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Global Projects: An Initiative to Train Chemical Engineering Students in Global Awareness

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Abstract

The United Nations General Assembly established a set of 17 goals in 2015 known as the Sustainable Development Goals (SDGs). They inspire concerted efforts around the world to be accomplished by the year 2030. Goal 17, "Partnerships for the Goals", embraces the fundamental strategy to achieve all the goals by the effective collaboration of all nations, institutions, organizations, and individuals. It relies on extensive global awareness as the fundamental ground to build the recognition of diversity and inclusion; striving to consider every perspective in our shared world.

Academic institutions, particularly colleges and universities, should take leadership roles in educating the upcoming generation of professionals and leaders to accomplish this mission. Engineering schools and departments are required to demonstrate these as educational outcomes for their students. Specifically, Student Outcomes 2, 3, and 4 of ABET Criterion 3, all involve awareness, communication, and consideration of global contexts. This is critical to address the Sustainable Development goals as the students make up the future workforce in charge of advancing technical solutions for a better and sustainable world.

This paper discusses a three-year experience in the Chemical Engineering Department, with the participation of 162 college students, in 33 projects, as a curricular requirement for a capstone course. The project provided a unique opportunity for students to become acquainted with problems around the world and to challenge them to consider multiple solutions. Student teams collaborated with foreign organizations (in the country they chose to address a problem) to analyze and propose solutions for challenges in that country.

Activities are organized during the entire semester following project management techniques. They include an early presentation of the proposal, a scheduled progress report presentation, a poster, and a final presentation. Foreign partners are asked to provide their reflections on the experience. All classmates review and peer grade every deliverable from other teams. Students evaluate their teammates' performance and provide a self-assessment of their individual experience at the end of the course. A ChE Global Day was held at the end of the semester to display the posters and presentations to a broad audience with the support of university offices and centers focused on global experiences and international relations. Students earn up to 10% of the definitive grade of the course for these global engagement projects. This approach has proved to be fully sustainable, and with an overwhelming satisfaction of all the participants.

It is important to note that the incorporation of a virtual platform during COVID-19 and the continuous monitoring and coaching by the instructor are producing best practices to foster communication between students and stakeholders.

Introduction

The final goal of the UN Sustainable Development Goals [1] is #17 "Partnership for the goals". In a certain way, this goal embraces all the other by strengthening the fact that better and faster results

are obtained by collaborating with multiple stakeholders. The process of partnering is grounded on the knowledge individuals develop or the unique context each partnership brings about. As it is stated, [2] no better knowledge can develop than from the actual experience of doing it.

This study aims to bring that experiential context to senior students in chemical engineering ready to graduate and take increasing responsibility to build a better and more sustainable world. It addresses both the sustainable development goal #17 and our goal in creating effective engineers (ABET criteria 3) by allowing them to engage in partnerships that require trust building and co-creation [2]. Global awareness, consideration, and communication is embedded in three of the seven student outcomes used by ABET to evaluate engineering programs. Specifically, outcomes 2, 3 and 4 can be found below:

- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as **global**, cultural, social, environmental, and economic factors
- an ability to **communicate effectively with a range of audiences**
- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in **global**, economic, environmental, and societal contexts

Finally, the project seeks to provide a systematic approach that can be institutionalized thus offering academic institutions an option for significant contributions to reach the Sustainable Development Goals while educating their engineering students. As an example of partnership between academia, communities, industry, and individuals this model may serve as an effective way for universities to translate new knowledge into practice for international scenarios

Project Description and Context

The project is part of the capstone course for senior students in chemical engineering on Process Control. Certainly, it would be part of some other course. However, the choice for this course is based on several advantages. It is taken by all the senior students once a year, so all of them can share the same learning experience. Students reach this point in their career where they know each other well enough to form teams with shared personal perspectives. They are more mature to address issues outside the classroom and to feel more comfortable on exposing to external environments. They are at the point of becoming professionals that will soon engage in broad industrial and social interests. In addition, this course addresses the basics of Process Control Theory, mainly the focus on the "feedback" concept. Lectures include references to the broad application of this concept to ecological, medical, and social sciences. Students are encouraged to identify "problems" as "deviations" from a certain "desired target", and to use that difference to compare with a certain "aspiration" (setpoint), and to imagine a "control" mechanism over selected ("manipulated") variables to adjust the "performance" towards "goals" ("controlled variables"). Though the projects are not required to be specifically "process control" based, they are supported by the background briefly mentioned here.

The project consists of a sequence of steps and deliverables (Table 1) that begins with the instructor introducing the motivation and the scope of the project and expanding on the content presented in

the syllabus in the first day of classes. The instructor also addresses the format for the project by describing the deliverables, grading and, expectations for team performance. Details can be seen in Table 1 and the descriptions below it.

