




# Green campus initiatives and strategies for sustainability in higher education



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The study on Green Campus Initiatives (GCIs) at Durban University of Technology (DUT) investigates the mechanisms for stakeholder engagement, plant protection and resource conservation, offering recommendations to enhance sustainability. The growing global emphasis on sustainability and environmental preservation motivates this research, aiming to elucidate GCI's role in reducing environmental impacts, raising awareness and embedding ecological consciousness in higher education. Employing a qualitative approach and evidence-based research, we explore and analyse the strategies employed by DUT to promote sustainability, focussing on stakeholder engagement, education and resource conservation. We reveal the successes and challenges faced in implementing GCIs, emphasising the importance of formalised environmental policies and sustainability education. The findings highlight DUT's effective GCIs implementation, particularly in stakeholder engagement and educational initiatives. We suggest that higher education institutions (HEIs) should engage in sustainability evaluation programmes, formalise environmental policies and enhance sustainability education to strengthen GCIs implementations, align with global standards and cultivate environmentally conscious graduates.

**Contribution:** This article contributes to the body of research on sustainability in higher education by providing a comprehensive analysis of GCIs at DUT. It offers insights for policymakers, academic practitioners and stakeholders, emphasising the need for formalised environmental policies and enhanced sustainability education. In addition, it proposes practical recommendations for HEIs to improve GCIs implementation and environmental stewardship.

**Keywords:** green campus initiatives; sustainability; stakeholder engagement; resource conservation; environmental policies; higher education; sustainability education; ecological consciousness; environmental stewardship.

## Introduction

In recent years, the global discourse on environmental protection and sustainability has gained unprecedented momentum, capturing the attention of societies and institutions worldwide (Rwelamila & Purushottam 2015). Universities, as hubs of knowledge and innovation, have recognised the importance of environmental preservation. According to Aleixo, Leal and Azeiteiro (2018), institutions of higher learning are crucial to the cause of sustainability. They can achieve this by aligning their operations with Sustainable Development Goals (SDGs). Green Campus Initiatives (GCIs) were introduced across universities to facilitate sustainability within their campuses and beyond. Green Campus Initiative has emerged as a strategy to minimise adverse environmental impacts, foster public awareness about sustainability and integrate principles of ecological consciousness (Bokolo 2021).

Despite the endorsement of GCI, there are limited traceable interventions that facilitate sustainability within universities. Renowned researchers such as Ntoyakhe (2018) and Mafongosi, Awuzie and Talukhaba (2018) posited that GCI was endorsed by the United Nations during the Sustainable Development Summit held in Johannesburg in 2002 as a response strategy to global sustainability. Consequently, higher education institutions (HEIs) assume a catalytic function in fostering societal involvement as partners in tackling sustainability (Barlett & Chase 2013; Caeiro et al. 2013; Lehmann et al. 2009).

The landscape of higher education is experiencing an influx of students, leading to heightened energy consumption and inefficiencies in campus operations (Tan et al. 2014; Tiyyarattanachai & Hollmann 2016). Campus activities contribute to substantial environmental footprints (Bukhary, Batista & Ahmad 2019; Yanthi et al. 2018). Understanding the different programmes and important

contributors working to promote sustainable development within universities, we can better grasp how significant and challenging this task is (Bulunga & Thondhlana 2018; Marinho, Gonçalves & Kiperstok 2013).

The objectives of this study are to investigate the mechanisms for promoting stakeholder engagement, plant protection and resource conservation, within HEIs and to recommend current strategies for improvement. To attain these objectives, a qualitative methodology was employed. Furthermore, this article scrutinises the contribution of the GCI to the advancement of SDG 4 (quality education), SDG 12 (responsible consumption and production), SDG 13 (climate action) and SDG 17 (partnerships for sustainable development), offering insights pertinent to policymakers, academic professionals, and stakeholders engaged in sustainable development and environmental stewardship within academic spheres.

## Literature review

The realm of sustainability literature encompasses a wide range of topics. To provide a focussed and contextual backdrop for the present article, the following sections undertake a review and discussion of pertinent concepts. Specifically, the ensuing sections delve into the literature on GCI and sustainable development, the role of leadership on successful implementation of GCI, and sustainability in higher institutions.

