

## **Pedagogical methodologies to achieve SDGs in developing economies**

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### **Abstract**

Aiming to achieve the Sustainable Development Goals requires alternative thinking modes, cultural approaches and behavioral practices. This is particularly relevant in developing economies that face considerable challenges at the social, economic and environmental levels. Higher educational platforms provide opportunities to address and promote such changes. Students, within a university context, are encouraged to engage in academic subjects and with knowledge disciplines that are different from their intended areas of study. For example, students at the Maroun Semaan Faculty of Engineering and Architecture (American University of Beirut) who are interested in cross-disciplinary work addressing the built environment can take two courses that develop the complementarity of their specializations.

“Environmentally responsive buildings” is a course where Architecture, Civil Engineering and Mechanical Engineering students address the quality of the current built environment using the way natural systems work as an inspiration to improve the quality of communities and the sustainable aspects of buildings and their surroundings. This interactive course is supported by the Climate Design Unit, a lab that provides possibilities for hands on investigations and real life simulations of issues pertaining to climate and buildings. The second course “Scales of sustainability” has a seminar format where students present and critically discuss issues relevant to the Sustainable Development Goals at both global and regional / national scales.

The aim of this paper is to reflect on the methodology associated with the two teaching courses by presenting two different models of course delivery, illustrating their outputs and assessing the pedagogical process in terms of the course learning outcomes. The paper will also discuss the opportunities of involving students with ongoing research initiatives such as the optimization of building form to reduce incident solar radiation, the different construction methods, such as rammed earth & vernacular walls as well as the study of the dynamic profile of energy use in the Mediterranean city of Beirut. The intent of engaging students within a high-level academic context is to train them to develop thinking frameworks that will enable them to address complex interrelated issues, similar to the ones that they will confront in their professional life.

### **Introduction**

The state of planet Earth requires acute attention due to the overwhelming degradation of the natural environment. In view of this fact, the last initiative of the UN General Assembly

was to adopt, on September 25, 2015, the 17 Sustainable Development Goals (SDGs).<sup>1</sup> The SDGs are overarching and reach out to almost all aspects of societies, addressing social, economic and environmental issues all of which need to be managed within fair and equitable governance<sup>2</sup>. Achieving the SDGs requires alternative thinking modes, cultural approaches and behavioral practices. Higher educational platforms provide opportunities to address and promote such changes<sup>3</sup>. Students, within a university context, are encouraged to engage in academic subjects and with knowledge disciplines that are different from their intended areas of study. This would help them develop capabilities that allow them to make informed decisions and advocate for change during their professional careers. This is particularly relevant in developing economies that face considerable challenges at the social, economic and environmental levels.

Several studies have addressed the importance of the university setting in promoting SDGs by offering opportunities to learn sustainability values, attitudes and behaviors through comprehensive approaches that integrate learning with practical experiences while stressing the importance of collaboration<sup>4</sup>. Sonetti, Brown and Naboni, for example, identified the university as a context where the transition of values can take place<sup>5</sup>. Following a thorough investigation on the integration of a regenerative approach into higher education, the authors focused on two dimensions: engaging in the educational aspect of sustainability and its relation to the civic sense, and promoting applied experiences where students and staff could practice sustainability in day-to-day activities on campus. Trott, Weunberg and McMeeking looked at how higher education enables the academic development of achieving sustainable development goals of undergraduate students by providing research approaches through community engagement<sup>6</sup>. This method, of building relationships and networks between students, researchers and the public society, brings about action-oriented behaviors that are instrumental in transforming communities.

The importance of a holistic approach was further emphasized in several studies concerned with assessing particular aspects of sustainability. A study by Akins et al identified barriers and opportunities for sustainability execution at Kennesaw State University in the USA<sup>7</sup>. Although the analysis pertained to a particular context, the conclusions provided insight about how change agents can alter behavior and actions in order to promote the successful implementation of sustainable development. Zamora-Polo, Sanchez-Martin, Corrales-Serrano and Espejo-Antunez found that, in general, students have a weak perception of sustainable development goals<sup>8</sup>. The authors pointed to the need for developing transversal student competences, by integrating the components and issues integral to the sustainable development goals in many courses

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<sup>1</sup> "Transforming Our World"; Sachs, "From Millennium Development Goals to Sustainable Development Goals."

