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A Model for Sustainable Development in Higher Education: Heliopolis University for Sustainable Development in Egypt

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Abstract. Sustainable development ensures future generations can meet their needs, making it vital for institutions to adopt sustainable practices. The UN's 17 Sustainable Development Goals (SDGs) offer a framework to tackle global challenges, with universities playing a key role through research, education, and partnerships. While studies have explored SDGs in Higher Education Institutions (HEIs), a comprehensive, institution-wide approach remains underexamined, particularly in the Middle East North African region. This study addresses that gap by analyzing SDG integration at Heliopolis University for Sustainable Development (HUSD) in Egypt. Established in 2012, HUSD embeds sustainability across academic and operational dimensions, aligning with SEKEM—a holistic sustainable development initiative in the Middle East—and its localized framework, the Sekem Vision Goals (SVGs). The case study examines SDGs across education, research, governance and community engagement, and using content analysis of curricula and journal publications. An UNESCWA-made survey assesses faculty and student perceptions, while thematic analysis highlights key priorities at HUSD, showing its attention to a holistic approach, community-building efforts, and the climate impact of university-led projects. By showcasing best practices for comprehensive SDG implementation, this study provides valuable insights for HEIs, particularly in the Global South, to integrate sustainability into their structures and enhance their global contributions.

Keywords:

Case Study, Egypt, Higher Education, Institutional Integration, Sustainable Development Goals

1. Introduction

Sustainable development ensures that future generations can provide for their own needs. In our fast-changing world a sustainable stance in the present is necessary to preserve opportunities and possibilities for the future. To guide this stance, the United Nations (UN)

established 17 Sustainable Development Goals (SDGs), 169 targets and 231 indicators. These SDGs, written in 2015 and adopted in 2017, stimulate a coherence across development endeavours in facing the economic, social, and environmental challenges [21,23] for the 2030 Agenda. In contrast with their predecessors, the Millennium Development Goals (MDGs), the SDGs stimulate policy-level revisions within institutions, companies and governments [10].

Educational institutions, and thus universities, contribute to developing a collective awareness on sustainable development in three ways according to the UN. First, they expand human capital with an SDG-perspective. Across disciplines, students are taught how to face the social, economic and environmental challenges in their work and careers. Universities expand the human capital not only within their own students, but also through online courses or training programs for non-university students, and continuous lifelong learning. Second, researchers at universities can add to the knowledge on SDGs. They can clarify the implementation, and it's cost in different parts of the world on a global or local level. Despite the possibilities of revealing gaps or dysfunctional implementations. Third, universities' role in multi-stakeholder partnerships increase. Researchers and students are engaging in projects outside of the academic institution, facilitating knowledge transfers and creating skills [20].

Starting from 2020, the involvement of Higher Education Institutions (HEIs) in the SDGs has become a topic of increasing academic interest. Ferrer-Estévez and Chalmeta (2021) showed with a literature review that article on this subject often result in three categories: maturity models, which evaluate the status of the SDGs at various levels and provide recommendations or strategies [13,17]; integration of the SDGs in the HEI [4, 26]; and educational and pedagogic methods [3,14]. Adding a fourth category of a literature review in itself. This is for example, already mentioned article of Ferrer-Estevez and Chalmeta (2021), Molina et al. (2023), Serafini et al. (2022). Despite this growing body of work, there remains a significant research gap regarding the implementation of the SDGs across all levels of a university. Much of the research to date has focused on individual courses or curricula or has analysed graduation projects to assess how students incorporate the SDGs. One of the research gaps that has not been done is the implementation of the SDGs in every level of the university. Often courses or curricula are researched, or the graduation projects are analysed to see how students embedded the SDGs. However, a comprehensive understanding of how the SDGs is holistically integrated into HEIs remains underexplored. This gap is especially evident in the context of the Middle East and North Africa (MENA) region, where studies on the broad, institutional implementation of the SDGs are scarce [22].

To address this gap, this study researches a university where sustainability is a core element of its mission and activities. Heliopolis University for Sustainable Development (HUSD) in Egypt presents such a case. Established in 2012 in Cairo, Heliopolis University has been at the forefront of embedding the SDGs into its daily academic and operational life. This institution takes a holistic approach, aiming to integrate all SDGs, not only within its student body but also across faculty and administrative staff. The university is deeply connected to SEKEM, an Egyptian organization dedicated to human development, community development, and biodynamic agriculture with the aim of reclaiming desert land. SEKEM, established in 1977, has made sustainability one of its foundational principles. In line with the SDGs, SEKEM has developed its own framework known as the Sekem Vision Goals (SVGs), which translate the global SDGs into a more context-specific set of 16 goals categorized into culture, ecology, economy, and society. These SVGs are intended to be integrated into all aspects of SEKEM's work and are designed to drive transformative change across Egypt (Figure 1).

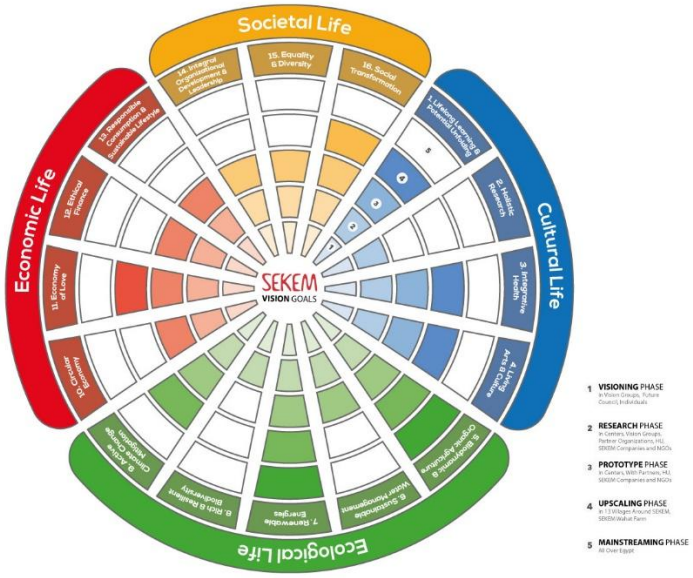

Figure 1. Sekem Vision Goals (Sekem annual report, 2023)

This case study seeks to understand how an Egyptian HEI implements the SDGs on a holistic level. Furthermore, the main focus will be on four specific SDGs: SDG 4 (Quality Education), SDG 5 (Gender Equality), SDG 6 (Clean Water and Sanitation), and SDG 8 (Decent Work and Economic Growth). These four SDGs were chosen because they address major challenges in Egypt across the four dimensions: social, cultural, economic and ecologic dimensions. By focussing on the four dimensions, the study aims to provide a comprehensive view of how HUSD contributes to tackling some of Egypt's most pressing issues through education and institutional practice. The research will also take into regard the linked SVGs, as SDG 4 aligns with SVG 1, SDG 5 with SVG 15, SDG 6 with SVG 6, and SDG 8 with SVGs 10, 11, and 12 (Figure 2).

This research aims to provide a framework of a holistic implementation of the SDGs in a HEI. By providing a detailed case study of Heliopolis University, the research seeks to offer new insights into how SDGs can be integrated across all levels of a university, from curricula and student projects to research, governance and partnerships. This case study was carried out using a variety of qualitative research methodologies such as participant observation, content analysis, and survey. In doing so, it will highlight best practices that could be applied to other HEIs, particularly in the Global South, to improve their contribution to global sustainability efforts.

