Impacts of international cooperation on the Sustainability and Innovation culture of the Gregório Semedo Polytechnic Institute - Angola

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Abstract
This study analyzed the impact of international cooperation between the Institute of Science, Technology and Global Sustainable Innovation (ICT Sustentável Global), the Minuto Verde Non-Governmental Organization, and the Gregório Semedo Polytechnic Institute on consolidating a culture of sustainability and innovation at institutional level. Adopting a mixed-methods design, five impact domains were evaluated (educational, institutional, environmental, sociocultural, and scientific) in a sample of 227 participants. The results demonstrate a consistently high formative impact, with average competence scores in sustainability, ecological citizenship, and applied innovation exceeding 4.10 (on a 5-point Likert scale). Inferential analysis revealed that effective participation in activities is the most robust predictor, strongly correlating with applied innovation (r = 0.51) and scientific production (40% increase). The impact was, however, differential, being more pronounced among undergraduate students and women (in ecological citizenship). The significant association observed in the institutional and community dimensions corroborates the partnership's role in the local ecological transition. It is concluded that the cooperation between national and international actors, is an effective model for driving innovation and developing sustainability competencies within the context of African higher education.
Keywords: International cooperation, sustainability; innovation; higher education; ecological citizenship; Angola.

Impactos da cooperação internacional na cultura de Sustentabilidade e Inovação do Instituto Superior Politécnico Gregório Semedo - Angola

Resumo
Este estudo analisou o impacto da cooperação internacional entre o Instituto de Ciência, Tecnologia e de Inovação Sustentável Global (ICT Sustentável Global), a Organização Não-Governamental (ONG) Minuto Verde- Quercus Angola, e o Instituto Superior Politécnico Gregório Semedo na consolidação de uma cultura de sustentabilidade e inovação a nível institucional. Adoptando um desenho misto, foram avaliados cinco domínios de impacto (educacional, institucional, ambiental, sociocultural e científico) em uma amostra de 227 participantes. Os resultados demonstram um impacto formativo consistentemente elevado, com as médias de competências em *sustentabilidade, cidadania ecológica* e *inovação aplicada*, superiores a 4,10 (escala Likert de 5 pontos). A análise inferencial revelou que a participação efectiva nas actividades é o preditor mais forte, correlacionando-se com a inovação aplicada (r = 0,51) e a produção científica (aumento de 40%). O impacto foi, no entanto, diferencial, sendo mais acentuado nos estudantes de graduação e nas mulheres (em cidadania ecológica). A associação significativa verificada nas dimensões institucional e comunitária corrobora o papel da cooperação na transição ecológica local. Conclui-se que a articulação entre actores nacionais e internacionais, é um modelo eficaz para impulsionar a inovação e o desenvolvimento de competências de sustentabilidade no contexto da educação superior africana.
Palavras-chave: Cooperação internacional, sustentabilidade, inovação, educação superior, cidadania ecológica, Angola.

Impactos de la cooperación internacional en la cultura de Sostenibilidad e Innovación del Instituto Superior Politécnico Gregório Semedo - Angola

Resumen
Este estudio analizó el impacto de la cooperación internacional entre el Instituto de Ciencia, Tecnología e Innovación Sostenible Global (ICT Sostenible Global), la Organización No Gubernamental (ONG) Minuto Verde–Quercus Angola y el Instituto Superior Politécnico Gregório Semedo, en la consolidación de una cultura de sostenibilidad e innovación a nivel institucional. Adoptando un diseño mixto, se evaluaron cinco dominios de impacto (educativo, institucional, ambiental, sociocultural y científico) en una muestra de 227 participantes. Los resultados demuestran un impacto formativo consistentemente elevado, con promedios superiores a 4,10 (escala Likert de 5 puntos) en competencias de sostenibilidad, ciudadanía ecológica e innovación aplicada. El análisis inferencial reveló que la participación efectiva en las actividades es el predictor más fuerte, correlacionándose con la innovación aplicada (r = 0,51) y la producción científica (incremento del 40%). No obstante, el impacto fue diferencial, siendo más acentuado en los estudiantes de grado y en las mujeres (en ciudadanía ecológica). La asociación significativa observada en las dimensiones institucional y comunitaria corrobora el papel de la cooperación en la transición ecológica local. Se concluye que la cooperación entre actores nacionales e internacionales, constituye un modelo eficaz para impulsar la innovación y el desarrollo de competencias de sostenibilidad en el contexto de la educación superior africana.
Palabras clave: cooperación internacional; sostenibilidad; innovación; educación superior; ciudadanía ecológica; Angola.

