Service Learning Course in the Engineering Curriculum: EPICS

M.M.Irfan[1], P.Sammaiah[2]

[1]Electrical Engineering Department, SR Engineering College, India

[2]Mechanical Engineering Department, SR Engineering College, India

[1]mmirfan.srec@gmail.com

[2]sammaiah@srecwarangal.ac.in

Abstract: In the quest for approaches to recreate "real" configuration experiences in our classrooms, the model of community service learning is frequently ignored within educational curriculum. It is, however, a powerful model for learning the engineering design process. SR Engineering College introduced the EPICS - Engineering Projects in Community Service as an elective course in the curriculum. This academic credit based course is highlighted with its objectives and some projects are illustrated to give complete awareness about the course modules. The projects selected illustrate: mechanical, civil, electrical, hardware and software design in the context of service learning. A discussion of how the Program Objectives align with the National Board of Accreditation's Outcome Based Education (NBA's OBE) criteria is also included.

Keywords: Course modules, service learning, technology-based problems, community partner and Community service.

1. Introduction:

Engineering is a process that begins with identifying people's and/or organizational needs and ends with actually designing of products and services to these people/organizations. The social sector is in need of innovation and technology. Technology can bring solutions to better the lives of majority people in society (target public of diverse social organizations) and can lead to efficient management. At SR Engineering College, the EPICS course is doing just that.

Under this course, undergraduate students in engineering earn academic credit for short-term team projects that solve technology-based problems for local community service organizations. The program successfully completed 19 project teams with approximately 110 students participated during the 2015-16 academic year. Each EPICS project team consists of five students and is paired with a local community service organization that functions as its customer. Each team has a faculty guide. The teams are inter-disciplinary including students from Civil, Electrical, Computer, Mechanical, and Electronics Engineering.

Group engagement teaching methods, regularly called "service learning," are ones that join learning objectives and group service in ways that can improve both student development and common product. In the expressions of the National Service Learning Clearinghouse, it is "a teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities." It is a type of experiential training where learning happens through a cycle of activity and reflection as students try to accomplish genuine goals for the community and more profound comprehension and abilities for themselves. All the while, students join individual and social improvement with scholarly and subjective advancement. This experience upgrades understanding; understanding prompts more viable activity.

Service-Learning, especially in the secondary school or college years, offers youngsters one of a unique chances to the connection what they realize in the classroom to certifiable circumstances in their communities. Frequently, these experiences push them out of their usual ranges of comfort zones to see the world in new ways. However, service-learning need not be bound to classrooms. Actually, open doors flourish for families to learn and serve together. These experiences are frequently transformative for youth and show them how to contemplate their general surroundings [1].

The benefits of integrating service learning into an engineering curriculum have been documented in several recent papers [2]. Recent examples of engineering service learning programs include projects integrated into freshman-level introductory courses [3,4], capstone senior design courses [4, 5], and multidisciplinary approaches [6]. Other initiatives have sought to integrate the co-curricular activities of student organizations with engineering service learning [7].

2. EPICS @ SREC

We, SR Engineering College (SREC) began our involvement with community-based projects in 2014 through participation in the Engineering Projects In Community Service (EPICS) program, an initiative of Purdue University. We engaged the community with

daylong brainstorming sessions based on the creation of a Thinking Environment to encourage open collaboration among all participants, technical and non-technical. Some of these first projects involved organizations as a community partner that supported physically challenged and old people. In 2015, our efforts expanded beyond the local community, supporting several global community-based organizations. At our institute, projects were focused on water filters, alternative energy sources, development of earthquake resistant techniques, and assistive devices at low cost for old people.

The objective of EPICS course is to make it workable for a large portion of the engineering students to take part in a community based projects sooner or later, during the academic year schedule. The course plans to make a credible learning experience for engineering students that permits them to work in groups to create and apply their specialized technical knowledge in multi disciplines and workforce abilities through real-time projects that serve the community. The course goals are given below.