### Sustainability in higher institutions

The concept of sustainable development, as articulated by the World Commission on Environment and Development (WCED 1987) entails the capacity to fulfil current needs without jeopardising the ability of future generations to satisfy their own needs. A pivotal component of this paradigm is sustainable consumption, which prioritises the utilisation of goods and services that fulfil essential needs while minimising natural resource depletion and mitigating waste, thereby contributing to the attainment of SDGs 12 and 13 (Tung et al. 2019). Engaging in sustainable practices involves active participation in endeavours such as reducing water, materials and energy consumption, as well as supporting environmentally responsible businesses. Scholars such as Mafongosi et al. (2018) and Aleixo et al. (2018) have identified various components of sustainable institutions, encompassing energy management, water management, landscape management, biodiversity management, waste management, building management and responsible purchasing.

Amaral, Martins and Gouveia (2015) posit that resource scarcity is not an insurmountable challenge, as human adaptability and innovation can address such issues. Genta et al. (2019) advocate for higher institution of learning to adopt educational strategies aimed at resource conservation, shedding light on the substantial energy and water consumption associated with student activities. Fischetti

(2013) proposes a transition to renewable energy sources through educational initiatives, research and innovation. Higher education institutions emerge as pivotal stakeholders in advancing society's pursuit of sustainable development, with universities committing to sustainability through international declarations and offering environmental education and research opportunities (Baker-Shelley, Van Zeijl-Rozema & Martens 2017). The imperative of proper education, research and the active involvement of university and local community stakeholders is accentuated as essential for constructing a sustainable future (Dumitriu 2017).

The literature reviewed highlighted the multifaceted nature of sustainability, with a focus on the role of GCIs in promoting sustainable practices within HEIs. The challenges posed by global environmental problems necessitate a comprehensive approach, involving universities, governments and individuals. As HEIs emerge as key contributors to sustainability, their commitment to environmental education, research and collaboration with local communities becomes paramount for building a sustainable future.

### Green campus initiative and sustainable development

The advent of the GCI in South Africa in 2012 marked a significant milestone in the advancement of sustainable practices within the academic sphere. Chankseliani and McCowan (2020) assert that GCI activities in HEIs are fundamentally guided by SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 17 (Partnerships for Sustainable Development). These goals furnish a comprehensive framework for institutions to implement endeavours that promote environmental stewardship, social responsibility and economic viability. Higher education institutions assume a pivotal role in advancing these objectives by integrating sustainable practices into their operations, curriculum development and community engagement endeavours. For example, institutions are increasingly embracing renewable energy sources, advocating for energy efficiency measures and incentivising sustainable transportation options to mitigate their carbon footprint (Hopkinson, Hughes & Layer 2008).

A study conducted by Mafongosi et al. (2018) delved into the awareness and perceptions of stakeholders, revealing a discernible gap between current efforts and the desired level of environmental sustainability. In a parallel exploration, Aleixo et al. (2018) conducted an exploratory study focussing on Portuguese Public HEIs. Employing a qualitative approach involving semi-structured interviews and content analysis, they aimed to elucidate the perspectives of key stakeholders, including leaders, faculty, staff, students and external contributors. Their findings underscored a notable lack of familiarity among stakeholders with the concept of sustainable development in HEIs. In addition, financial constraints stemming from reduced funding for higher education emerged as a significant impediment to the realisation of greening initiatives (Moyo & McKenna 2021).

The collective insights from Biancordi et al. (2023), Mariani et al. (2022), and the UNDP (2023) emphasise the pressing need for concerted efforts and financial support to bridge the awareness and implementation gaps in combating climate change within HEIs. Ribeiro et al. (2021) posited that HEIs are increasingly adopting GCIs as a strategic approach to advance actions towards environmental sustainability. Mafongosi et al. (2018) asserted that these initiatives primarily focus on the implementation of sustainable infrastructure, the mitigation of environmental impacts and economic costs, and the cultivation of student awareness concerning the principles of sustainable development. The primary goal of adopting GCIs in universities is to implement programmes and projects that prioritise minimising environmental impact and promoting sustainable practices among students and staff (Al-Dmour 2023).

