Learning Social Innovations and Social Entrepreneurship During COVID-19 Pandemic: Lessons Learned

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Learning Social Innovations and Social Entrepreneurship
During COVID-19 Pandemic: Lessons Learned

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Abstract

The COVID-19 pandemic has brought multiple social, economic, and technological divides to the forefront as key societal issues that were previously silent to the engineering and STEM community. These issues must be addressed through social innovations that can be easily implemented at the point of need. Social innovations are defined as new solutions (products, services, models, markets, processes, etc.) that simultaneously meet a social need (more effectively than existing solutions) and lead to new or improved capabilities and relationships and better use of assets and resources [1]. The design and development of socially conscious and frugal engineering solutions are a critical part of many of these techno-economic social innovations [2]. This is calling for new approaches to implement social innovation and entrepreneurship education to the engineering students, in addition to the traditional STEM curriculum. Additionally, in the primarily ‘remote’ learning mode during the COVID-19 pandemic, different pedagogies are crucial for effective and engaged student learning.

This paper presents the methodology, highlights, and execution of the “Social Innovations: Engineering, Globalization, and Leadership” class that was conducted ‘virtually’ through the 8-week summer session of 2020. The motivation behind the class was to introduce, educate and encourage students to learn, adopt and implement attributes of social innovation philosophies and servant leadership via case studies and discussion during the class meeting times. Weekly modules were developed to include one social innovation case study (including presentation rubric) per week and leadership lessons. The class proceeded in the flipped classroom approach, where each student presented their perspective and analysis of the assigned social innovation case study, followed by interactive discussion within the group. Throughout the class, students advanced their understanding of the attributes of social innovation and leadership and its context to globalization and social equity. Concurrently, students were divided among two groups for the class project to practice the development of frugal engineering solutions for the COVID-19 pandemic. The projects focused on developing a multi-functional mask (physical) and a fact check plugin (digital), to prevent the spread of virus and misinformation, respectively. The project was executed in parallel with the class and culminated in an ‘open house’ presentation attended by multiple invited faculty and industry professionals. Throughout the duration of the class, each student developed their own model and attributes for delivering impactful social innovation along with a leadership mind map as a part of the final report. Students were graded based on their presentations, in-class interactive participation, and the final project report. At the end of the semester, based on the feedback from the students as well as the open house attendees, this virtual class, helped students to build a framework for social innovation, entrepreneurship, and leadership for successful implementation within the frugal engineering model.
1. Introduction: Engineering, social entrepreneurship, and equity

1.1. Problem: American and global inequity and inequality

The COVID-19 pandemic not only seriously disturbed the routine operations in the US and throughout the world, but also brought multiple social, economic, and technological divides to the forefront [2, 3]. From (1) increased food insecurity [4, 5] - to – (2) the disproportionate number of deaths within the racial minority groups [6–9] - to – (3) lack of internet connectivity and resulting challenges in accessing online education/classes in rural as well as tribal land [10, 11] - to – (4) its adverse impact on small retailers across the world [12] - to - (5) exacerbating social wealth gaps fueled by tech companies [9, 13], these divides exist at multiple levels in multiple forms. This division of resources/access gaps results in inequity and inequality spread across many layers of society. As a result, a significant percentage of the population, both within the US and globally, lack access to basic human needs necessary for improving the quality of life and providing upward mobility, including escaping generational poverty. In today’s world, digitization allows for high interconnectivity and intercommunicability between people, processes, and technologies. However, it also globalizes and grows the inequities because of the digital divide within society. Many of these key societal issues were previously ‘silent’ to the engineering and STEM community [14] despite the potential of technological innovations addressing the inequity. Furthermore, many technological/digital advancements and innovations remain unaffordable and inaccessible [2, 15] to large populations including the underprivileged and underrepresented population groups further compounding the existing equity gap. This scenario is depicted in Figure 1, where despite the technological advancements and digitization, gaps remain in addressing equity for basic human needs. Thus, inequity and inequalities present a complex socio-economic-technological problem that requires immediate attention from the community. Many technological companies over the past few years are realizing the need to build and implement a corporate social responsibility program.

Similarly, it is important to introduce the societal issues and technological aspects of social innovation to the engineering students, in addition to the traditional STEM curriculum where researchers are studying digital and physical technologies.

