Embedding Sustainability in a Liberal Arts and Science Curriculum

Dr. George E Nasr, Lebanese American University

Dr. George E. Nasr has been Provost at the Lebanese American University (LAU) since 2018, following his tenure as Dean of the LAU School of Engineering. He holds a Ph.D. in Electrical Engineering from the University of Kentucky and has published extensively on energy modeling and engineering education. He is an active member of IEEE and ASEE and serves on various international educational committees.

Nadine Zeeni, Lebanese American University

Dr. Nadine Zeeni is an Associate Professor of Nutrition and the Coordinator of Liberal Education - Sciences at the Lebanese American University (LAU). She has played a key role in the development and implementation of the recently launched Liberal Arts and Sciences curriculum (LASC). Collaborating closely with faculty from various disciplines, she focuses on developing, coordinating, teaching, and assessing innovative interdisciplinary courses related to the Sustainable Development Goals (SDGs).

Dr. Haidar Harmanani, Lebanese American University

Haidar Harmanani received the B.S., M.S. and Ph.D. degrees in Computer Engineering from Case Western Reserve University, Cleveland, Ohio, in 1989, 1991 and 1994, respectively. He is currently a professor of computer science and the Dean of the School of Arts and Sciences at the Lebanese American University. His research interests span high-level synthesis, design automation, parallel computing, machine learning, and applied artificial intelligence. Throughout his career, he has led and contributed to multiple institutional initiatives in academic program development, accreditation, research infrastructure, and strategic planning. Dr. Harmanani has published extensively in the areas of design automation and optimization techniques for hardware–software systems, and he has supervised numerous graduate and undergraduate research projects in computing and data-driven systems.

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Abstract

This paper presents the design of a Liberal Arts and Sciences Curriculum at a private university classified as a Master's College and University — Larger Programs, according to the Carnegie Classification system. The curriculum integrates critical themes that are closely aligned with the United Nations' Sustainable Development Goals [1]. Adopting a constructivist approach [2], the curriculum emphasizes learning through experience, participation, and reflection [3], fostering interdisciplinary thinking and equipping students with the intellectual tools needed to address complex global challenges [4].

A key feature of the curriculum is the integration of social issues as a critical lens, enabling students to analyze social inequities and advocate for inclusive societies [5]. Artificial intelligence is also a central focus, addressing the transformative influence of technology on human interaction, identity, and knowledge production. Sustainability, social justice, and global responsibility are woven throughout the curriculum to align with the SDGs, ensuring that students are equipped to tackle pressing contemporary issues. This interdisciplinary approach aims to cultivate informed, adaptable, and ethical graduates prepared for civic engagement, holistic education, and leadership in a diverse and interconnected world.

1 Introduction

Established as a liberal arts college, the University has always adopted a strong liberal arts model that fosters intellectual, personal, and professional growth among its students. The model followed a traditional approach, emphasizing a strong foundation in core disciplines such as literature, history, philosophy, mathematics, and the natural sciences. While this classical approach provided students with a broad base of knowledge and fostered essential skills in critical thinking, communication, and analysis, it lacked an interdisciplinary focus–a crucial element for addressing complex, interconnected contemporary issues like climate change, globalization, and technological advancements. These issues require an integrated understanding of scientific, social, economic, and ethical dimensions, often absent from traditional curricula. Additionally, the program did not sufficiently consider the social and economic policies impacting Earth, its resources, inhabitants, and environments, creating a critical gap in preparing students to address urgent global challenges.

Consequently, beginning in Fall 2019, the university embarked on a transformative process to

implement a new approach to liberal education designed to be: 1) aligned with the United Nations' Sustainable Development Goals (SDGs) [1]; 2) encompassing essential digital skills [6]; and 3) grounded in experiential learning [6].

A university-wide committee was formed, leading to the development of a new, modern curriculum that integrates interdisciplinary perspectives and addresses the complex challenges of the 21st century. The curriculum was piloted in Fall 2021 and implemented in Fall 2024, now becoming a requirement for all students at the university.

