Outcome based project for betterment of rural community

V. Arunajanani[1], Naresh Kumar Sharma[2], N. Hariram[3], G. Vishnuvarthanan[4], S. Reginold Jebitta[5], T. Arunprasath[6], K. Chitradevi[7], S. Sheik Asraf[8]

[1]Department of Chemical Engineering, Kalasalingam Academy of Research and Education, Krishnankoil-626 126
[2,3,8] Department of Biotechnology, Kalasalingam Academy of Research and Education, Krishnankoil-626 126
[4,6]Department of Biomedical Engineering, Kalasalingam Academy of Research and Education, Krishnankoil-626 126
[5,7] Department of Food Technology, Kalasalingam Academy of Research and Education, Krishnankoil-626 126

[1]aruna.biotek@gmail.com, [2]naresh@klu.ac.in
[3]n.hariram@klu.ac.in, [4]gvvarthanan@gmail.com
[5]reginoldjebitta@gmail.com , [6]aruna.aklu@gmail.com
[7]k.chitradevi@klu.ac.in , [8]s.sheikasraf@klu.ac.in

Abstract: In the last about one decade, science, technology and innovation have greatly influenced in shaping the modern engineering education. However, there is an urgent need to take the benefits of science and technology influence to offer practical solutions to the betterment of the society. The B.Tech curriculum of KARE (Kalasalingam Academy of Research and Education) is designed to include mandatory one year long course of Community Service Project with an aim to address the difficulties faced by the rural women and farmers of neighbouring community. This study focuses on the strategy adopted and the success witnessed with the introduction of this course. The participants included in the study are 18 engineering undergraduate students. The students surveyed the community with a specifically designed questionnaire to identify the specific problems of the community stakeholders in relation to the social, economic and other aspects. The students through their survey identified the problem of the chosen community as the outcome of Phase I of the project. In Phase II, the students involved in designing and developing the prototype through simple scientific solution. The main challenge is in sustaining the motivation of students to work beyond the duration of the project to bring everything to final shape. This can be done both by developing empathy in the minds of students for their fellow being in the community as well as creating awareness of the many funding schemes available to recognize and support such endeavour. It is recommended that all the institutions should create an avenue in their curriculum to facilitate students' involvement with the community.

Keywords: community service project, sanitary napkin, bio-fertilizer, robotic arm, refrigerator, survey, field visit, prototype

Corresponding Author
Department of Biotechnology, Kalasalingam Academy of Research and Education, Krishnankoil- 626126.
s.sheikasraf@klu.ac.in

1. Introduction

The advancements in the science, technology and innovation have played a vital role in promoting in the engineering education in our institution (KARE) and elsewhere. Integration of community based service learning into engineering curricula has been promoted by leading educational institutions in India and elsewhere [1,2]. More, emphasis has been provided by the educational institution for learning by doing from engineering projects in community services for the betterment of the underserved communities throughout the world [3,4]. Faculty play a vital role in mentoring the students to engage in community based learning projects [5] with a design based thinking approach [6]. Such community based projects have been implemented in the curriculum of the leading education institutions in the initial years of the program itself [7] for addressing the different needs of the rural community such as water supply, sanitation, quality air and solid waste management [8]. The technology such as Arduino nano, electromyography signal, servo motor has been implemented worldwide [9, 10] for developing prosthetic limbs for amputees in the developing world. There have been many instances in the past where socially relevant projects like sanitary napkin dispensing system, reusable sanitary pads have been implemented by the educational institutions worldwide [11, 12]. Many initiatives have been encouraged worldwide by many educational institutions through community service projects to address the problems faced by farmers [13, 14, 15, 16, 17]. The B.Tech curriculum of KARE is designed to include mandatory one year long course of Community Service Project with an aim to address the difficulties faced by the rural women and farmers. We have used the principles of science and technology and offered suitable innovative solutions for the problems faced by the rural women and farmers of the villages in the immediate neighbourhood of KARE through the implemented community service project.