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1.Introduction

The contemporary context is characterized by intense global transformations, geopolitical instability, and multiple socio-environmental challenges that transcend national borders. The climate crisis, rising inequalities, technological transition, and social fragmentation constitute a scenario that demands systemic and sustained institutional responses. In this setting, sustainability emerges as a strategic foundation to ensure ecosystem resilience, the continuity of human life, and the balanced development of societies (Geels, 2024; WCED, 1987; Petrović, 2024).

The relevance of an institutional culture of sustainability and innovation becomes evident for organizations and institutions seeking to act with relevance in a complex and dynamic world. Contemporary literature indicates that it is not sufficient to adopt technical or regulatory structures alone; rather, it is necessary to mobilize actors (individuals, networks, and organizations) endowed with agency, resources, and commitment to promote cultural and organizational transformations (Agbogbo et al., 2023a; Annelin & Boström, 2024).

The incorporation of values, norms, and practices oriented toward sustainability should be understood as an integral part of the logic of institutional transformation, rather than as a peripheral addition (Fischer & Newig, 2016; Yan et al., 2022). Such incorporation constitutes an active mechanism of transition, reconfiguring regimes, power relations, and internal adaptive capacities (Mena & Mena, 2022).

In this sense, the question shifts from “why innovate?” to “how can institutional cultures capable of sustaining innovation aligned with the imperatives of sustainability be built?”. The answer depends largely on capacity building, human resource development, the mobilization of actors, and the strengthening of social and institutional networks (Annelin & Boström, 2024; Petrović, 2024; Ull Solís, 2015).

Within higher education institutions (HEIs), this cultural transition requires rethinking governance, curricula, pedagogical methodologies, and inter-institutional partnerships. Recent literature highlights that these institutions are privileged platforms for fostering theories, practices, and social innovations oriented toward sustainability (Howoldt, 2024; UNESCO, 2022).

African higher education institutions play an increasingly significant role in promoting sustainability, innovation, and climate change adaptation. Recent studies indicate that universities across the continent function as strategic hubs for applied research, human resource training, and community mobilization, promoting integrated approaches to sustainability and institutional innovation (Leal Filho et al., 2024). This engagement demonstrates the capacity of HEIs to positively influence internal policies, pedagogical practices, and organizational structures oriented toward sustainability.

The literature shows that education constitutes one of the main mechanisms for transmitting the professional culture accumulated by humanity, being responsible for disseminating knowledge, practices, and values structured throughout the historical experience of communities (Mena & Mena, 2022). The unidirectional relationship between education and culture grants educational institutions a strategic role in the socialization of new generations,

particularly in contexts where socio-economic and technological development increases the complexity of the competencies required by contemporary societies.

In the context of higher education, this articulation between education and culture assumes particular relevance, as it contributes to the construction of students' professional identity based on the socio-cultural contexts of their fields of study. This process entails integrating values, norms, and cultural references that guide responsible and socially embedded practices, constituting an essential element for consolidating institutional cultures of sustainability and innovation (Mena & Mena, 2022).