Figure 2. Comparison SDGs and SVGs

2. Theoretical Approach and Methodology

2.1. Research Design

UNESCO and Makrakis et al. (2013) designed a competency framework to empirically research ESD. The framework developed under the 'Revising University Curricula to Address Sustainability' (RUCAS) project, evaluates how education influences awareness and actions related to SD. It includes five dimensions: Learning to Be (LB), which emphasizes personal growth, self-actualization, and becoming proactive, autonomous citizens; Learning to Live Together (LL), which fosters empathy, collaboration, and partnerships to advance sustainability; Learning to Know (LK), which provides broad knowledge and understanding of sustainable development and its relevance across fields; Learning to Do (LD), which focuses on applying knowledge through skills and practices in social and professional contexts; and Learning to Transform Oneself and Society (LT), which encourages the transformation of unsustainable values and behaviours and inspires collective action for societal change. The five components of this framework are connected to the dependent variables, which include the curriculum's course content, the ongoing professional development of both teaching and non-teaching staff, the activities undertaken by students, and the university's various centres (Table 1).

2.2. Heliopolis University for Sustainable Development

Heliopolis University for Sustainable Development (HUSD) claims to be the first university in the Middle East to prioritize sustainable development as its core mission [7]. Established in 2012, this private institution comprises five faculties—business and economics, engineering, pharmacy, organic agriculture, and physical therapy—all integrating sustainability through interdisciplinary education, research, and practice. The university's annual sustainability report outlines achievements across the 17 SDGs and 16 SVGs [8]. All

students follow a shared core program, consisting of 12 mandatory and 6 elective courses, fostering innovation and social responsibility. Beyond academics, seven specialized centers drive sustainability and community engagement, focusing on areas such as rural development, ESD, health, carbon footprint reduction, entrepreneurship, organic agriculture, and ecosystem research. HUSD also promotes cultural diversity through the Space of Culture and prioritizes inclusivity via its Sexual Harassment Free Campus initiative (SHFC). The Social Initiative Forum (SIF) further connects local grassroots movements with the global economic and social landscape, reinforcing the university's commitment to sustainable impact.

Table 1. RUCAS ESD Clusters (Merakis et. al., 2013)

ESD-Clusters of RUCAS	Definition
Learning to be (LB)	LB focuses to help people grow into their full potential, manage themselves effectively and prioritize personal growth over material possessions.
Learning to live together (LL)	LL encourages actions and habits that promote a peaceful, inclusive society and a harmonious relationship between people and nature.
Learning to know (LK)	LK helps people explore, create, and apply knowledge to make sustainability a natural part of their daily lives and identity.
Learning to Do (LD)	LD connects knowledge with action, empowering individuals to contribute to a sustainable future.
Learning to transform oneself and society (LT)	LT encourages people to rethink harmful habits and values, working together to create a more sustainable society.

2.3. Hypotheses and Method

Hypothesis: HUSD's integration of the SDGs into the campus, education, research, partnerships and governance, led to a greater understanding and implementation of the SDGs for students and staff.

The hypothesis was analysed using a mixed-methods approach, incorporating quantitative and qualitative data collection and analysis to provide a holistic overview. Given the breadth and complexity of the full set of 17 SDGs, this study focuses specifically on SDG 4 (Quality Education), SDG 5 (Gender Equality), SDG 6 (Clean Water and Sanitation), and SDG 8 (Decent Work and Economic Growth). Limiting the scope to these four goals was necessary to ensure a focused and manageable discussion, allowing for a more in-depth analysis of HU's targeted efforts and impacts. Participant observation, which involves the researcher actively engaging in the environment while systematically recording observations [9], provided valuable insights into everyday practices and informal dynamics surrounding SDG integration.

To provide a more objective and in-depth analysis, a Qualitative Content Analysis was conducted on the university's curriculum and academic journal publications, offering a counterbalance to the more subjective approach of the participant observation and case study. This approach involves systematically identifying and classifying patterns within a large volume of written materials, emphasizing overt meanings and explicit content. A key feature of content analysis is its ability to quantify qualitative data without reducing it to numerical

representation; instead, it considers the frequency and recurrence of certain codes to develop categories. The quantification of data in this context serves as an intermediary step to enhance analytical rigor and support triangulation in mixed-method research. This process ensures that data categorization remains structured while allowing for interpretative insights [27].

Additionally, survey results from the ESCWA (2025) Annual SDG Review were analysed for HUSD, aiming to evaluate the impact of the case study and content analysis. This survey used closed ended questions and a Likert scale to assemble the data. The descriptive analytics focused on summarizing and interpreting through sorting the data from "No Knowledge" (0) to "Extensive Knowledge" (4) or from "Strongly Disagree" (0) to "Strongly Agree" (4). This allowed calculating measures such as mean, mode, standard deviation, and frequency distributions, providing a clear overview of the collected responses. Descriptive analysis was performed as an initial step to better understand the data. Additionally, in this research, it served as the primary method for analysing survey results, as the sample size was too small for a comprehensive quantitative analysis [1].

The survey results were submitted to a chi-square (χ^2) test. This test is a non-parametric statistical method used to determine whether there is a significant association between categorical variables. It is commonly applied in social sciences to test hypotheses about independence or goodness-of-fit [1]. The test compares observed frequencies with expected frequencies under the null hypothesis (H_0), and the significance is assessed based on the chi-square to examine the relationship between student year group (first year or not) and their knowledge of SD and the SDGs. The H_0 states that student year group and SDG understanding were independent, while the alternative hypothesis (H_a) suggested a dependent relationship. The chi-square test statistic was computed using following formula, where fo is observed frequency and fe (1) expected frequency. The formula for χ^2 can be seen in (2). [1].

$$fe = \frac{(row\ total).(column\ total)}{(total\ sample\ size)} \quad (1)$$

$$X^2 = \sum \frac{(fo-fe)^2}{fe} \quad (2)$$

There are two limits to this quantitative data. Due to the limited number of responses, second year students until fifth and more years were grouped into one category, and compared to the first years, new to HUSD. This way the data can show the impact of HUSD method on students and their awareness of SDGs. The second limit to this quantitative study is that only student data could be considered as there was no sufficient information on the duration of staff employment at HUSD.

3. Results and Discussions

3.1. Case Study and Participant Observation

HUSD aims to embed sustainability across the HEI common disciplines, education, research, and governance. However, HUSD also emphasizes a fourth pillar: community outreach. These four pillars will serve as the guiding framework for presenting the case study results.

HUSD's educational approach is defined by innovative learning models that actively engage students in real-world challenges. Among these, community-based learning (CBL) has been the most long-standing and significant, designed to bridge theory and practice by

involving students directly with local and rural communities. In practice, CBL at HUSD includes visits to 13 villages around Belbeis or to Wahaat Bahariya, where students undertake projects to gain hands-on experience [19, 25]. However, not all CBL activities fully integrate cultural immersion, as seen in cases where students, such as those in green architecture, focused on technical tasks without engaging deeply with the community. Additionally, some CBL initiatives lack continuity; for example, pharmacy students identified early-stage kidney failure in Wahaat schools but did not collect follow-up data due to the short-term nature of the project. Recognizing these challenges, the ESD Center, one of the seven centers at HUSD, is refining the CBL model to ensure sustained engagement with local stakeholders, deeper community integration, and a more holistic learning experience.