2 Liberal Arts and Science Curriculum Design Process

The new curriculum aligns liberal arts competencies with global frameworks such as the Sustainable Development Goals (SDGs) and the Engineering for One Planet (EOP) initiative. This alignment is intended to equip students with competencies in artificial intelligence while fostering critical awareness of interconnected global challenges, including sustainability, poverty, quality education, climate action, gender equality, and responsible consumption. To guide its development and implementation, a steering committee was established, and the curriculum was designated the Liberal Arts and Sciences Curriculum (LASC) to underscore its interdisciplinary character and the integration of diverse academic fields.

The curriculum was developed through active collaboration with stakeholders, including faculty, students, and local industry professionals, to identify gaps in the existing Liberal Arts Curriculum (LAC) and address future needs. A university-wide committee drafted the program's measurable student outcomes, while the steering committee oversaw the design and implementation of courses to ensure alignment with the curriculum's overarching objectives.

The LASC framework is directly informed by current global development trajectories, which reveal stalled or uneven progress across multiple SDGs. Key challenges, including accelerating climate change, widening socioeconomic inequality, and persistent food and water insecurity, are compounded by conflict, political instability, and the weakening of public institutions in vulnerable regions. Environmental degradation, rapid urbanization, and unsustainable consumption patterns further exacerbate systemic pressures. Simultaneously, technological inequities and chronic underfunding impede the ability of many states to operationalize SDG-aligned policies. These converging dynamics highlight the necessity of integrated, data-driven, and equity-centered educational models. LASC responds to this imperative by embedding interdisciplinary inquiry, ethical reasoning, and global responsibility at the core of its design, thereby preparing graduates to address complex challenges within an increasingly interconnected world.

2.1 Liberal Arts and Science Student Outcomes

A key challenge was developing the liberal arts and sciences curriculum within a unified, modern framework incorporating experiential learning opportunities [7], community engagement, and collaborative projects, thereby enabling students to apply their learning in real-world contexts. The updated student outcomes of the LASC are organized into distinct yet interconnected groups. They are:

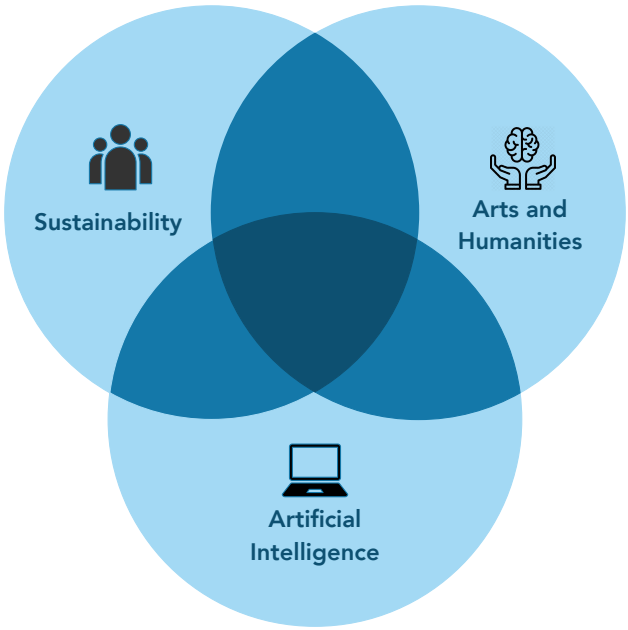

Figure 1: Proposed LASC Dimensions

1. Demonstrate knowledge, abilities and dispositions necessary for the continuing study of the worlds, peoples, arts, environments, literature, cultures, sciences and institutions.
2. Appraise substantial knowledge, abilities and dispositions through an interdisciplinary lens.
3. Value intercultural knowledge and competencies in addressing local and global issues.
4. Construct coherent arguments, counterarguments and rebuttals needed for engaging in decision-making and problem solving.
5. Articulate ideas using a variety of contexts and modes of communication.
6. Analyze evidence related to complex local and global problems.
7. Integrate informational resources and technology in exploring of individual and societal issues.
8. Synthesize learning through a culminating experience.
9. Suggest creative solutions on open-ended local and global problems.
10. Apply ethical standards required to enter into the professional world.
11. Demonstrate commitment to the sustainability of the world.