### **Role of leadership in the successful implementation of green campus initiatives**

Leadership plays a critical role in the successful implementation of GCIs. Ribeiro et al. (2021) highlighted the importance of university administrators and decision-makers in fostering an environment that cultivates essential skills among students to effectively contribute to GCIs. The study also emphasised the impediments to comprehensive implementation of GCIs, such as limited student engagement and inadequate communication of sustainable development initiatives.

Implementing GCIs in universities faces a multitude of challenges, as highlighted by Tshivhase and Bisschaff (2023) and supported by various scholarly works. These challenges include limited student engagement with sustainable development information, infrequent integration of sustainability actions in classrooms, reduced emphasis on sustainability in social contexts, inadequate communication of sustainable development initiatives by HEIs, a lack of student awareness regarding green initiative projects, lower participation of males in sustainability practices and older students perceiving themselves as having a greater understanding of sustainable development. These barriers intersect with broader obstacles such as financial constraints, organisational hurdles, cognitive biases and informational deficiencies. Financial barriers, as discussed by Wills (2020) and Purwandani and Michaud (2021), revolve around debates over initial capital costs and access to funding, impeding investment in sustainable practices. Organisational barriers, elucidated by Ali et al. (2021) and Anwar et al. (2020), underscore the importance of strong leadership, clear sustainability targets and effective collaboration among stakeholders for successful implementation. Cognitive limitations, as articulated by Ghadge et al. (2021) and Abdel-Baset, Chang and Gamal (2019), manifest through bounded rationality and resistance to change, hindering decision-making processes, while imperfect information exacerbates risks associated with green investments. In addition, the presence of split incentives, observed by Agyekum et al. (2020) discourages departments from investing in green efficiency

measures when they do not directly benefit. These challenges collectively highlight the complexity of promoting sustainability in university campuses and stress the necessity of comprehensive strategies to overcome them.

Rwelamila and Purushottam (2015) emphasise the multifaceted nature of the GCI, describing it as a programme composed of numerous projects. They advocate for universities to establish a conducive internal environment to ensure the success of GCI projects, incorporating various aspects into their activities (Karimi, Naini & Sadjadi 2021; Marpa 2020; Vasileva et al. 2021) and employing different approaches. According to Tshivhase and Bisschaff (2023), GCI projects include environmental awareness campaigns aimed at transforming consumption patterns and the development of green buildings to improve energy and resource efficiency. Mafongosi et al. (2018) highlight the importance of continuous improvement in the learning curriculum to achieve successful GCI implementation, along with raising awareness through greening projects and small activities.

Effective and proactive leadership emerges as a critical dimension for sustainability in HEIs. Freidenfelds, Kalnins and Gusca (2018), Nurdiana (2017) and Guerra et al. (2018) assert that leadership plays a pivotal role in fostering harmony between education, buildings and/or environment and management at HEIs. Ribeiro et al. (2021) emphasise the application of Talloires sustainable development guidelines, covering aspects such as environmental sustainability education, green technologies, ecosystem preservation, transdisciplinary studies, cooperation with other universities and development of skills and awareness.

## **Research methods and design**

In this investigation, we employed a qualitative research methodology to explore GCIs at Durban University of Technology (DUT). This approach aligns with methodologies used by Shange (2021), Shange, Lawa and Dlamini (2024), Aleixo et al. (2018) and Bokolo (2021) in their studies on GCIs within HEIs. The interpretivist paradigm guided our research, aiming to understand the subjective experiences and perspectives of participants regarding GCIs.

Non-probability purposive sampling was used to select participants meeting specific inclusion criteria, including senior registered students at DUT, members of the GCI and employees of the student housing department at the same university. This sampling method was crucial for effective data triangulation and ensuring a thorough comprehension of GCI implementations fostering sustainability development at DUT. Our study comprised of 61 individuals from the 2020 DUT GCI annual database, with a population of 150 GCI members. Among the participants, 2 were GCI practitioners, 1 was a Student Residence Life Officer, and 58 were GCI members. Recruitment occurred through email communication facilitated by the leadership structures of the university's department of student housing.

Data collection primarily involved remote interviews conducted using Microsoft Teams, which is consistent with virtual data collection methods used in previous studies carried out by Dellorco et al. (2021), Shange (2021), Shange et al. (2024). Ethical considerations were paramount; all participants provided informed consent before participation, and the study adhered to ethical guidelines for virtual research, ensuring confidentiality and voluntary participation.