2. Literature Review

Community service project based learning is encouraged by leading education accreditation bodies like National Board of Accreditation (India) and Accreditation Board for Engineering and Technology (USA) [18]. Many instances of prototypes and products developed by the students has been implemented for betterment of the neighbouring community in the aspects of health [19, 20], in which students learn by doing [21]. The important aspects of community based project are the positive interdependence among the stakeholders, face-to-face promotive interaction with community members, individual responsibility, collective skills, and group processing [22]. Sustainability of such community based projects have been tested by many education institutions [23, 24]. Thus, community service based learning provide ample opportunity to students to gain leadership and team-building qualities besides providing the sustainable solution to the real life problems faced the neighboring community [25]. Many socially useful products such as sanitary napkins for women, bio-fertilizers and bio- control agent for the farmers, robotic arm for amputees and zero energy low cost refrigerator for the farmers have been developed by the students of KARE and transferred to the community.

3. Methodology

The B. Tech. Curriculum of KARE emphasises on mandatory 1 year duration community service project course. The structure of this course includes two phases which is undertaken by the students mentored by a faculty adviser. In phase I, the students meet the members of the community in the selected area (village) and conduct field visit. During the field visit, the students interact and establish rapport with chosen community. The students conduct survey which includes questions pertaining to social, health, economic, educational and occupational status of the members of the community. Later, the students identify the target group i.e. rural women, men and farmers. Then, the students identify the need and problem of the chosen community. Later, the faculty advisor and the students integrate academic expertise for the identified need and problem on the basis of three factors: curriculum, community need and student interest. Emphasis is also made to collaborate with community agency i.e village panchayath and village leaders. Then, the students prepare a proposal which is viable in terms of science, technology and innovation. Later, the students prepare a report on the basis of literature survey, need analysis survey and proposed prototype details. In Phase II of the project, the students involve themselves in designing and developing the prototype through simple scientific solution.

A. Phase I

1. *Meeting the community:* The students discussed prominent issues that need attention in nearby rural area. The foremost step was to select the target area such as rural village and marginalized community like farmers, women and physically handicapped person. The field visit was planned by the students three times in a month. The students visited the nearby rural community and interacted with them. They identified the target group such as rural women, farmers and physically handicapped person. They were selected based on the interaction with the community people (Fig.1).

2. *Survey analysis I:* The survey was conducted with target group and prepared a report. The students prepared an individual report for every visit. They conducted a survey to collect the information regarding social status, health status, economic status, educational status and occupational status of the chosen community. This was the essential component to know the people and was carried out through the observation and interaction. The initial objective was to find and know about the problem faced by rural people. The students collected basic level information like name, age, educational qualification and the core problem they are facing in their daily life.

3. *Identifying the problem statement:* The interaction performed by students with rural community people was sufficient to identify the problem. They learned the real need of the rural community. The major issues of rural area were determined and the students were determined to address the needs of the rural people. The students prioritized the needs and selected the pre-eminent problem. An idea was formulated by student team to find a scientifically and technologically viable solution for this problem.

4. *Integrate with academic expertise:* Good planning was crucial to any community service project. The students have performed literature survey with the guidance of faculty advisor for finding the solution for the problem faced by rural community. The technical plan was developed by students. The plan included aspects of task and responsibilities of individual stakeholders. The students executed the task by developing the product, analysing the product and delivering the product.

5. *Review report:* The literature review was done by the students with guidance of faculty advisor. The proposal was prepared based on need analysis survey. The report included the survey interpretation, product/ proto-type preparation methods, analysis procedures and technical solution for the indentified the plan.

B. Phase II

1. *Colloborate with community agency:* The technical solution was implemented in the rural community therby alleviating the identified problem. The solution was demonstrated with community agency such as village panchayath and village leaders. The product/

proto-type was demonstrated to the community agency.

2. *Preparing proposal and prototype:* The task completed in the form of proto type product which helped the community and satisfied their needs. The product/ proto- type preparation methods were demonstrated to the community people. This was a good opportunity for the students to know about the societal needs and issues. The demonstrated prototype was implemented by the rural area target people.

C. Course outcomes of the community service project

The students are assessed on the basis of the following course outcomes:

1. Identify the different needs and understand a specific problem of a particular community
2. Suggest and implement a sustainable solution for the specific problem identified in the community
3. Interact very well with their team members and with the chosen community members during the implementation of the project
4. Design the experiments and make power point presentation with results and challenges
5. Document their observations and results with proper literature

D. Student survey and result analysis

The students were surveyed and result analysis was carried out at the end of the implemented projects. The students were surveyed on the basis of the following questions on a scale of 0-5:

1. Whether the students felt comfortable with yearlong project?
2. Whether the students had developed empathy for rural community?
3. Whether the students are convinced about their innovative practical solution?
3. Whether the students are comfortable with the time duration of the project?
4. Whether the suggested sustainable solution was implemented effectively in the community?