The above student outcomes will equip students with the knowledge, skills, and habits of mind essential for meeting workplace demands and contributing meaningfully to society [8, 9].

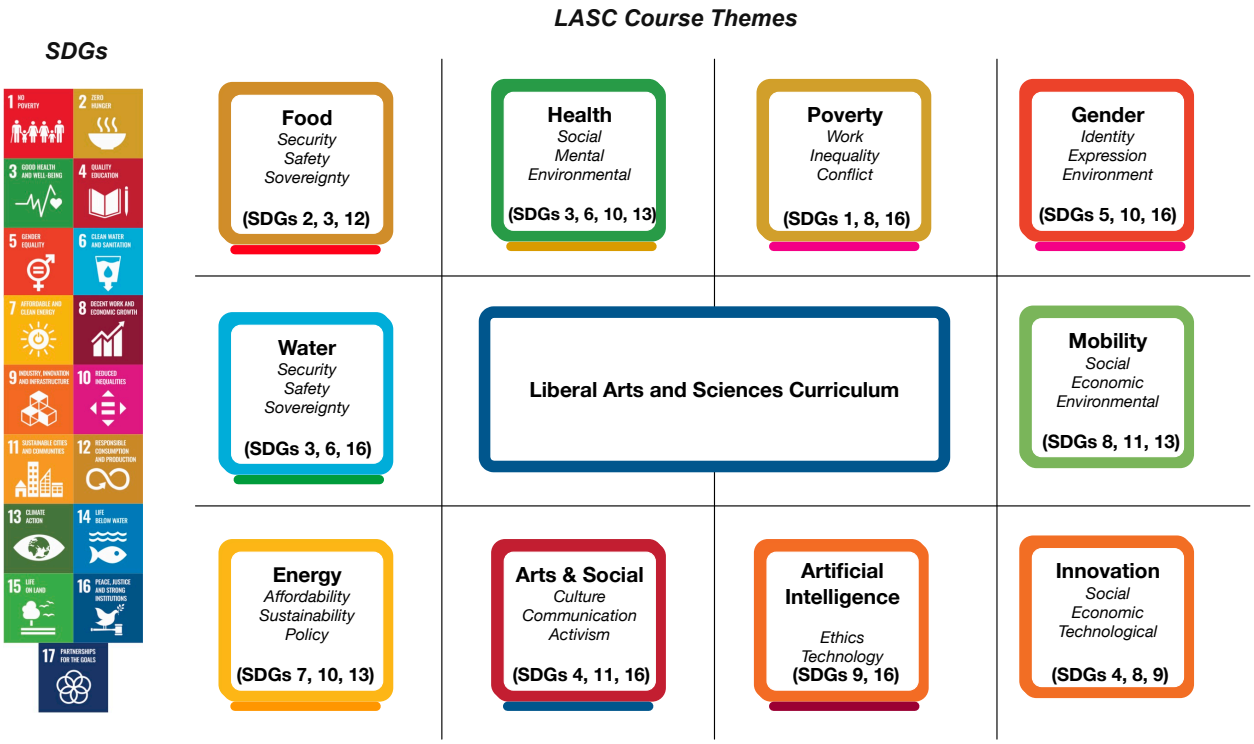

Figure 2: Alignment of LASC Course Themes with Relevant SDGs

2.2 Curriculum Framework

The LASC prepares graduates to be not only knowledgeable but also actively engaged in advancing the principles of sustainability and social justice in their personal and professional lives. As illustrated in Figure 1, the LASC is structured around the following dimensions:

1. *Sustainability*: This dimension aligns closely with the SDGs [10] and EOP [6], emphasizing interdisciplinary knowledge, sustainability, and social responsibility. It promotes inquiry, self-reflection, and critical thinking based on case studies that are anchored in the 17 sustainable development goals (SDGs) that provide a ”blueprint to achieve a better and more sustainable future for all.”[1] The dimension was coined as the *Change Makers* series and is the cornerstone of the LASC.