NVivo 12 was employed for data analysis, utilising cluster analysis, diagrams and word clouds to depict key themes, response concentration, and higher-frequency words. These analytical methods facilitated a comprehensive understanding of stakeholder engagement, plant protection and resource conservation mechanisms at DUT.

### Ethical considerations

Ethical approval to conduct this study was obtained from the Durban University of Technology Institutional Research Ethics Committee (No. IREC 056/20).

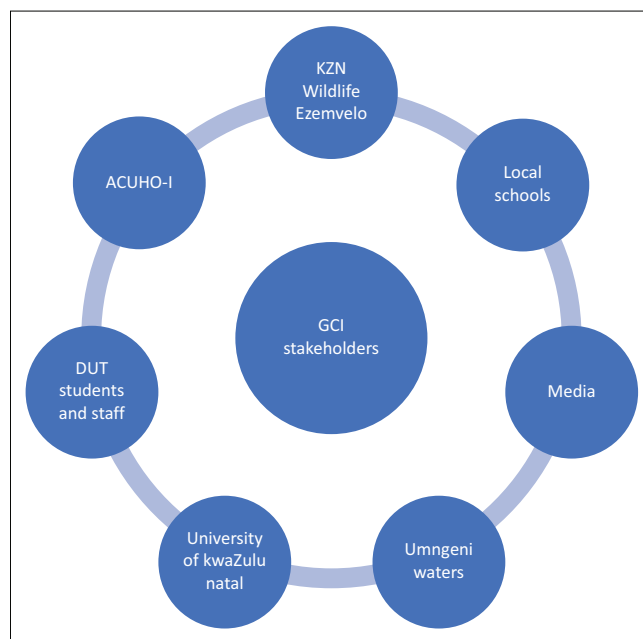
## Results

In the endeavour to comprehend the intricacies of GCIs at DUT, the research outcomes illuminate essential dimensions encompassing stakeholder engagement, measures for plant protection and initiatives aimed at water and electricity conservation. These findings afford a comprehensive perspective on the role of GCI as a catalyst for fostering sustainability within the university milieu. The interrelated nature of various initiatives unveiled in the results emphasises the advantages of adopting a holistic approach to conservation and operating within a cohesive global framework.

### Stakeholder engagement measures

As depicted in Figure 1, GCI's success at DUT relies heavily on the participation of both internal stakeholders (students and staff) and external stakeholders (surrounding schools, media, other universities, higher education associations, KZN Wildlife Ezemvelo and Umngeni Waters). The essence of the stakeholders depicted correlates with those mentioned in studies conducted by Christie et al. (2015), Mafongosi et al. (2018), Barth et al. (2012) when they mentioned that all stakeholders are expected to provide exemplary leadership in this endeavour, through adoption and implementation of various facets of sustainable development in their core and non-core activities.

Annual summits have been held to capacitate stakeholders, fostering collaboration and understanding of sustainability challenges and goals. This approach resonates with findings from Too and Bajracharya (2015), Jones et al. (2013), Sammalisto, Sundstrom and Holm (2015) and Figueredo and Tsarenko (2013), which underscore the significance of stakeholder participation in sustainability efforts within HEIs.



Source: Shange, H.S., 2021, *The role of Green Campus Initiative (GCI) as integral part of environmental and sustainable resources utilization: A case study of Durban University of Technology*, viewed 23 December 2023, from [https://openscholar.dut.ac.za/bitstream/10321/3945/3/HS%20Shange%20dissertation%20in%20PDF\\_Redacted.pdf](https://openscholar.dut.ac.za/bitstream/10321/3945/3/HS%20Shange%20dissertation%20in%20PDF_Redacted.pdf)  
GCI, green campus initiative; DUT, Durban University of Technology.

