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Case study

Intercultural STEM for sustainability

Co-creating intercultural pathways with Indigenous youth and students in Brazilian higher education

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Acronyms

- **FIEI**: Formação Intercultural para Educadores Indígenas (Intercultural Teacher Education Course for Indigenous Educators)
- **STEM**: Science, technology, engineering and mathematics
- **UNESCO IESALC**: UNESCO International Institute for Higher Education in Latin America and the Caribbean
- **UFMG**: Universidad Federal de Minas Gerais (Federal University of Minas Gerais)

Executive summary

The *Intercultural STEM for sustainability* initiative was convened by UNESCO International Institute for Higher Education in Latin America and the Caribbean (UNESCO IESALC) with support from Innospec Fuel Specialties LLC, a global specialty chemicals company, and implemented in Brazil in collaboration with the Federal University of Minas Gerais (UFMG). It aimed to explore how higher education institutions can strengthen Indigenous participation and leadership in Science, Technology, Engineering and Mathematics (STEM) in ways that advance sustainability and intercultural dialogue.

Conducted between September 2024 and early 2026, the initiative engaged a broad range of stakeholders, including Indigenous youth and students, faculty members, community knowledge holders, and institutional representatives. A total of 12 consultations were organized, alongside 9 in-depth interviews, and 5 stakeholder institutions were engaged, ensuring diverse perspectives informed the process. The initiative culminated in a four-day intercultural workshop held at UFMG in November 2025.

The initiative responded to a persistent gap within higher education systems: while sustainability challenges require diverse knowledge systems and inclusive innovation, Indigenous participation in STEM fields remains limited, and Indigenous knowledge is often insufficiently recognized within academic sustainability debates. Through a structured process of dialogue and co-creation, including the engagement of 20 co-designers in an intercultural STEM workshop, participants examined how scientific and ancestral knowledge systems can interact to strengthen both sustainability-oriented research and institutional practice.

The implementation phase demonstrated strong participation and reach. The project engaged 91 direct workshop participants, including 34 youth under the age of 35 (more than double the initial target), and reached 535 indirect beneficiaries. Notably, Indigenous women were strongly represented, accounting for 41 out of 91 participants, exceeding initial expectations. The project launch event gathered 90 participants, reflecting significant interest and engagement.

The experience demonstrated that advancing intercultural STEM for sustainability requires more than expanding access to higher education. It depends on strengthening the institutional foundations that enable Indigenous youth and students to participate fully in academic life and decision-making. Key dimensions identified during the process include having a meaningful Indigenous presence in governance structures, student retention and well-being, recognition of Indigenous students as knowledge producers, and institutional mechanisms that support dialogue between knowledge systems.

To sustain engagement beyond in-person activities, an online dialogue mechanism was established through a WhatsApp group bringing together 111 participants and enabling ongoing intercultural exchange in an accessible and context-appropriate format.

The discussions also highlighted the role of Indigenous youth and students as bridges between universities and their territories. Participants emphasized that knowledge flows in both directions: academic learning can contribute to community priorities, while ancestral knowledge systems bring relational understandings of land, sustainability, and intergenerational responsibility into university spaces. These exchanges illustrate how intercultural approaches can enrich sustainability education and research.

Several good practices emerged from the initiative. These include beginning with a contextual understanding of Indigenous presence within the institution, establishing structured listening mechanisms linked to institutional action, strengthening the material and institutional conditions that support student retention, integrating Indigenous knowledge through collaborative research and community engagement, and ensuring ethical co-creation processes that respect intellectual property and authorship.

Rather than proposing a universal model, this publication documents a context-specific experience in Brazil that offers practical insights for universities seeking to advance intercultural approaches to STEM for sustainability. The practices presented should therefore be understood as illustrative rather than prescriptive and adapted to local contexts, institutional realities, and the priorities of Indigenous communities. The findings suggest that meaningful transformation in STEM education begins with institutional relationships, shared authority in knowledge production, and sustained engagement with Indigenous communities. Strengthening these foundations creates the conditions for more inclusive and innovative sustainability-oriented STEM education within higher education systems.

Introduction

The *Intercultural STEM for sustainability* initiative was convened by UNESCO IESALC with financial support from Innospec and implemented in collaboration with the UFMG as a local partner in Brazil. Launched in September 2024 and continuing through early 2026, the initiative was designed as a sustained process of dialogue, reflection, and institutional engagement. Over the course of the initiative, 12 consultations, 9 in-depth interviews, and exchanges with 5 stakeholder institutions contributed to shaping the process and grounding it in diverse perspectives. The process evolved iteratively, including an early adjustment to strengthen Indigenous representation within the research team, reinforcing the co-creation approach that shaped the initiative.