<sup>2</sup> Griggs et al., "Sustainable Development Goals for People and Planet."

<sup>3</sup> Ferrer-Balas, Buckland, and de Mingo, "Explorations on the University's Role in Society for Sustainable Development through a Systems Transition Approach. Case-Study of the Technical University of Catalonia (UPC)."

<sup>4</sup> Ferrer-Balas, Buckland, and de Mingo.

<sup>5</sup> Sonetti, Brown, and Naboni, "About the Triggering of UN Sustainable Development Goals and Regenerative Sustainability in Higher Education."

<sup>6</sup> Trott, Weinberg, and Sample McMeeking, "Prefiguring Sustainability through Participatory Action Research Experiences for Undergraduates."

<sup>7</sup> Akins et al., "Sustainability Education and Organizational Change."

<sup>8</sup> Zamora-Polo et al., "What Do University Students Know about Sustainable Development Goals?"

and at all instructional levels. Dlouha et al. examined the possibility of integrating cognitive, socio-emotional and behavioral learning domains within the higher education process<sup>9</sup>. Their aim was to re-question the traditional pedagogic approach to scientific training that addresses the three domains independently. The study concluded that higher education should focus on methodologies that build on the interdependence of “competence-oriented teaching” and relevant pedagogies. Similarly, in their study on tools and indicators that assess the impact of higher education institutions on sustainable development, Findler, Schonherr, Lozano and Stacherl, found that high-level education remains compartmentalized and that a more comprehensive approach would be instrumental in strengthening the contribution of higher education to sustainable development<sup>10</sup>.

Other essential components to enable sustainability include networking and governance as discussed in Oyama, Pasquier and Mojica who looked at the challenges that face the integration of sustainability in the National Autonomous University in Mexico<sup>11</sup>. The context of Mexico is representative of a public University in the global South. The study argued that a key factor in integrating sustainable initiatives is the lack of articulation between institutions at the University. The successful integration requires the modification of governance and the identification of the organizational development so that the transformational process towards sustainability is continuous and can be sustained over a long timeframe. These ideas are reinforced by Kahle, Risch, Wanke and Lang who presented two case studies that used an analytical framework to highlight the associated benefits.<sup>12</sup> The successful and continuous network operation in higher education is based on a number of parameters including governance structures, modes of interaction, definition of roles and decision making based on consensus. Moreover, enhanced outcomes can be supported by enabling and enhancing the exchange of knowledge between different actors in the institution.

A few papers focused on best practices by referring to specific applications such as courses,<sup>13</sup> curriculum<sup>14</sup> and modes of transportation<sup>15</sup>. In an attempt to expand the engagement of students in the subject of sustainability, a study at the University of Toronto set out to create an inventory of undergraduate sustainability courses clustered by learning type as well as a list of faculty members that teach courses related to sustainability and community engaged learning.<sup>16</sup> Designed to enhance students’ involvement in sustainability programs, the study allowed students to focus on community engagement opportunities by enrolling in courses addressing sustainability, connecting with instructors, as well as increasing opportunities for application outside the classroom. A study by Dehghanmongabadi and Hoskara at the Eastern Mediterranean University looked at initiatives and recommendations that are good practices of sustainable for transportation strategy within the European Platform on Sustainable Urban Mobility Plans under the

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<sup>9</sup> Dlouhá et al., “Competences to Address SDGs in Higher Education—A Reflection on the Equilibrium between Systemic and Personal Approaches to Achieve Transformative Action.”

<sup>10</sup> Findler et al., “Assessing the Impacts of Higher Education Institutions on Sustainable Development—An Analysis of Tools and Indicators.”

<sup>11</sup> Oyama, Pasquier, and Mojica, “Transition to Sustainability in Macro-Universities.”

<sup>12</sup> Kahle et al., “Strategic Networking for Sustainability.”

<sup>13</sup> Brugmann et al., “Expanding Student Engagement in Sustainability.”