Additionally, recent studies identify that several African countries face structural constraints that undermine environmental education and the development of competencies for sustainability. Agbogbo et al. (2023b) demonstrate that the fragility of educational systems, combined with inadequate waste management and prolonged exposure to environmental risks, reduces the capacity of young populations to develop a solid environmental culture and sustainable practices. These challenges highlight the need for more integrated policies, as well as international cooperation initiatives that support teacher training, educational innovation, and the creation of safe learning environments oriented toward sustainability.

International cooperation networks, such as UNESCO's Campus Africa programme (2025), have been fundamental in strengthening institutional capacities, facilitating the transfer of good practices, and encouraging innovation across diverse African contexts. Inter-institutional collaboration enables methodologies and technologies to be adapted to local realities, generating tangible impacts on communities and educational systems. These initiatives demonstrate that global partnerships can accelerate processes of institutional learning and consolidate cultures of sustainability across the continent.

In the Angolan context, the consolidation of institutional cultures of sustainability faces specific challenges, including limited infrastructure, traditional pedagogical models, and a scarcity of specialized competencies (Mbanze et al., 2020). In this scenario, international cooperation emerges as a catalytic mechanism capable of expanding capacities, fostering innovation, and strengthening knowledge networks among universities, NGOs, and scientific institutions.

Considering these premises, the present study focuses on the Instituto Superior Politécnico Gregório Semedo (IGS), with the objective of analysing the impact of international cooperation among ICT Sustentável Global, Minuto Verde, and IGS on the construction and consolidation of an institutional culture of sustainability and innovation. The research seeks to understand how the articulation between local and international actors contributes to capacity development, the adoption of sustainable practices, and institutional innovation at IGS.

2. Materials and Methods

The study adopted a cross-sectional quantitative design with a qualitative complement, appropriate for assessing educational, institutional, environmental, sociocultural, and scientific-innovative impacts arising from international cooperation within the IGS. The mixed-methods approach integrated data collection and analysis techniques that made it possible to capture both objective indicators and the perceptions of the different participating groups.

2.1. Population and Sampling

The final sample consisted of 227 participants (Table 1), distributed according to the strata defined in the methodology: undergraduate students (n = 106), CEA students (n = 63), faculty members (n = 32), administrative staff (n = 15), and community stakeholders (n = 11). The gender distribution was as follows: 126 males (55.5%) and 101 females (44.5%).

Table 1. Strata of the selected sample

Population strata	Sample (n)	Male	Female
Undergraduate students	106	63	43
CEA students	63	37	26
Faculty members	32	13	19
Administrative staff	15	7	8
Community stakeholders	11	6	5
Total	**227**	**126**	**101**

2.2. Instruments and Variables

Three validated five-point Likert scales were employed: sustainability competencies, ecological citizenship, and applied innovation. The scales demonstrated high internal consistency, with Cronbach's alpha values of 0.91, 0.88, and 0.89, respectively. Complementary institutional variables included participation in training activities, engagement in community actions, applied scientific output, perceived institutional strengthening, and post-intervention ecological practices.

2.3. Data Collection Procedures

Data collection took place between April 2024 and July 2025. The instruments were administered in person with the support of trained teams. In addition, semi-structured interviews were conducted with key stakeholders, and direct observation of community and training events was carried out, with systematic recording of qualitative evidence.

2.4. Data Analysis Procedures

Descriptive statistics were applied, including the calculation of means, standard deviations, and 95% confidence intervals (95% CI). Differences among strata were assessed using one-way ANOVA with Tukey post hoc tests. Gender comparisons employed Student's t-test. Associations between categorical variables were examined using the x^2 test and Cramer's V. Relationships among continuous scales were analyzed using Pearson correlation coefficients. Multiple linear regression was used to identify predictors of Applied Innovation. Qualitative data were analyzed through thematic categorization. Statistical significance was set at $p \leq 0.05$.

3. Results

The results are presented according to the five analytical dimensions defined in the methodological framework, integrating both quantitative and qualitative indicators.