2. *Arts and Humanities*: This dimension includes foundational knowledge in the humanities and arts, with a strong emphasis on developing written and oral communication skills.

3. *Artificial Intelligence*: This dimension includes topics essential for employment and 21st-century competencies, including emerging AI technologies such as using large language models (LLMs); the ethical, social, and professional implications of AI.

The curriculum moves away from the faculty ownership model of courses to a more collaborative, module-based approach, where multiple faculty members contribute to teaching a given course. Each module will incorporate at least one case study, encouraging students to engage in inquiry and critical thinking while fostering a deeper understanding of the course content. These case

studies provide students with the opportunity to apply theoretical knowledge to real-world scenarios, sharpening their problem-solving skills and enhancing their ability to analyze complex issues.

2.3 Courses Development

A call for course proposals was issued to faculty members across the University, encouraging the design of innovative content that integrates SDGs themes. Proposals underwent a thorough review and were approved by the Steering Committee based on their alignment with the LASC objectives, outcomes, and potential for impact.

To support this initiative, a grant was secured to provide financial and logistical assistance to faculty, enabling them to dedicate time and resources to developing high-quality educational materials. Compensation was provided for the creation of lesson plans, case studies, and teaching materials designed to foster an engaging, hands-on learning experience. This was essential for establishing a cohesive, project-based learning approach across the University's various sections.

The courses were developed collaboratively by faculty from diverse departments, including engineering, computer science, sociology, environmental science, nutrition, and ethics. The planning process drew from established educational frameworks like EOP (Engineering for One Planet) and gathered input from industry professionals, policymakers, community leaders, and students through surveys and focus groups.

Figure 3 shows some partial assessment results from the first year. These results were collected from the following outcomes and indicators:

1. SO.1. Performance Criterion: Examine the student's familiarity with newly introduced terminology and definitions (In general on sustainability and focusing on water security)
2. SO.4. Performance Criterion: Prepare a persuasive argument for an advocacy speech
3. SO.5. Performance Criterion: Complete a critique of a social media speech
4. SO.6. Performance Criterion: Respond to knowledge-based assessment questions that connect the concepts of food systems, healthy diets and sustainability
5. SO.7. Performance Criteria: a) A case study that uses Python in order to analyze a social issue, and b) a case study that tackles an artificial intelligence solution for a specific real-life scenario
6. SO.8. Performance Criterion: Analyze the social implications and risks in a digital culture case study
7. SO.9. Performance Criterion: Produce a situational analysis paper proposing reforms and solutions to enhance the sustainability of food systems in an assigned country or region
8. SO.10. Performance Criterion: Apply ethical standards necessary for entering the professional world