1.2 Addressing inequity through engineering

Social innovations are defined as new solutions (products, services, models, markets, processes, etc.) that simultaneously meet a social need (more effectively than existing solutions) and lead to new or improved capabilities and relationships and better use of assets and resources [1]. These new socially conscious frugal solutions are a result of the convergence of techno-socio-economic attributes. Thus, engineering innovations along with the means to apply them through effective social entrepreneurship could play an effective role in addressing above mentioned inequities. As discussed above, access gaps are key barriers that hamper equity. Thus, the development of simple, frugal, and accessible engineering
innovations (not to be equated with crude and cheap) is vital for addressing inequity in basic human needs. Additionally, it is important to implement these innovations through social entrepreneurship and leadership efforts for achieving the desired societal impact. To apply the above principles effectively, students (especially the Gen-Z students) need to have a skill set in understanding the role of engineering innovations in a globalized society with an attitude of leadership to serve society [16], which was the motivation behind this class. Selected successful social innovations across the world were studied through the lens of fundamental science and engineering along with the societal impact. At the same time, students also reflected on how the innovators applied/integrated leadership skills/approaches with social entrepreneurship principles for the betterment of the community they were part of. The detailed structure of the class comprising the study of affordable and accessible engineering through social innovations, frugal engineering, and servant leadership is discussed in the next section.

2. Description of course: Thesis, synopsis, course material, and execution

Using global cases of social innovations, students in the class researched and studied the fundamentals of (1) engineering social innovations, (2) globalization, and (3) leadership for effective implementation and success. The course also involved a project component where students were challenged for the identification of project statements and developing a well-thought-out engineering solution for a specific situation resulting from the COVID-19 pandemic. The structure in the class adapted self-learning via case studies, presentations, and interactive discussions led by the instructor. During the class meeting times, specific emphasis was given to class interaction and the engagement of students, especially in a virtual classroom. Following are the key details for the grading, scope, and implementation of the virtual class framework as a part of the class syllabus.

**Table 1: Class schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Monday-Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Introduction to social innovations, discussion of topics, and course expectations</td>
<td>Introduction to globalization and leadership</td>
<td>Introduction to the project and discussion of project rubric</td>
</tr>
<tr>
<td>Weeks 2-7</td>
<td>Student presentations on social innovation case study</td>
<td>Discussion of project progress</td>
<td>Discussion on leadership and development of leadership mind map</td>
</tr>
<tr>
<td>Week 8 (final week)</td>
<td>Student presentations on social innovation case study</td>
<td>Final project presentations and conclusion (open-house session)</td>
<td></td>
</tr>
</tbody>
</table>

Per the schedule shown in Table 1, the first week was focused on the class introductions, discussing the motivation and background for the class along with discussing the framework for the rest of the weeks. To maintain class engagement and interaction among the peers, the online meetings were focused on student-led presentations and discussions as a part of flipped classroom approach. Every week, each student had an opportunity to research the case study, present their understanding, and discuss key takeaways from that week’s assigned case study (on Monday and Tuesday) followed by an interactive discussion on leadership lessons (on Wednesday) based on that week’s assignment. Throughout this process, students continued to build and reiterate their definition of social innovation along with the leadership mind map. One class every week (on Thursday) was dedicated to the class project where two
student groups discussed the project’s problem statement, shared progress on frugal engineering methodology towards the solution, and plan for execution.

(a) Case Study Quad Chart (Template)

Quadrant 1
Social Problem

: __
: __

Quadrant 2
Engineering solution:

: __
: __

Quadrant 3
Introduction to Inventor and Leadership:

: __
: __

Quadrant 4
About the country where innovation is launched:

: __
: __

(b) Employment

- __

What need is served

- ___

Innovation

Sustainability

- ___

(C) Metric of Social Innovation

The following table checks ___ against the social innovation attributes, to see if it fits the requirements of what should be referred to as social innovation.