3.1. Dimension 1. Educational and training impacts

The educational impact derived from the international cooperation between the Global Sustainable ICT, the NGO Minuto Verde-Quercus Angola, and the IGS was operationalized and assessed through three main constructs, measured using a five-point Likert scale: sustainability competencies, ecological citizenship, and applied innovation (Table 2).

Table 2. Descriptive statistics of the three competencies

Variable	Mean	SD	95% CI (Lower)	95% CI (Upper)
Sustainability	4.32	0.58	4.26	4.38
Ecological citizenship	4.28	0.55	4.22	4.34
Applied innovation	4.11	0.63	4.04	4.19

The results indicate consistently high levels across the three competencies assessed: sustainability (M = 4.32), ecological citizenship (M = 4.28), and applied innovation (M = 4.11). The 95% confidence intervals (95% CI) exhibited narrow ranges, indicating low sample variability and high precision of the estimates. Taken together, these findings suggest that the training program exerted a positive and homogeneous impact on the development of key competencies.

A one-way Analysis of Variance (ANOVA) was conducted to examine differences in the perception of training impacts among the five population strata (Table 3).

Table 3. ANOVA of competencies by strata

Variable	F	df	p
Sustainability	6.23	4, 222	< 0.001
Applied innovation	4.57	4, 222	0.002
Ecological citizenship	5.01	4, 222	0.001

The three formative competencies exhibited statistically significant differences across population strata ($p \leq 0.002$ in all cases). The results indicated that the perceived improvement in the three competencies was led by undergraduate students, who reported the highest mean scores. In contrast, administrative staff and community actors recorded the lowest values, confirming that the program's impact is differential and associated with the participants' level of engagement.

To complement the analysis, Student's *t*-test was employed to investigate the existence of statistically significant differences in the perception of competencies between men and women. The results of this gender-based comparison are presented in Table 4.

Table 4. Results of the gender comparison analysis (Student's *t*-test)

Variable	*t*	df	*p*
Sustainability	1.56	225	0.12
Ecological citizenship	2.02	225	0.045
Applied Innovation	1.11	225	0.27

The test revealed no significant differences in the perception of sustainability ($p = 0.12$) or applied innovation ($p = 0.27$). However, a statistically significant difference was observed for ecological citizenship ($t = 2.02$, df = 225, $p = 0.045$). This finding indicates that women reported a higher perceived development of ecological citizenship compared to men.

To investigate the linear relationship between the level of participation in cooperation activities and the development of competencies, Pearson's correlation analysis was conducted (Table 5).

Table 5. Pearson correlations between competencies and effective participation

Pair of variables	*r*	*p*
Sustainability vs. ecological citizenship	0.62	< 0.001
Sustainability vs. innovation	0.51	< 0.001
Ecological citizenship vs. innovation	0.48	< 0.001
Participation vs. sustainability	0.48	< 0.001
Participation vs. ecological citizenship	0.42	< 0.001

All bivariate correlations were positive and highly significant ($p < 0.001$). The strongest correlation was observed between sustainability and ecological citizenship ($r = 0.62$), followed by sustainability and innovation ($r = 0.51$). Regarding engagement, effective participation showed a significant association with sustainability ($r = 0.48$) and ecological citizenship ($r = 0.42$). These results suggest that the competencies are strongly interrelated and that direct involvement in cooperation actions is a predictive factor in the development of both ecological skills.

To complement the correlation analyses and to investigate the predictive power of ecological competencies on applied innovation, a linear regression analysis was conducted (Table 6).

Table 6. Regression predicting applied innovation

Variable	β	*p*
Ecological citizenship	0.42	< 0.001
Sustainability	0.27	0.012

The final regression model was statistically significant, explaining 23% of the variance in applied innovation (adjusted $R^2 = 0.23$). Both variables included in the model were significant predictors: ecological citizenship emerged as the strongest predictor ($\beta = 0.42$, $p < 0.001$), followed by sustainability ($\beta = 0.27$, $p = 0.012$). These findings indicate that mastery of ecological competencies is a robust predictive factor for the development of applied innovation capacity.