Table 1. Project schedule and grading

Activity/Product	Week	Grading	
		Type	%
Introduction, scope, and rubrics (by the instructor)	1	-	-
Topic proposal and foreign partner (3-min pre-recorded presentation)	2	Peer	10
Progress report (3-min pre-recorded presentation)	4	Peer	10
Project Management follow-up (plan, logbook, MS TEAMS space)	2-14	Inst.	20
Poster	13	Peer	20
Presentation (6-min pre-recorded)	14	Peer	20
Self-assessment (three pp)	14	Self	20

The first deliverable is submitted in week 2 following the formation of the team and the brainstorming for the potential initiatives. It is a short (3-min) pre-recorded proposal presentation on the topic, *describing a problem or opportunity in a foreign country*, and the identification of the foreign partners. Students expand on their motivation for the selection of the topic, partner, and its potential impact. We started with live class presentations in the initial year, but we moved to pre-recorded versions due to the pandemic. We have adopted this method moving forward given the added flexibility for team management and additional time saved for in-class lectures. The second deliverable (week 4) is another short, pre-recorded presentation to highlight the progress on the project and the main difficulties and solutions to develop it.

The third deliverable is a project management follow up that was added in the third iteration of the course. Students were requested to develop their activities/schedule/documents in MS TEAMS (other than in-person meetings) when possible. There they developed their deliverables as collaborative pages (documents, slides, spreadsheets) and held their virtual meetings. In addition, this space provided opportunities for asynchronous community (i.e., chatting and posting of messages). The instructor played the role of coach in every team. The instructor provided feedback, advice and, suggestions for next steps. The instructor also available for individual or group meetings to follow up on more project specifics.

Students were also required to develop two project management tools: a plan and a logbook. Both are living documents enriched with frequent posts, at minimum once every week. Each plan schedule started in the second week detailing the main activities, deadlines, roles, and responsibilities as students envisioned the start of the project. The students are requested to provide updates and additions as the project progressed, and as they deemed convenient. The logbook recorded more detail on individual and team main activities, comments on critical issues, justifications for delays, and any other relevant notes for track the progress of the project.

The fourth deliverable was a poster. Students summarized the problem, analysis, and proposed solution in a one-page poster (about 30”x 40” in size), with the identification of team members

and foreign partners. We added this required deliverable for the second edition of the project to provide students with training on visual communication and technical presentations. These posters also serve as an archive for future students and a promotion for outreach programs for future audiences.

The fifth deliverable was a final presentation (6-min, pre-recorded) highlighting the main findings and a proposed solution. Presentations needed to consider the impact of the proposed solution in global, social, environmental, economic contexts and ethical impact, as requested by ABET in outcomes two and four for criterion 3. At the beginning of the project, we started with live classroom presentations and moved to this asynchronous strategy with the pandemic. It is now the adopted method.

The sixth deliverable is a short (two page) individual assessment on the experience, where students highlight the major takeaways and reflect on the impact of the activity on their education. They provide reflections on their concerns for people in need, around the world.

In the most recent iteration of the project, the third edition, we incorporated a significant addition. We arranged with different offices at the university in charge of global studies and affairs for a Global Day, where students presented their posters and presentations to a selected panel of six judges. The panel included faculty, professional staff, alumni, and industry representatives. This was a major improvement for the project as the engagement of each team now incorporated many institutional partners beyond this single class, department, or school. The faculty at the Department supported the event. It took place at the facilities for the Center for International Studies, an open space for public attendance, with the promotion on their information channels, reaching the whole university and beyond.

Results and Discussion

We have developed three annual editions of this project (2019, 2020, and 2021). Table 2 presents some demographics of the corresponding courses. One hundred sixty-two students have participated in this initiative, with 32 projects. A slight majority of non-white-male Americans characterized these courses. Teams' diversity indices ranged broadly between 0.00 and 0.62. Calculations and significances are presented in detail elsewhere [3] where the "proof of concept" for the proposal of this diversity index is introduced. That publication [3] extends the analysis of similar data for other courses in the Chemical Engineering curriculum. One relevant result is that self-selected teams are less diverse than the course group, leaning to the confirmation of the trend reported above for senior student to conform teams with shared members' perspectives.

Table 2. Course demographics

Year	2019	2020	2021	Total
Students	59	55	48	162
Teams	11	11	10	32
Minority Index	0.56	0.55	0.52	0.55
Diversity Index	0.57	0.56	0.53	0.56
Team Diversity Index range	0.10-0.53	0.00-0.62	0.02-0.50	0.00-0.62

Students covered the globe extensively selecting projects in 24 countries as reported in Table 3. Students were mainly interested in Asia, particularly on India (with six projects) which may be due to the prevalence of Indian students in the engineering program.