In 2024, HUSD introduced industry-based education, strengthening connections between students, professionals, and enterprises to provide hands-on experience aligned with market needs. This model fosters collaboration on real-world problems while integrating industry expertise into coursework through guest lectures. Additionally, HUSD is experimenting with alternative teaching methods, including flip the classroom, and project-based learning, to enhance student engagement, critical thinking, and self-directed learning—reinforcing sustainability and innovation at the core of its curriculum.

A detailed content analysis will follow later but next to its faculties and departments that are supposed to be more directed towards realizing the SDGs/SVGs, HUSD's curriculum distinguishes from other universities through a shared core program, which requires all students to complete 12 foundational courses, along with 6 electives chosen from a pool of 15 options. This structure promotes interdisciplinary knowledge and social responsibility, equipping students with the skills needed to drive sustainable transformation across various sectors. By looking at the curriculum of the HUSD's Business and Economics faculty, it became clear that, in 2018, the integration of ESD faced challenges. This includes faculty expertise gaps, regulatory resistance, and limited student engagement [15]. These challenges were addressed but some still remain, like the faculty expertise gaps due to a high turnover rate within the faculty. Furthermore, sustainability-focused courses were removed during curriculum approval, prompting a shift toward embedding sustainability within traditional subjects. This approach led to reconstructing the curriculum, increasing SD-related courses and promoting interdisciplinary learning.

Findings from Ola Hussein Hosny's (2023) dissertation, *Opening Windows and Closing Gaps: A Case Analysis of the Agenda Setting of Egypt's Inclusion Policymaking Process in Higher Education Institutions*, highlight several key challenges and contradictions within the HUSD setting regarding the inclusion of students with disabilities (SWDs). While HUSD is structured around a core program designed to foster social responsibility and diversity integration, the absence of effective channels for amplifying SWDs' voices undermines the quality of anticipated inclusion. At both intra- and interpersonal levels, the university seeks to create more opportunities for non-violent dialogue and collaborative activities. However, its reliance on incorrect evidence and data manipulation contradicts these efforts, particularly in fostering non-violent communication. Additionally, the university demonstrates limited awareness of SWDs' needs and lacks a clear strategy for addressing them [16].

HUSD's dedication to sustainability extends beyond formal coursework through its seven specialized centers, each driving community impact and innovation in unique ways. The Education for Sustainable Development Center (ESDC) fosters transformative educational models to unlock human potential, while the Rural Development Center (RDC) applies a holistic approach to economic, environmental, and social sustainability in rural communities.

The Carbon Footprint Center (CFC) conducts climate research, issues carbon credits, and supports the Economy of Love's accreditation system to promote sustainable economic practices. The Integrative Health Center (IHC) bridges healthcare, education, and sustainability, particularly in underserved areas, ensuring equitable access to well-being. Meanwhile, the Entrepreneurship Center for Social Impact (ECSI) nurtures sustainable start-ups by providing tailored support and resources for social entrepreneurs. The Center of Organic Agriculture in Egypt (COAE) plays a crucial role in advancing organic farming through technical expertise, certification, and awareness initiatives. Lastly, the newly introduced Ecosystem Research Center (ERC) leads research and consultation to address pressing sustainability challenges. However, this center does not currently have a working team. Together, these centers form the backbone of HUSD's sustainability mission (Figure 3).

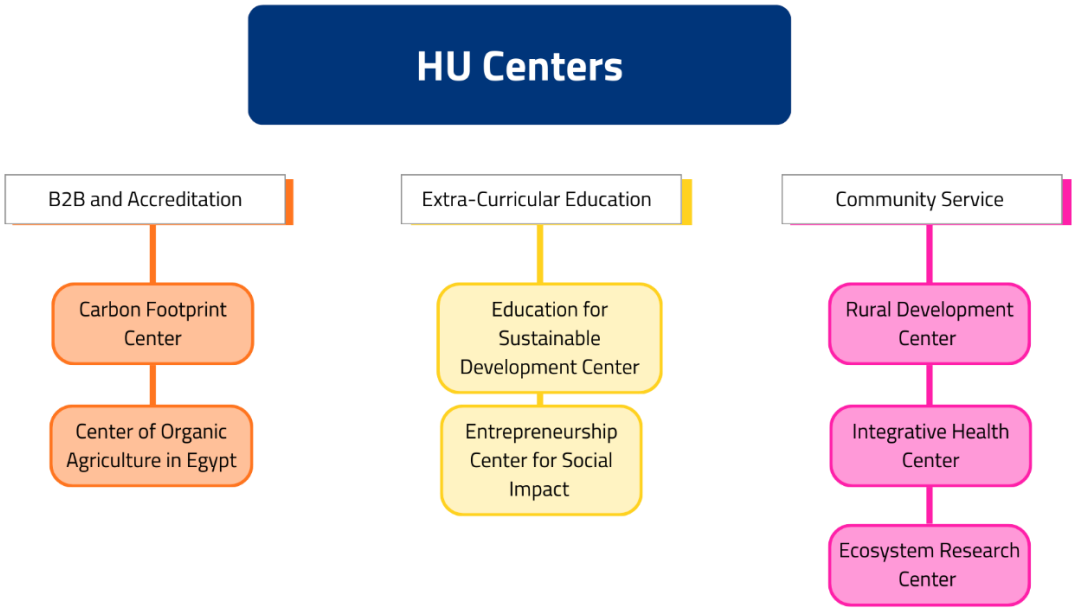

Figure 3. HUSD Centers linked to their main focus points

The seven centers can be categorized into three distinct categories: business-to-business and accreditation, extra-curricular education, and community service. The CFC (7 projects) and COAE (3 projects) fall under the business-to-business and accreditation category, as they work closely with organizations, industries, and policymakers to provide research, certifications, and consultancy services that promote sustainable business practices. The ESDC (6 projects) and ECSI (5 projects) align with extra-curricular education, equipping students, staff and young professionals with transformative learning experiences and entrepreneurial support to drive sustainable impact within and beyond the classroom. Meanwhile, the RDC (26 projects), IHC (7 projects), and ERC (8 projects) are primarily engaged in community service, addressing social, economic, ecological, and health-related sustainability challenges by implementing grassroots initiatives that improve the well-being of underserved populations. This categorization further highlights how each center plays a unique yet interconnected role in advancing HUSD's sustainability mission, ensuring a multi-faceted approach to education, research, and community impact.

For instance, a solar-powered night irrigation system under the DeveloPPP project aims

to cut water use by 20% and boost crop yields by 10%, training 725 students and benefiting 150 farmers. Afterwards, five new projects were launched, including afforestation (170,000 trees), compost distribution (7,365 tons), biodynamic input centers, PV panel installations, and drip irrigation support. These initiatives have directly benefited 503 farmers, reinforcing sustainable agriculture in Wahaat [6].

At HUSD, research is deeply integrated with the SDGs, focusing for this case study specifically on Sustainable Water engineering. The Faculty of Engineering actively engages in applied research, including projects on sustainable water treatment, hydroponics, wastewater recycling, and desalination. For instance, the wetland pilot area in Belbeis naturally treats domestic and drainage water for safe agricultural reuse, while the hydroponics experiment at HUSD campus emphasizes zero waste and energy efficiency through solar-powered aquaponics. These projects, often in collaboration with national and international institutions, not only contribute to environmental sustainability but also align with global efforts. Through continuous research, pilot projects, and knowledge-sharing, HUSD ensures that scientific advancements directly contribute to practical solutions for a sustainable future.

