

IEEE Direct to Student Program (D2S): Changing dynamics of education and innovation

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Abstract—Most of the developing countries, suffer from an intrinsic and extrinsic divide between the classroom education and its practical implementation for societal well-being. In a new program termed as 'IEEE Direct to Students'(D2S) we try to lessen the gap by involving college and high school students, and young professionals. D2S aims to empower rural and urban informal sector youth to address district problems via frugal engineering innovations. The first pilot of the program was done in Philippines through seminar and awareness lectures, hands-on projects and exhibitions, and will be rolled out in newer geographies based on the initial observations of the pilot study.

Keywords- Outreach; innovation; technical education; undergraduate education; humanitarian technology; entrepreneurship

I. INTRODUCTION

Imagine a world without engineers, or try to think of a world without a holistic commitment to elevate humanity from disasters of varied magnitude and source. In such a world simple everyday items like a computers and mobile phones, logistical tools like aircrafts and vehicles, or the life-saving medical devices would cease to exist. Innovations and technological advancements would have no avenue to prosper; and we would probably be struggling with the mundane problems of our daily lives. Casualties and losses will be a soaring in times of calamities, like the super typhoon Yolanda in Philippines, without basic support infrastructure for relief. It is thus essential to motivate young students toward technical education, and more importantly inculcate in them the skills and capabilities to advance technology for humanity. Driven by this vision of elevating technical literacy for humanitarian innovations among the college students and encouraging awareness in schools imparting STEM education [1], the IEEE Direct to Students (D2S) Program was initiated in session 2012-13. The program was conceived and designed by IEEE Education Society Student Activities Committee (SAC) and implemented as a pilot project in association with IEEE Philippines Section (under codename D2S-Humanitarian Manila), with support from IEEE R10 and local Student Branches.

A. Motivation

Some of us are lucky enough to take part of a higher education which promotes intellectual development and renders us with valuable skill sets. However, it has been observed that there exists a huge divide between the taught lessons and

its practical implementations. Moreover, a huge proportion of young children do not even make the cut-off for acquiring technical education, putting them at disadvantage in the present technology driven society. Our goal in D2S program is to try to shrink the gap, if not eliminate it, by engaging college students in generating ideas and prototypes outside school curriculum [2], [3]. Secondly, the product development lifecycle that is documented during the ideation phase can be used as an essential teaching aid to encourage real-life and hands on training in schools and educational outreach centers [4].

B. Aims and Objectives

We are driven by the mission to facilitate engineering students for elevating human condition via cost-effective engineering innovations. The aim is to aid the growth of technical literacy and creative problem solving abilities among students, to ingrain the culture of technological advancement and development even beyond the campuses. Last but not the least, to intend to guide the engineering students in finding their suitable career path via multi-disciplinary and interactive seminars. The D2S program has been closely associated with the typhoon relief in Philippines and directly helped the victim through technical support and motivating international aid [5]. IEEE members and volunteers from different universities in Manila metropolitan region have come together under D2S Program and created useful prototypes for providing relief to affected communities. The program also envisages to create a bridge between IEEE Teacher in service program (TISP) and direct student engagement, which was felt to be lacking in some parts of the world, specially is high growth economies like India, Brazil etc [6]. In this article we outline the structure of the program and its engagement strategy in Section II. We discuss the social impact of the program on the local communities, and outline a roadmap for future engagements in Section III.

II. INNOVATION AND IMPLEMENTATION

This section illustrates the program structure, as well as presents a critical analysis of the novel features of the program and the implementation strategy adopted. D2S broadly follows an iterative project based mentor-mentee relationship model which is discussed in II-A.

