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CASE STUDY

Transforming Engineering Education through Student-Led Collaboration: The ISES Model for Quality Education in Sudan

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ABSTRACT

PURPOSE: To present the Integration of the Sudan University of Science and Technology (SUST) Engineering Societies (ISES) as a student-led model for enhancing quality education in Sudan through interdisciplinary collaboration, experiential learning, and Sustainable Development Goals (SDGs)-focused activities. The paper explores how ISES empowered students to become active community contributors, bridging academic learning with national development priorities.

DESIGN/METHODOLOGY/APPROACH: The paper uses a descriptive case study approach, drawing on the development and implementation of ISES from 2020 to 2022 at the SUST. The case study draws on diverse student-led activities and applies Communities of Practice principles to explore their impact on learning and engagement.

FINDINGS: ISES significantly improved students' awareness of the SDGs, fostered interdisciplinary collaboration, and developed leadership skills among participants. It also created a sense of belonging and professional identity, preparing students for post-graduation success and national rebuilding. Students reported transformative learning experiences and increased civic engagement.

VALUE: The paper highlights how youth-led, collaborative models such as ISES can advance educational reform and community resilience in conflict-affected settings.

RESEARCH LIMITATIONS/IMPLICATIONS: The paper focuses on a single institution and may require broader validation across multiple universities in Sudan. Future studies should explore the scalability of this model in diverse educational contexts.

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PRACTICAL IMPLICATIONS: ISES offers a scalable framework for integrating quality education with national rebuilding efforts, emphasising student leadership, interdisciplinary collaboration, and community impact.

KEYWORDS: *Quality Education; Student-Led Initiatives; Interdisciplinary Collaboration; Sustainable Development Goals; Engineering Education; Sudan; Higher Education Reform; Communities of Practice*

EDUCATION AS A TOOL FOR NATIONAL HEALING AND DEVELOPMENT

In times of national crisis and post-conflict recovery, education transcends its conventional role as a developmental goal to become a cornerstone for social cohesion, peacebuilding, and national resilience (Nesterova *et al.*, 2022; Branch *et al.*, 2025; Barakat *et al.*, 2013). In Sudan, where decades of conflict, economic instability, and social fragmentation have left lasting scars, rebuilding the education system is both a critical challenge and a strategic opportunity. Education must restore lost learning and prepare a new generation to lead the nation's recovery, innovate sustainable solutions, and promote lasting peace (Milton, 2018; Breidlid, 2016). This paper explores how a student-led model, the Integration of SUST Engineering Societies (ISES), has contributed to this mission by fostering interdisciplinary collaboration and socially relevant engineering education.

Engineering education has a unique role to play in Sudan's reconstruction. Engineers are responsible for physical infrastructure and designing systems that address essential needs such as clean water, reliable energy, resilient infrastructure, and digital connectivity, which are critical elements for post-conflict recovery (UNESCO, 2021). Engineering students are uniquely positioned to become agents of change, applying their technical skills to solve real-world problems while promoting social and economic stability (Bertolini *et al.*, 2024; Richter and Kjellgren, 2023; Mittal and Bansal, 2024). When integrated with the Sustainable Development Goals (SDGs), engineering education can prepare students to become change-makers, designing innovations that are both context-sensitive and socially responsible (UNESCO, 2021).

Broader Role of Engineering Education in National Recovery

Engineering education plays a pivotal role in national recovery by equipping future professionals with the skills to rebuild critical infrastructure, support economic revitalisation, and foster social cohesion (Gebeshuber and Doyle-Kent, 2024; Bolu *et al.*, 2024). Beyond technical proficiency, engineering students are uniquely positioned to address complex, interdisciplinary challenges that arise in post-conflict settings, such as restoring essential services, developing resilient energy systems, and building sustainable urban infrastructure (Acuña *et al.*, 2025). These contributions extend beyond physical reconstruction to include the creation of innovative technologies that drive economic growth, improve public health, and enhance overall quality of life. In Sudan, where the legacy of conflict has disrupted economic stability and fractured social networks, engineering education must produce technically competent graduates and socially responsible leaders capable of driving national development. This broader educational mission aligns closely with the SDGs,

particularly SDG 9 (Industry, Innovation, and Infrastructure) and SDG 11 (Sustainable Cities and Communities), emphasising the need for context-sensitive, socially impactful engineering solutions.