<table>
<thead>
<tr>
<th></th>
<th>Social Impact</th>
<th>New to Target Group</th>
<th>Increases Happiness</th>
<th>Addresses a Need</th>
<th>Effectiveness</th>
<th>Able to Implement, Reproduce and Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Figure 2: Social innovation case studies presentation rubric.
2.1 Social innovation case studies

The social innovation case studies for the class were chosen to represent a variety of frugal, inclusive, and accessible approaches taken to address community-specific problems at hand. Following are such case studies across the world integrating social innovations with effective social entrepreneurship:

(1) Food storage: Zeer, pot-in-pot (innovator entrepreneur- Mohammed Bah Abba),

(2) Ice Stupa: efficient water irrigation in Himalayas (innovator entrepreneur- Sonam Wangchuk),

(3) Household entrepreneurs: Grameen Bank (innovator entrepreneur- Muhammad Yunus),

(4) Energy for lighting: ‘Liter-of-light’ (innovator entrepreneur- Illac Diaz),

(5) Project tom’s shoes (innovator entrepreneur- Blake Mycoskie),

(6) Fog harvesting nets: water collection (innovator entrepreneur- Abel Cruz), and

(7) Food delivery: Mumbai Dabbawala (innovator entrepreneur- Mahadeo Bacche).

A PPT slide template rubric for the weekly case study presentations was provided to the students as a guiding framework for preparing their weekly discussion and Figure 2 shows selected slides from the template. The rubric covered key aspects of social innovation, social entrepreneurship, and leadership for each case study. Figure 2(a) shows an example quad chart to summarize the background of the social innovation along with the social entrepreneur. Figures 2(b) and (c) highlight the evaluation metric for each social innovation case study. Each week, students researched the assigned case study to highlight important aspects of social innovation and its implementation. Each student analyzed the case study based on their ongoing research area(s) through the lens of key parameters (e.g., science and engineering approach, impact on the community, and others), from the rubric for their 15-20 minutes weekly presentation and discussions. Through their research, varied academic backgrounds, and experiences, a diverse set of viewpoints were presented each week along with interactive discussion among the cohort. Consistent with the course title, each week’s activity harbored on the three aspects of the class as follows:

**Engineering** – Through the case studies, the science and engineering behind the specific solution were discussed by the students. Apart from discussing the technical approach, key items for successful implementation were also discussed. Questions such as ‘what makes a specific solution viable and effective?’, ‘how the community engagement and surrounding environment contributed to the implementation?’, ‘is the approach sustainable?’ were foundational for the class discussion. Students also discussed if the approach could be further modified for the betterment of the existing solution.

**Globalization** – The case studies spanned from various locations across the world. Along with the science and engineering solution, the geographic location of the need, cultural aspects, and global perspective are equally crucial for developing a holistic model for successful social innovations. Through their own diverse experiences (as international students in the US, participants in study abroad programs, social activities, research areas), each student discussed the globalization aspect of the innovation case study. Students also discussed if the specific solution would apply to other geographic locations/societal problems either in the present form or with modifications.
Leadership – Part of each week’s student presentations on social innovations involved discussion of the social innovator/entrepreneur. Background of the innovator, his/her story/motivation behind the social innovation along with community engagement were presented and discussed. These aspects of the discussion were important for each week’s leadership lessons and developing the leadership mind map.

2.2 Leadership lessons

As outlined above, one class period each week was focused on the discussion of various aspects of leadership, especially in the context of social innovations. Topics such as roles of simplicity in thinking, compassion, courage, change, messaging, immersion, servant leadership were presented and discussed. Students reflected on each of the talking points at the beginning of the class to facilitate the discussion. Following that, each student communicated their thoughts on each topic especially in the context of social innovations accompanied by interactive class discussion. Throughout the semester, this discussion was documented through a leadership mind map which was submitted at the end of the semester and was also presented during the open-house session.

Table 2: Project timeline

<table>
<thead>
<tr>
<th>Time</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1 (06/22)</td>
<td>Background development for the project</td>
</tr>
<tr>
<td>Week 2 (06/29)</td>
<td>Brainstorming and develop the thesis of the project</td>
</tr>
<tr>
<td>Week 3 (07/06)</td>
<td>Identify key parameters and specifications, and design structure of an integrated physical structure</td>
</tr>
<tr>
<td>Weeks 4-5 (07/13)</td>
<td>Procurement, fabrication, assembly</td>
</tr>
<tr>
<td>Weeks 6 (07/27)</td>
<td>Testing, refinement, and method(s) of marketing</td>
</tr>
<tr>
<td>Weeks 7 (08/03)</td>
<td>Presentation, project report, and submission</td>
</tr>
</tbody>
</table>