HUSD fosters cultural exchange and inclusivity through initiatives such as, every Monday, the Space of Culture, a vibrant platform promoting artistic expression across disciplines and backgrounds. One of its key components is a weekly event that showcases different art forms or raises awareness on social issues. These events have included theatrical performances, musical showcases, poetry readings, and discussions on topics such as gender inequality in the STEM workforce. This initiative falls under the performing arts branch of the Space of Culture. The university's Sexual Harassment Free Campus initiative ensures a safe and inclusive environment for all students and staff. Through plays, documentaries, information boards, awareness booths and talks students and staff become aware of the initiative. A study was done in 2023 on the impact of the SHFC, it showed that most students are still too afraid to tell their story [5]. Meanwhile, the Social Initiative Forum (SIF) serves as a bridge between local grassroots movements and the broader economic and social landscape, fostering global-local collaboration for sustainable development.

Regular Pedagogy (PED) meetings provide a space for faculty to refine their teaching methods, while the ESDC oversees the ESD program, equipping HUSD educators with the knowledge, skills, and values needed to foster a culture of SD and the SVGs. A variety of professional development modules support this mission, covering topics such as leadership, effective assessment, AI in higher education, social entrepreneurship, and student engagement. However, challenges remain, including limited time for academic staff to participate, varying levels of motivation, and a lack of local experts in the field of ESD, often requiring the involvement of international specialists. Additionally, while summer break is the most suitable period for offering ESD modules, it often coincides with personal vacations, making scheduling difficult. Addressing these challenges through flexible learning opportunities and increased institutional support is essential for advancing sustainability education at HU.

Non-teaching staff play a crucial role in implementing sustainability beyond the classroom. They actively participate in university-wide initiatives. These include Sunday meetings where staff engage with the SVGs, fostering a deeper understanding of sustainability principles within the institutional framework and the SDGs. Additionally, the Training Academy offers specialized courses designed to equip staff with the skills needed to integrate sustainability into their respective roles. While participation in these courses is not

always consistent, ongoing efforts are being made to streamline and enhance professional development opportunities. This Training Academy courses are supervised by the ECSI and revolve around the four dimensions of SEKEM and the SVGs, Culture (8 courses), Ecology (3 courses), Economy (4 courses) and Society (4 courses).

The participant observation showed strengths and challenges in the leadership development at HUSD. The leadership can generally be perceived as top-down mandates rather than organically integrated opportunities. For instance, the PED-meetings and Sunday meetings are mandatory and have been met with mixed reactions among faculty and staff. However, a positive aspect of these meetings is that they expose participants to the SDGs and SVGs. These sessions provide a genuine space for cultural and intellectual exchange, fostering a more participatory and inclusive environment. The PED-meetings for example clarify the best practices from multiple universities and knowledge institutions, allowing for cross-pollination of ideas that extend beyond the immediate university context. While the Sunday meetings encourage non-academic staff to create a culture where professional and personal development go hand in hand.

A second challenge that emerged from participant observation of this top-down leadership is the importance of return-on-investment. This issue was also highlighted in Hosny's PhD dissertation (2023). She notes that this uncertainty often leads to the rejection or discontinuation of initiatives, resulting in the inefficient use of manpower and resources and ultimately hindering collaboration and integration at the meso-level [16]. Hosny's critique of top-down governance at HUSD reflects a broader trend observed in many projects, where financial return-on-investment is prioritized as a key measure of success. However, there is also a competing perspective within HUSD that suggests a different approach—one that assumes that if a project is valuable and meaningful, the necessary funding will follow. These contrasting viewpoints create an ongoing tension in the university's governance, where economic considerations are weighed against the belief in the intrinsic value of initiatives and their potential to attract resources organically. Additionally, the sheer multitude of projects and research initiatives at HUSD further complicates this dynamic. With many different proposals competing for limited resources, decision-makers often prioritize projects based on their perceived financial sustainability rather than their long-term impact, which can make it even more difficult for accessibility-focused initiatives to receive adequate support.

However, grounded in experiential learning, two programs offer students a platform to develop leadership skills and find innovative solutions aligned with the SDGs. The Youth Leadership Program empowers university students to step beyond the walls of HUSD, providing them with opportunities to represent the institution on international platforms. Accompanied by weekly courses at HUSD in preparation. Secondly, the Leadership Students Program focuses on community leadership, fostering a collaborative environment where students live together, participate in extracurricular community engagements, and gain hands-on work experience.

HUSD's community outreach is deeply embedded in its educational framework, particularly through its Core Program and CBL-initiatives. By integrating interdisciplinary learning and real-world engagement, students from different faculties collaborate on sustainability-driven projects, fostering both social responsibility and innovative problem-solving. This well-designed mixture of academic and practical experiences equips students with the skills necessary to drive meaningful change, bridging the gap between theoretical knowledge and hands-on application. The Core Program, with its structured yet flexible

approach, encourages students to explore various disciplines while remaining rooted in a broader idea of sustainability and social impact.

The university's sustainability efforts are defined by an interdisciplinary and holistic approach to community outreach, addressing pressing social, cultural, economic, and environmental needs by combining academic research with practical engagement. Through partnerships with SEKEM and various centers and projects, students gain first-hand experience in sustainability while actively contributing to community well-being. The scale of these efforts is significant. In the academic year of 2024-2025, a total of 41 projects were spread across three centers: the RDC, IHC, and ERC. Initiatives range from supporting local entrepreneurs through microloans to empowering women with vocational training and promoting environmental stewardship through waste management and tree-planting programs. Healthcare projects like "Health on Wheels" provide vital medical services in underserved villages, while educational programs introduce children to arts, theatre, and environmental awareness. However, these initiatives face several challenges, including limited financial resources, logistical constraints, and a shortage of specialized experts. Ensuring consistent community engagement and long-term impact requires improved follow-up mechanisms and sustainable funding models. Despite these hurdles, HUSD's commitment to outreach continues to create meaningful change, fostering a collaborative model of education that benefits both students and communities. The diversity and volume of these projects also present challenges. With so many ongoing initiatives, ensuring consistent funding, long-term sustainability, and meaningful community integration becomes increasingly complex. Some projects face issues of continuity, as seen in previous CBL engagements where short-term involvement limited the overall impact. To address these concerns, HUSD is working towards refining its outreach strategy to ensure that projects are not only impactful in the short term but also maintain sustainable engagement with local stakeholders. Strengthening partnerships between the different centers and fostering deeper collaboration between faculties can further enhance the effectiveness of these initiatives.

3.2. Content Analysis

Two content analyses were done, one on the content of the courses given at the faculties, one on the publications that were made at HUSD in scientific journals.