Table 3. Selected regions and countries

Region	Projects	Countries
Africa	3	South Africa (2), Sub Sahara
America, North	1	Canada
America, Central	5	Guatemala, Haiti, Honduras, Panama (2)
America, South	2	Brazil (2)
Asia, Middle East	2	Lebanon, Turkey
Asia, Russia, North-Asia	1	Kazakhstan-Uzbekistan
Asia, Other	11	China (2), India (6), Japan, Nepal, Philippines
Europe	4	Germany, Portugal, Spain (2), Sweden
Oceania	3	Guam, Micronesia Islands, New Zealand

Students collaborated with 43 foreign partners (not counting those who did not engage in a continuous collaboration). "Foreign partners" are people, generally professionals of diverse careers (i.e., engineers, medical doctors, educators, government officials, ONG leaders), living in the country where the selected problem for the project was chosen and involved with the situation around that problem. The source for the identification of foreign partners was mainly by the combination of friends and family, as presented in Figure 1. Study abroad experiences, college professors, and graduate students (international students) provided a direct source for foreign partners identification. In addition, some foreign partners were identified by searching the web for people potentially related to the selected problem. We also allowed for some exceptions when circumstances were pressing (running out of time, abandoning of former contacts, etc.). They included international students on campus and professors with significant experience, networks, and work in the selected country and project field. Figure 1 represents this category as "local" foreign partners, that increased over the years of the COVID19 pandemic.

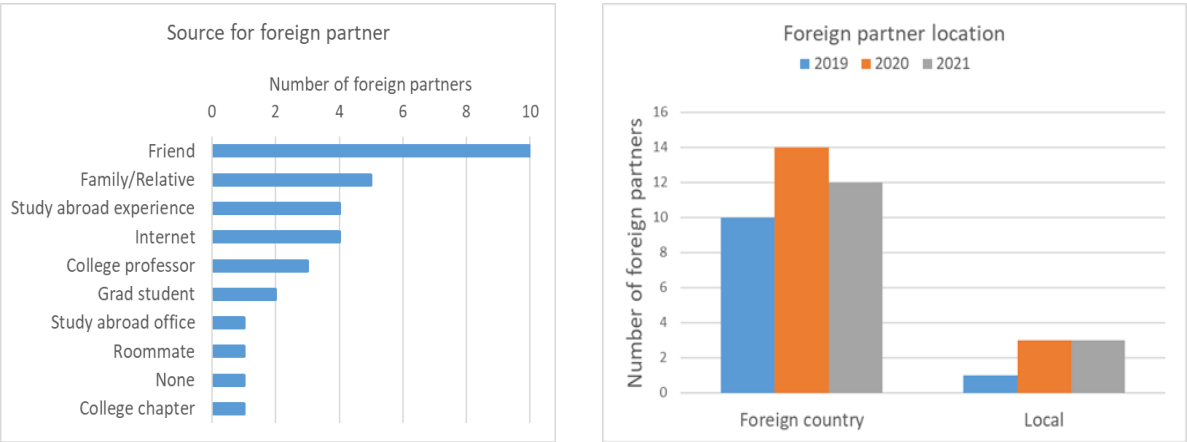

Figure 1. Foreign-partners source and location

Water quality, pollution and availability were the main challenges explored by students (Figure 2). It included topics like the water shortage in rural India, the degradation of lakes in China and Guatemala and, the dramatic reduction of the Aral Sea. Air pollution ranked second, with topics like urban air contamination (Manila, Barcelona) or indoor air pollution at Sub-Saharan Africa. Projects focused on healthcare crises included topics like the medical limited assistance in Eastern China and in Syrian refugee's camps in Turkey. Land degradation included topics like deforestation in Honduras and forest fires in Spain and Portugal. Energy poverty included load shedding in South Africa. Other topics like the barriers for women education in India, the protection of species in risk of extinction (i.e., jaguars in Panama), or the convenience for more networking among engineering students around the world were interesting initiatives.

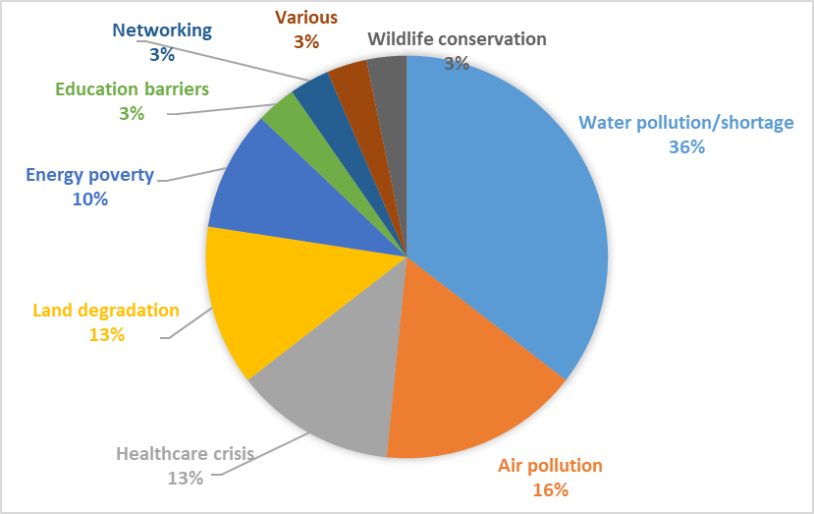

Figure 2. Fields of problems explored by students

Table 4 reports on the most common difficulties found by the students in developing the projects. Certainly, communications with foreign partners due to time zone differences, language barriers, short-term commitments, and time availability, were significant constraints. Students also called the attention to the need for them to acquire a broader knowledge on topics and cultures to understand the problems and elaborate on solutions.