<sup>14</sup> Chowdhury and Koya, “Information Practices for Sustainability.”

<sup>15</sup> Dehghanmongabadi and Hoşkara, “Challenges of Promoting Sustainable Mobility on University Campuses.”

<sup>16</sup> Brugmann et al., “Expanding Student Engagement in Sustainability.”

Urban Mobility Observatory<sup>17</sup>. Although the study showed that there were more barriers than motivations to adopting alternative modes of transport commuting to and from the campus as well as within the campus, it ended with a set of recommendations for promoting the implementation of a sustainable transportation scheme. The aim of the recommendations was to encourage students and staff to shift their behavior by adopting the proposed transport methods. A study by Chowdhury and Koya underlined the importance of information schools (iSchool) in promoting sustainable development goals<sup>18</sup>. The study continued to state that pursuing education at iSchools could help students and graduates play a key role in achieving the SDGs due to the knowledge acquired in the collection, management, use and sharing of information and data.

Therefore, although studies have discussed the benefits of integrating learning with collaboration and practical application, there appears to be no clear consensus on best practices in terms of course content and delivery or even the balance between theory and practice. Added to that is the fact that most of the literature cited in this paper comes from the perspective of developed economies where commitment to SDGs and efforts towards achieving the global goals are well under way. There is a need to focus more on emergent economies and the challenges faced by universities in that context. Therefore, the purpose of this paper is to reflect on two specific courses, addressing sustainability, that are taught within the Maroun Semaan Faculty of Engineering and Architecture (MSFEA) at the American University of Beirut (AUB) in Lebanon. The paper will describe the two courses in terms of content and course delivery, illustrate their outputs and assess the pedagogical process in terms of the course learning outcomes.

### **Study Design and Context**

AUB is an institution of higher learning whose mission is “to provide excellence in education, to participate in the advancement of knowledge through research, and to serve the peoples of the Middle East and beyond”<sup>19</sup>. Established in Lebanon since 1866, it currently consists of seven faculties and offers more than 130 programs taught mostly in English. The university as a whole is involved in multiple sustainability initiatives that relate to academics and community outreach. Most recently, AUB became a member of the sustainable development solutions network.

Students at the MSFEA, are involved in and deal with issues related to sustainable development in a number of ways. First, students are offered courses that address diverse aspects of sustainable development. Many of these courses include lab work that provides hands on experiences within the same subject domains. Second, students have the possibility to work with professors whose expertise lies in the fields of sustainability. Within the faculty, these fields include building design, renewable energy, efficient and optimized systems, water and energy systems, etc. Third, students have the option to participate in initiatives external to AUB, through the Center for Civic Engagement, competitions, neighborhood initiatives, and other activities.

Using a case study design this paper will describe two elective courses, offered at MSFEA with the aim of promoting sustainable thinking and practices. “Environmentally responsive

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<sup>17</sup> Dehghanmongabadi and Hoşkara, “Challenges of Promoting Sustainable Mobility on University Campuses.”

<sup>18</sup> Chowdhury and Koya, “Information Practices for Sustainability.”

<sup>19</sup> “AUB.”

buildings” is offered to Architecture, Civil and Mechanical students who are in their last or before last academic year. Some graduate students might also choose to take the course in order to strengthen their knowledge base pertaining to the performance of the built environment. This course is designed to provide undergraduate and graduate students with a deeper understanding of green building principles and to help them make a connection between the conceptual and the practical aspects of climate responsive and environmentally friendly buildings. The second course, “Scales of sustainability”, is a seminar course that is offered to fourth (last) year undergraduate as well as graduate Civil Engineering students. The course provides the students with a deeper and more enhanced understanding of the main dimensions of sustainability with an emphasis on urbanization. Students’ background and capacity to understand and process complex subjects (having completed three and a half years of studies in the engineering discipline or having an undergraduate degree in engineering) is instrumental and provides an advantage to study the different dimensions of sustainability in a more profound way. Students capacity to understand and manipulate complex engineering related mathematical concepts allows them to understand and calculate values related to energy, economy or other, with relative ease.