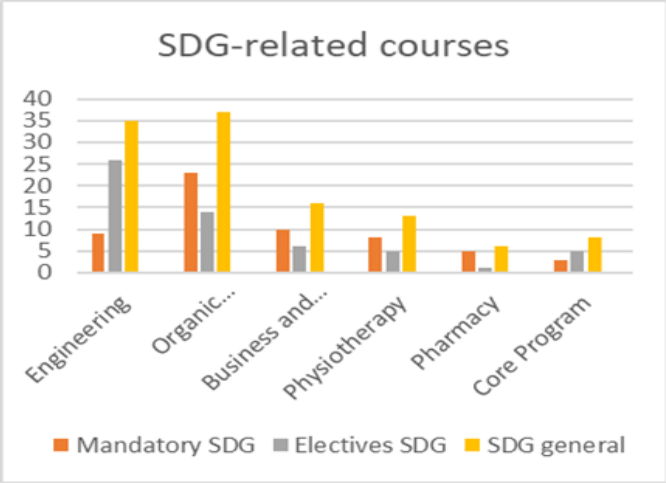

Figure 4. Content analysis of curriculum at HUSD

Table 2. Engineering Curriculum Analysis (N = 124)

Engineering faculty	Basic Sc.	Civil Engin.	Green Arch.	Electro-mech.	Mecha-tronics
Mandatory SDG	1	9	16	1	1
Electives SDG	1	2	3	1	0
SDG General	2	11	19	2	1
Total courses in Dep.	12	27	37	25	23
SDG percentage	**17%**	**41%**	**51%**	**8%**	**4%**

Table 3. Organic Agriculture Curriculum Analysis (N = 141)

Engineering faculty	Organic Crop Prod.	Food Processing Tech.	Biotechn.
Mandatory SDG	17	2	4
Electives SDG	10	1	3
SDG General	27	3	7
Total courses in Dep.	52	31	58
SDG percentage	**52%**	**10%**	**12%**

Out of 572 general courses across all faculties, 115 were identified as SDG-related, amounting to an overall SDG percentage of 20%. Core programs exhibited the highest SDG percentage (29%), while Pharmacy had the lowest (8%). The analysis of faculty-wise SDG distribution reveals significant variations (Figure 4).

In Engineering, SDG integration stood at 28%, with Green Architecture (51%) and Civil Engineering (41%) showing the highest sustainability emphasis, while Mechatronics had the lowest (4%) (Table 2). Business and Economics demonstrated moderate SDG inclusion, with Business Administration at 14% and Economics at 19%, aligning with findings from previous studies that reported similar trends in SDG integration within this faculty (Table 3).

Physiotherapy had an overall SDG inclusion of 14%, with Physiotherapy for Women's Health & Paediatrics leading at 43%, while Orthopaedic & General Surgery lacked SDG courses (0%). Pharmacy exhibited minimal SDG integration, with fields such as Pharmacognosy, Toxicology, and Biochemistry showing no SDG courses, whereas Pharmaceutical Chemistry (30%) and Public Health (9%) had some level of inclusion. Organic Agriculture showed strong SDG presence with 24%, Organic Crop Production leading with 52%.

The data reveals uneven SDG integration across faculties. Disciplines like Green Architecture and Organic Agriculture show strong sustainability engagement, while technical and medical fields require more structured inclusion. Overall, 29% of courses align with at least one SDG. However, a key limitation of this content analysis is its focus on added-value courses rather than the general curriculum. As a result, while many core courses in faculties such as Pharmacy and Physiotherapy inherently relate to SDG 3 (Good Health and Well-being) and other sustainability themes, only specialized offerings like Community Health or Complementary and Alternative Medicine were considered. This may lead to an underrepresentation of SDG integration in those faculties. Mandatory courses include SD, which explores a different SDG each week, and Human Rights and Politics. Electives such as Deep Ecology, Diversity Interaction, and Consciousness Development further expand sustainability learning. The curriculum fosters interactive, challenging, and communicative learning through real-world engagement, student-led inquiry, and dynamic formats.

The distribution of journal publications at HUSD reflects a strong focus on specific SDGs, particularly those aligned with the university's faculties and their core research areas (Table 4). As of December 2024, a total of 642 scientific articles have been published, with SDG 3 (Good Health and Well-being) being the most extensively covered, accounting for 404 publications (63%). This substantial share highlights a strong emphasis on health-related research, which aligns with the presence of two out of five health-focused faculties at HUSD, Pharmacy and Physiotherapy.

Table 4. Representation of SDGs in Journal Publications (N=642)

SDGs	# JP	%
SDG 1	0	0
SDG 2	12	2
SDG 3	404	63
SDG 4	9	1
SDG 5	2	0
SDG 6	22	3
SDG 7	58	9
SDG 8	3	0
SDG 9	60	9
SDG 10	0	0
SDG 11	9	1
SDG 12	23	4
SDG 13	8	1
SDG 14	6	1
SDG 15	25	4
SDG 16	1	0
SDG 17	0	0
Total	**642**	**100%**

Beyond SDG 3, the highest number of publications are associated with SDG 9 (Industry, Innovation, and Infrastructure) and SDG 7 (Affordable and Clean Energy), with respectively 60 and 58 publications. Additionally, SDG 6 (Clean Water and Sanitation) has received notable attention, with 22 published articles. Together, these three SDGs account for 140 publications, highlighting the university's strong research engagement in Energy Engineering, Water Engineering, Mechatronics, Electromechanics and Green Architecture. Research related to SDG 15 (Life on Land) has resulted in 25 publications, reflecting the focus of the Organic Agriculture faculty on land and ecosystem sustainability. Similarly, SDG 12 (Responsible Consumption and Production) has 23 publications, highlighting the faculty's engagement with sustainable agricultural practices and resource efficiency. In contrast, SDG 8 (Decent Work and Economic Growth) has only 3 publications, despite the presence of a business faculty. This suggests that sustainability and environmental topics receive significantly more research attention than economic and labour-related issues at HUSD.

This trend is further reflected in the overall distribution of research across SDGs. Goals that do not strongly align with the university's primary research fields through the faculties, have significantly fewer publications. These include SDG 1 (No Poverty), SDG 5 (Gender Equality), SDG 8 - as mentioned, SDG 10 (Reduced Inequalities), SDG 14 (Life Below Water),

SDG 16 (Peace, Justice, and Strong Institutions), and SDG 17 (Partnerships for the Goals), all of which have either minimal or no dedicated research publications.

3.3. Descriptive Analysis

In 2024, the UN ESCWA conducted a survey at HUSD. Two different questionnaires were handed out, one for students and one for staff. While the student survey underwent statistical analysis, the faculty survey lacked a structured method to measure the SDG framework's impact at HU. Additionally, faculty respondents were only asked about their age, without information on tenure or prior experience in SDG-related institutions. Another limitation was the absence of a survey for non-academic staff, as it was not conducted by UN ESCWA [11]. The results indicate that most faculty members associate sustainable development primarily with environmental protection and climate action (Figure 5) [11], followed by social inclusion, human rights, and economic prosperity.