Rather than a single event, the initiative unfolded through preparatory consultations, focus groups, structured discussions, and institutional exchanges that culminated in a four-day intercultural workshop held at UFMG in November 2025. The workshop represented a key milestone within a broader co-creation process, bringing together 91 participants, including 34 youth under the age of 35, for in-depth dialogue and collective reflection. It provided a facilitated space to consolidate earlier reflections, examine how sustainability, ancestral knowledge, and scientific approaches intersect within higher education, and collectively formulate institutional proposals for strengthening Indigenous participation and retention in STEM fields.

The initiative was designed in response to a persistent gap. Sustainability challenges require diverse knowledge systems, intergenerational responsibility, and inclusive innovation. While research highlights the significant contributions of Indigenous knowledge to environmental management and sustainability (Mistry & Berardi, 2016; Whyte, 2018), its integration into STEM education and academic practice remains challenging. Institutional structures and dominant knowledge frameworks continue to constrain the recognition and inclusion of Indigenous knowledge systems within higher education (Aikenhead & Michell, 2011).

For many Indigenous participants, sustainability was not framed as resource management or environmental recovery. It was described as a relational way of living with territory, where land is not an external resource but a living foundation of knowledge, responsibility, and continuity. This distinction underscores that intercultural STEM does not only diversify participants. It invites a re-examination of how sustainability itself is defined within higher education.

Indigenous youth and students have increasingly entered universities through access policies and intercultural education programmes. However, access alone does not guarantee inclusion in STEM fields, nor does it ensure recognition of Indigenous knowledge as epistemically valid within sustainability debates. Interculturality in higher education extends beyond representation. It requires shared authority in defining knowledge, research priorities, and institutional practice.

Throughout the initiative, Indigenous youth and students were engaged not as beneficiaries of inclusion, but as co-designers of dialogue and institutional reflection. This was reflected in the broader engagement of 91 direct participants and 535 indirect beneficiaries, demonstrating both depth and reach. Through facilitated discussions, experiential activities, and collective drafting sessions, participants identified institutional barriers and co-created a protocol letter addressed to university leadership. The pilot initiative demonstrated that deeper transformation in STEM fields depends on institutional foundations related to governance participation, student retention,

language, infrastructure, and recognition of Indigenous youth and students as knowledge producers. Identifying and strengthening these foundations emerged as a central lesson of the experience.

The initiative also deliberately fostered intergenerational and gender-balanced participation. Indigenous youth and students engaged alongside faculty members, community knowledge holders, and institutional representatives, creating dialogue across generations and roles. Notably, 41 out of 91 participants were Indigenous women, reflecting strong gender representation within the process. This structure reflected an understanding of sustainability as a responsibility that extends across time and communities. Ensuring balanced participation strengthened the legitimacy of the co-creation process and reinforced equity as a practical principle rather than an abstract commitment.

This publication presents the good practices that emerged from the process and is structured to support reflection and adaptation across diverse institutional contexts. It does not propose a universal template. It documents a context-specific experience that may inform other universities seeking to build intercultural STEM approaches grounded in sustainability, youth and students' leadership, and shared institutional responsibility. The experience therefore offers a practical pathway for advancing interculturality in STEM for sustainability within higher education, rooted in relational and institutional transformation.

Methodology

The *Intercultural STEM for sustainability* initiative was designed as a participatory, intercultural, and co-creation-based process to generate practical insights on how higher education institutions can strengthen Indigenous participation and leadership in STEM. Conducted between September 2024 and early 2026, the initiative unfolded as a multi-phase process of dialogue, reflection, and institutional engagement rather than a single intervention.

The methodology was grounded in three core principles: intercultural dialogue which recognizes the coexistence of scientific and Indigenous knowledge systems; participation and co-creation positioning Indigenous youth and students as active contributors to the process and its outcomes; and institutional engagement linking discussions to concrete university structures, policies, and practices. This approach ensured that the process moved beyond consultation toward shared authorship and collective reflection. The approach was also informed by existing literature on interculturality, Indigenous knowledge systems, and inclusive STEM education.

While the initiative was initially designed without Indigenous representation in the research team, this was quickly recognized as a critical gap. An Indigenous doctoral researcher was therefore invited to join the group at an early stage, significantly strengthening the intercultural perspective and shaping the co-creation process from that point onward.

The initiative was implemented through four interconnected phases. The baseline and exploratory phase (January to June 2025) focused on understanding Indigenous student presence, experiences, and perspectives through consultations, and mapping exercises. A structured survey was initially developed but not implemented following concerns raised by participants, leading to a shift toward in-person dialogue and culturally responsive approaches.