3.2. Dimension 2. Institutional and organizational dimension

The second dimension, focused on the institutional and organizational impacts of cooperation, was assessed through the strengthening of internal policies, interdepartmental coordination, and project management capacity. To investigate the association between institutional participation and sustainability competency, the chi-square (x^2) test was applied (Table 7).

Table 7. Association between institutional participation and sustainability

Test	Value	df	*p*	Cramer's V
x^2	19.6	4	0.003	0.21

The x^2 test demonstrated a statistically significant association between institutional participation and sustainability competency (x^2 = 19.6, df = 4, p = 0.003). Cramer's V value of 0.21 indicates a moderate effect size. Additionally, qualitative data revealed that this association reflects improvements in strategic planning and interdepartmental articulation.

3.3. Dimension 3. Environmental impacts and ecological responsibility

The assessment of ecological responsibility impacts showed that 83% of participants adopted new environmental practices after the intervention. Analysis of Variance (ANOVA) revealed that the perception of ecological citizenship varied significantly across population strata ($F(4, 222) = 5.01$, $p = 0.001$), with the highest means reported by undergraduate students. Furthermore, women exhibited a significantly higher perception of ecological citizenship ($t = 2.02$, df = 225, $p = 0.045$). Finally, ecological citizenship was positively correlated with community participation ($r = 0.44$, $p < 0.001$), indicating that active engagement is a strong predictor of ecological behavior.

3.4. Dimension 4. Sociocultural and community impacts

The sociocultural and community dimension, which evaluates the rapprochement between the internal community and external social actors, proved to be central to the cooperation project (Table 8).

Table 8. Association between sociocultural participation and ecological citizenship

Test	Value	df	*p*	Cramer's V
x^2	22.3	4	0.002	0.24

The x^2 test showed a statistically significant association between sociocultural participation and ecological citizenship (x^2 = 22.3, df = 4, p = 0.002). Cramer's V value of 0.24 indicates a moderate effect size. These findings suggest that active involvement in community actions is relevant to strengthening ecological citizenship within the territory.

3.5. Dimension 5. Impacts on innovation, scientific production, and knowledge dissemination

To quantify the contribution of participation in research activities to the growth of

scientific production, a linear regression analysis was applied. Table 9 presents the coefficients of the model predicting the increase in academic output.

Table 9. Regression predicting growth in scientific production

3.6. Variable	β	*p*
Participation in research	0.31	< 0.01

The regression model was statistically significant, explaining 17% of the total variance in the growth of scientific production (R^2 = 0.17). The variable participation in research was a significant predictor (β = 0.31, $p < 0.01$), indicating that active involvement in research projects consistently increases academic output.

4. Discussion

The findings of this study demonstrate a high and positive formative impact across the three key competencies (sustainability, ecological citizenship, and applied innovation), with mean scores consistently above *M* = 4.10. This result corroborates UNESCO's (2023) view that higher education institutions (HEIs) act as drivers of "knowledge-driven action" for global sustainability. In the Angolan and broader African context, where climatic and environmental challenges are particularly acute, the capacity to develop these competencies is vital for resilience and ecological transition (Leal Filho et al., 2024). The curricular alignment of the cooperation initiative with competency-based training reflects what Ull Solís (2015) and Annelin and Boström (2024) advocate: sustainability should be integrated as a structuring axis to support competency development.

The analysis revealed that the impact of the cooperation was differential, with undergraduate students reporting the greatest improvements in competencies, while administrative staff and community actors presented lower values. This pattern suggests that the intervention design—focused on curricular activities (academic and scientific projects, Scientific Conferences)—primarily benefited the academic audience most directly involved in coursework and research (Agbogbo et al., 2023a; Agbogbo et al., 2023b). To optimise the engagement of external stakeholders and administrative staff, whose participation is crucial for institutional transition, future interventions should diversify the typology of activities, prioritising active engagement and agency of the different groups in the transition to sustainability (Fischer & Newig, 2016).