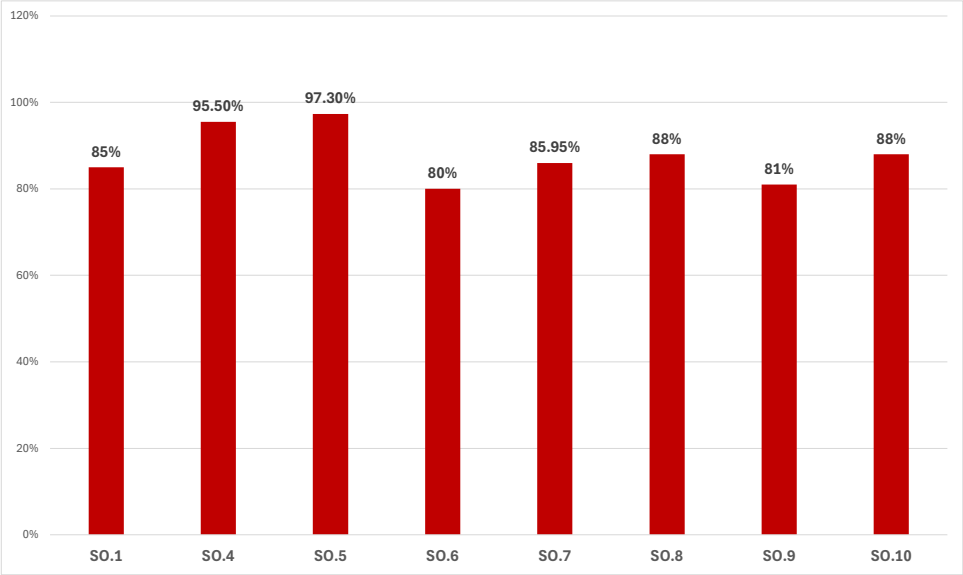

Figure 3: Some Initial Assessment Results

The assessment results in Figure 3 demonstrate strong alignment between learning outcomes and assessment methods, effective curriculum delivery, and high levels of student achievement. Overall student performance across the evaluated Student Outcomes (SOs) is consistently strong, with achievement levels ranging from 80% to 97.3%. The highest attainment was recorded for SO.5 (97.3%) and SO.4 (95.5%), indicating exceptional student mastery and suggesting that instructional strategies, assessment design, and curricular alignment in these areas are highly effective. Strong performance was also observed in SO.8 (88%), SO.9 (88%), and SO.7 (85.95%), all exceeding common institutional benchmarks and reflecting solid competency development.

Relatively lower—though still satisfactory—results appear in SO.1 (85%), SO.6 (81%), and SO.10 (80%). Although these scores remain above acceptable thresholds, they point to potential areas for refinement in instructional emphasis, assessment clarity, or student preparation. For continuous improvement, a focused review of SO.6 and SO.10 may help identify opportunities for pedagogical enhancement, strengthened formative feedback, and targeted curricular reinforcement.

2.4 Assessment

Assessment and evaluation play a critical role in the success and continuous improvement of the proposed program. Each individual course is reviewed every time it is offered to ensure its alignment with learning objectives, relevance, and effectiveness. Additionally, the overall program will undergo a comprehensive evaluation at the end of each cycle. Currently, a cycle is defined as three years, with the first cycle set to conclude by the end of 2026.

To measure the program's effectiveness, the LASC student outcomes have been mapped into specific, fine-grained performance criteria, which are mapped to individual courses within the program. Data is being actively collected from these courses throughout the cycle, enabling

ongoing tracking of student progress and performance. At the end of the cycle in Spring 2026, the program will undergo a comprehensive assessment, with the data used to evaluate the achievement of ABET outcomes 2, 3, 4, and 5. This evaluation will be most effectively conducted using the case studies, which provide students with the opportunity to collaborate in teams while analyzing key engineering challenges and issues.

3 Curricular Focus Areas

The curriculum integrates interdisciplinary topics, blending technical knowledge with societal issues like climate change. Sustainability is woven across disciplines, not confined to isolated courses. For example, sustainable energy courses incorporate sociology, political science, economics, and policy, while sustainable food systems cover both environmental impacts and social justice. Topics are organized under sustainability principles, grouped into various focus areas as shown next.

3.1 Artificial Intelligence

This component introduces students to the landscape of Generative Artificial Intelligence (Gen AI) through a multi-disciplinary lens. Rather than focusing solely on technical proficiency, the component emphasizes the intersection of AI with human expression, ethics, and philosophy. Students engage in practical workshops covering topics such as prompt engineering and AI-assisted creative writing—while simultaneously critiquing the societal impacts of the technology, including algorithmic bias, deepfakes, and the future of labor.

3.2 Water-Energy-Food

This component explores the interdependencies between water, energy, and food systems, promoting a systems-thinking approach. Students engage in real-world projects that examine how efficient resource management in one sector impacts the others, such as optimizing water use in agriculture, developing renewable energy for food production, and creating integrated strategies for resource efficiency.

3.3 Sustainability and Climate Justice

This component explores the intersection of climate change, environmental policies, and social justice, focusing on how marginalized communities are disproportionately affected by environmental degradation. The curriculum highlights ”just transitions” and ensures climate solutions benefit vulnerable populations.

3.4 Ethical and Social Aspects of Sustainability

In this area, students critically examine the ethical dimensions of engineering and sustainability, exploring the social and environmental impacts of their work. They assess the implications of climate mitigation technologies and the responsibility of engineers in advocating for sustainable practices.