The consultation and dialogue phase (June to October 2025) involved a series of in-person and online consultations, as well as group discussions. A total of 12 consultations were conducted, contributing to the refinement of the initiative's conceptual framing and the integration of Indigenous perspectives.

The co-creation and programme development phase (July to November 2025) built on these consultations through co-design sessions, curriculum development, and iterative reflection. This phase culminated in a four-day intercultural workshop held at UFMG in November 2025, which served as a key milestone for consolidating insights and formulating institutional recommendations.

The final phase, implementation, reflection, and feedback (November to December 2025), included the delivery of the workshop, feedback sessions, and post-activity reflections. This phase engaged 91 direct participants and reached 535 indirect beneficiaries, with 58 female participants, reflecting efforts toward gender-balanced participation. These figures correspond to the implementation phase and are distinct from the consultation process detailed in the Annex.

The methodology combined qualitative and participatory methods including interviews, consultations, focus groups, experiential activities, and co-design sessions. These approaches supported dialogue, mutual learning, and joint knowledge production, ensuring that Indigenous youth and students contributed meaningfully to both the process and its outcomes.

The initiative engaged a diverse range of stakeholders, including Indigenous youth and students, faculty members, community-linked

knowledge holders, institutional representatives, and UNESCO IESALC contributors. Efforts were made to ensure inclusive, intergenerational, and gender-balanced participation throughout.

While the methodology enabled rich qualitative insights and strong engagement, quantitative data on participant numbers, age, and gender were not systematically disaggregated for the consultation phase. The findings should therefore be understood as context-specific and primarily qualitative, reflecting the experiences and perspectives of participants involved in the process.

Best practices

The following section outlines the specific practices that emerged from this participatory process.

1. Begin with context and Indigenous presence

Intercultural STEM for sustainability cannot begin with tools or formats. It must begin with context and presence.

The discussions that led to the workshop and protocol letter made one point clear: Inclusive sustainability policies require meaningful Indigenous presence within the university. Physical and meaningful presence and engagement are the foundation of intercultural transformation.

Participants emphasized that Indigenous youth and students must be recognized not merely as beneficiaries of public policy, but as co-producers of knowledge and institutional actors capable of shaping governance and policy. Representation in collegiate bodies, councils, and decision-making spaces was identified as essential.

The protocol letter explicitly reaffirmed that it is impossible to design inclusive institutional policies if Indigenous youth and students are not meaningfully present in governance structures. Strengthening the collegiate bodies of the university was identified as a priority, with regular meetings and greater Indigenous participation in institutional decisions.

For universities seeking to replicate this approach, the first step is mapping:

- Which Indigenous communities are represented
- Through which pathways Indigenous youth and students access higher education
- What institutional mechanisms allow or limit participation in governance
- What internal diversity exists among Indigenous youth and students

There is no generic Indigenous population. Intercultural sustainability initiatives must reflect plurality and specificity from the outset.

2. Make listening a structural method

Across interviews and discussions, listening emerged as a central condition for intercultural STEM for sustainability.

As one Indigenous doctoral student reflected:

> **'What the workshop brought me was listening… it gave us a voice… about our permanence at the university.'**

Listening was not treated as a symbolic gesture. It shaped the methodology of the workshop and the drafting of the protocol letter. Structured dialogue was complemented by facilitated reflection activities designed to bring to the surface institutional barriers and enabling factors, reinforcing reflection through practice rather than discussion alone.

Student retention and well-being were framed not as secondary issues, but as foundational to sustainability and academic participation. Without decent housing, financial stability, and institutional recognition, Indigenous youth and students cannot fully engage in STEM fields or contribute to sustainability debates.

Another participant stressed:

> **'Listening is important… but also practical actions… not only in theory, but in practice.'**

The final day of the workshop was dedicated to drafting a collectively authored protocol letter addressed to university leadership. Participants identified institutional barriers and co-created

concrete proposals for strengthening Indigenous participation and retention in STEM fields. This process translated dialogue into articulated recommendations, reinforcing shared responsibility for institutional change.

Listening becomes transformative when it leads to institutional reflection and action. To replicate this universities should design structured dialogue mechanisms that produce documented outcomes and institutional follow-up.

3. Recognize Indigenous youth and students as bridges for sustainability

A defining feature of the initiative was the recognition of Indigenous youth and students as bridges between territory and university.

Participants described their educational journeys as circular. Knowledge acquired in the university is returned to communities. Ancestral knowledge is carried into academic spaces.