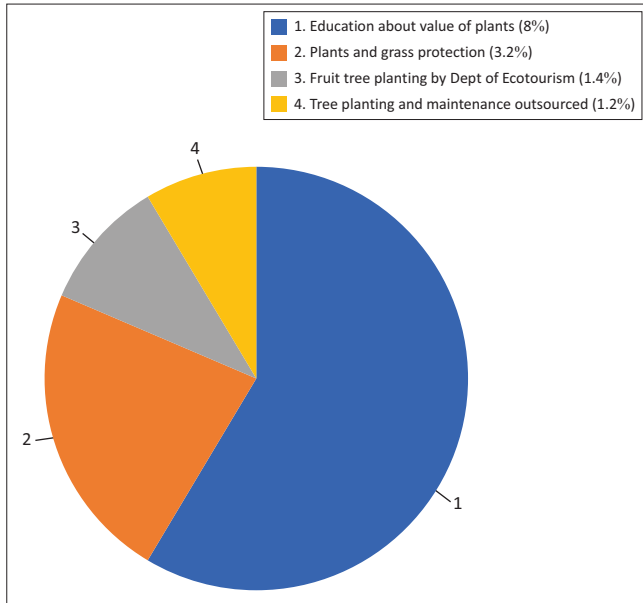
**FIGURE 1:** Durban University of Technology's green campus initiatives stakeholders.

### Plant protection initiatives

The GCI at DUT has significantly contributed to plant protection efforts. The primary mechanisms include educating students about the value of plants, which accounted for 59% of the initiatives. This educational focus ensures that students understand the importance of flora conservation. Additional strategies included plant and grass protection (23%), fruit tree planting (10%), and outsourced tree planting and maintenance (9%). These efforts align with principles of preservation and conservation, emphasising the role of education in fostering an environmentally conscious community. The findings affirm the substantial role of education in plant protection at DUT. This agrees with studies conducted by Oyama, Pasquier and Mojica (2018) and Sundarapandian et al. (2014), which suggest that using native plants in campus landscaping contributes not only to CO<sub>2</sub> capture but also to the conservation of local biodiversity. Figure 2 presents data on the relationship between GCIs and plant protection at DUT.

### Water and electricity conservation initiatives

Durban University of Technology has implemented several GCIs to conserve water and electricity. Key initiatives include installing water tanks and meter boxes to monitor usage and organising competitions and educational programmes to promote conservation. Noteworthy initiatives include 'power-hour', 'dark hour' and 'shower hour', which encourage reduced usage of resources. For instance, 'power-hour' and 'dark hour' involve turning off all electrical devices for an hour, while 'shower hour' limits the time students can spend in the shower to reduce water and



Source: Shange, H.S., 2021, *The role of Green Campus Initiative (GCI) as integral part of environmental and sustainable resources utilization: A case study of Durban University of Technology*, viewed 23 December 2023, from [https://openscholar.dut.ac.za/bitstream/10321/3945/3/HS%20Shange%20dissertation%20in%20PDF\\_Redacted.pdf](https://openscholar.dut.ac.za/bitstream/10321/3945/3/HS%20Shange%20dissertation%20in%20PDF_Redacted.pdf)

GCI, green campus initiatives.

**FIGURE 2:** Green campus initiatives and plant protection at Durban University of Technology.

electricity consumption. These initiatives are supported by a water monitoring system and the creation of 'green police' to enforce conservation practices Figure 3 illustrates various initiatives undertaken for water and electricity conservation at DUT.

### Partnership with other universities

Durban University of Technology (DUT) actively engages in joint awareness campaigns on environmental sustainability with other universities. These initiatives raise awareness among students, faculty, and staff about environmental issues and sustainable practices through workshops, seminars, and educational events. By informing and empowering individuals, DUT fosters a culture of environmental responsibility within participating institutions.

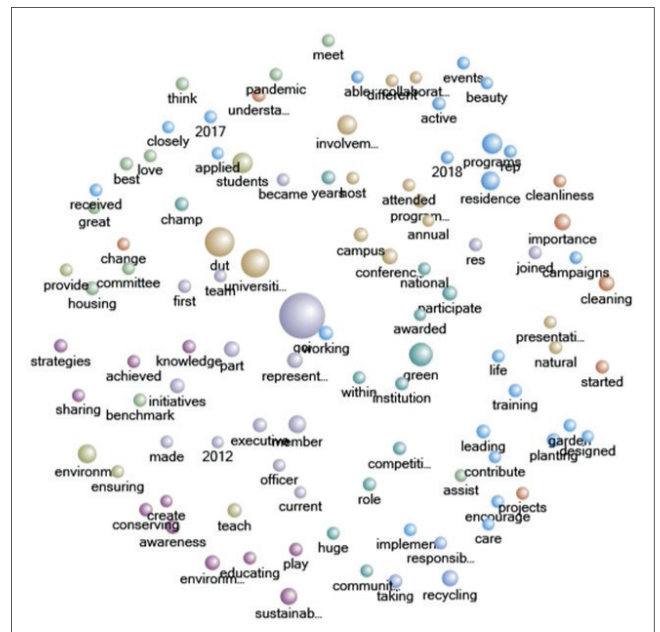
Durban University of Technology also collaborates with universities to enhance the impact of its GCIs through shared best practices, GCI competitions, and joint environmental education projects. These partnerships expand DUT's reach, facilitate the exchange of ideas, and strengthen sustainability initiatives, ultimately advancing sustainable development goals (SDGs).

