected avatars that looked "too Western" or wore inappropriate clothing.
- **Speed and Rhythm Control:** Users wanted the ability to slow down or repeat signs, reflecting how they actually learn and process sign language.

Addressing Infrastructure Challenges

The technical solution had to work within Kenya's technological constraints while serving users who might have limited access to high-end devices:

- **Offline Capability:** The system needed to function without constant internet connectivity, crucial for users in rural areas or those with limited data plans.
- **Mobile Optimization:** The avatar animation had to run efficiently on smartphones and tablets, the most accessible computing devices for many deaf users.
- **Low-Latency Processing:** Real-time translation required processing speeds that would enable natural conversation, not just delayed interpretation.
- **Scalable Architecture:** The system needed to handle multiple concurrent users while maintaining performance quality.

Data as community language asset

The Ethical Challenge of Sign Language Data

Collecting data for sign language AI presented unique ethical challenges that text-based language models never face. Every sign language data point involves a human face, body, and personal expression. Many potential contributors were minors in specialized schools. The deaf community had legitimate concerns about privacy, consent, and the potential misuse of their linguistic data.

Dr. Wanzare's team approached data collection as a process of community partnership rather than extraction. "We had to convince them that there was no point in time they would find their video online somewhere that had been posted, that nothing would be leaked, and that they could trust us in maintaining their privacy and security," she explains.

Participatory Data Collection

The data collection process involved multiple stakeholders across Kenya's deaf education system:

- **Primary and Secondary Schools:** Teams visited specialized schools for the deaf across the country, from primary through secondary levels, ensuring representation across age groups and educational stages.
- **Diverse Signer Representation:** The dataset includes first-language signers (deaf from birth), second-language signers (those who became deaf later), expert signers (teachers and community leaders), and novice signers (students still learning).
- **Regional Coverage:** Boarding schools provided access to students from across Kenya, including neighboring countries, ensuring the dataset captured regional variations and dialects.
- **Gender and Cultural Balance:** The team ensured balanced representation across gender lines, noting that female signers tended to be more facially expressive while male signers showed different patterns.

Anonymization and Privacy Protection

The team developed innovative approaches to protect signer privacy while preserving linguistic data:

- **Pose Extraction Technology:** Rather than storing raw videos, the system extracts "landmarks"—mathematical representations of hand positions, facial movements, and body postures that capture signs without revealing individual identity.
- **Community Consent Processes:** Data collection involved not just individual consent but community-level agreements with schools, parents, and deaf community organizations.
- **Controlled Access:** The dataset is not publicly released but made available to

researchers through controlled access that protects community interests.
- **Benefit Sharing:** The community retains rights to the data and receives regular updates on how it's being used and what benefits are being generated.

AI as a tool for linguistic justice

Beyond Translation: Addressing Systemic Exclusion

The KSL avatar system represents more than technological innovation—it embodies a commitment to linguistic justice. The AI serves multiple functions that directly address the exclusion of deaf communities from digital society:

- **Educational Inclusion:** The avatar enables deaf students to access educational content in their native language, potentially transforming their learning experience in hearing-dominated institutions.
- **Family Communication:** The system provides families with tools to communicate with deaf members, addressing the isolation that often begins in the home.
- **Cultural Preservation:** By digitizing KSL, the system helps preserve and promote a language that risks being lost in an increasingly digital world.
- **Economic Empowerment:** Access to digital communication tools can improve employment prospects for deaf individuals by enabling them to participate in digital workplaces.

The Community-AI Partnership Model

The system explicitly positions AI as a tool for community empowerment rather than replacement of human communication. Community feedback shaped every aspect of the avatar's design and behavior:

- **Customization Options:** Users can choose the avatar's gender, appearance, and clothing to match their preferences and cultural context.
- **Linguistic Authenticity:** The avatar's signing style reflects authentic KSL rather than simplified or artificial gestures.
- **Educational Integration:** The system is designed to support rather than replace sign language education, helping teachers and students in their learning processes.
- **Community Ownership:** The deaf community retains control over how their linguistic data is used and how the technology evolves.

Addressing the "Replacement" Concern

Some community members worried that AI would replace human interpreters or reduce the value of sign language skills. The team addressed this through transparency about the technology's limitations and explicit positioning as a supportive tool:

- **Complementary Function:** The avatar is designed to supplement rather than replace human communication, particularly in contexts where interpreters aren't available.