In addition, engineering education can catalyse long-term peacebuilding by promoting collaboration across disciplines, fostering critical thinking, and empowering students to become active community contributors (Yarnall *et al.*, 2021; Jordan *et al.*, 2024). This holistic approach to education strengthens social cohesion by creating networks of young professionals committed to rebuilding their country and addressing the root causes of instability. Engineering education can help transform conflict-affected societies into resilient, innovative, and inclusive economies by integrating technical skills with leadership, ethics, and community engagement (Jordan *et al.*, 2024).

Role of Student Professional Societies in National Recovery

Student professional societies play a critical role in this transformation. These societies act as platforms for leadership development, interdisciplinary collaboration, and practical learning, helping students bridge the gap between theoretical knowledge and real-world application. They foster a sense of belonging, enhance technical competencies, and promote networking among peers and professionals (Rosch and Collins, 2017; Igbal *et al.*, 2023). In conflict-affected contexts like Sudan, these societies also serve as safe spaces for dialogue, innovation, and collective problem-solving, empowering students to contribute actively to their communities' recovery. One student reflected:

> *"Personally, it opened my eyes to other scientific societies, helped me build an excellent community, and allowed me to work on outstanding projects".*

These testimonials illustrate how student-led collaboration can transform individual perspectives and inspire broader social change.

However, achieving these outcomes requires shifting from traditional, lecture-based education to more participatory, transformative learning approaches. Recent studies have emphasised that education in conflict-affected contexts must be designed to rebuild technical skills and empower youth as peacebuilders and community leaders (USIP, 2021; UNESCO, 2017). Educational spaces must be created where students are not passive recipients but active participants, leading, collaborating, and innovating in ways that contribute directly to national rebuilding.

The ISES Model: A Blueprint for Student-Led Recovery

The ISES model represents one such innovative approach. Founded in 2020, ISES emerged at the Sudan University of Science and Technology (SUST) as a student-led initiative to transform engineering education through interdisciplinary collaboration and SDG-focused learning. Importantly, ISES was established and actively operated before the recent conflict, demonstrating the potential of youth-driven educational models as a foundation for future recovery and resilience.

It has since evolved into a platform for youth leadership, community engagement, and real-world problem-solving, bridging academic learning with national development priorities.

Through ISES, students have become active contributors to Sudan's rebuilding process, designing context-sensitive solutions and cultivating the leadership skills needed for sustainable recovery. Their projects reflect a deep commitment to community impact and personal growth. One student expressed this transformation:

> *"It boosted my confidence in leadership, enabled me to develop teamwork and management skills, and changed my perspective on the role of engineering in serving the community".*

This paper traces the origins, growth, and impact of ISES, demonstrating how grassroots student collaboration can drive meaningful educational reform and contribute to national resilience. By examining the ISES model, this paper aims to provide a blueprint for integrating quality education with community empowerment, highlighting the critical role of youth in post-conflict recovery.

FRAGMENTED STUDENT SOCIETIES AND SDG AWARENESS GAPS

Before the formation of the ISES, the student environment at SUST reflected a common issue in higher education across Sudan: fragmentation. Engineering student societies operated in disciplinary silos, often organising events and activities in isolation from one another. This isolation limited interdisciplinary collaboration, leadership development, and collective problem-solving opportunities, weakening the overall student experience and reducing the potential for impactful learning (World Bank, 2021; Arnold and Willis, 2024). One student reflected on this challenge, noting:

> *"Collaboration between different disciplines can lead to outstanding results".*

This insight underscores the missed potential when students remain confined to their respective fields, lacking opportunities to share knowledge and co-create solutions to complex problems.