2.3 Class project: Hands-on application to solve a problem in need during the COVID-19 pandemic

Apart from the discussion and student-led presentations, the class also involved a project which was focused on the challenges encountered during the COVID-19 pandemic. The project ran parallel to the class discussion and weekly progress revolved around identification of the problem, ideation for a possible solution, design, and execution. The problems were chosen from the discussion of pain points by students during the first week of the class. The students were divided into two teams: 1) team 1 focused on the digital aspect, specifically the misinformation on the internet, 2) team 2 focused on the physical aspect of the solution, functional masks. The project progress was presented each week according to the timeline provided shown in Table 2. A presentation template was provided to the students for their guidance and for preparing the final project report. Individual sections from this template are listed below. These sections highlight the rationale behind the project, step-by-step progress, and testing as a part of the final report.

• Required Functions of the physical solution and science
• Identification of boundary conditions
• Design architecture
• Physical structure building (exploded view of the physical system illustrating sub-systems)
• Subsystem specifications, design considerations, building using COTS (one slide per/sub-system and name of responsible team member)
• Testing and refinement (one slide for each sub-system)
• Testing and refinement for integrated system (one slide for all the team)
• Three most effective (fast, simple, and meaningful) ways to market (one slide for all the team)

The progress presentations were followed by a discussion where the instructor and other students provided a brainstorming platform and feedback for each team to further refine their project tasks. The overarching goal was to implement lessons from the social innovation case studies into the proposed solution such as simplicity of the solution, components off-the-shelf (COTS) as a part of frugal engineering. The final report was presented during the open-house session as discussed below for completion and grading. Figure 3 shows salient features of the final report prepared by one of the teams to summarize the class project.

2.4 Open house session and grading

At the end of the semester, a 2-day open house session was conducted which was attended by guest judges (members from industry and academia). During this event, students made short presentations about each of the social innovation case studies, leadership mind map, and the class project followed by a question/answer session.

The following grading scheme was adapted for this class. The weekly presentations followed peer grading where each student graded their peers based on their weekly presentation and class discussion. Students graded their peers for 10 points per case study. The 10 points were distributed as 1) content (5 pts), 2) originality (3 pts), and 3) presentation quality (2 pts). The grades for individual students were then averaged based on the points they were assigned by their peers. The project grade was decided by the instructor based on the final presentation and the feedback from open-house attendees.

a. Weekly presentations on social innovation case studies 40%
b. Project 40%
c. Reflections, mind maps 10%
d. Class participation 10%
Figure 3: Highlights of a project report
3. Lessons learned: Engineering, globalization, leadership

3.1 Learning from the in-class discussion:

3.1.1 Attributes of social innovations and frugal engineering -

Through the continued interactive discussions throughout the semester, a model and attributes of social innovations were developed. It was recognized that successful social innovations rely on the immersion of the innovator within the community in need (these innovators have experienced the problem firsthand) as a driving factor. Additionally, these innovations rely on technological simplicity and frugal engineering approaches which makes them easy to implement and easily accessible. The impact of these innovations on society is typically manifested in multiple forms, for example, access to basic human needs (which was the driving problem), improved quality of living, local job creation community engagement. Table 3 presents representative examples of social innovations that were discussed in the class through the above-discussed attributes of social innovation. The observations noted in this table are consolidated based on the weekly student assignment submissions and the class presentations.