### **Description of Courses**

#### Environmentally responsive buildings

In this course, Architecture, Civil Engineering and Mechanical Engineering students work in groups to address the quality of the current built environment. The course includes topics such as the current construction methods as well as building concepts related to solar radiation, wind flow and daylight<sup>20</sup>. Particular focus is placed on the thorough understanding of the sustainable dimension of building materials by addressing the sustainable dimension of structures / materials in nature and the performance of materials. Other topics that inform student work include water in the environment, structural systems in nature and the critical assessment of building performance. The course will encourage the students to consider green options and to apply their knowledge of green buildings in their career.

The course starts with an assignment whereby students, working in groups that include different disciplines, analyze their choice on natural / animal made system. The intent is to understand how the system has evolved and they need to identify the environmentally responsive strategies. Then, each group would translate the way natural systems work and abstract the concepts to serve as an inspiration to improve the quality of communities and the sustainable aspects of buildings and their surroundings. The delivery of the course content relies on discussions and presentations using interactive methods such as online scorm lectures that present basic information as well as wiki lectures.

This interactive course is supported by the Climate Design Laboratory (CDL), a resource that provides possibilities for hands on investigations and real-life simulations of issues pertaining to climate and buildings. The CDL includes a heliodon, a wind tunnel, sensors and instruments to measure and log temperature, relative humidity and other environmental data as well as references.

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<sup>20</sup> Whitsett and Fajkus, *Architectural Science and the Sun: The Poetics and Pragmatics of Solar Design*; Whitsett and Fajkus; Hausladen, *Climate Design*; Moore, *Environmental Control Systems*; Szokolay, *Introduction to Architectural Science: The Basis of Sustainable Design*.

Typically, a group would build a three-dimensional study model and place it on the heliodon to study the impact of solar radiation. This interactive process would require a few iterations in order to fine tune the project's massing as per the assignment requirements (occupancy patterns, seasons, overshadowing, etc.). Once a reasonable and satisfactory configuration is achieved, the same study model is inserted in the wind tunnel in order to test for wind flow. Again, multiple iterations usually result in a suitable massing arrangement. Given the changes made to comply with wind flow, another solar test on the heliodon may be useful to ensure that the project adheres to the solar and wind requirements. Students find this interactive process useful because it helps them understand the repercussions of modifying the building massing of a project on its relationship to climate.

The Course Learning Outcomes are presented such that each student should acquire the ability to:

- Enhance the understanding and critical thinking pertaining to the subject of environmentally friendly buildings.
- Analyze and assess design proposals regarding their environmental performance.
- Understand the design process informed by applied research.
- Understand principles of passive strategies relating to orientation and building form.
- Consider, select, evaluate and implement the appropriate technical methods and processes in developing climate-responsive design solutions.
- Understand basic principles, appropriate application and performance of environmental systems as integrated in the building envelope.

These learning outcomes are assessed by two course assignments as well as a final exam. The first assignment focuses on people's behavioral aspect in today's society whereby, in most contexts, objects are consumed without a sensible understanding of the impact or repercussion such behavior has on the environment. In today's society, objects that require assembly and / or construction surround us. These entities range in scale from ships to buildings to cars to mobile phones, usb sticks, etc.

In order to better understand the impact that objects have on the environment, each student chooses an "object" and researches the environmental dimensions related to its assembly. The main issues to be addressed include the:

- history or evolution of the object, other issues of interest,
- design process,
- materials required to assemble the object,
- recycled content of the initial materials,
- recyclability of the materials in the object – at the disposal phase.

The deliverable is in the form of a digital report and an oral presentation that that opens the floor for discussions whereby the students can interact by comparing certain aspects of what was presented with their own researched object. The oral presentations present opportunities for students to improve their oral presentation skills and provide a platform for an informed discussion between students. In some cases when the communication becomes subjective and judgement based, introducing a technical question re-positions the discussion on a knowledge-based track that is based on the scientific course content.

The second assignment, which takes up most of the semester, is where the student groups translate abstracted concepts in nature and apply them to the built environment with the aim of proposing environmentally sensitive and low impact design ideas.