Table 4. Most frequently reported difficulties in developing the projects

Time zone difference with foreign partners limiting opportunities for communication
Deciding on several alternative options to explore
Accommodating cultural barriers (language difference, government regulations, differences in the level of development),
Limited knowledge and limited information available on the selected topics
Short time to create a solution of impact
Identification, connection, and reduced support of a foreign partner (sometimes leading to a topic change)
Understanding expectations for the project
COVID19 constraints
Conflicting schedules for team members to meet

It is not the scope of this publication to deal in detail with the analysis and proposed solutions that students advanced for their projects, however, Figure 3 presents a quantitative relation of the type of solutions presented. Educational proposals focused on raising awareness about the problem among the public and spreading alternative solutions. This was often coupled with calls to fund active organizations already involved in some solution. Technical proposals offered advice in the use of equipment or technology to overcome or mitigate the problem. They included references to potential suppliers. Direct fundraising consisted of events or assistance with crowdfunding campaigns to collect money for an active organization. Regulatory proposals emphasized the urgent call to agencies and governments to enforce preventive measures. One software proposal provided the reference frame for the development of an app. A few specific examples of proposed solutions are listed in Table 5.

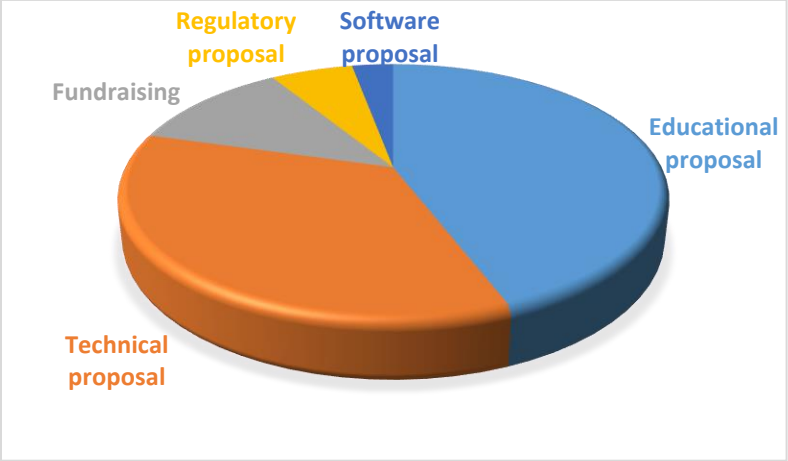

Figure 3. Types of proposed solutions.

Table 5. Some examples of proposed solutions

Social media app to connect old Japanese people by neighborhood to overcome loneliness and engage in social activities and keep track of health issues
Sterilization equipment for Syrian refugees' hospitals in Turkey
Controller device for Intra-venous (IV) medication in Eastern China hospitals and care centers
In-situ bioreactors fed with denitrifying bacteria to remove nitrates from water streams and reserves in New Zealand
Fundraising campaign to support Panamanian ONG protecting jaguars from extinction
Social media campaign promoting "green roof buildings" to harvest rainwater in India
Website for public participation in rising awareness and developing strategies for environmental protection at Barcelona (Spain)
Educational campaign to promote planting mangroves along the shores of Micronesian Islands to mitigate shore erosion and sea level rise

Students presented their proposals in poster and presentation format. Figures 4 and 5 displays some examples of posters. In some cases, they report an abundance of information where they have documented the problem and potential solutions while providing warnings about possible barriers for implementation. Alternatively, some posters promoted their work via a website for further information and action. Final presentations offered narrative and graphical support for the documentation of the problem and potential solutions where team members addressed their area of responsibility. Special attention was given to social, cultural, economic, public health and welfare factors.