One student described partnership as:

> **'The university and the village… so that Indigenous people can… contribute… and return and give feedback to their territories.'**

This reciprocity is central to intercultural STEM for sustainability. Indigenous youth and students are not only future professionals in STEM fields. They are mediators between different knowledge systems, bringing territorial perspectives into discussions on environmental care, health, technology, and education.

The protocol discussions reinforced the fact that territory is foundational. As leaders emphasized, Indigenous peoples without territory have no education, no health, and no spiritual base. Sustainability was framed not as an abstract concept, but as responsibility toward land, culture, and future generations. Several youth and students contrasted technology-driven approaches that seek rapid solutions with Indigenous understandings that emphasize ecological cycles and the need to follow nature's timeframe.

Another student articulated complementarity clearly:

> **'Scientific knowledge… and the ancestral knowledge of Indigenous peoples can go hand in hand. One strengthens the other.'**

Complementarity, however, does not imply fusion or assimilation. It suggests dialogue between distinct knowledge systems. Scientific approaches often seek generalizable principles, while Indigenous systems emphasize relational and contextual coherence. These differences point toward mutual strengthening rather than hierarchy.

Intercultural STEM for sustainability therefore requires moving beyond substitution models. Indigenous knowledge should not be added to existing frameworks as supplementary content. It needs to be recognized as a living system capable of informing scientific research and sustainable practices.

4. Build the institutional foundations for intercultural STEM

The discussions made clear that interculturality in STEM for sustainability cannot be reduced to curriculum content alone. Structural and institutional conditions shape not only access but retention and progression within STEM fields. Research on higher education institutions indicates that formal commitments to inclusion often coexist with entrenched hierarchies in knowledge validation, limiting meaningful integration of Indigenous epistemologies.

The pilot initiative demonstrated that institutional infrastructure, governance participation, and student support systems are prerequisites for deeper intercultural transformation in STEM education.

Challenges identified during the discussions included limited access to technology and reliable internet connections, housing instability, language barriers in selection processes, and the absence of clear employment pathways for Indigenous graduates returning to their communities. Participants also emphasized that separation from territory and collective life significantly affects retention, particularly when Indigenous learners spend extended periods away from their communities.

These barriers were not only academic but cultural, affecting belonging, identity affirmation, and continuity with territorial and spiritual practices. Without stable housing, financial support, linguistic accessibility, institutional recognition, and connectivity, intercultural STEM remains aspirational rather than operational.

The recommendations that emerged were therefore both structural and academic in nature. They included strengthening Indigenous student housing and ensuring proper maintenance of existing facilities, consolidating and better coordinating support programmes, expanding supplementary admission to additional academic areas including STEM fields, and promoting intercultural curricula that integrate ancestral methodologies alongside scientific approaches.

Building these foundations is not peripheral to intercultural transformation. It is the condition that makes it possible.

5. Integrate knowledge through intercultural practices

A core theme of the discussions was the integration of ancestral knowledge into academic practice.

Participants advocated for:

- Outreach and community engagement projects and programmes linking university and Indigenous communities
- Collaborative research between faculty and Indigenous youth and students
- Curricular inclusion of Indigenous methodologies
- Documentation of Indigenous presence and resistance within the institution

Youth and students emphasized that Indigenous knowledge is grounded in lived practice and experiential learning, rather than abstract theoretical instruction. Holistic education practices that occur in forests, by rivers, and within community spaces were presented as equally valid forms of knowledge production.

Participants also noted that Indigenous forms of writing and knowledge production are often perceived as less credible within academic settings, and that there remains a scarcity of cited Indigenous theoretical references in university curricula. Expanding intercultural STEM therefore requires not only curricular inclusion, but epistemic recognition.

Intercultural STEM approaches may benefit from expanding their understanding of where and how knowledge is generated.

6. Ensure ethical co-creation

Participants raised concerns about intellectual property and the protection of Indigenous creation. Co-created technologies, methodologies, and knowledge must respect authorship and avoid extractive dynamics.

The participatory structure of the workshop was intentionally designed to centre Indigenous leadership in defining priorities and formulating recommendations. This approach shifted the dynamic from consultation to shared authorship.

Ethical co-creation is a condition for long-term collaboration in sustainability-oriented STEM initiatives.

Conclusion: Foundations before transformation

This pilot initiative marked the first structured experience of co-creation around intercultural STEM for sustainability for the Indigenous youth, students, faculty members, and institutional actors involved. It did not produce a fully redesigned STEM curriculum. Instead, it clarified what must be in place for such a transformation to occur.