Given that this is not a design course, the students are asked to reflect on the methodology of a design process and to apply the understanding to a simplified set of parameters. The assignment starts with an investigation phase whereby each group is required to investigate a notion or a question relating to the design and construction of buildings. Examples of these notions are “what are alternative structures to make a building stand”, “how can buildings be cooled”, “how could an envelope relate to orientation”, “how does a building relate to the ground”, “how light can a building be”, etc. These notions need to be addressed within a strategic vision of sustainability. This phase is associated with an investigation of systems in nature. Student groups are asked to wander on the AUB campus (which is a botanical garden) and identify natural components that they find interesting in relation to the assignment.

The next phase in the process requires that each group visit the given site and identifies environmental aspects such as wind direction, relative humidity levels, incident solar radiation, shade cast by adjacent structures, the character of existing vegetation as well as the existence of noise generated in the vicinity of the site. The spatial program requirements (the functions to be included inside and outside the building) are defined by each group. The program can be modified as you address climatic issues.

Following this analysis, each group would establish a concept that addresses and/or engages with the notion investigated as in phase one. Subjects addressed in class, such as the integrated design approach, design in nature, response to climate, contemporary / future building methods, materials, etc. are concepts that may be integrated and developed within the projects.

In thinking about the proposals, it is important to develop a design that integrates passive design strategies: relating to the sun, relationship to wind flow, adequate daylight and that has a clear intent regarding the envelope design and materials, whereby the environmental aspect of the materials should be addressed.

The assignment ends with lab work where each group proposes a method to construct their project. The construction material that is proposed needs to be environmentally friendly and have a low environmental impact. A full sample of the proposed material is prepared in the Civil Engineering Laboratory and then tested for resistance to heat flow in the Mechanical Engineering Lab.

The final exam assesses the knowledge that students have acquired in several ways. Multiple-choice questions help in evaluating basic terms and definitions. Another part requires the students to propose concepts and ideas (in annotated sketch form) in response to a particular given set of parameters (such as site and building typology). This mimics their eventual involvement in a design team whereby their input would be valuable in guiding the climate responsive and environmentally friendly massing configuration of a project. A third part assesses students’ understanding of quantitative aspects of the building envelope by controlling the relationship between construction materials and the associated heat flow through this building component.

During the course, two professors meet with the students and talk to them about Water, Landscape and other integral components of a project. During the Q and A sessions, the professors address particular aspects of student projects.

One of the main course aims is to encourage a discussion between the three professional backgrounds. Given that there is little or no academic interaction between students as they pursue their respective disciplines, this course provides a much-needed platform for dialogue across their backgrounds. One example of such cross disciplinary discussion is when students are asked to reflect on and describe the term “building envelope”.

There is a sense of surprise when they hear each other explain the term. The architecture students relate more to construction materials, color, texture and window sizes and shapes. The mechanical engineering students refer more to pressure differences, vapor migration across the envelope assembly and solar radiation while the civil engineering students focus on structural stability, wind loads, seismic loads and relationship to other structural components. Once the student groups finish their descriptions, a discussion ensues whereby they examine synergies between their respective understandings while keeping in mind that a building envelope needs to satisfy all the mentioned issues.

### Scales of Sustainability

This course has a seminar format where students present and critically discuss issues relevant to the Sustainable Development Goals at both global and regional / national scales. The subjects include economic development, the industrial revolution and the diffusion of economy, waves of technological change, poverty and health, growth dynamics, energy, population, social inclusion, divided societies, health, planetary boundaries / threats on the environment, climate change, urbanization, urban resilience and biodiversity<sup>21</sup>. Discussions focus on understanding how the contemporary requirements and strategies of water, energy, transportation, materials, urbanization, etc. impact the human race at different scales. In addition to addressing these topics at a global level, the student researches the subject at a national or regional level and elaborates on the similarity or difference in trends between the global and local conditions.

After starting the course with a general discussion about sustainable development, each student is required to prepare and present a subject related to sustainability in the form of an interactive discussion. A typical session would start with the introduction of the day's topic. After that, the student starts his / her presentation, which, in most cases, is in digital format (such as a PowerPoint presentation). Since the discussion needs to be interactive, the students interrupt their presentation at key moments in order to ask a question, create an activity or request an informed opinion from the other students.