- **Educational Tool:** The system serves as a learning aid for both deaf students and hearing individuals who want to learn KSL.
- **Advocacy Platform:** The technology raises awareness about KSL and the deaf community, potentially increasing demand for human interpreters and services.
- **Skill Development:** The system can help deaf individuals develop literacy skills by providing visual representation of text concepts.

Language and cultural authenticity

Capturing the Complexity of Sign Language

Sign language AI faces challenges that spoken language systems never encounter. Signs involve five simultaneous components: hand shape, palm orientation, hand location, movement direction, and movement speed. Each component affects meaning, and all must be captured accurately for effective communication.

The team learned that cultural authenticity required attention to details that might seem peripheral to technical developers but were fundamental to the deaf community:

- **Facial Expression Integration:** Non-manual features like eyebrow movement, lip patterns, and head position are grammatically significant in KSL and needed to be accurately represented.
- **Spatial Relationships**: Sign language uses space to show relationships between concepts, requiring the avatar to maintain spatial consistency across signs.
- **Rhythm and Timing:** The speed and rhythm of signing affects meaning and comprehensibility, requiring fine-tuned control systems.
- **Cultural Appropriateness:** The avatar's appearance, clothing, and behavior needed to reflect Kenyan culture and be acceptable to the deaf community.

Community-Driven Refinement

The development process involved continuous feedback from the deaf community, resulting in multiple refinements:

- **Avatar Appearance:** Early versions were rejected because the avatar didn't look sufficiently Kenyan. The team had to find more culturally appropriate representations.
- **Signing Speed:** While deaf signers naturally sign very quickly, they wanted the avatar to sign more slowly so they could analyze and learn from individual signs.
- **Facial Expression Enhancement:** The community requested more realistic facial expressions and lip movements to capture the full linguistic content of signs.
- **Personalization Options:** Users wanted the ability to customize the avatar's gender, appearance, and clothing to match their preferences.
- **Repetition Control:** The system needed to allow users to request repetition of signs, reflecting how people actually learn and process sign language.

Expanding impact: From education to community empowerment

Multi-Language Integration

Building on the success of English-to-KSL translation, the team expanded the system to include other languages important to the Kenyan deaf community:

- **Kiswahili Integration:** The system now translates from Kiswahili to KSL, enabling deaf individuals to access content in Kenya's national language.
- **Local Language Support:** Plans include expanding to other Kenyan languages, allowing deaf individuals to learn and communicate in multiple linguistic contexts.
- **Cross-Cultural Communication:** The system can potentially bridge communication gaps between deaf individuals and hearing people who speak different languages.

Community Health and Legal Applications

The technology's potential extends far beyond educational settings:

- **Healthcare Communication:** The avatar could help deaf patients communicate with healthcare providers who don't know sign language.
- **Legal Interpretation:** Court proceedings could become more accessible to deaf individuals through avatar interpretation.
- **Emergency Services:** The system could provide critical communication tools for emergency situations.
- **Workplace Integration:** Employers could use the system to communicate with deaf employees, improving workplace inclusion.

Community Capacity Building

The initiative has sparked broader conversations about deaf rights and inclusion:

- **Awareness Raising:** The project has increased visibility of KSL and the deaf community in Kenya's tech sector.
- **Policy Advocacy:** The research provides evidence for policy changes that could improve deaf inclusion in education and employment.
- **Community Organizing:** The project has strengthened connections within Kenya's deaf community and provided platforms for collective advocacy.
- **International Collaboration:** The work has inspired similar initiatives in other African countries working to digitize their sign languages.

Community-based data licensing: A new model

The Challenge of Digital Exploitation

The KSL project confronted a fundamental question: who owns linguistic data, and how should communities benefit from AI systems built on their languages? Traditional open-source licensing models assume that making data freely available benefits everyone, but this approach can lead to exploitation of marginalized communities.

Dr. Wanzare explains the dilemma: "If today we collect 200 hours of sign language data and put it online, by Friday Meta will have it integrated into their systems. The community asks: what's there for the local ecosystem? Is that competition too unfair for us to even begin competing?"

Community-Controlled Innovation

Working with Mozilla, the team is pioneering community-based licensing models that give linguistic communities control over how their data is used:

- **Community Ownership:** The deaf community retains ownership of their linguistic data and has a say in how it's licensed and used.
- **Benefit Sharing:** Commercial applications built on community data would need to provide benefits back to the community, potentially including royalties or revenue sharing.
- **Use Restrictions:** The community can specify how their data can and cannot be used, protecting against exploitation or misrepresentation.
- **Local Ecosystem Development:** The licensing model prioritizes local developers and applications that directly benefit the community.