Table 3: Attributes of social innovations as discussed and presented in class

<table>
<thead>
<tr>
<th>Example Social Innovations (SIs)</th>
<th>SI-1</th>
<th>SI-2</th>
<th>SI-3</th>
<th>SI-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social innovator</td>
<td>Mohammed Bah Abba</td>
<td>Abel Cruz</td>
<td>Illac Diaz</td>
<td>Muhammad Yunus</td>
</tr>
<tr>
<td>Target problem area of basic human need</td>
<td>Food refrigeration to keep food fresh in a harsh desert climate without electricity?</td>
<td>Water harvesting in the dry and arid desert climate</td>
<td>Energy (lighting); Potential to be integrated with other digital technologies</td>
<td>Social equity and job creation (with women) within an economically constrained community</td>
</tr>
<tr>
<td>Embedded environment for the innovation and location</td>
<td>Extremely hot and arid desert climate in Nigeria</td>
<td>Very dry climate in Atacama Desert area, Peru</td>
<td>Space constrained and resource (electricity) scarce areas in the Philippines</td>
<td>Rural parts of Bangladesh</td>
</tr>
<tr>
<td>Integrated science and engineering solution</td>
<td>The system contains two porous clay pots separated by a layer of wet sand. Evaporating water through the outer pot creates a cooling effect that refrigerates in the</td>
<td>Maximization of surface area to promote condensation and water capture by design</td>
<td>Water-filled recycled plastic soda bottles mounted on roofs to collect/refract sunlight for indoor lighting</td>
<td>Cooperative community-owned banking: Financing is done via microloans without requiring collateral. The people who borrow themselves control the money thus</td>
</tr>
<tr>
<td>Impact of the innovation on population</td>
<td>Reduced wastage and increased shelf life of produce without using electricity; Better selling price for farmers; Involvement of the local community in pot manufacturing</td>
<td>Access to water for domestic and agricultural use; minimal carbon footprint</td>
<td>Light without the electricity in resource-constrained households; The solution was simple, low-cost, and integrated plastic waste management</td>
<td>Increased employment by supporting local businesses; Avoided exploitation from loan sharks;</td>
</tr>
<tr>
<td>Community engagement</td>
<td>Created jobs for potters, taking advantage of local know-how</td>
<td>The synergy between community and local government</td>
<td>Communities taught how to use locally sourced recyclable material to create a plastic light bulb</td>
<td>Household entrepreneurs increased access and employment by supporting local businesses</td>
</tr>
<tr>
<td>Cost of innovation</td>
<td>$1-2 per pot</td>
<td>About $100 per net</td>
<td>$1 per bottle</td>
<td>N/A, no-profit/no-loss model</td>
</tr>
</tbody>
</table>

Based on these lessons, a frugal engineering model for social innovations was developed and presented in Figure 4.

Figure 4: Social innovations and frugal engineering [3]

(b) Attributes of social innovations
- Frugal innovation under resource constraints (cost reduction by 100X);
- Open-source intellectual property for wide access;
- Innovation led by social innovator and entrepreneur as “servant” leaders;
- Impact is on more than 10,000 people in disadvantaged communities across the world providing means for equity;
- Impacts are in the areas of food, water, employment, shelter, education and energy;
- Almost zero carbon footprint;
- Innovations driven by communities for the communities;
- Participation in innovation process science and engineering (S&E), policy, economics, and other STEM and non-STEM societies;
- Rapidly scalable (in less than 10X);
- Simple, elegant and robust;
- Accessible to haves and have-nots.
3.1.2 Development of leadership mind map -

Similarly, the discussion on different aspects of leadership and their importance in the context of social innovations are presented through leadership mind maps shown in Figure 5. The mind map is developed around the aspects of leadership discussed in class through student reflections. Additionally, the connection between various aspects of leadership was made through the example social innovation case studies discussed during the class. Aspects of frugal engineering, execution, and implementation of social innovations within the community as well as the marketability of the solutions for acceptance and wider dissemination are also presented.

![Figure 5: Example of leadership mind map](image)

3.2 Reflection from the instructor:

This class was introduced in the summer semester as a ‘special topic’ pilot class aimed at integrating aspects of engineering fundamentals including design, social tech innovations for social equity in the curriculum for engineering students. Eventually, the instructors envision the class and curriculum evolving into a regular class. In the future, for larger classes, a group-based presentation approach could be more effective and manageable for case studies and in-class discussions.

Additionally, it was noted that the engineering subject diversity within the group (presentation of different ideas, perspectives, and cultures) was helpful to foster meaningful discussion in the class. Students from various engineering disciplines, countries brought their individual and unique perspectives to the class on social innovations. As an example, Figure 6 shows quad charts prepared by 3 students for one case study (liter-of-light). As seen, the charts represent common themes about the innovation yet bring out the individual viewpoints on the specific problem/solution conducive to engaging classroom discussions and paying attention to individual learning experiences.
Figure 6: Case study quad chart comparison for 3 students
Another important aspect of the class is increasing student awareness of the inequities and accessibility challenges to basic human needs in the US and across the globe. This pilot class (through social innovation case studies and class project), aimed to effectively communicate the role of technology, entrepreneurship with servant leadership, and frugal engineering to the STEM graduate students for addressing the techno-socio-economic challenges. Following list shows the evolution of the definition of social innovation for students through the semester:

**Student 1**

Week 2: “A product, technology, policy or idea that addresses an immediate problem faced by a community with a big picture overview of associated socio-techno-economic issues through sustainable use of resources, ensuring equitable and accessible benefits.”