In one case, the student that was presenting handed out writing / drawing material and asked her classmates to form groups, think about a particular issue and then write down their feedback / proposals on large pieces of paper. The resulting discussion and exchange of ideas created an interactive, student based, motivating environment. In this case, the issue was to calculate the CO<sub>2</sub> emissions associated with different types of natural resources used to generate electricity. This led to a discussion on and assessment of national energy production methods.

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<sup>21</sup> The Worldwatch Institute, *Is Sustainability Still Possible?*; Sachs, *The Age of Sustainable Development*.



The course learning outcomes assume that at the end of the course, a student will be able to:

- Critically address topics of social, economic and environmental sustainability.
- Relate between the global and regional / local dimensions of sustainability.
- Assess the different topics within a broader perspective of human development.
- Explain the development of technology and agriculture over the past few centuries.
- Discuss the conditions that governed the diffusion of economy on the planet.
- Propose mitigation measures to allow the sustainable development of urbanization in the future.

The degree of a student's understanding is assessed during the presentation of assignments, the class discussions and the final exam. The required assignment is in the form of a research project. The theme of the work addresses the fact that many places on this planet are being restored to a better state after having been subjected to dramatic environmental disturbance. The aim of the assignment is to allow the student to acquire a thorough understanding relating to the process of, and reasons for, environmental devastation and its subsequent recovery and preservation - within the framework of sustainable development.

Each student is required to choose a site that was harmed by man in the recent future. The key parameter directing their choice of site is that the site needs to have been remediated. In parallel with researching the site, understanding its history and background, how man disfigured it and how the site was restored to its initial ecological balance, the students need to find a similar site, in this region, that has been scarred by man. The student will analyze a case study and to illustrate a thoughtful understanding of key sustainability (social, economic, environmental) issues. The research ends in trying to identify strategies that may be applicable to restoring the site to its initial condition given the different context, economy, environment and social setting.

The assignment should include all relevant research work to underline the case study's intellectual context as per the suggested outline:

1. Background: how did the context become damaged? What are the reasons that led to that state?
2. Process of recovery: What were the initiatives and decisions that led defined the remedial process?
3. Current state: How is the performance of the current context's condition?
4. Regional parallel: How does a scarred site in the region learn from the analysis above?

The final exam consists of several parts. Part one requires short and concise answers to questions That relate to key issues of ecology, economy and social context. In part two, students have to match the names of key people with their associated theories and/or concepts. Part three consists of calculation problems such as calculating the growth rate of an economy, the CO<sub>2</sub> ppm concentration as associated with economic growth, etc. Three of the fifteen questions relate to the urban condition and its repercussions on different contexts, either global or regional.

Students' capacity to critically understand, analyze and address with the issues included in the learning outcomes develops throughout the course. The class discussions that revolve around the three main pillars of sustainability (social, economic and

environmental) present numerous opportunities to investigate subjects from different perspectives.

### **Discussion**

This paper has focused on two courses offered at MSFEA as potential elective courses that students can choose to engage in. The courses are both focused on sustainable thinking and aim to encourage and promote sustainable behavior. However, the two courses differ in content, delivery and general aim. “Environmentally responsive buildings” equips students with knowledge about buildings and their impact on the larger built environment as well as the impact of the built environment on buildings. “Scales of Sustainability”, on the other hand, initiates a thorough understanding of social, economic and environmental issues on the planet, how we (inhabitants of planet earth) got to where we are and what are our options for the future. Although the course content goes deep into the main concepts of economic growth, food and agriculture, urbanization, health and poverty, the course remains an initiation to these subjects whereby the students would develop their knowledge base during their careers. Whereas the first course trains students in group work and team dynamics by building on their diverse background knowledge, the second focuses more on strengthening the students’ knowledge base and presentation skills.