Small Language Models for Community Control

The team advocates for small, specialized language models rather than integration into large corporate systems:

- **Community-Specific Applications:** Small models can be designed for specific use cases that directly benefit the deaf community, such as educational tools or healthcare communication.
- **Local Control:** Communities can maintain control over smaller models in ways that are impossible with large corporate systems.
- **Cultural Sensitivity:** Small models can be fine-tuned to reflect community values and preferences without being overwhelmed by broader dataset biases.
- **Sustainable Development:** Local developers can maintain and improve small models in ways that serve community needs rather than corporate profits.

Lessons for digital inclusion

Key Principles for Language Justice

The KSL initiative offers crucial insights for AI development that promotes linguistic justice:

- **Community Partnership is Essential:** The most sophisticated AI system fails if communities don't trust it, understand it, or control its use. Starting with community needs rather than technical capabilities ensures that AI serves justice rather than perpetuating existing exclusions.
- **Participation Must Be Genuine:** Tokenistic consultation differs fundamentally from the deep engagement required for effective language AI. Community involvement in problem definition, solution design, and implementation creates genuine ownership that sustains initiatives over time.
- **Cultural Authenticity Matters:** Every technical choice—from avatar appearance to signing speed—embodies assumptions about users and culture. Designing for African contexts requires fundamental rethinking of standard approaches, resulting in more authentic and acceptable systems.
- **Data Sovereignty is Fundamental:** Linguistic data becomes a tool for justice only when communities control its collection, use, and benefits. Community data sovereignty ensures that AI serves empowerment rather than extraction.
- **AI Can Preserve and Promote Languages:** Rather than contributing to language loss, AI can become a tool for language preservation and promotion when developed with community control and cultural sensitivity.

Addressing Responsible AI Throughout Development

The KSL experience demonstrates how human rights principles can be integrated throughout AI development:

- **Privacy and Security:** Protecting signer privacy while preserving linguistic data requires innovative technical approaches and community consent processes.
- **Fairness and Representation:** Ensuring the dataset represents the full diversity of the deaf community requires intentional inclusion of different genders, ages, regions, and signing abilities.
- **Transparency and Interpretability:** Community members need to understand how the system works and why it makes specific decisions, requiring explainable AI approaches.
- **Reliability and Safety:** The system must work consistently and safely, particularly in educational and healthcare contexts where errors could have serious consequences.

Future directions: Scaling linguistic justice

Cross-Border Expansion

The success of the KSL initiative has inspired similar projects across Africa:

- **Regional Collaboration:** Other African countries are adapting the methodology to develop AI systems for their own sign languages.
- **Comparative Research:** Cross-country studies are examining how different sign languages can benefit from shared technical approaches while maintaining linguistic authenticity.
- **Continental Networks:** The project is contributing to broader networks of African language technologists working to digitize indigenous languages.

Integration with Broader Language Justice

The KSL work is part of a broader movement to ensure African languages are included in the digital age:

- **Multi-Modal Systems:** Future systems will integrate sign language with spoken language AI, creating more comprehensive communication tools.
- **Educational Integration:** The technology is being integrated into educational curricula to support both deaf students and hearing students learning KSL.
- **Policy Advocacy:** The research provides evidence for policy changes that could improve digital inclusion for all marginalized linguistic communities.

Mapping the AI Lifecycle HRIA Framework for the Kenyan Sign Language Initiative

1 Stage 1: Objective and Team Composition

Objective Definition: The initiative began with a community-identified problem: deaf students' systematic exclusion from higher education due to lack of sign language interpretation services. The objective evolved through community engagement to address not just individual accommodation but the broader digital exclusion of Kenyan Sign Language and the deaf community.

Team Composition: The team intentionally included diverse expertise and lived experience:

- Computational linguists (Dr. Lilian Wanzare and research team)
- Sign language experts and teachers from specialized schools
- Deaf community members as co-designers and validators
- Educational specialists familiar with inclusive pedagogy
- Technology experts in computer vision and avatar animation
- Students and families from the deaf community
- Community leaders and advocates for deaf rights

HRIA Framework Alignment:

- **Purpose & Context of the System:** The system addresses documented discrimination in educational access, where deaf students face systematic exclusion from higher education. The domain has a clear history of linguistic discrimination, with KSL being marginalized in favor of spoken languages.
- **Effects of the System:** Benefits explicitly designed to empower the deaf community—historically marginalized in educational and digital spaces—by providing access to technology in their native language and creating pathways for broader social participation.
- **Empowering Affected Communities:** Deaf community members serve as data contributors, system validators, co-designers, and advocates, with genuine decision-making power in system design and implementation.
- **Team Composition:** Diverse expertise spanning technical, linguistic, educational, and cultural domains, with meaningful representation from the deaf community throughout the process.