Another significant gap was the limited awareness and engagement with the United Nations SDGs, a critical framework for addressing global social, environmental, and economic challenges. Despite the SDGs being widely recognised as essential for sustainable development, many engineering students were unfamiliar with their relevance to engineering practice. As one student observed:

> *"Sometimes the ideal solutions to big problems that experts struggle with come from the ideas and projects of students".*

This disconnect between academic learning and global challenges leaves students underprepared for the complexities of Sudan's national recovery, limiting their ability to contribute meaningfully to broader development goals (UNESCO, 2023; Sorooshian, 2024).

Additionally, Sudanese engineering education has historically faced external constraints. Decades of international sanctions (1997-2020) significantly restricted Sudanese students' participation in global engineering activities and professional bodies, limiting their exposure to

international best practices, emerging technologies, and interdisciplinary collaboration (Minalla, 2021). These barriers reduced students' ability to engage with global engineering communities, hindering their professional growth and innovation potential. The recent conflict in Sudan has further disrupted educational systems, reducing opportunities for impactful, hands-on learning and professional development, and intensifying the need for locally driven, student-led solutions.

Recognising these gaps, a clear need emerged for a unifying platform to bridge disciplinary divides, integrate SDG literacy into co-curricular activities, and promote a sense of collective responsibility among students. This platform needed to be student-led to ensure ownership and sustainability, aligning with global education quality indicators such as inclusivity, relevance, collaboration, and real-world impact. ISES was born from this recognition, a response to the need for a more cohesive, empowered, and socially responsive engineering student community. Through ISES, students at SUST have redefined their roles as active contributors to their academic institutions and the broader national recovery effort, creating a foundation for future educational reform and resilience.

THE ISES INITIATIVE: A VISION FOR COLLABORATIVE, IMPACTFUL LEARNING

ISES was launched in early 2020 as a visionary student-led initiative to transform the engineering education culture at SUST. It emerged as a grassroots response to the challenges of disciplinary isolation and the need for a more collaborative, context-aware approach to engineering education. Before ISES, student professional societies at SUST operated primarily in isolation, limiting opportunities for interdisciplinary learning and collective problem-solving. This fragmented structure often prevented students from developing broader context-sensitive perspectives to address complex real-world challenges.

The foundational idea behind ISES was to create a unified platform that fosters student leadership, cross-disciplinary teamwork, and community impact. Inspired by the principles of Communities of Practice (CoP) (Lave and Wenger, 1991; Matemba *et al.*, 2023), ISES emphasises collaborative learning, shared goals, and progressive participation. This approach creates a space where students can co-create knowledge, develop their professional identities, and prepare for future leadership roles. One student described this transformation, noting:

> *"Through my work in ISES, I realized that youth have tremendous and limitless potential, and we can all make a difference from nothing".*

This insight captures the transformative impact of student-led collaboration. Testimonials such as this highlight how the ISES model fosters not only technical competencies but also the soft skills essential for community leadership and social impact.

From its inception, ISES sought to break down disciplinary silos by encouraging students to connect their technical skills with real-world challenges (Musa *et al.*, 2024). It brought together student chapters from diverse fields, including petroleum, civil, electrical, and industrial

engineering, promoting a culture of innovation and collective problem-solving. This interdisciplinary collaboration aligns closely with SDG 4 (Quality Education), which promotes inclusive and equitable learning opportunities, and SDG 17 (Partnerships for the Goals), which emphasises the importance of cross-sector collaboration and global partnerships. By integrating CoP principles, ISES has enabled students to become active community contributors, fostering a sense of belonging and professional identity.

In addition to technical expertise, ISES emphasises developing critical soft skills such as leadership, teamwork, and communication. These competencies are cultivated through exhibitions, seminars, collaborative projects, and virtual engagements, reinforcing the critical role of youth in post-conflict recovery. One student reflected on this growth, noting that their participation in ISES:

> *"allowed me to work on outstanding projects, build an excellent community, and connect with like-minded peers".*

This holistic approach to learning has positioned ISES as a platform for transformative education, bridging the gap between classroom theory and real-world application.