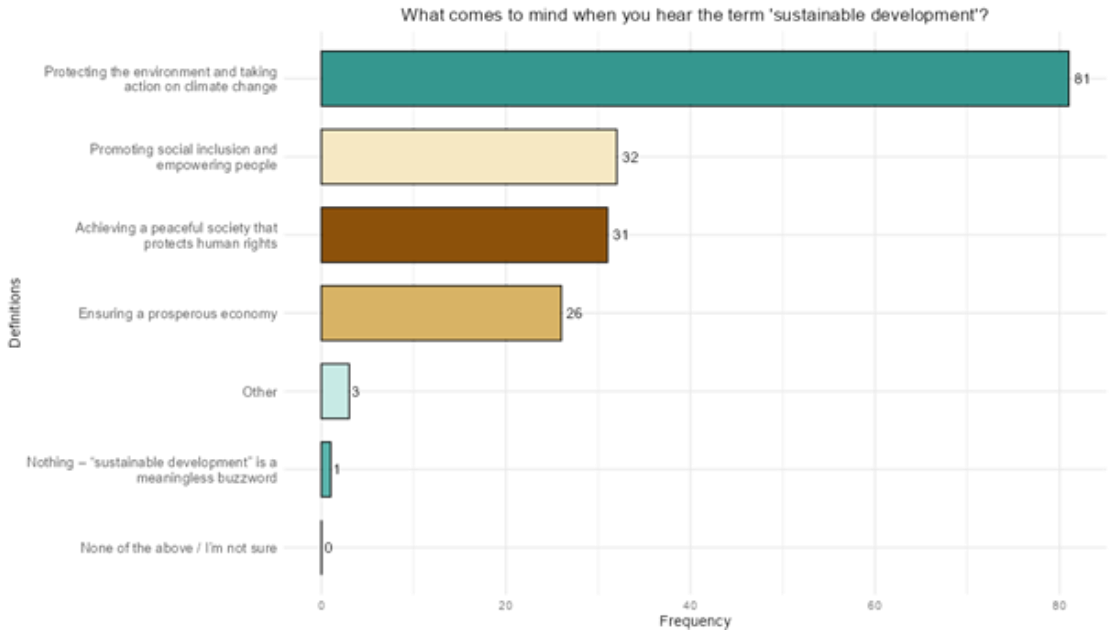

Figure 5. Definition of SD – Faculty Staff

Table 5. Knowledge of SDG (N=89) – Faculty Staff

Knowledge Level	Frequency (n)	Percentage (%)
No knowledge	0	0
Very little knowledge	9	10
Some knowledge	23	26
Good knowledge	41	46
Extensive knowledge	16	18
Total	**89**	**100%**

Only one out of 89 respondents dismissed sustainability as a meaningless concept, while another viewed it solely as an economic issue (Table 5). The ability to select multiple responses suggests faculty perceive sustainability as a multifaceted issue, with a strong emphasis on environmental concerns. Faculty members generally have a good perception of the SDGs, with 46% expressing good knowledge and 18% even had extensive knowledge.

However, 10% exhibit very little knowledge, but no one claimed to have 'no knowledge'.

The analysis of faculty-level mean scores (Table 6) on the knowledge of SDGs, reveals notable differences between faculties. Business Administration and Economics, and Organic Agriculture consistently report the highest mean scores. These faculties demonstrate particularly strong familiarity with SDGs. Conversely, faculties such as Engineering and Pharmacy and Drug Technology tend to score slightly lower, suggesting moderate levels of awareness with room for further engagement. Physical Therapy also shows consistent engagement, particularly in global SDG awareness. These findings indicate that disciplinary orientation may influence the depth of understanding and prioritization of sustainability-related topics, with socially and environmentally oriented disciplines displaying more comprehensive familiarity.

Table 6. Mean of SD and SDG Knowledge (0-4 Scale) – Faculty Staff

Faculty	SD Concept	General SDGs	SDGs in Home Country	SDGs in the World
Engineering	2.1	2.2	1.3	1.5
Pharmacy & Drug Tech.	1.9	1.8	1.2	1.3
Physical Therapy	2.2	2.3	1.5	1.1
Business Admin & Economics	2.6	2.5	2.1	2.0
Organic Agriculture	2.8	2.5	1.8	1.6