Key Human Rights Considerations:

The initiative explicitly addresses linguistic rights as human rights, recognizing that access to communication technology in one's native language is fundamental to dignity and participation. Team composition ensures that those most affected by digital exclusion have agency in system development.

2 Stage 2: Defining System Requirements

Community-Driven Requirements: System requirements emerged from participatory sessions with deaf students, teachers, and community members rather than technical specifications. Requirements included:

- Avatar animation that captures facial expressions as grammatically significant elements
- Customizable avatar appearance to reflect Kenyan cultural context
- Variable signing speed with repetition capability
- Multi-language support (English, Kiswahili, potential local languages)
- Offline functionality for areas with limited connectivity
- Educational integration features for classroom use

Cultural Authenticity: Requirements prioritized cultural authenticity and community acceptance over technical optimization, ensuring the avatar would be embraced by the deaf community.

HRIA Framework Alignment:

- **Involving Affected Communities:** Requirements definition involved extensive consultation with deaf students, teachers, families, and community leaders through schools for the deaf across Kenya.
- **Explainability Considerations:** The system provides explanations about how signs are constructed and why specific movements create meaning, supporting both learning and transparency.
- **Ecosystem of Values:** The initiative balances technical accuracy with cultural authenticity, privacy protection, community agency, and educational utility, making conscious trade-offs that prioritize community acceptance.

Key Human Rights Considerations:

Requirements prioritize dignity and cultural authenticity for the deaf community. Features like customizable avatar appearance, culturally appropriate signing, and community control over data use ensure that system design serves linguistic justice rather than perpetuating cultural imperialism.

3 Stage 3: Data Discovery

Community-Partnered Data Collection: The team created a comprehensive dataset through ethical partnerships with deaf schools across Kenya. Data collection involved:

- Visits to specialized schools from primary through secondary levels
- Recording diverse signers across age groups, genders, and regions
- Both scripted and spontaneous signing to capture natural language use
- Expert glossing and linguistic annotation by sign language teachers
- Rigorous segmentation marking the beginning and end of each sign in sentences

Privacy-Preserving Innovation: The team developed pose extraction technology that abstracts linguistic content from personal identity, enabling data sharing while protecting individual privacy.

HRIA Framework Alignment:

- **Data Origin:** Data collection involved comprehensive consent processes with individuals, families, schools, and community organizations. The focus on pose extraction rather than raw video protects privacy while enabling linguistic research.
- **Data Bias:** The participatory approach explicitly addresses historical bias by including diverse signers across regions, genders, ages, and skill levels, ensuring representation of the full deaf community.
- **Documentation:** All data sources, collection methods, and processing steps are documented transparently, with regular reports shared back to contributing communities.

Key Human Rights Considerations:

The data discovery process treats KSL as a complete language system worthy of preservation and promotion. Communities define signing standards and participate in data validation rather than having external definitions imposed. This approach addresses historical marginalization of sign languages.

4 Stage 4: Selecting and Developing a Model

Community-Informed Model Architecture: The three-stage pipeline (text-to-gloss, pose extraction, avatar animation) was designed to serve community-identified needs rather than demonstrate technical sophistication. Model selection prioritized:

- Cultural authenticity in avatar representation
- Linguistic accuracy in sign production
- Educational utility for both deaf and hearing users
- Privacy protection through pose abstraction
- Accessibility across different technological contexts

Iterative Community Validation: Each stage of model development involved community feedback, with deaf signers validating the accuracy and cultural appropriateness of system outputs.

HRIA Framework Alignment:

- **Model Type and Explainability:** The staged pipeline prioritizes interpretability, allowing users to understand how English text becomes sign language and enabling community validation at each step.
- **Fairness Aspects:** The initiative explicitly considers how the system performs across different demographic groups within the deaf community, ensuring equitable representation and accuracy.

- **Transparency:** Model development processes are transparent to the community, with regular demonstrations and feedback sessions that allow community input into technical decisions.

Key Human Rights Considerations:
Model development serves community empowerment and linguistic preservation rather than technical optimization. The AI enhances rather than replaces human communication, providing tools for linguistic justice and cultural preservation.