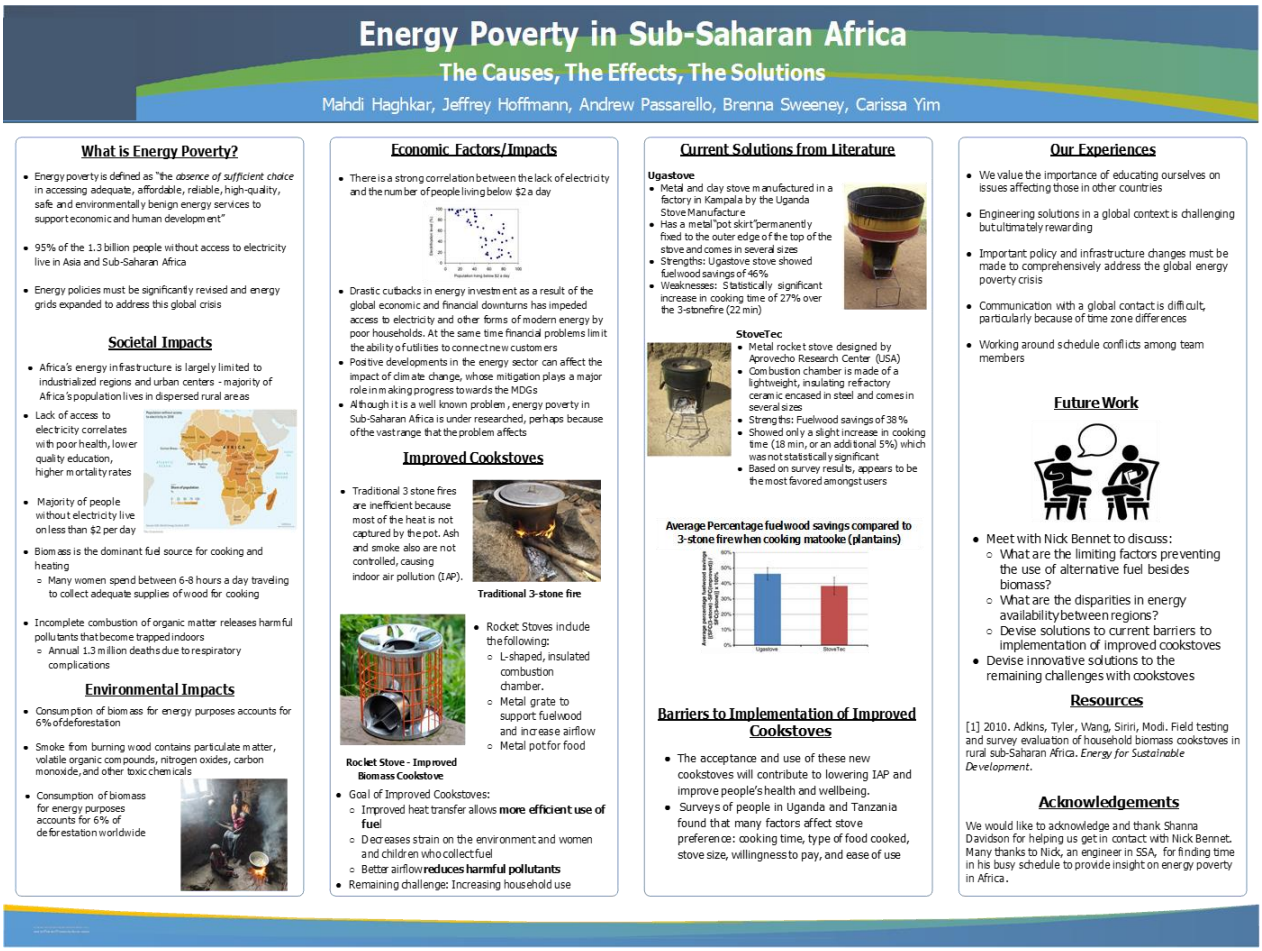

Figure 4. Example of extensive poster

Individual assessments at the end of the project were valuable narratives about the experiences with the project. Students assessed their motivation for selecting the topic, their individual roles and activities, their relationships with the foreign partner, the scope of the analysis and solution proposed for the problem, the performance of the team, the impact of this initiative in their college education, the strategies for project management and their suggestions to improve future editions of the project. The guidelines and rubric for this assignment are provided in Appendix 1. A complete and qualitative analysis goes beyond the scope of this publication and will be considered later in combination with proposed solutions. However, it may be added here that students reported

their satisfaction on having the opportunity to address a real problem and deal with a situation outside their comfort area. They appreciated the contrast of this experience with the classroom training that is often limited to theory, calculations, processes, equipment, and technology. We also received grateful and enthusiastic notes from some foreign partners that were included in the assessments. A common students' complaint was the open-ended nature of the project, with many uncertainties to handle, and the time investment, in a busy semester close to graduation.

Figure 5. Example of posters for educational campaigns

All deliverables were provided with a corresponding rubric for grading. Table 6 reports on summary grading data. "Weight %" corresponds to the contribution of this project to the final grade of the course. Grading was distributed among the instructor, peers, and self-evaluation. We provided a smooth introduction of the project in 2019, encouraging students to pioneer this initiative and provide us with valuable insights. We had to work out the stressful conditions of the pandemic in the second edition of the project with a soft approach for grading. The instructor leaned to give high scores to every project in these circumstances, and students gave themselves and their peers the highest grades, as reflected in the high average values and small standard deviations for project evaluations in years 2019/2021. We are increasing the demand on more structured work, particularly on team performance, that is reflected in some lower grades for the third edition.

Table 6. Grading data

Year	Weight %	Self %	Peers %	Instructor %	Average	St. Dev.
2019	8	0	75	25	100.00	0.00
2020	10	20	80	0	98.37	1.69
2021	10	20	60	20	86.20	6.62

A major turning point was the celebration of the ChE Global Day in the third edition. This was a unique and highly stimulating experience. We explained the initiative of this project to other related offices in the University, and we came across the idea of displaying these projects in an open public space to increase their potential impact and promoting collaboration. We got enthusiastic collaboration from the Center for International Studies, the Global Office (formerly Study Abroad), the Center for Innovation and Sustainability, the Asian Studies Center, the Graduate Students Association, and one large industry with global operations. We presented the initiative to make it an annual celebration and got the support from the Faculty at the Department. Students presented their posters and presentations in person in a public environment and with six judges (representing each one of the collaborating partners) evaluating their products and performance. Some images are displayed in Figure 6, and some results in Figure 7.