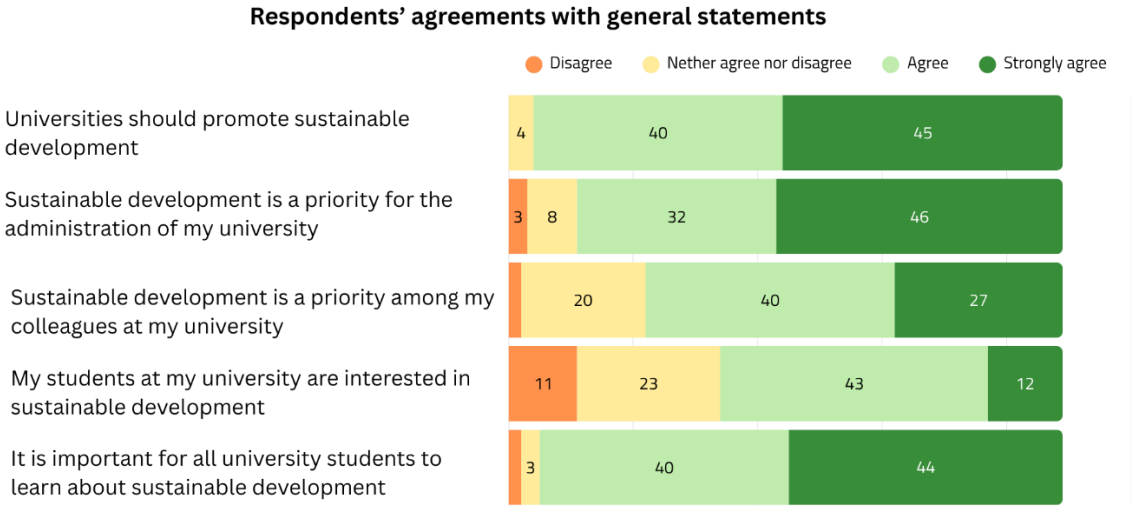

Figure 6. Faculty Staff Opinion on HEI Role

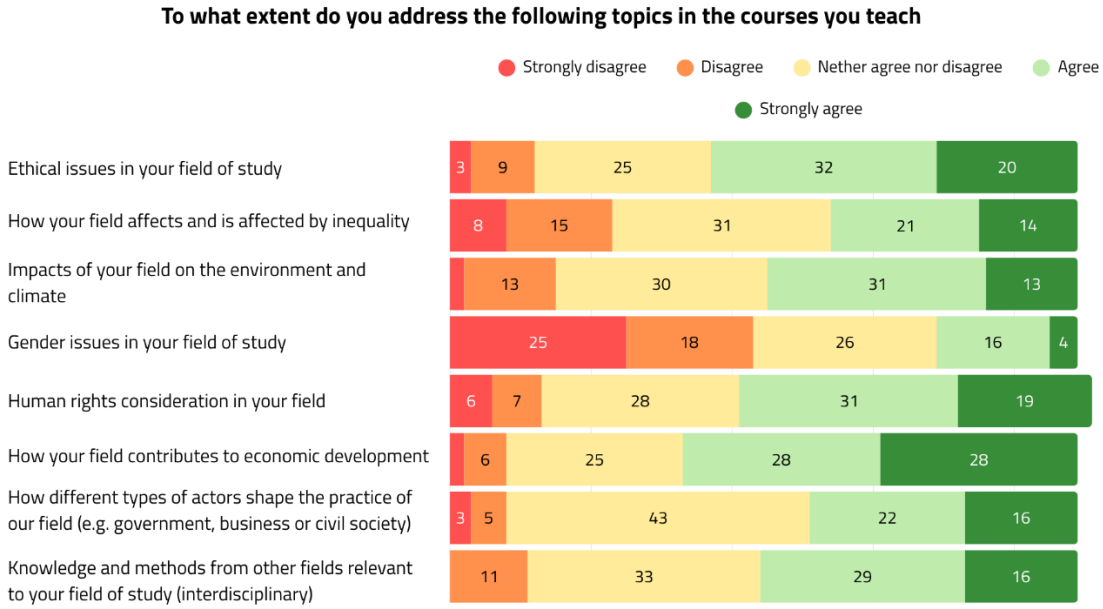

Figure 7. SDG Topics in Courses – Faculty Staff

Most faculty members agree that universities should promote sustainable development, and they perceive it as a priority for administration, though opinions on whether colleagues share this priority are mixed. While many believe students are interested in sustainability, this statement has the highest level of disagreement, pointing to a possible engagement gap. There is strong agreement that sustainability should be integrated into all university programs (Figure 6) [11]. A majority of faculty members incorporate SDG-related topics into their courses. Especially topics such as 'environment and climate', 'ethical issues', and 'human rights. However, gender issues are less discussed in the courses at HUSD (Figure 7) [11]. Beyond teaching, faculty engagement in sustainability is highest in on-campus activities and research, followed by community service and private-sector collaborations. Participation in sustainability networks is moderate, while a small portion of respondents do not engage in sustainability beyond their courses.

For HUSD-students, the survey data indicated that their knowledge of the SDGs generally improves with each academic year at HUSD. The mean scores in Table 7 show an increase from first-year to fifth-year students on the knowledge of SDGs. Especially, the knowledge on SD, SDGs, and the global context showed improvement after the third year of enrolment. These results suggest a positive correlation between years of enrolment and the depth of understanding of the SDGs, highlighting the educational impact of sustained academic engagement at HUSD.

If the students' knowledge on SD and SDGs is further regarded and analysed against their faculties, students from Business and Economics exhibited the highest overall awareness. However, Mechatronics Engineering students had the lowest scores overall, suggesting limited emphasis on sustainability within their academic experience. These findings underscore the need for incorporating SD and SDGs in the courses (Table 8).

The survey furthermore showed that 87% of the respondents agree or strongly agree that SD is a priority within their university, though 2% express disagreement, 11% neither agreed nor disagreed. When examining student perspectives, there is slightly less confidence in sustainability being a priority among students themselves. While a significant portion still

agrees, a noticeable share (3% strongly disagree, 6% disagree, 25% neither agrees nor disagree) suggests that student engagement in sustainability efforts may not be as strong as institutional efforts [11].

Table 7. Knowledge of SDGs (0-4 Scale) - Students

Year	General SD	General SDGs	SDGs in Home Country	SDGs in the World
1st year	1.94	1.86	1.70	1.66
2nd year	2.33	1.83	1.75	1.83
3rd year	2.62	2.95	1.76	2.40
4th year	2.69	2.59	1.72	1.97
5th year	2.14	2.57	1.43	2.29

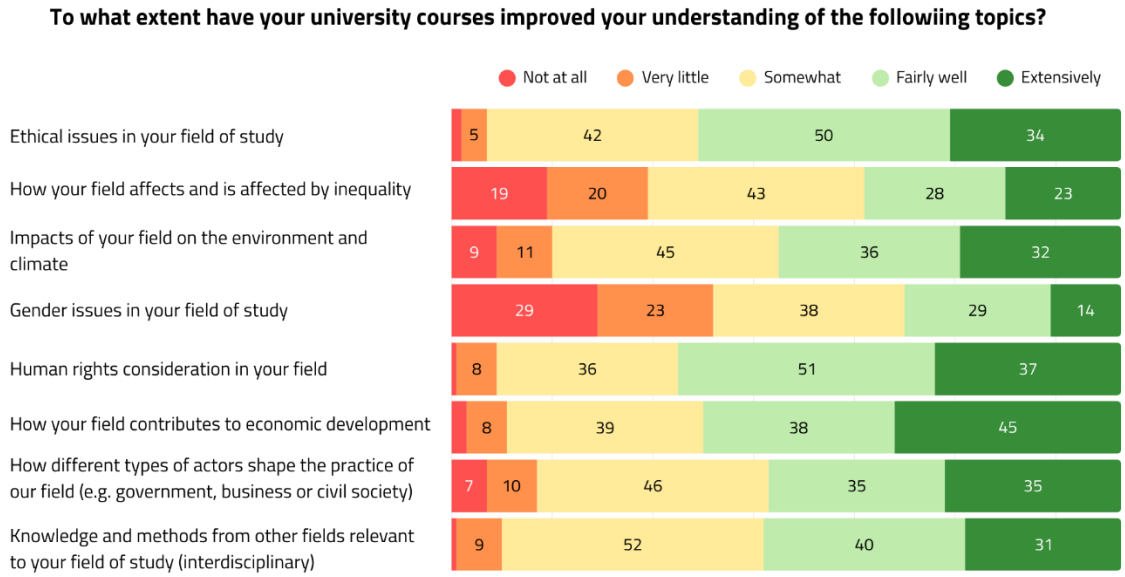

Figure 8. SDG Topics in Courses – Students

Table 8. Mean of SD and SDG Knowledge (0-4 Scale) - Students

Department	SD Concept	General SDGs	SDGs in Home Country	SDGs in the World
Biotechnology	2.50	2.44	1.56	1.72
Business administration	2.86	3.05	1.77	2.50
Economics	4.00	4.00	2.00	2.00
Food Processing Tech.	3.25	3.25	2.75	2.50
Mechatronics Eng.	1.00	2.00	1.00	1.00
Organic Crop production	2.64	1.91	2.09	1.91
Pharmacy	1.90	1.83	1.67	1.64
Physical therapy	2.12	2.23	1.64	1.93

Figure 8 [11] shows perceived understanding of various topics related to their field of study. Ethical issues, economic development of their field, and human rights appear to be well understood, suggesting these topics are well integrated into their studies, as also seen in the survey of the faculty staff. Similarly, to the faculty staff results as well, inequality and gender issues appear to be more less understood. A significant proportion of respondents report limited knowledge in these areas, particularly gender issues, where nearly a third indicate low understanding. The impacts of their field on the environment and climate are also moderately understood, though there is room for improvement.

The analysis of students' perceptions across different enrolment years highlights notable patterns in their attitudes towards the SD of their future employment (Table 9). There is only a slight elevation of the students' perception of their employment choice and the wage they would get for a SD related job. However, the 5th year students are less considering the SDG-values of their future employer. This could be out of a wish to find a job more easily. The ethics of the employer stagnates throughout the years and is relatively high, suggesting that students have an appreciation for ethical employment from the first year.

Table 9. Mean Students Consideration of Employer's SDG Values (0-4 Scale)

Year	Employer Choice	Employer Pay	Employer Values
1st year	2.94	2.43	2.72
2nd year	2.50	2.00	2.33
3rd year	2.86	2.52	2.80
4th year	3.10	2.38	2.69
5th year	3.00	2.00	2.57

3.4. Chi-squared Test

Through a chi-squared test, the relationship between students' years of enrolment and their level of awareness on SD and SDGs was tested. The two test results indicate a statistically significant association, suggesting that students who have spent more time at the university are more likely to have internalized SD and SDG principles. The chi-square test revealed a significant association between student year group and their understanding of the SD as a concept, X^2 (4) = 19.42, p= 0.00065. Since the p-value was well below the significance level of 0.05, the null hypothesis was rejected, indicating that SD understanding is dependent on the student year group (Table 10).