5 Stage 5: Testing and Interpreting Outcome

Community-Centered Evaluation: Testing involved extensive community feedback in real educational and social settings. Deaf community members evaluated:

- Avatar appearance and cultural appropriateness
- Signing accuracy and linguistic authenticity
- Educational utility and integration potential
- Privacy protection and data security
- Customization options and user control

Iterative Refinement: Community feedback directly shaped system improvements, from avatar appearance to signing speed to facial expression integration.

HRIA Framework Alignment:

- **Testing Context and Outcomes:** Testing occurs in real community contexts with actual users, incorporating feedback from diverse community members about system utility, accuracy, and cultural appropriateness.
- **Operation Manual:** Training materials and user guides are developed in collaboration with deaf educators and community leaders, ensuring accessibility and cultural sensitivity.

Key Human Rights Considerations:
Testing evaluates whether the system genuinely empowers the deaf community to participate in digital society. Community feedback shapes system evolution, ensuring that technical performance serves linguistic justice and cultural preservation.

6 Stage 6: Deployment & Post-Deployment Monitoring

Community-Controlled Deployment: Deployment involves comprehensive community partnerships, ongoing support for users, and continuous adaptation based on community feedback. The initiative includes:

- Integration with educational institutions and community organizations
- Training programs for educators and community leaders

- Ongoing technical support and system maintenance
- Community-based licensing models that protect community interests
- Expansion planning to other languages and applications

Sustainable Community Ownership: Long-term sustainability built through community ownership models, local capacity development, and innovative licensing arrangements that ensure community benefits.

HRIA Framework Alignment:

- **Deployment:** The deaf community has genuine agency in deployment decisions, with robust support systems and community-controlled licensing that protects their interests.
- **Monitoring:** Continuous monitoring includes both technical performance and community impact, with mechanisms for the deaf community to provide feedback and guide system evolution.

Key Human Rights Considerations:

Post-deployment monitoring ensures that the system continues to serve community needs and linguistic justice rather than becoming extractive. Community-based licensing models maintain community ownership and ensure that benefits flow back to the deaf community.

Integrated Analysis: Human Rights Throughout the AI Lifecycle

The KSL initiative demonstrates how human rights considerations can transform language AI development. Several key principles emerge:

— **Community agency:** At every stage, the deaf community has genuine decision-making power rather than tokenistic consultation. This agency extends from initial problem definition through ongoing system evolution.

— **Cultural Authenticity:** Technical choices consistently prioritize cultural authenticity and community acceptance over technical optimization or efficiency metrics.

— **Linguistic Preservation:** The initiative treats KSL as a complete language system worthy of preservation and promotion, creating technology that strengthens rather than marginalizes the language.

— **Innovative Privacy Protection:** The pose extraction approach demonstrates how technical innovation can protect individual privacy while enabling linguistic research and community empowerment.

- **Sustainable Community Ownership:** Community-based licensing models ensure that the deaf community retains control over their linguistic data and benefits from AI systems built on their language.

The KSL experience demonstrates that language AI can serve human rights and linguistic justice when developed with genuine community participation throughout the lifecycle. This approach results in more culturally authentic, community-controlled, and sustainable systems that empower rather than marginalize linguistic communities, creating technology that truly serves the right to language and cultural expression.

About the case study and author

This case study analyzes research conducted by Dr. Lilian Wanzare, Dr. Joel Okutoyi, Dr. Mildred Ayere and Dr. Maureen Kang'ahi of Maseno University, examining Kenyan Sign Language across Kenya, HomaBay, Siaya, Kisumu, Kakamega and Vihiga counties in Western Kenya, between 2023 - 2024.

This research was supported by EduAI Hub at the University of Lagos as part of a project under AI4D Africa. AI4D is a collaborative initiative by the International Development Research Centre (IDRC), Canada, and the Swedish International Development Cooperation Agency (SIDA), Sweden.

Dr. Lilian Wanzare is a lecturer and chair of the Department of Computer Science at Maseno University. Her research interests are in Artificial Intelligence and Machine Learning, in particular Natural Language Processing (NLP), Sign Language research and building text processing tools for low-resource languages. She holds a PhD degree in Computational Linguistics and an Msc. in Language Science and Technology from Saarland University, Germany.

Other contributors to this case study are Caitlin Kraft-Buchman, Emma Kallina, and Sofia Kypraiou, authors of the original *Framework to AI Development: Integrating Human Rights Considerations Along the AI Lifecycle* upon which the Toolbox structure is based. Additional contributors are Amina Soulimani and Pilar Grant, from Women at the Table and the <AI & Equality> Human Rights Initiative.