A. Program Outline

At the onset contributions were invited from students in areas of global sustainability and millennium development goals (viz. health, nutrition, environment etc) and local issues like security and social justice. We encouraged the participants to work on community issues, given the fact that our focus is essentially local and, the teams are free to address any problem they see fitting. Student volunteers were selected from engineering and science colleges, they engaged in conducting seminars and 'how-to' tutorials. These tutorials were aimed at showcasing previous academic or extracurricular projects of IEEE volunteers or NGO partners, that have had a humanitarian impact in the Filipino or similar communities [7], [8], [9]. After submission of their projects for evaluation, the participants were invited to the D2S seminar and tutorial series where they were able to augment their domain knowledge and meet their peers. The student speakers could also present their ideas, and get a chance to meet the leaders from industry and academia face-to-face during these events. The innovators were expected to learn their lessons from the educational sessions and apply them to real life scenarios, and enrich their projects – thus creating a bonded mentor-mentee relationship. In the next stage, the projects were evaluated and the best projects were selected to whom professional guidance (and financial assistance) was extended to optimize the efficiency. Finally the finished prototypes were deployed for ground level testing and the technical knowhow were passed onto younger students, thus creating a complete cyclic workflow which is the structural basis of the IEEE D2S Program.

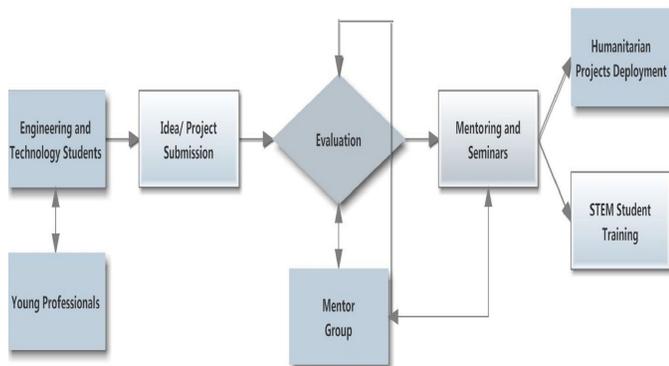


Fig. 1. The functional workflow of the D2S program (D2S—H Manila Pilot) – This model shows the interrelationships of the activities undertaken and the individual roles of the stakeholders.

The functional workflow of the program and the mentoring/evaluation scheme (as illustrated in figure 1) was adopted for D2S- H Manila pilot, it can however, be easily customized to suit the specific local requirements in other geographical territories. The direct interactions enabled a healthy flow of ideas and nurtured an environment of collaboration. To give a brief example, manufacturing engineering students were thinking of a prototype idea that involved automation technologies and robotics; meanwhile electronics engineering students tinkered with wireless electronic gadgets, they think-tank activity brought them together to design a usable new product.

B. Key Features and Novelty of Approach

IEEE members from different universities in the Philippines participated in D2S sessions and presented their solutions to pertinent local problems. The ideas presented included: harnessing piezoelectric power via monsoon rains; water filtration to provide portable water during floods; system to detect the severity of flood and alert the targeted community via SMS. These projects were motivated by the distress caused by natural calamities and urge to alleviate the sufferings of local population. Given an avenue to creatively innovate and implement, the young engineering students were able address challenging humanitarian problems effectively (figure 2). D2S has been one of the very few initiatives in this part of the world which nurture and mentor young talents to achieve their dreams, and thus easily captured the attention of students and appreciation of the faculty/young professions.

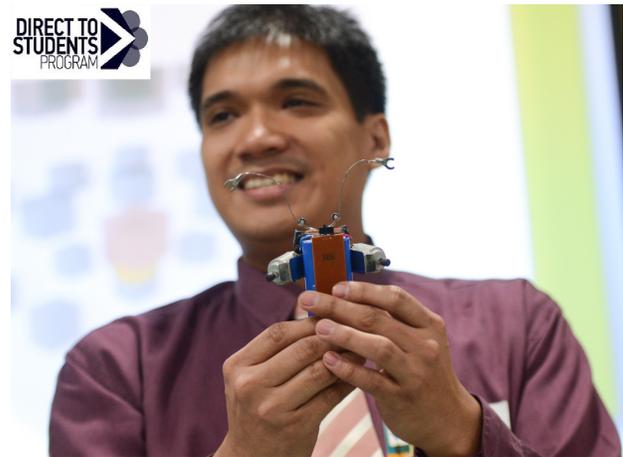


Fig. 2. D2S allows students to promote their hobby/school humanitarian projects in front of industry, academia, young professions and interested peers through seminars: Our student speaker Rikki Macolor (University of Santo Tomas) showcasing his cost effective innovations in one such session.