1. Develop effective listening and collaboration skills while working with customers.

2. Design a service or product using the engineering design process.

3. Recognize and summarize ethical responsibilities of engineers.

Throughout the course, faculty supervises the student teams to ensure that the quality of the end product not only satisfies the community partner but also meets the standards. The partnership requires deliverables from all parties. The engineering students provide a comprehensive conceptual design based on creative problem solving and preliminary impact analysis with complete design details, a significant portion of the hardware/software for the project, and a demonstration of the design along with a design report. The community partner provides a review of their experience and satisfaction with the project results.

The team size also enables students from disciplines across engineering to participate in an EPICS team. The disciplinary composition of an EPICS team can thus be tuned to a project's needs. For example, teams producing devices to assist children or adults with disabilities have drawn from such disciplines as electrical engineering, mechanical engineering, computer science. EPICS provide a start-to-finish design experience for students. Each project begins with identification of the project partner's needs and the definition of a project to meet one of more of those needs. It then progresses through design, development, testing and deployment with the project partner. [8]

3. Modules of the EPICS Course @ SREC

A. Societal survey and Problem Identification

After the formation of teams, the students will go through multiple brain storming sessions and societal surveys. After deeper discussions, they will finalize any of the community based problems. They will identify and interact with the community partners, to get some initial inputs from them, as shown in fig.1.

Fig.1.Students during the survey

B. Project initiation and specification

Students will present their idea through the poster; expert team will interact with them and will give appropriate suggestions. After accepting their titles, they will meet community partners and note their needs, requirements and specifications, as shown in fig.2.

Fig.2.Students during the brain storming and poster presentation

C. Design skill development for implementation

Faculty will deliver the lectures on design skills and also Students will listen video lectures of Purdue University. Then they will come up with the conceptual design of their product. Now they should do market survey and produce an analysis report; which will compare the existing product with the newly developed concept.

Fig.3.Prof.William Oakes explaining about EPICS Design process

Fig.4.Students listening Video Lecture by Dr. Carla Zoltowski, Purdue University

D. Project/product design for deployment

Students will prepare their design document and start building the prototype. They will go through the start-to-end design process and will complete the design of the product. During this process, they regularly interact and work collaboratively with their partners. Faculty advisors will guide them in the complete design process, as shown in fig.3 and fig.4.

Fig.5.Students designing the products under the guidance of Faculty Advisors

E. Product delivery and Review

Once the product is ready, the models should be demonstrated, as shown in fig.5 and fig.6. Product-Expo is the platform where they will exhibit and demonstrate their models. Experts from industry and NGO's visit the Expo and will give valuable comments. Then students will modify the end product according to the expert comments. Now they will deliver the product to their community partners, as shown in fig.7. and note the feedback from them.

Fig.6.Students demonstrating their products

Fig.7.Students delivering the products to partners

4. EPICS Teams during the academic year 2015-16 @ SREC

Each student in the EPICS course attends a weekly two-hour meeting of his/her team in the EPICS class. During this time, the team members address administrative matters, do project tracking and planning, and work on the technical aspects of their project. All students also attend a common one-hour lecture each week. A majority of the lectures are by guest experts, and have covered a wide range of topics related to engineering design, communication, and community service.

During odd semester of 2015-16, 76 students registered from Electrical, Mechanical and Civil Engineering departments. In even semester strength increased to 90 from departments of Electronics, Computer Engineering. During odd semester of 2016-17, student registrations were raised to 115. During the academic year 2015-16, students who have registered this course had successfully completed their projects and also delivered their products to the community partners. Some of their project titles are tabulated in the table.1 shown.