The results of the University Instructor Course Evaluation System (ICE), allow an overall comparison of the students’ acceptance of the courses. Using a scale that ranges from 1 to 5 where 1 indicates and 5 represents, the UICES scores specific to the course evaluate the following five criteria:

- 1 – The course objectives were clear;
- 2 – The course content covered stated objectives;
- 3 – The course was appropriately organized and paced;
- 4 - The resources available were adequate (handouts, textbooks, readings, demonstrations,etc.);
- 5 – The assessment was appropriate to course content & learning outcomes.

The students complete this evaluation online, towards the end of the semester. “Environmentally responsive buildings”, scored 4.4 over 5, while “Scales of Sustainability”, got a score of 4.8 over 5. The scores on individual items were similar to the average score for the course.

In addition to the ICE scores, verbal feedback from the students and the fact that students keep requesting to enroll in the courses after the number has capped, shows that students receive the delivery of the courses in a positive manner.

Nevertheless, there is still room for improvement especially with regard to providing real-life experience and interactions that go beyond the university setting. Regarding “Environmentally responsive buildings”, it would be more interesting and enlightening for students to actually visit buildings and discuss / reflect on the particular climate responsive the construction material – associated subjects. Moreover, it would be beneficial to invite Architects and Engineers from the Professional industry to discuss the student projects during the mid and final presentations. Similarly, with respect to the “Scales of Sustainability” course, the sequence of discussions should to be modified to allow for three or four guests speakers to come and present their respective expertise to the students. These guests could include professionals with particular expertise related to a subject or

theme discussed in class, or people involved in governmental agencies such as the water directorate, energy directorate, Ministry of Public Works, etc.

Although the courses are delivered in indoor spaces, students are encouraged to complement their experience in the subject and expand their knowledge base by engaging in other initiatives. These include ongoing research projects such as the optimization of building form to reduce incident solar radiation, alternative construction methods (such as rammed earth & vernacular walls) as well as the study of the dynamic profile of energy use in the Mediterranean city of Beirut. The intent of engaging students within a high-level academic context is to train them to develop thinking frameworks which will enable them to address complex interrelated issues, similar to the ones that they will confront in their professional life.

## Conclusion

It is clear that it is important to address sustainability thinking and behavior at the university level. The university offers a platform to promote change and collaboration. However, it is still not clear where the efforts should start / focus. More work is needed on assessment tools, delivery methods and collaboration on all fronts. This is especially true in a developing context where countries are still dealing with issues of electricity and water shortages, access to drinking water, proper waste management techniques and an influx of displaced populations.

## References

- Akins, Edwin, Elizabeth Giddens, David Glassmeyer, Amy Gruss, Maria Kalamas Hedden, Vanessa Slinger-Friedman, and Matthew Weand. "Sustainability Education and Organizational Change: A Critical Case Study of Barriers and Change Drivers at a Higher Education Institution." *Sustainability* 11, no. 2 (January 2019): 501. <https://doi.org/10.3390/su11020501>.
- "AUB." Accessed August 1, 2019. <http://aub.edu.lb/AboutUs/Pages/default.aspx>.
- Brugmann, Rashad, Nicolas Côté, Nathan Postma, Emily A. Shaw, Danielle Pal, and John B. Robinson. "Expanding Student Engagement in Sustainability: Using SDG- and CEL-Focused Inventories to Transform Curriculum at the University of Toronto." *Sustainability* 11, no. 2 (January 2019): 530. <https://doi.org/10.3390/su11020530>.
- Chowdhury, Gobinda, and Kushwanth Koya. "Information Practices for Sustainability: Role of ISchools in Achieving the UN Sustainable Development Goals (SDGs)." *Journal of the Association for Information Science and Technology* 68, no. 9 (2017): 2128–38. <https://doi.org/10.1002/asi.23825>.
- Dehghanmogabadi, Abolfazl, and Şebnem Hoşkara. "Challenges of Promoting Sustainable Mobility on University Campuses: The Case of Eastern Mediterranean University." *Sustainability* 10, no. 12 (December 2018): 4842. <https://doi.org/10.3390/su10124842>.
- Dlouhá, Jana, Raquel Heras, Ingrid Mulà, Francisca Perez Salgado, and Laura Henderson. "Competences to Address SDGs in Higher Education—A Reflection on the Equilibrium between Systemic and Personal Approaches to Achieve Transformative Action." *Sustainability* 11, no. 13 (January 2019): 3664. <https://doi.org/10.3390/su11133664>.
- Ferrer-Balas, Didac, Heloise Buckland, and Mireia de Mingo. "Explorations on the University's Role in Society for Sustainable Development through a Systems