The D2S program draws parallel with the hugely successful IEEE EPICS Program [10], [11]; however a closer observation will show that D2S uses the EPICS model as inspiration and develops a iterative training-implementation-education model. D2S builds up on the rich IEEE education program portfolio by integrating components not only EPICS but also TISP. The 'Think Tank' and 'Student Speaker' activities that were integrated into the D2S workflow, makes the project unique and novel and specifically addresses problems in undergraduate technical education in developing nations.

C. Engagement Strategy

Our target beneficiaries are mostly youth, thus using traditional pathways to communicate with them were deemed unengaging. Almost all university students are online and active in groups, pages and events posted in social media. Every college student is connected with every other with maximum four (4) degrees of separation and, when someone likes, comments, and shares a certain item in social media, there is always a possibility that more interested volunteers will be referred back to our online community page [1]. Therefore, we D2S publicity and awareness drive was built on the digital platform (website, blogs and social media) to allow students

to spread our causes, events, activities, and announcements to a bigger audience across Metro Manila and rest of the world. In fact we have been able to engage the following universities (students and faculty members) via social media: engineering departments of De La Salle University, University of the Philippines, Ateneo de Manila University, University of Santo Tomas, University of the East—Caloocan, and MAPUA Institute of Technology. Study of demographic data reveals that most participation came from 17–24 year age group; electrical and electronics engineering, computer science and engineering, and manufacturing engineering were the most popular majors. Apart from the online efforts the seminar series served as a platform for direct interpersonal contact.

D. Implementations and Timelines

As of August 2013 (Phase I), we accepted the following prototype ideas from five groups across universities in Metro Manila Region:

- Localized flood detection and alert system via SMS
- End-to-end implementation of manually assembled low-powered solar harvesters in an energy deprived community
- Typhoon piezoelectricity for power generation
- Solar rain for disaster relief and other applications

The selected project teams were offered small seed grant and mentoring support - three (3) projects moved onto Phase II and attempted to implement the system with advise from dedicated mentor groups [12].

From October onward, D2S Program started its interface with IEEE members via a series of seminars. The objective was to fully equip the selected participants with sufficient knowledge to execute their projects, and acquaint them with theoretical knowledge as well as real applications skills. Moreover, we tried to orient the D2S volunteers to work closely with innovators, thus motivating them to intrinsically contribute to the program. The seminars organized under aegis of D2S were broadly segmented into these six categories:

- 1) Technopreneurship and Patenting for frugal innovations
- 2) Solar Power and Renewable Energy
- 3) Embedded Systems and Controls Engineering
- 4) Network and Telecommunications
- 5) Transportation Engineering and Structuring
- 6) Robotics and Mechanics

The last segment in our talks sessions was the “Think Tank Activity” - where students groups brainstorm the ideas they submitted during the D2S participation, and also use the insight gains from the guest lectures. The speakers provide guidance and evaluate the attendees’ outputs through direct dialogue. We have witnessed astonishingly authentic engineering creativity and problem solving abilities during this phase, which indeed is delightful. The recent natural calamity has brought the D2S-Humanitarian (D2S-H) team members and project to the forefront. Upto 40 volunteers has been redeployed in Yolanda relief under a new spin off program ‘Engineers 4 Change’. Moreover, a special session was organized to design prototypes

that would directly be deployed to aid the victims and their families. We were able to setup a technical support team immediately, and innovations enabling access to portable water and electricity were pressed into service within a very short timeframe with help of Red Cross [13], [14].

III. SOCIAL IMPACT AND FUTURE PLANS

The program significantly impacted the local community where the pilot study was conducted, it also made a important mark on the operation and complex relationships of IEEE units and academic institutions. The current section provides more insights on the program’s impact, both locally and globally.