Figure 4 illustrates the structure and effectiveness of these collaborations, highlighting their role in promoting sustainability by enabling knowledge-sharing and resource pooling. DUT's collaborative approach aligns with SDG 17 – Partnership for the Goals. By hosting GCI conferences, training students on sustainability, providing recycling bins, and organising sustainability competitions, DUT exemplifies the importance of partnerships in



Source: Shange, H.S., 2021, *The role of Green Campus Initiative (GCI) as integral part of environmental and sustainable resources utilization: A case study of Durban University of Technology*, viewed 23 December 2023, from [https://openscholar.dut.ac.za/bitstream/10321/3945/3/HS%20Shange%20dissertation%20in%20PDF\\_Redacted.pdf](https://openscholar.dut.ac.za/bitstream/10321/3945/3/HS%20Shange%20dissertation%20in%20PDF_Redacted.pdf)

**FIGURE 3:** Water and electricity saving through green campus initiatives.



Source: Shange, H.S., 2021, *The role of Green Campus Initiative (GCI) as integral part of environmental and sustainable resources utilization: A case study of Durban University of Technology*, viewed 23 December 2023, from [https://openscholar.dut.ac.za/bitstream/10321/3945/3/HS%20Shange%20dissertation%20in%20PDF\\_Redacted.pdf](https://openscholar.dut.ac.za/bitstream/10321/3945/3/HS%20Shange%20dissertation%20in%20PDF_Redacted.pdf)

**FIGURE 4:** Partnership with other universities.

achieving sustainable development. These collaborations contribute to fostering global sustainability efforts on a broader scale.

### Green campus initiatives leadership and their contribution

The leadership of DUT's GCIs plays a pivotal role in driving these initiatives. They have spearheaded the implementation of various conservation measures, organised educational programmes and facilitated partnerships with other universities. Their efforts have been instrumental in raising awareness and promoting sustainable practices within and beyond the university community. The GCI leadership's commitment to environmental sustainability has positioned DUT as a leader in this area, inspiring other institutions to follow suit.

## Discussion

This study investigates the GCIs at DUT, focussing on mechanisms for stakeholder engagement, plant protection and resource conservation, and provides recommendations for enhancing sustainability. The primary research purpose was to explore GCIs at DUT, analysing strategies for promoting sustainability in higher education and contributing insights into GCIs' multifaceted role in environmental stewardship. By adopting a qualitative approach, the study successfully achieved its objectives, as evidenced by several key findings.

One of the primary findings highlights the crucial role of stakeholder engagement in the GCIs at DUT. The initiative's inclusive strategy involves both internal and external stakeholders, demonstrating a comprehensive approach that acknowledges the interconnectedness of the university with its community and environmental entities. These findings resonate with the work of Baker-Shelley et al. (2017) underscoring the essential role of stakeholders in advancing sustainable development. Furthermore, the study indicates that universities, including DUT, commit to sustainability through international declarations, environmental education and collaborative efforts.

Another noteworthy discovery pertains to the pronounced emphasis on education within the GCIs. The initiative assumes a pivotal role in inculcating a sense of accountability and consciousness among students regarding the significance of plant life, thereby aligning with overarching sustainability objectives. This educational focus contributes to the triple bottom line of economic, social and environmental equilibrium. These findings align with Rwelamila and Purushottam's (2015) assertions regarding the multifaceted character of GCI, encompassing diverse initiatives aimed at sustainability. Moreover, the integration of sustainability into educational curricula by DUT fosters an environmentally aware mindset among students and faculty, thus advancing SDG 4 (Chankseliani & McCowan 2020; Hopkinson et al. 2008).