Table.1 Active EPICS Teams During 2015-16, SR Engineering College

S.No	Title of the Project	Community Partner
01	Bus Detection System for Blind People using RFID	Carmel Convent School (Visually Challenged). warangal
02	Automatic Railway Gate Controller with High Speed Alerting System	Bridge Department of Engineering, South Central Railway, Kazipet
03	Alcohol Ignition Interlock System (Drunk and Drive Prevention system)	Traffic Police Department, Hanamkonda
04	Design of Hand Talk System for the for Dump People	Malikamba Manovikasa Institute for dumb children
05	Prevention of Coal Mine Disasters using Mobile Robots	Singareni Collieries Company Limited (Mines)
06	Detection of Fire Accidents in Trains and Automatic Passenger Saving System	Railway Protective Force, Kazipet Railway station
07	Shoe based Power Generation	DR.IP's fitness centre, Nakkalagutta, Hanamkonda,
08	Low Cost Fire Alarm	Telengana Grameena Bank, Vemulawada branch, Karimnagar
09	Soil Moisture Sensed Automatic Irrigation System	Local Farmers of village, Hasanparthy, Warangal
10	Safe Helmet	Traffic Department, Warangal
11	Bi-Litters	Greater Warangal Muncipal Corporation
12	Self supporting Hand stick	Sahrudaya old age home, Kazipet
13	Electric Jacket for women protection	Police Department Women Police Department, Hanamkonda
14	Low cost Ferro Cement house	Security Guard Shed, Sparkrill International School
15	Rooftop rain water harvesting	Mechanical Workshop, SR Engineering College
16	Gesture controlled wireless wheelchair prototype	Sai Old Age Home, warangal
17	Low cost Advanced Dustbin	School or domestic purpose
18	Multi Agri Machine	Farmers
19	Face mask with air filters	Traffic police
20	Jugaad Room air cooler	College canteen

5. Assessment

Student evaluations of the program have included quantitative evaluation along the specific educational objectives, as well as descriptive, formative and summative evaluations. A majority of the students polled have cited the opportunity to obtain `practical, real-world experience in engineering design' as their primary reason for participating in the EPICS program. A significant number have also identified the opportunity 'to do community service' as a major factor in their participation. As part of the summative evaluations, students were asked: `What impact, if any, has the EPICS program had on your resolve to continue in engineering?. Ability to work on a team consistently receives the highest grades, followed by Communication skills and awareness of the customer in an engineering project.

Qualitative data collected as part of the summative evaluation included students' responses to the question, `What are the three most valuable things you have learned as a participant of the EPICS program?' from their responses, `collaborative work' is the most common response to this question; it is selected by an average of 75% of the students each semester. The students also frequently report learning other professional skills that are part of the OBE of NBA criteria (Graduate attributes), including `communication skills, relational abilities and project management'. This is noteworthy because it is difficult to teach these skills in traditional classes. `Leadership' is also selected frequently, approximately one third of the EPICS students eventually assume leadership roles on their teams.

6. Conclusions

It's extremely challenging to encourage the module with its large number of diverse students, different campus-community partners with various needs, as well as few available resources. For most of the students, it is their first community outreach experience as the service learning course is not yet included in the curricula of institutes. The successful facilitation of the module depends highly on the partnerships between students, lecturers and community partners. Community partners keep on accommodating the students in light of the fact that there is such a huge requirement for societal service.

These communities understand that all students won't deliver the same level of yield, yet they have the chance to change the students into a drew in subject or even to build up a long lasting relationship between a student and a specific cause or non-profit associations. Service-learning projects and a profound duty to community improvement are critical for the accomplishment of these projects.

The 'Engineering Projects in Community Service' Program has added a new dimension to the educational design experience for engineering undergraduates at our institute. It represents the first program at SREC that formally integrates service-learning into the engineering curriculum. It has proven successful in the several areas of engineering design including Electrical, Computer, Mechanical and Civil Engineering. The student experience in the EPICS program is very well suited to meet the Accreditation Board for Engineering and Technology, Engineering Criteria 2000 **(**ABET EC 2000) and NBA requirements related to design experiences.

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