The experience demonstrated that intercultural STEM for sustainability depends on:

- Meaningful Indigenous presence in governance spaces
- Institutionalized listening linked to action
- Strengthened student retention and infrastructure
- Recognition of Indigenous youth and students as knowledge producers and institutional actors
- Ethical safeguards in co-creation processes
- Intergenerational and gender-balanced participation as a structural principle of sustainability work

Strengthening these foundations creates the conditions for deeper curricular and methodological innovation in STEM fields.

For universities seeking to replicate this experience, the lesson is clear. Intercultural transformation in STEM does not begin with technical modules. It begins with relationships, institutional responsibility, and shared authority in defining what sustainability means within higher education.

Foregrounding these foundations, the pilot initiative contributes a replicable pathway. It shows how intercultural dialogue can move from symbolic inclusion toward structural engagement, creating the conditions for future advances in sustainability-oriented STEM education.

Funding partner acknowledgement

This initiative was supported by Innospec Fuel Specialties LLC, a global speciality chemicals company whose commitment to sustainability, STEM education, and community partnerships enabled the development of this intercultural, multistakeholder process. Innospec Fuel Specialties manufactures fuel technologies to improve efficiency, reduce emissions, and enhance engine performance across diesel, gasoline, jet fuel, marine fuel, and fuel oil applications. The company also supports customers in the transition to renewable fuels, helping them meet evolving regulatory standards. Learn more about Innospec's commitment to sustainability and advancing access to STEM education at https://innospecsustainability.com/.

Technical and regional partner acknowledgment

This initiative was supported by the following technical and regional partners:

- The FIEI Leaders Council, which brings together representatives from Indigenous peoples (including Pataxó, Xakriabá, Maxakali, Xukuru-Kariri, and Krenak, among others) and supports UFMG's policies for Indigenous peoples.
- The School of Education at the Federal University of Minas Gerais (UFMG), which hosted the workshop and provided logistical support and infrastructure for its implementation.
- The FIEI Collegiate, the academic management body with Indigenous representation for the Intercultural Teacher Education Course for Indigenous Educators (FIEI) at UFMG.
- The COLLEN Collegiate, the central academic management body with Indigenous representation for undergraduate programmes across various fields at UFMG.

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Annex. Summary of consultations conducted

The consultation process was a central component of the *Intercultural STEM for sustainability* initiative, supporting dialogue, reflection, and the co-creation of an intercultural STEM workshop. Conducted primarily throughout 2025, the consultations engaged Indigenous youth and students, faculty members, and institutional actors across multiple formats and locations.

Purpose

The consultations aimed to explore Indigenous perspectives on STEM and knowledge systems, identify institutional barriers and enabling conditions for Indigenous participation, inform the co-design of the intercultural STEM workshop, and strengthen dialogue between Indigenous and scientific knowledge systems.

Consultation methodology

The consultation process combined semi-structured interviews, in-person consultations, online meetings, group discussions, and consensus-building sessions. A total of 12 consultations and 9 interviews were conducted. The methodology prioritized dialogue-based and culturally responsive approaches, following the decision not to implement standardized surveys.

Participants

The consultation process engaged a diverse group of stakeholders, including Indigenous youth and students at undergraduate and postgraduate levels, faculty members and researchers, UNESCO IESALC representatives, and other academic and institutional stakeholders. Efforts were made to ensure inclusive, intergenerational, and gender-balanced participation throughout the process, although detailed demographic data were not systematically recorded for consultation activities.

Participant data

A total of 12 consultations and 9 interviews were conducted as part of the consultation phase. Data on the total number of participants, as well as their age and gender distribution, were not consolidated within the available documentation for this phase.

Table A1. Overview of consultation activities (2025)

Date/period	Location	Format	Participants	Purpose
Jan – Jun 2025	UFMG/Brazil	Interviews, consultations	Indigenous students, faculty	Baseline assessment and initial engagement
16 June 2025	Muã Mimatxi Indigenous village	In-person consultation	Indigenous students (FIEI (Formação Intercultural para Educadores Indígenas), Pedagogy, postgraduate)	Initial dialogue and conceptual exploration
25 June 2025	Online	Consultation meeting	Postgraduate Indigenous students, faculty	Validation and refinement of concepts
20 October 2025	Belo Horizonte (UFMG)	Group discussions (focus groups)	Indigenous students (multiple programmes)	Co-design of workshop content
30 October 2025	Online	Representative meeting	Selected student representatives	Finalization of programme structure
Additional sessions (2025)	UFMG/Online	Consultations and discussions	Students, faculty, stakeholders	Ongoing dialogue and consensus-building

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