The holistic approach adopted by DUT towards water and electricity conservation exemplifies the GCI's dedication to efficiently managing resource utilisation. Concrete measures, such as the installation of water tanks and meter boxes, underscore a proactive approach aimed at monitoring and regulating resource consumption. Complementary educational endeavours, including competitions and advocacy for sustainable technologies, further accentuate a comprehensive strategy integrating infrastructure development, awareness campaigns and active student participation. This strategic alignment resonates with the views expressed by Fischetti (2013), who advocates for a shift towards renewable energy sources through educational outreach, research initiatives and technological innovation. Moreover, the findings concerning water and electricity conservation echo the observations made by Kumari and Singh (2017), who documented the implementation of water conservation strategies on various

campuses, encompassing the adoption of low-flow water fixtures, waterless urinals and automated sink sensors. Beyond these initiatives, fostering responsible consumption habits and reducing waste generation emerge as pivotal facets of GCI efforts. These endeavours are geared towards minimising the depletion of natural resources and curbing waste production, thereby directly contributing to the objectives outlined in SDGs 12 and 13 (Chankseliani & McCowan 2020).

The role of DUT as an advocate for sustainability among other universities signifies effective and proactive leadership, showcasing a commitment to promoting environmental awareness and collaborative efforts. Various activities, including competitions, events and collaborations, exemplify a proactive approach to benchmarking and sharing best practices in sustainability. These findings align with the work of Freidenfelds et al. (2018), Nurdiana (2017) and Guerra et al. (2018) emphasising the critical role of effective leadership in fostering sustainability in HEIs.

The research findings provide a nuanced understanding of how GCI operates at DUT, showcasing a multifaceted approach to sustainability. The initiatives discussed emphasise the importance of stakeholder engagement, education and collaborative efforts with other universities. This comprehensive view contributes to the broader discourse on sustainable practices within HEIs, positioning GCI as a transformative force in fostering environmental stewardship and responsible resource management.

The results of this study underscore the importance of a holistic and collaborative approach to environmental sustainability within HEIs. The plant protection initiatives at DUT highlight the role of education in promoting environmental stewardship among students. By fostering an understanding of the value of plants and implementing tangible conservation measures, DUT ensures the preservation of its campus flora for future generations.

The water and electricity conservation initiatives demonstrate how targeted programmes can effectively reduce resource consumption. The success of 'power-hour', 'dark hour', and 'shower hour' initiatives illustrate the potential of behaviour modification strategies in achieving sustainability goals. Furthermore, the implementation of monitoring systems and enforcement mechanisms, such as the 'green police', ensures sustained compliance and effectiveness of these initiatives.

Partnerships with other universities have amplified the impact of DUT's GCI, facilitating the exchange of best practices and fostering a collective commitment to sustainability. These collaborations enhance the reach and effectiveness of individual initiatives, promoting a culture of environmental consciousness across institutions.

Finally, the leadership of DUT's GCI has been crucial in driving these initiatives forward. Their vision and dedication have not only advanced the university's sustainability

agenda but also inspired similar efforts in other institutions. This leadership model underscores the importance of committed and proactive governance in achieving long-term sustainability goals.

## Recommendations

Based on the comprehensive analysis conducted in this study, several expert recommendations can be proposed to further augment the efficacy of the GCIs at DUT and other HEIs.

Primarily, it is imperative to sustain and broaden stakeholder engagement endeavours. The proven effectiveness of the inclusive approach involving both internal and external stakeholders underscores the importance of fostering a holistic approach to sustainability. Strengthening these initiatives through structured and frequent interactions, such as workshops, seminars and collaborative projects with community and environmental entities, can deepen the impact and ensure a broader commitment to the GCI's objectives.

Moreover, the emphasis on education within the GCI framework should be reinforced. Educational programmes designed to instil a sense of responsibility and awareness among students are paramount for long-term sustainability. Integrating sustainability topics more comprehensively into the curriculum across various disciplines can bolster this effort. In addition, practical hands-on projects related to plant protection, resource conservation and other sustainability practices can provide students with experiential learning opportunities that solidify theoretical knowledge.