ISES's commitment to inclusivity and equity is another core component of its mission. Promoting women's leadership and participation in engineering activities aligns with SDG 5 (Gender Equality). The initiative ensures that all student professional societies, regardless of size or discipline, have an equal voice and opportunity to contribute. This inclusive approach has been a cornerstone of ISES, reflecting the broader goals of social resilience and community empowerment. It not only empowers under-represented groups but also strengthens the collective capacity of students to drive positive changes in their communities.

Overall, the ISES model has proven to be more than just a platform for academic development. It has become a powerful mechanism for fostering active citizenship, building leadership capacity, and connecting education with national development priorities. This model of education, rooted in collaboration, sustainability, and active citizenship, offers a practical blueprint for integrating quality education with community empowerment in other conflict-affected regions.

ENHANCING QUALITY EDUCATION THROUGH ISES ACTIVITIES

ISES was designed to unify student efforts and redefine the nature of learning in engineering education. Its activities reflect a commitment to active, inclusive, and globally informed education, aligned with the principles of SDG 4 (Quality Education). By shifting students from passive recipients of knowledge to active contributors and community collaborators, ISES has fostered a more responsive and empowered learning culture. This approach closely aligns with the CoP framework that emphasises collaborative learning, shared goals, and a strong sense of professional identity.

Experiential Learning: Bridging Theory and Practice

One of the most impactful features of ISES is its emphasis on experiential learning (Ajani, 2023; Kong, 2021). Annual exhibitions allow students to design, present, and receive feedback on real-world projects addressing Sudanese community challenges, including environmental engineering, energy efficiency, and health technologies. These events promote creativity, critical thinking, and practical application of classroom knowledge, reinforcing students' roles as problem solvers and community leaders (Kong, 2021).

Community-based projects extend this hands-on learning, enabling students to address pressing local issues and develop practical solutions (Natarajarathinam *et al.*, 2021). For example, one student described their experience as transformative:

> *"It allowed me to apply my technical skills in real-world contexts, strengthening my confidence and sense of purpose as an engineer".*

This direct engagement with community needs builds technical competence and cultivates a sense of social responsibility and leadership.

Global Exposure: Building a Global Professional Identity

ISES also connects students with global engineering education networks, providing exposure to international best practices and emerging technologies. Partnerships with organisations such as the International Federation of Engineering Education Societies (IFEES), the Global Engineering Deans Council (GEDC), the Sustainable Development Response Organization (SuDRO), University of Emerging Technologies (UET), the World Bioenergy Association (WBA), and the Sudanese Engineers Association Qatar (SEAQ) have offered credibility, mentorship, and visibility to students' efforts. These collaborations have helped students build technical skills, expand their professional networks, and gain confidence as global professionals. One student reflected on this international exposure:

> *"These experiences broadened my perspective, motivated me to pursue excellence, and inspired me to contribute to global engineering challenges".*

Digital Access: Resilience through Online Engagement

ISES swiftly adapted to the COVID-19 pandemic by transitioning to digital platforms. Webinars, livestreamed panels, and virtual exhibitions ensured continued student engagement and learning, even under crisis conditions. These activities not only sustained the momentum of ISES but also expanded its reach, allowing more students, including those in remote or displaced settings, to participate. Despite challenges such as power outages and limited Internet access, this digital transition demonstrated the adaptability and innovation required for sustainable education in post-conflict contexts. During ongoing conflicts, ISES maintained communications through WhatsApp

groups, where students continued to share learning opportunities and support each other, reinforcing their commitment to education despite adversity.

Inclusive Pedagogy: Embracing Diversity and Collaboration

ISES promotes a learning environment that values diversity in discipline, gender, and perspective. Its events are designed to ensure participation across all engineering colleges, encouraging students to work in multidisciplinary teams. This inclusive approach breaks down traditional academic silos and fosters a culture of mutual respect, shared leadership, and collective problem-solving. It also aligns closely with the principles of SDG 5 (Gender Equality) and SDG 10 (Reduced Inequalities), reinforcing the broader goals of social resilience and community empowerment. Reflecting on the inclusive environment fostered by ISES, one participant described it as "Unique, creative, united". This inclusive environment empowers students to challenge stereotypes, lead teams, and contribute meaningfully to their communities.