- Transition Approach. Case-Study of the Technical University of Catalonia (UPC)." *Journal of Cleaner Production* 17, no. 12 (August 2009): 1075–85. <https://doi.org/10.1016/j.jclepro.2008.11.006>.
- Findler, Florian, Norma Schönherr, Rodrigo Lozano, and Barbara Stacherl. "Assessing the Impacts of Higher Education Institutions on Sustainable Development—An Analysis of Tools and Indicators." *Sustainability* 11, no. 1 (January 2019): 59. <https://doi.org/10.3390/su11010059>.
- Griggs, David, Mark Stafford-Smith, Owen Gaffney, Johan Rockström, Marcus C. Öhman, Priya Shyamsundar, Will Steffen, Gisbert Glaser, Norichika Kanie, and Ian Noble. "Sustainable Development Goals for People and Planet." *Nature* 495, no. 7441 (March 2013): 305–7. <https://doi.org/10.1038/495305a>.
- Hausladen, Gerhard. *Climate Design*. Birkhauser, 2005.
- Kahle, Judith, Katrin Risch, Andreas Wanke, and Daniel J. Lang. "Strategic Networking for Sustainability: Lessons Learned from Two Case Studies in Higher Education." *Sustainability* 10, no. 12 (December 2018): 4646. <https://doi.org/10.3390/su10124646>.
- Moore, Fuller. *Environmental Control Systems*. New York: McGraw Hill, 1993.
- Oyama, Ken, Ayari G. Pasquier, and Edgar Mojica. "Transition to Sustainability in Macro-Universities: The Experience of the National Autonomous University of Mexico (UNAM)." *Sustainability* 10, no. 12 (December 2018): 4840. <https://doi.org/10.3390/su10124840>.
- Sachs, Jeffrey. "From Millennium Development Goals to Sustainable Development Goals." *The Lancet; London* 379, no. 9832 (June 9, 2012): 2206–11. [http://dx.doi.org.ezproxy.aub.edu.lb/10.1016/S0140-6736\(12\)60685-0](http://dx.doi.org.ezproxy.aub.edu.lb/10.1016/S0140-6736(12)60685-0).
- . *The Age of Sustainable Development*. New York: Columbia University Press, 2015.
- Sonetti, Giulia, Martin Brown, and Emanuele Naboni. "About the Triggering of UN Sustainable Development Goals and Regenerative Sustainability in Higher Education." *Sustainability* 11, no. 1 (January 2019): 254. <https://doi.org/10.3390/su11010254>.
- Szokolay, Steven. *Introduction to Architectural Science: The Basis of Sustainable Design*. London: The Architectural Press, 2004.
- The Worldwatch Institute. *Is Sustainability Still Possible?* New York: Island Press, 2013. "Transforming Our World: The 2030 Agenda for Sustainable Development." Accessed August 1, 2019. </resources/transforming-our-world-2030-agenda-sustainable-development>.
- Trott, Carlie D., Andrea E. Weinberg, and Laura B. Sample McMeeking. "Prefiguring Sustainability through Participatory Action Research Experiences for Undergraduates: Reflections and Recommendations for Student Development." *Sustainability; Basel* 10, no. 9 (2018): 3332. <http://dx.doi.org.ezproxy.aub.edu.lb/10.3390/su10093332>.
- Whitsett, Dason, and Matt Fajkus. *Architectural Science and the Sun: The Poetics and Pragmatics of Solar Design*. 1st ed. Routledge, 2018.
- Zamora-Polo, Francisco, Jesús Sánchez-Martín, Mario Corrales-Serrano, and Luis Espejo-Antúnez. "What Do University Students Know about Sustainable Development Goals? A Realistic Approach to the Reception of This UN Program Amongst the Youth Population." *Sustainability* 11, no. 13 (January 2019): 3533. <https://doi.org/10.3390/su11133533>.