Regarding water and electricity conservation, DUT should persist in investing in infrastructure conducive to sustainable resource management. The positive outcomes observed from the installation of water tanks, meter boxes and other monitoring devices underscore the efficacy of such measures. Expanding these initiatives to incorporate advanced technologies such as smart grids, renewable energy sources and automated systems for resource management can further curtail consumption and bolster efficiency. Moreover, ongoing educational campaigns and competitions aimed at fostering behavioural change among students and staff should be perpetuated and innovated to sustain community engagement and commitment to conservation endeavours.

Furthermore, fostering and fortifying partnerships with other universities emerge as a critical recommendation. The substantial benefits derived from these collaborations, including the sharing of best practices and the cultivation of a culture of sustainability, underscore their significance. Establishing formal networks or consortia focussed on sustainability in higher education can institutionalise these partnerships, providing a platform for continuous exchange of ideas, joint initiatives and mutual support. Such networks can also advocate for policy changes at higher levels, further embedding sustainability into the educational framework.

Lastly, robust and proactive leadership is indispensable for the success of the GCI. The pivotal role played by leadership at DUT in propelling the initiative forward underscores its importance. To build upon this success, it is recommended that leadership training programmes tailored to sustainability be developed. These programmes can equip current and future leaders with the skills and knowledge necessary to effectively champion sustainability initiatives. Recognising and rewarding leadership efforts in sustainability can further incentivise continuous improvement and innovation in this domain.

## Limitation and future studies

The applicability of the results to other HEIs and GCIs may be constrained by the study's sample size. The utilisation of qualitative techniques, such as interviews, in the study might have limited its capacity to present a comprehensive depiction of the mechanisms employed to promote the GCIs and their resultant effects. The application of purposive sampling in selecting study participants could have introduced biases into the research. Prospective studies may assess the methodologies employed by HEIs in diverse locations to facilitate sustainable development. Subsequent investigations could be conducted over an extended duration to monitor the evolution and impacts of GCI mechanisms.

## Conclusion

The research underscores the pivotal role that HEIs play in advancing sustainability, particularly through initiatives such as the GCI. The study at DUT reveals a comprehensive approach that includes stakeholder engagement, education and resource conservation. These efforts are vital in fostering an environmentally conscious culture within academic communities and beyond.

The GCI at DUT demonstrates the effectiveness of inclusive strategies that engage both internal and external stakeholders, aligning with global sustainability goals. Educational initiatives are particularly significant, as they cultivate awareness and responsibility among students, ensuring long-term commitment to environmental stewardship. The successful implementation of water and electricity conservation measures further highlights the potential for behaviour modification and infrastructure improvements to achieve sustainability targets.

Partnerships with other universities amplify the impact of GCIs, promoting a collective approach to environmental challenges. The proactive leadership at DUT has been instrumental in driving these initiatives, showcasing the importance of dedicated governance in sustainability efforts.

The findings suggest that continued stakeholder engagement, enhanced educational programmes, advanced resource management technologies and strong leadership are crucial for the success of GCIs. Expanding partnerships and establishing formal networks can further institutionalise

these efforts, promoting a broader commitment to sustainable development within higher education.

Overall, the study provides valuable insights into the multifaceted role of GCI in environmental sustainability, offering a model for other institutions to follow. As universities continue to grapple with global environmental issues, the lessons from DUT's GCI highlight the importance of comprehensive, collaborative and innovative approaches to fostering sustainability.

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## Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

## Authors' contributions

This research project was a joint effort by three authors, each contributing to different aspects of the study. Their combined efforts resulted in a thorough and high-quality research study. H.S.S. was crucial in the initial phases, offering expertise in conceptualisation, investigation, visualisation, project administration and validation. His leadership and guidance were key to the project's design and execution. L.-K.J.Z. played a major role in developing the methodology, drafting the original manuscript and was heavily involved in revising and editing to ensure the final work was of high quality and aligned with the research goals. B.I.D. provided vital resources and support, including funding, supervision and oversight, which were essential for the project's success.

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## Data availability

Interviews conducted at the DUT with 61 people provided the data used in this study. To find sub-themes that complemented the study goals, an analysis was conducted on the qualitative data gathered through a Microsoft link form. The published article presents the study's conclusions together with pertinent data and tables. However, sharing the raw data and transcripts of the interviews is prohibited owing to privacy and confidentiality considerations. The corresponding author, H.S.S., will take into account any requests for more data.

## Disclaimer

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