Empowering Learners as Knowledge Producers

At the core of ISES is student leadership. Students are not just participants but designers, facilitators, and evaluators of the programmes. They organise events, moderate panels, lead project teams, and conduct surveys to assess the initiative's impact. This hands-on involvement transforms students into knowledge producers and community leaders, equipping them with transferable skills in communication, management, and critical thinking, competencies that are vital for post-graduation success and national development. One student highlighted this growth:

> *"Leading projects within ISES taught me how to manage teams, make strategic decisions, and communicate effectively in challenging situations".*

While ISES remains a student-led initiative, faculty support has been crucial in navigating complex challenges. Faculty involvement has been particularly critical in mediating conflicts between student societies, facilitating international partnerships, and securing sponsorships for ambitious projects. This supportive guidance ensures that student leaders can fully embrace their roles as community innovators without being overwhelmed by external pressures, creating a balanced learning environment where students can thrive.

OUTCOMES AND RECOGNITION

Since its inception in 2020, ISES has transformed the educational experience for engineering students at SUST and beyond, achieving significant outcomes across three key areas: increased SDG awareness, leadership development, and international recognition. These impacts reflect the broader goals of building resilient, context-sensitive engineering education systems in post-conflict contexts.

Increased SDG Awareness and Community Engagement

One of the most impactful outcomes of ISES has been its success in raising awareness about the United Nations SDGs among engineering students. By integrating SDG principles into seminars, exhibitions, community projects, and digital platforms, ISES empowered students to align their learning with global development challenges. This approach strengthened the connection between academic knowledge and community service.

One example is the annual World Engineering Day that provides a platform for students to showcase SDG-aligned projects. As one student reflected:

> *"The World Engineering Day events helped us develop participants' skills, understand the SDGs, and align projects to serve these goals".*

Leadership Development and Professional Growth

ISES's student-led structure fostered practical leadership, project management, and teamwork skills. Students who had not previously taken active roles in professional societies emerged as workshop facilitators, mentors, and project leaders. These experiences nurtured public speaking, planning, and decision-making capabilities – core competencies for future engineers.

As a student remarked:

> *"Through my work in ISES, I realized that youth have tremendous and limitless potential".*

Another student added:

> *"Despite the challenges ISES faced since its inception, it has achieved unprecedented success and will surely be an even brighter and more successful model in different environments".*

These testimonials highlight ISES's role in transforming learners into leaders and echo the CoP framework that values shared ownership, experiential learning, and progressive participation.

Local and International Recognition

ISES has also gained recognition from prestigious organisations. For example, the Society of Petroleum Engineers (SPE) Sudan Section included detailed descriptions of ISES activities in its annual report, contributing to the section receiving the prestigious 2020 Presidential Award, placing it among the top 5% of SPE-affiliated sections worldwide (SPE, 2020). This was a significant milestone, marking the first time the Sudan Section, established in 2005, received this recognition, reflecting the quality and impact of ISES activities. Similarly, the Industrial Engineering and Operations Management (IEOM) student chapter received the Silver Award (IEOM, 2020), further validating the excellence of the ISES model.

ISES projects were also featured by international organisations such as the Global Engineering Deans Council (GEDC) and IFEES in bulletins such as GlobalEngineer (IFEES-GEDC, 2020), enhancing the global visibility of Sudanese students and inspiring pride and motivation among participants.

This recognition underscores the scalability and replicability of the ISES model. By placing students at the forefront of educational reform, ISES provides a practical framework for youth-driven transformation that bridges academic learning and real-world impact, offering a compelling blueprint for other conflict-affected regions.