Week 5: “A technology, policy or institution that addresses an immediate problem faced by a community, leverages community involvement and ensures equitable and accessible benefits through sustainable use of resources”

Weeks 7/8: “A technology, policy or institution that directly or indirectly addresses an immediate problem faced by a community, leverages community involvement and ensures equitable and accessible benefits through sustainable use of the resource”

**Student 2**

Week 2: “An approach that pieces together economics and culture to challenge a social issue “

Week 5: “A technical framework of an application to challenge a specific issue at a pace reasonable to adapted to a specific area by involving economic and social background information to target short-term impacts with increasingly positive lasting effects.”

Weeks 7/8: “A transformative framework of application that advances abilities of underserved populations to adapt to rising challenges by targeting short-term impacts with increasingly positive lasting effects at a reasonable pace”

As shown, the definition evolved to include various attributes of successful social innovations that were covered through the case studies and in-class discussion. This shows the maturity of the thought process for the students through the 8 weeks and also reflects their effective engagement. Thus, instructors believe that the goal of increased awareness through the course material was attained to a satisfactory level.

### 3.3 Feedback from the students

At the end of the semester, students were asked for their feedback on the course in terms of their experience, the knowledge gained, and any suggestions for improvements/iterations. This was done through the course evaluation surveys as well as through short face-to-face virtual meetings with the instructor. The comments are summarized in Table 4. Overall course rating was 4.33/5. Overall, the interactive nature of the course was well received and appreciated by the students. The overall
structure and organization of the class, weekly presentations, and discussions, and learning social innovations as an interdisciplinary topic were well received by the students.

**Table 4: Summary of student feedback on the class**

<table>
<thead>
<tr>
<th>Survey Q: We welcome your written comments below. What is something/are some things that the instructor does well e.g. something you hope that the instructor continues to do in the class in the future?</th>
</tr>
</thead>
<tbody>
<tr>
<td>“In general the course is perfect, but it is too much material for the time of a summer class”</td>
</tr>
<tr>
<td>“The instructor has great ideas that he introduced to the class and fostered discussion. Introduced a great number of innovations”</td>
</tr>
<tr>
<td>“Well-thought topics, organized discussions, good moderation, and availability for discussions. Piazza could have been used to open discussions and sharing ideas.”</td>
</tr>
<tr>
<td>“Provided us a template to build upon. Has all of us present individually and no thoughts were lost. Encouraged our ideas when even we ourselves were skeptical about them.”</td>
</tr>
<tr>
<td>“Makes course as interactive as possible. Very guided thoughts so that we arrive at new understanding holistically, which is difficult to plan for.”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other feedback communicated by the students through one-on-one communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>“It was a great learning experience for me. The course touched on topics that I have pondered upon for quite a while. I didn’t expect a regular college course to actually help me mold my thought process. I look forward to more similar experiences.”</td>
</tr>
<tr>
<td>“I really enjoyed the class and I am the opinion that it is one of the classes that are offered where you learn skills that you can use your whole life and that can be applied interdisciplinary.”</td>
</tr>
</tbody>
</table>

3.4 Summary and conclusions

This class was organized to introduce important social challenges and their socially conscious frugal engineering solutions to the students from various disciplines. The main goals were to illustrate and discuss the nexus of social innovations, the application of simple yet powerful concepts, and the role of the individuals to meet the goals of equity and equality through social entrepreneurship. The class accomplished the first goal through structured case studies of successful social innovations. The discussed innovations were founded on principles of frugal science and engineering approach across the world and were inclusive of the participation of the communities where they were implemented. The second goal was to understand the role of individuals in the techno-socio-economic society and was illustrated through the individual leadership mind maps developed by the students. The last goal was met through group projects where the students applied their knowledge to develop multifunctional solutions for physical and digital problems at hand during the COVID-19 pandemic. The solution, socially conscious designs, and fabrication of prototypes were done using off-the-shelf components/tools for multifunctionality as an illustration of a frugal engineering approach. Through discussions and student-led presentations, interaction among the students and instructor was encouraged which was especially beneficial in a virtual meeting format. All the above-mentioned goals were met using various success matrices as discussed. Overall, the class delivered on its purpose and was also impactful to the students as conveyed through their feedback.
Acknowledgments

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