3.5 Digital Cultures

This area explores the transformative impact of digital technologies on societies, focusing on the relationship between technology and culture. Students are introduced to social sciences while examining how these technologies shape society. The area also addresses key risks, including digital media, computer crimes, and the manipulation of public opinion.

3.6 Activism and Social Change

This area explores how visual media can be used for activism and political expression, while emphasizing critical thinking in media consumption and creation. Students develop skills to analyze digital content and engage responsibly with digital platforms. The area also explores how media shapes public perceptions, political discourse, and social norms, focusing on issues like media ownership and representation.

3.7 Gender and Social Equality

This area focuses on gender roles, equality, and discrimination, exploring how gender is shaped by cultural, social, and historical contexts. It examines the influence of media representations on public perceptions and social norms, as well as strategies for achieving workplace equity. Additionally, the area prepares students to address and resolve gender-based conflicts, equipping them with the tools to navigate and promote gender equality in various settings.

3.8 Social Wellbeing and Change

This area focuses on the various factors that contribute to both individual and collective well-being, emphasizing the importance of physical, mental, and social health in fostering a thriving society. It encourages students to critically engage with social justice issues, exploring the root causes of inequality and the ways in which social, economic, and environmental factors impact well-being. The area also challenges students to think creatively and explore innovative solutions to contemporary social challenges, such as poverty, access to healthcare, and education.

3.9 Migration and Development

This area offers an overview of global migration patterns and their effects on individuals and societies, while also exploring the complex relationship between poverty, economic development, and human well-being. It encourages students to critically assess sustainable strategies for poverty alleviation and highlights the importance of addressing global challenges through interdisciplinary solutions.

4 Implementation and Teaching Methods

The LAS Curriculum (LASC) fosters cross-disciplinarity, complexity, and contextual understanding through several evidence-based approaches. Student-centered learning, including group projects, discussions, and independent research, encourages collaboration across

disciplines to address complex challenges. Research shows that student-centered pedagogies improve engagement, retention, and the development of higher-order thinking skills [11].

The curriculum deliberately integrates theory with practice, offering real-world applications through internships, case studies, and community-based projects. Experiential learning has been shown to strengthen students' ability to transfer knowledge to novel contexts, particularly in sustainability and interdisciplinary fields [12].

The LASC has also developed online components for two courses. Students engage in one hour of online learning per week alongside two hours of in-person interaction. This hybrid modality not only streamlines learning across multiple sections but also enhances students' contextual understanding of global sustainability issues. Research on blended learning demonstrates that combining online and in-person engagement improves flexibility, accessibility, and critical engagement with content [13].

Active learning strategies, such as project-based learning, engage students in real-world sustainability projects. Contextualized education helps students understand how regional and cultural factors influence adaptation strategies, aligning with literature emphasizing the importance of culturally responsive pedagogy for complex problem-solving [14]. By preparing students to navigate competing priorities and contradictions in sustainability-related work, the curriculum fosters critical thinking, ethical reasoning, and decision-making skills, which are essential competencies in interdisciplinary sustainability education [15].

Finally, the University organizes a bi-annual student conference, where students present and discuss their projects. Research indicates that opportunities for public presentation and peer feedback enhance learning, reflection, and communication skills. One edition was held in the pilot year, and the Spring 2026 session will feature a major conference to culminate the year, further supporting students' synthesis of knowledge and professional development.

5 Conclusion

This paper presented the design of the Liberal Arts and Sciences Curriculum (LASC) as a forward-thinking framework for engineering and higher education. Rather than focusing on isolated themes, the LASC was structured around clearly defined curricular dimensions and focus areas that integrated sustainability, arts and humanities, and artificial intelligence within a coherent interdisciplinary model. Aligned with the United Nations' Sustainable Development Goals (SDGs), the curriculum addressed pressing global challenges while embedding these priorities across courses, learning outcomes, and assessment strategies. Grounded in a constructivist philosophy, the LASC emphasizes experiential learning, interdisciplinary inquiry, and critical reflection, equipping students with the intellectual, ethical, and analytical tools needed to navigate complex societal and technological landscapes.

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