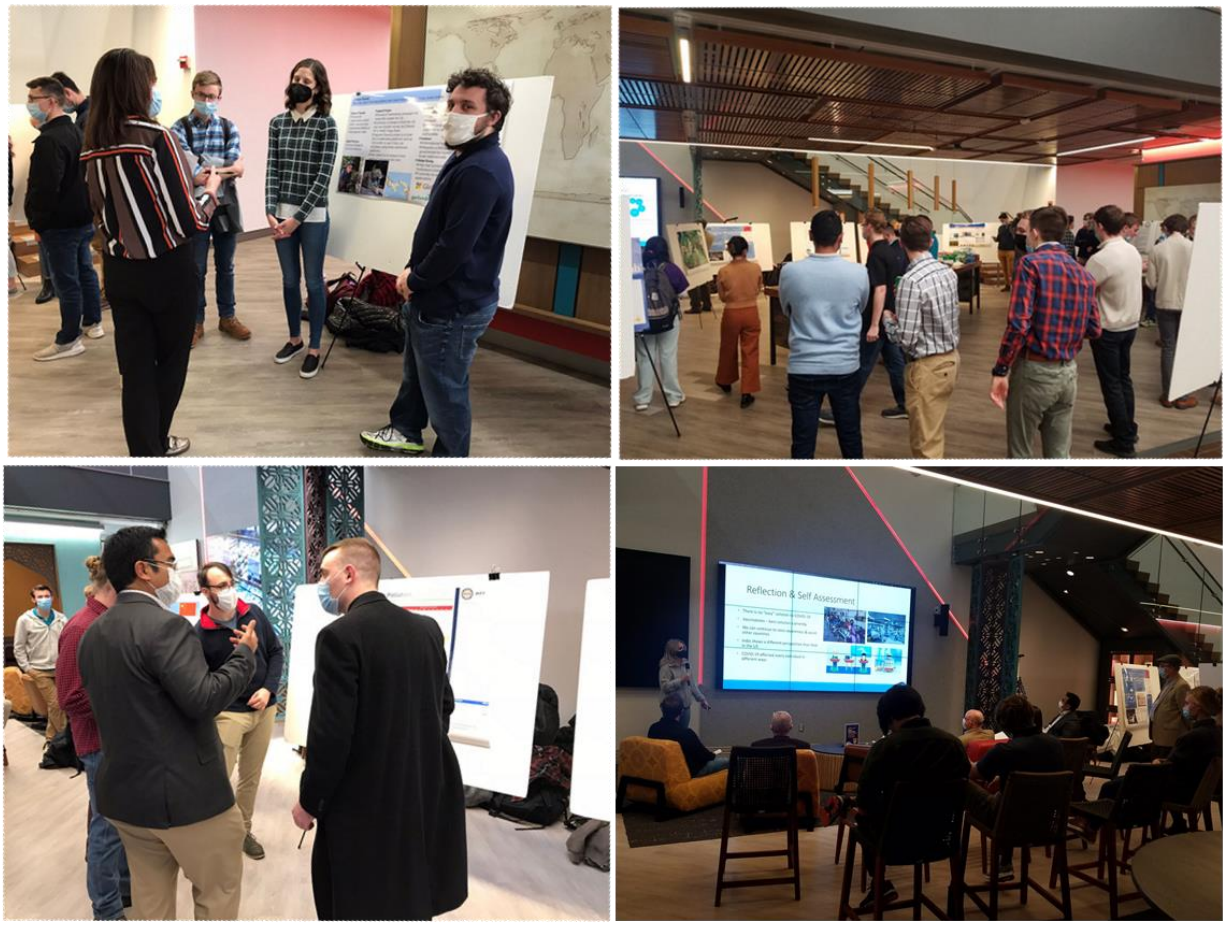

Figure 6. Posters and presentations at ChE Global Day 2021

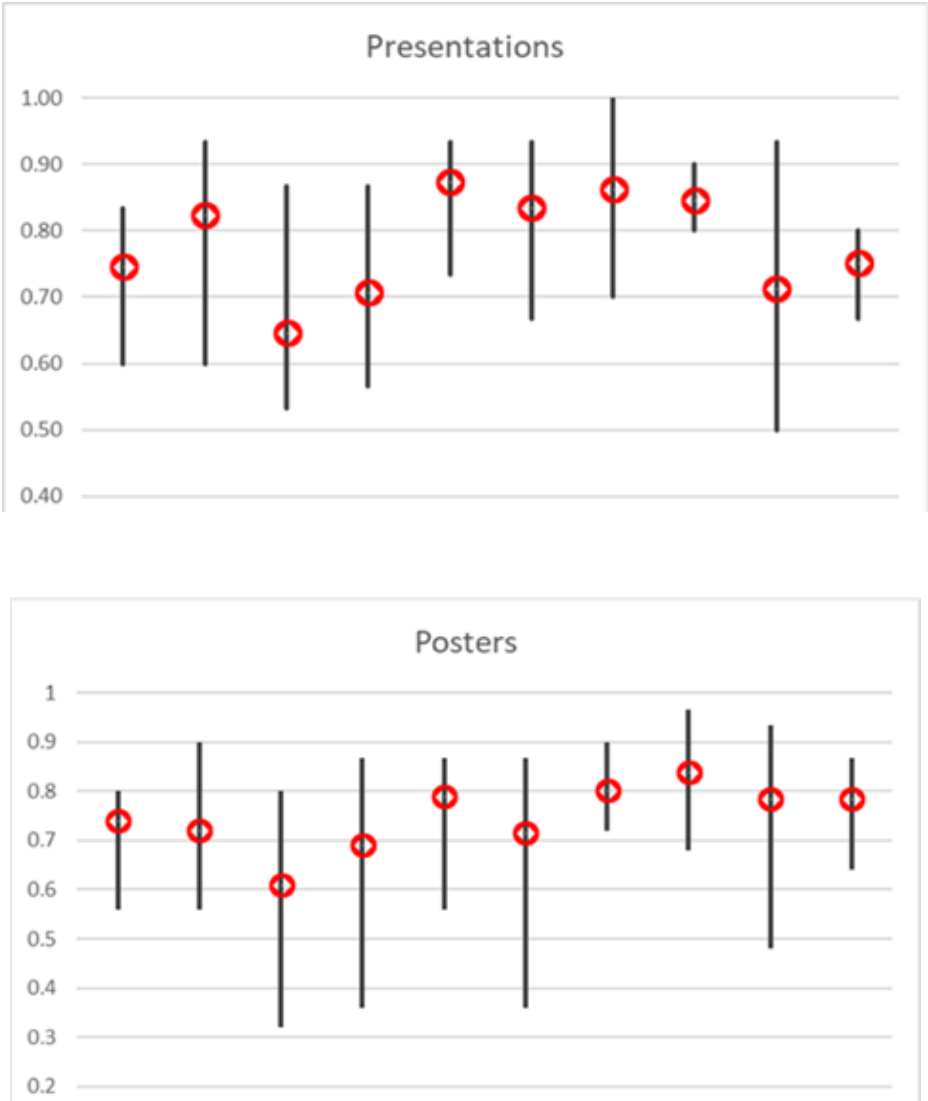

Figure 7. Evaluation of posters and presentations at ChE Global Day event by six judges

Judges used a prescribed rubric of six criteria for presentations, and six criteria for posters, using a Likert scale of 1, 2, 4, and 5. There was a significant variability for judge evaluations as presented in Figure 7 by the bars around the weighted average (red circle) of each of the ten projects. Average was 74.50 for presentations and 77.89 for posters over a total of 100 each. All the judges reported an extraordinary level of satisfaction with the content of posters and presentations and the performance of students. We gave certificate awards for the best poster, best presentation, and most popular poster (voted by phone app with a total 226 votes collected).

In comparing data on grading at Table 6 and Figure 7 it is noticeable that judges' evaluation for posters and presentations (74.50-77.89 on average) is lower than grade average (86.20) for the entire projects. Project grade includes more items than the final products (posters and presentations) as reported before. However, grading is still a work in progress due to the broad

range of activities included in this initiative, and more experience is required for a better assessment.

Finally, addressing the learning outcomes related to this initiative, Table 7 reports a summary relationship with the deliverables.

Table 7. Learning outcomes and deliverables

Learning Outcomes. ABET Criterion 3	Deliverables
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	Proposals, presentations, posters, and individual assessments report on students' approaches to identify needs of concern for public health, safety, and welfare in countries around the world, engaging in consideration of global, cultural, social, environmental, and economic factors, in relation to the selected topic.