A. Program Response

The D2S program have enjoyed a positive audience trend which is increasing with time. The idea of blending technical talks/seminars while associating all the diverse engineering disciplines to support humanitarian projects, steered attention within the universities in Metro Manila Region. Based of public feedback a segment termed as ‘Student Speakers’ was introduced, where interested undergraduate students can showcase their prototype projects. Thereafter, the program established an buzz within the IEEE student branches and general IEEE membership to attend and engage. Further, buoyed by the initial success of D2S-H Manila project, many student branches/chapters registered their interest to replicate the model in their own hinterland with required modifications (ref. III-C). The overall program reach was 1650 individuals and upto 150 member volunteers were involved directly or indirectly. The D2S-H Manila pilot involved approximately 66 mentor groups volunteers and 22 young innovators (3 funded projects selected in Phase II) in direct roles (refer. II-D).

B. Impact of D2S as an Educational Model

D2S initiative offers a fresh perspective to engineering education in the Philippines, due to the equal and open innovation opportunities provided to the participants, which is rather unlikely in the traditional education system. It also provided the industry, academia, and young volunteers equal time and scope for discussion. The live peer review of the participants’/volunteers’ ideas during the think-tank activity was unique, and gave each participant a chance to propose and improve upon their solutions. Many of the participating students were determined to take their ideas into further research / thesis and extracurricular endeavors, and the mentor group agreed to extend their support as and when needed. This pattern of iterative engagements made sure that projects are followed up - thus D2S does not have a firm ‘ending’ just a different ‘what’s next’.

The D2S educational model has been experimented, and evolving over the last couple of years. We have witnessed emerging of few active collaborations, and the follow-up strategy has been the cornerstone of its sustainability, even in perilous times. To highlight one of the effective collaborations, University of the East-Caloocan Student Speaker worked with a faculty member of manufacturing engineering of De La Salle University, who was also a speaker during that session. There have been a dynamic exchange of knowledge and future project possibilities to solve problems even beyond D2S parameters.

We invited university faculty members, industrial leaders and undergraduate students to share their insights, experience and showcase cost effective prototypes that have a significant humanitarian benefit to the local scenario. This process have provided a purpose and noble meaning towards engineering education, several undergraduate students have become interested to cause positive change in their communities. The talks and the way it is designed encouraged students to ask questions (something that is not so commonplace in many cultures), suggest new devices and design modifications, share insights, seek advice from the experts and engage in brainstorming activities to solve social problems both local and global.

C. Challenges and Future Goals

No project can be successful without the challenges it faces; one of the obstacles that D2S faced was the unstable commitment of the geographical operations units to this pilot initiative. This was primarily triggered due to the diverse nature of engagements and multiple stakeholders of the program. It is thus advisable to have a complete framework of administrative engagement before embarking on interdisciplinary projects. Another issue was that, the groups which submitted prototype ideas came from different universities across the metropolitan, for e.g one group had 6 members from 5 different universities, it was hard for them to coordinate with each other and the cultural conservativeness made it challenging for them to open up to each other and work outside D2S events.

The program is designed to be a global initiative, and despite of the myriad of challenges, the first pilot was successfully launched in Philippines. The initial success makes us hopeful about the future of the program, as well as more cautious as we enter new regions and social ecosystems. In early 2014 the program is to make the windfall in the Indian subcontinent with 4 different cities in 3 separate countries in the subcontinent Mumbai/Vellore (India), Lahore/Faisalabad (Pakistan) and Dhaka/Khulna (Bangladesh). Discussions are in progress with student volunteers in Bogota (Colombia) and Sao Paulo (Brazil) for possible initiation of D2S in South America. We shall continue the seminars under the categories mentioned earlier, as well as, facilitate the D2S volunteers in manifesting their cost effective prototypes for real usage within the community, and throughout the entire network we envisage to build.

IV. CONCLUSION

The D2S pilot initiative has raised interest among the members of IEEE Philippine section as well as non-members. We have witnessed engagement from students of different universities, different engineering courses and different levels of society. All the stakeholders have been contributing their ideas, suggestions, and shared their experience for the betterment of the Filipino community. We expect D2S encourage the engineering student innovations globally, as we grow geographically. The developments made so far highlights the diversity and dynamic nature of the program, and makes us optimistic about an exciting future that it promises in new countries and to impact new communities.

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