ISES AS A MODEL FOR FUTURE EDUCATION REFORM

Building on the successes outlined in the previous sections, the ISES model presents a compelling case for rethinking educational reform in Sudan through bottom-up, student-driven models that prioritise experiential learning, community engagement, and global collaboration. By shifting the focus from traditional, top-down curriculum delivery to participatory, collaborative, and real-world learning experiences, ISES exemplifies how students can become powerful change agents within higher education systems. This approach reflects the principles of CoP and Cooperative Learning that emphasise shared ownership, progressive participation, and the co-creation of knowledge within supportive learning communities (Johnson *et al.*, 2007; Felder and Brent, 2007; Skedsmo and Huber, 2019).

Student-Driven Structures to Enhance Quality Education

ISES demonstrates that when students are empowered to take ownership of their learning environment, the quality of education improves substantially. This student-centred approach encourages deeper learning outcomes that align with the targets of SDG 4, particularly in terms of equity, relevance, and lifelong learning skills. Students gain essential competencies such as leadership, teamwork, and social responsibility through exhibitions, community projects, and interdisciplinary events linking theory to practice.

One participant captured this transformation:

> *"Through my work in ISES, I developed the confidence to lead projects, manage diverse teams, and make strategic decisions in challenging environments".*

These experiences highlight how student-led initiatives can reshape engineering education to be more socially responsive, context-aware, and empowering.

Conceptual Scalability and Adaptability

The ISES model is built on inherently adaptable principles: peer learning, interdisciplinary collaboration, and SDG integration. These characteristics allow it to serve as a conceptual blueprint that other institutions can adopt, particularly in regions facing similar constraints. This aligns with broader discussions in higher education literature advocating for the strategic scaling of community-based education al models to enhance equity, relevance, and institutional resilience (Chowdhury and Alzarrad, 2025). While replication requires contextual adaptation, the foundational philosophy,

student leadership, community engagement, and inclusive pedagogy, remains universally applicable (Musa *et al.*, 2025).

ISES also shows how digital engagement, such as virtual exhibitions and webinars, can support resilient education systems during crises, promoting continuity, participation, and innovation. These conceptual insights are especially relevant for universities navigating uncertainty or post-conflict recovery.

Education for Resilience and Peacebuilding

More than a pedagogical model, ISES advances education as a means of nation-building and healing. It cultivates students as engineers, peacebuilders, and civic actors by fostering empathy, agency, and inclusive leadership. Its commitment to gender equity, disciplinary diversity, and collaborative learning aligns with broader goals of social cohesion and long-term resilience.

As Sudan rebuilds, ISES illustrates how youth-driven educational frameworks can lay the foundation for inclusive, future-oriented development. It offers a compelling vision for higher education in a post-conflict setting where students are not only recipients of knowledge but co-creators of a more just, resilient, and sustainable society.

LESSONS LEARNED, INSTITUTIONAL STRATEGIES, AND POLICY IMPLICATIONS

ISES has provided valuable insights into how student-led models can transform engineering education, particularly in conflict-affected regions such as Sudan. These lessons are relevant for Sudanese universities and offer broader guidance for educational institutions seeking to integrate experiential learning, leadership development, and community engagement into their curricula.

Integrating Extracurricular Leadership with the Curriculum

One of the most powerful lessons from ISES is the transformative potential of aligning extracurricular engagement with formal academic learning. Students who participated in ISES gained technical knowledge, critical leadership, and organisational skills, learning to apply their engineering expertise to real-world social and environmental challenges. Integrating theory and practice is essential for preparing graduates to address complex, context-specific problems.

To institutionalise this approach, universities should:

- **Create Credit-Bearing Activities:** Recognise student-led projects in the formal curriculum, offering academic credit, certificates, or awards to motivate broader participation.
- **Develop Co-Curricular Programmes:** Establish structured, multidisciplinary programmes that allow students to apply technical skills to real-world challenges, reinforcing the principles of the CoP framework.

- **Incorporate Project-Based Learning:** Emphasise hands-on, project-based learning as a core component of engineering education, ensuring students develop technical competence and leadership skills.

One ISES participant reflected on this approach, emphasising the value of project-based learning in developing leadership, decision-making, and communication skills.

This reflects the transformative impact of integrating extracurricular leadership with academic learning, reinforcing the value of student-led education.