3. An ability to communicate effectively with a range of audiences.	Project management involves the communication of students with foreign partners, many of them non-engineers, Posters and presentations are delivered to judges from diverse fields of studies.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Posters and presentations emphasize the ethical and professional responsibilities of engineers to identify, assess and solve problems in the globalized world we share, and to offer their contributions to provide engineering solutions respectful of cultural diversity and integrated with social concerns.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	Project management guides the performance of the team for the entire semester, including an updated plan and logbook. Meetings, documents, communications, and instructor coaching develop over a specific MS TEAM project. Students are encouraged to distribute and rotate leadership on various activities. Team performance assessments are included at least three times during the project.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	All the deliverables relate to the challenge for every student to address an actual problem outside their career instruction and make use of their developed skills to gather information, understand diverse social and cultural environments, approach technical and non-technical solutions, and collaborate with peers and foreign partners in managing the selected problem

Conclusions

The initiative of including global projects as part of a regular course for senior students in chemical engineering has proved to be sustainable, effective, and enjoyable during the three years that it has been in place.

The global project initiative provides students with a unique opportunity for teamwork, increasing their global awareness and preparing them for global partnerships as requested by UN Sustainable Development Goal 17 and as required for ABET student outcomes.

The global project initiative provides the department with a highly efficient instrument to collaborate with other offices in the university and beyond, projecting their influence and impact in broader scenarios.

The global project initiative can be scaled up to other departments, institutes, schools, and university wide to foster a culture of global awareness and partnerships for a sustainable world.