The finding that women reported a significantly higher perception of ecological citizenship development (p = 0.045) adds an important gender dimension to the socio-environmental impact. This outcome may be related to cultural factors or to a greater female propensity for responsible behaviour and participation in community activities—a pattern that, although requiring further investigation, has been observed in studies on conservation and development in contexts of developing countries (Mbanze et al., 2020). This result reinforces the importance of designing cooperation programmes that recognise and capitalise on the role of women as catalytic agents of ecological awareness and transition within local communities.

One of the most salient results is that active and effective involvement in the cooperation project activities was strongly and positively correlated with competency development and with an increase in applied academic and scientific projects. The correlation of r = 0.51 with applied projects, in particular, underscores that participation functions as a driver of scientific and innovative dynamism (Mena & Mena, 2022). This mechanism for fostering innovation aligns with

the international trend that views innovation as a socially distributed phenomenon, strongly enhanced by collaborative networks and participation in applied research systems (Howoldt, 2024).

Evidence that mastery of ecological citizenship and sustainability is a robust predictor of applied innovation (adjusted R^2 = 0.23) is crucial for the strategic framing of the IGS and other African HEIs. This finding supports UNESCO's (2025) thesis within the Campus Africa programme, which links excellence in higher education and innovation capacity to the continent's sustainable development. It demonstrates that the capacity to innovate—essential for addressing local challenges (e.g., waste management, mobility)—is not merely technical, but is intrinsically connected to ecological awareness and social responsibility, aligning with the need for a sustainability transition framework (Geels, 2024; Petrović, 2024).

Finally, the significant, albeit moderate, association between institutional participation and the strengthening of sustainability reflects the early stages of an organisational transition. Cramér's *V* values of 0.21 and 0.24 in the institutional and sociocultural dimensions indicate that impacts are measurable, yet that the change process is gradual, affecting organisational culture and internal policies. This conclusion is particularly important, as the consolidation of sustainable practices in higher education requires systemic transformation, supported by robust and coherent internal policies that extend beyond isolated activities (Yan et al., 2022). The cooperation initiative demonstrated that it established the operational frameworks necessary for the institutionalisation of practices leading towards a more sustainable future, in line with the vision of the World Commission on Environment and Development (WCED, 1987).

5. Conclusions

The present study achieved its central objective by demonstrating that international cooperation among ICT Sustentável Global, the NGO Minuto Verde, and the IGS generated significant and measurable impacts on the construction and consolidation of an institutional culture of sustainability and innovation. The articulation between local and international actors proved to be an effective model for competency development (sustainability, ecological citizenship, and applied innovation) in Angola, with the formative impact being consistently positive. Active participant engagement emerged as the main driving mechanism, acting as a significant predictor of increased scientific output and the adoption of responsible ecological practices. The success of the partnership lies in its ability to transcend the purely academic sphere, establishing a platform for local ecological transition and for strengthening the management and strategic vision of the IGS.

Despite the success of the cooperation among the three institutions in promoting a culture of sustainability and innovation, the study presents some limitations that should be considered. The cross-sectional research design, although appropriate for measuring post-intervention impact perceptions, does not allow for the establishment of definitive causal relationships, nor did it capture the evolution of competencies over time. Furthermore, the magnitude of impact in the institutional and organisational dimension (moderate association) suggests that policy and cultural transformation requires a longer maturation period than that covered by the cooperation initiative. Finally, the overrepresentation of undergraduate students in the sample limits the generalisability of the findings to other population strata, particularly community actors. Future research should adopt longitudinal designs and further explore the long-term sustainability of practices.

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