Table 10. Students' Knowledge on SD as a Concept (N=194)

Year	No Knowledge	Little Knowledge	Some Knowledge	Good Knowledge	Extensive Knowledge
1st year	7	39	42	29	8
2 – 5+ year	2	7	19	33	8

The chi-square test revealed a significant association between student year groups and their understanding of the SDGs, X^2 (4) =22.24, p=0.00018. Again, the p-value was well below the significance level of 0.05 so the null hypothesis where years of enrolment and SDG understanding was unrelated, was rejected. Higher-year students generally reported a greater understanding of SD and SDGs compared to first-year students, suggesting that HUSD's integration of SDGs into campus initiatives, education, research, and governance

contributes to increased awareness over time (Table 11).

Table 11. Students' Knowledge on SDGs (N=194)

Year	No Knowledge	Little Knowledge	Some Knowledge	Good Knowledge	Extensive Knowledge
1st year	11	35	47	24	8
2 – 5+ year	4	9	16	24	16

By aligning HUSD's sustainability efforts with the ESD clusters of RUCAS, this analysis demonstrates how education, research, partnerships, and institutional culture can collectively drive sustainable development. The university's continuous adaptation and commitment to innovation not only reinforce its leadership in sustainability education but also offer a replicable model for institutional transformation across higher education.

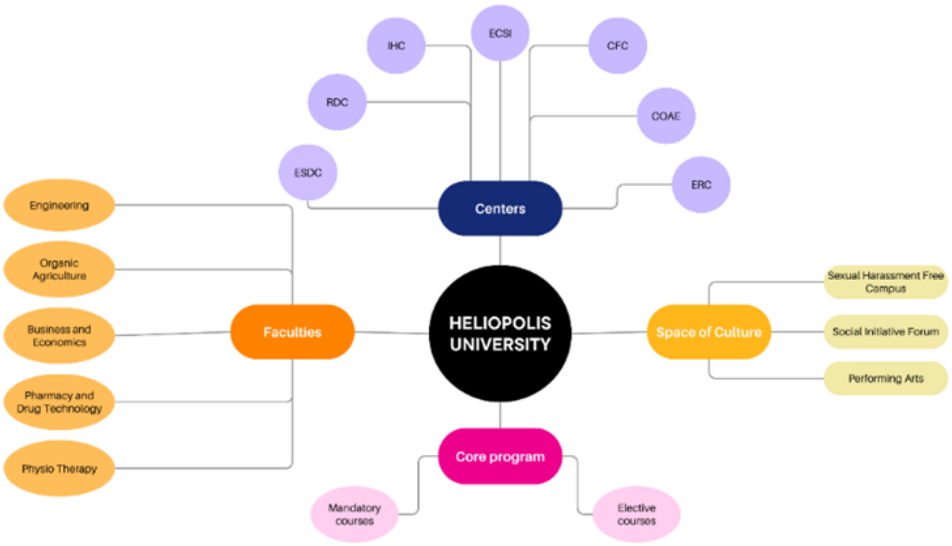

Figure 9. HUSD structure

4. Conclusions

HUSD integrates sustainability across disciplines, education, research, and institutional culture, framed within the four ESD clusters of RUCAS: Learning to Be (LB), Learning to Live Together (LL), Learning to Know (LK), and Learning to Do (LD), with an overarching focus on Learning to Transform (LT). This structure enables a holistic analysis of sustainability initiatives and their impact on institutional capacity. The integration of the SDGs into its campus, education, research, partnerships, and governance has led to a greater understanding and implementation of sustainability concepts among students and staff. The active participation of students, faculty, and research centres in SDG-aligned projects fosters innovative problem-solving and interdisciplinary collaboration, enhancing institutional capacity to address sustainability challenges.

Its curriculum incorporates sustainability, with strong SDG integration in Business Administration and Economics, Engineering – with the exception of Mechatronics – and Organic Agriculture, yet limited presence in Pharmacy and Physiotherapy. This disparity

highlights the need for interdisciplinary reinforcement. The Core Program and CBL embody LD principles by bridging academics with social responsibility, preparing students for real-world sustainability challenges. The survey of faculty staff indicated that socially and environmentally oriented faculties such as Business and Economics, and Organic Agriculture, tend to have more understanding of SD and SDGs; this is less present in Engineering. The same trend was found among students—Business Administration and Economics, and Organic Agriculture lead, while Physiotherapy lags behind.

The centers at HUSD focus primarily on business collaboration, extracurricular education, and community service, aligning with LK by generating knowledge and LD by applying it. Faculty-led initiatives, particularly in sustainable water management and agriculture, contribute to clean water and sanitation goals, reinforcing the link between research and applied sustainability solutions. The content analysis of journal publications shows an emphasis on environmental and health-related sustainability, with limited attention to social and economic SDGs. Interestingly, the faculties of Pharmacy and Physiotherapy publish more than Business Administration and Economics.

HUSD fosters sustainability through partnerships with SEKEM and the centers, advancing projects in healthcare and cultural exchange. These collaborations align with LL by integrating social and environmental considerations into sustainability initiatives. However, funding constraints and a shortage of experts limit long-term impact. Strengthening follow-up mechanisms and securing sustainable funding are crucial for maintaining project effectiveness. HUSD's commitment to inclusivity is evident in initiatives such as the Sexual Harassment-Free Campus (SHFC), raising awareness through plays, documentaries, and discussions. Despite these efforts, a 2023 study highlights student hesitancy in reporting cases, underscoring the need for stronger support systems. Additionally, inclusion initiatives for students with disabilities, though supported by CBL and the Core Program, require enhanced faculty training and policy refinement.

Leadership at HUSD follows a top-down approach, with mandatory PED and Sunday meetings receiving mixed reactions. Implementing more flexible learning and engagement strategies could enhance participation and align with LB by fostering a more adaptable institutional culture. Additionally, the lack of return-on-investment studies complicates resource allocation, reinforcing the need for evidence-based decision-making to support sustainability initiatives.

Despite HUSD's strong sustainability commitment, challenges in interdisciplinary coordination and project documentation hinder long-term impact. For example, pharmacy students identifying health concerns among children without research follow-up illustrates gaps in cross-disciplinary engagement. Strengthening institutional mechanisms for interdisciplinary cooperation and documentation will be critical in addressing these challenges. One critical area that remains underexplored in this research—and in many others—is the role of non-academic staff in supporting SDG implementation. While their inclusion in Sunday meetings was noted, their awareness and involvement were not examined through surveys or qualitative methods, pointing to the need for further research to ensure a truly inclusive, whole-institution approach to sustainability.

By aligning HUSD's sustainability efforts with the ESD clusters of RUCAS, this analysis demonstrates how education, research, partnerships, and institutional culture can

collectively drive sustainable development. The university's continuous adaptation and commitment to innovation not only reinforce its leadership in sustainability education but also offer a replicable model for institutional transformation across higher education.

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Not available

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Authors Contribution

All authors contributed substantially to the work. **E.A.** conceived the research idea, designed the methodology and contributed to critical revision of the manuscript. **V.E.** carried out the experiments, data collection, data analysis and interpretation and contributed to the manuscript writing. All authors reviewed and approved the final version of the manuscript.

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