Future Work

The next steps for this global project initiative are to incorporate feedback into the next course iteration while looking to partner and expand the project to other departments, institutes, schools and university wide to foster a culture of global awareness and partnerships for a sustainable world. Specific objectives are:

To establish a global day event to celebrate the achievements of students, foreign partners and faculty on addressing critical issues all over the world

To provide a highly visible digital platform to exhibit the products from the global project initiative (posters, presentations, assessments) and increase the promotion of the initiative.

To develop a more structured program to integrate more students, graduate students, faculty and partners (industry, agencies, NPO, etc.)

To structure the possibility for projects to develop over time, with new students, advancing towards final implementations.

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Appendix 1. Guidelines and rubric for the individual assessment assignment

GLOBAL PROJECT
INDIVIDUAL ASSESSMENT (GP6)

Description. A short 3 pages individual assessment (GP6) at week 13 with the essential narrative of the project, the specific individual role taken on the project, and the individual self-assessment on the learning experience, both on the scope of the project and the team performance. In addition, a critical assessment from every foreign partner should be included as appendix. Note: The rubric provides the guidelines for grading. You are expected to address all the items but with a fluent narrative, not with a Q&A style.

Grading: 2 points, self-grade

Rubric

Item	Points	Grade
Provide a summary of the project: country, topic, proposal for solution, potential impact	2	
Describe your motivation for the project: how you came to know about the topic and the foreign partner, how you got involved, any previous experience.	2	
Describe your main roles and activities in the project	2	
Describe your relationship with the foreign partners	2	
Provide an analysis of the performance of the team: what went well, what went wrong, what could have done better. Please, do not identify members in your praises or criticism	2	
Describe your three major takeaways	2	
Assess the convenience, scope, and impact of the Global Project as part of the chemical engineering formation	2	
Provide any suggestions on how to improve this project for future students, based on your experience	2	
Comment on the project management, coaching and use of MS TEAMS to follow up the development of the project	2	
Make sure to report your self-grade (scale 0-2)	2	
Total	20	
Divide total by 10. Report one decimal figure.	2.0	

Appendix 2. Judges' scorecard for final presentations

Criteria Points	Attention to audience	Clarity	Content	Creativity	Length (3-5 min)	Speaking Skills	Total
1	Did not attempt to engage audience	No apparent logical order of presentation, unclear focus	Thesis is unclear and information appears randomly chosen	Delivery is repetitive with little or no variety in presentation technologies	Greatly exceeding or falling short of allotted time	Monotone: speakers seamed uninterested in material	
2	Little attempt to engage audience	Content is loosely connected, transition lack clarity	Thesis is clear, but supporting information is disconnected	Material presented with little interpretation or originality	Exceeding or falling short of allotted time	Little eye contact; fast speaking rate, little expression, mumbling	
4	Engaged audience and held their attention most of the time by remaining on topic and presenting facts with enthusiasts	Sequence of information is well organized for the most part, but more clarity with transitions is needed	Information relates to a clear thesis; mainly relevant points, but they are somewhat unstructured	Some apparent originality displayed through use of original interpretation of resented materials	Remained close to the allotted time	Clear articulation of ideas, but apparently lacks confidence with material	
5	Engaged audience and held their attention throughout with creative articulation, enthusiasm, and clearly focused presentation	Development of thesis is clear through use of specific and appropriate examples; transitions are clear and create a succinct and even flow	Exceptional use of material that clearly relates to a focused thesis; abundance of various supported materials	Exceptional originality of presented material and interpretation	Presented within the allotted time	Exceptional confidence with material displayed through poise, clear articulation, eye contact, and enthusiasm	
P01	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P02	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P03	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P04	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P05	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P06	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P07	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P08	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P09	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	

Appendix 3. Judges' score card for poster presentations

Criteria Points	Title Team, Members, Topic, Foreign partner	Attractiveness	Content	Creativity	Graphics	Free You may add one more category	Total
1	It does not contain all the information. It is too small and do not call the attention	The poster is distractingly messy or very poorly designed. It is not attractive	The poster reflects insufficient knowledge about the topic and facts	Monotonous description using words with no innovative artistic approach	Graphics do not relate properly to the topic. Improper or missing citations		
2	It contains all the information, can be read from 1 m away, but lacks attractiveness	The poster is acceptably attractive though a little bit messy	The poster reflects only partial knowledge about the topic and facts	Some elements of creativity but mixed with standard use of words and descriptions	Some graphics relate to the topic but still missing proper citations or relevance		
4	It contains all the information, can be read from 2 m away, and calls the attention	The poster is attractive in terms of design, layout, and neatness	The poster satisfactorily document the topic and facts with a good synthesis	Innovative presentation, well arranged to highlight the main messages	Most graphics are in focus and the content easily call the attention for the main messages		
5	It contains all the information, can be read from 2 m away, and it is very creative	The poster is exceptionally attractive in terms of design, layout, and neatness	The poster summarizes exceptionally well the topic and facts	Exceptionally creative to convey the main messages and to call the attention	Graphics are all in focus and they display exceptionally the main messages		
P01	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P02	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P03	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P04	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P05	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P06	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P07	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P08	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P09	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	
P10	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	1 2 4 5	