Institutional Support for Student-Led Innovation

While student enthusiasm and creativity were central to ISES's success, institutional support was equally critical. Faculty mentorship, administrative openness, and logistical support played vital roles in sustaining momentum and ensuring long-term impact. Without this support, student-led initiatives risk becoming isolated efforts disconnected from broader institutional goals.

To support student-led innovation, universities should:

- **Provide Faculty Mentorship:** Establish mentorship programmes that connect students with experienced faculty members who can guide project development, mediate conflicts, and secure external partnerships.
- **Create Platforms for Visibility:** Provide platforms for students to showcase their work, including exhibitions, conferences, and digital platforms, reinforcing the value of their contributions.
- **Remove Barriers to Interdisciplinary Collaboration:** Encourage interdisciplinary teamwork by creating flexible academic structures that support cross-disciplinary learning and collaboration.

One student reflected on the importance of this support, saying:

"Having the guidance of faculty mentors helped us navigate challenges and take our projects to the next level".

This highlights the critical role of institutional support in sustaining student-led initiatives.

The Role of International and Community Partnerships

ISES also illustrates the critical role of external partnerships in enriching student experiences and broadening impact. Collaborations with organisations such as IFEES, GEDC, SuDRO, UET, WBA, and SEAQ connected students to global resources, ideas, and audiences. These partnerships provided mentorship, technical expertise, and platforms for international exposure, reinforcing the global relevance of student-led initiatives.

At the same time, community engagement grounded ISES in local realities, ensuring that student activities were educational, socially relevant, and context sensitive. This connection to local

communities is essential for building resilient, context-aware engineers who can address real-world challenges. One student reflected:

> *"Leading projects within ISES taught me the importance of context-sensitive engineering, where solutions must be tailored to the specific needs of local communities".*

This reinforces the need for project-based learning to be locally grounded and responsive to societal needs.

To strengthen the impact of student-led initiatives, universities should:

- **Foster Tri-Sector Collaboration:** Build strong partnerships between academia, industry, and community organisations to provide students with practical, real-world experience.
- **Encourage International Collaboration:** Create opportunities for students to engage with global engineering networks, enhancing their professional development and cultural competence.
- **Promote Local Relevance:** Ensure that student projects are grounded in local contexts and address the specific needs and challenges of the communities they serve.

Policy Implications for Broader Replication

To scale the ISES model effectively, policy-makers and university leaders should consider the following recommendations:

- **Institutionalise Student-Led Projects:** Create formal structures for recognising and supporting student-led initiatives, including academic credit, funding, and external partnerships.
- **Invest in Digital Infrastructure:** Support digital learning platforms that enable collaboration, remote learning, and global networking, ensuring educational continuity during crises. The ISES model's adaptation to digital platforms during the COVID-19 pandemic demonstrated its potential for resilience and scalability, even during crises. This approach included virtual exhibitions, online training sessions, and digital collaboration tools that maintained student engagement despite physical and logistical barriers.
- **Promote Faculty-Student Partnerships:** Encourage faculty mentorship and collaboration to support student leadership, project management, and community engagement.
- **Embed SDG Literacy in Curricula:** Integrate SDG education into academic programmes, ensuring graduates are prepared to address complex global challenges.
- **Foster Inclusivity and Gender Equality:** Ensure student initiatives are accessible to all, promoting diversity and equal participation in leadership roles.
- **Support Tri-Sector Collaboration:** Build strong networks between universities, industry partners, and community organisations to enhance the practical impact of student projects.

CONCLUSIONS: BUILDING A RESILIENT FUTURE THROUGH EDUCATION

As Sudan continues its journey towards recovery, the ISES model offers a powerful example of how youth-driven educational reform can contribute to national rebuilding and long-term resilience. This inclusive approach addresses immediate educational challenges and contributes to long-term social stability by fostering mutual respect and collective problem-solving. By empowering students to become active contributors to their communities, ISES has demonstrated the transformative potential of education in conflict-affected regions. This model prepares students for professional success and cultivates a generation of leaders committed to building a more resilient, inclusive, and sustainable society.

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