4. Result and Discussion

A. Robotic arm for the amputees

A community service based project implemented by the students mentored by the faculty of department of biomedical engineering, KARE dealt with the introduction of electromyography signal from the body of the amputee shown in Fig.2. The robotic arm was controlled by microcontroller [26, 27, 28].

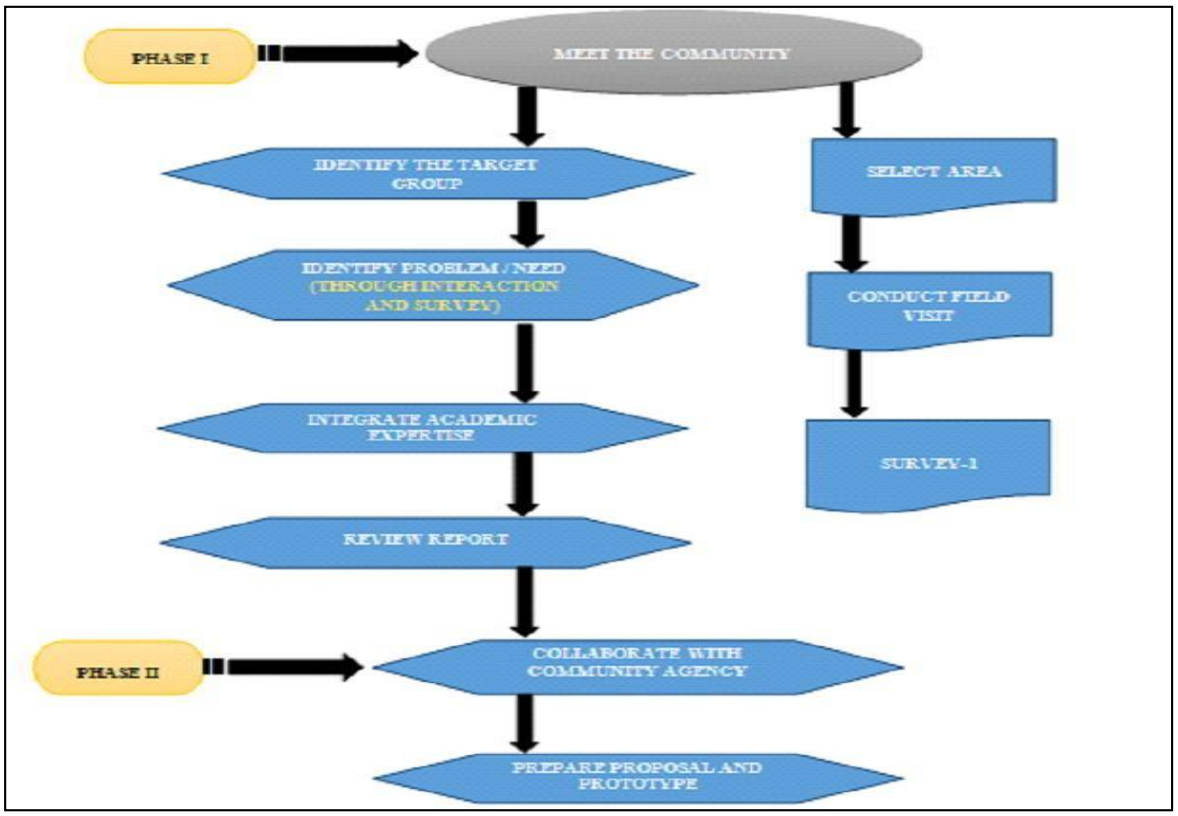

Fig. 1 The research methodology of the community service project

The students used the servo and successfully drived the robotic arm to produce the desired movements with the help of electromyography signal values acquired from the body of the amputee. The students have helped the amputee by bringing back the lost functions of the upper extremities of the amputees thereby achieving the objective of this community service project. This has helped the amputees to do their day-to-day activities, with the help of robotic arm developed by the students.

B. Sanitary napkin for the rural women

Rural women face the day to day hygiene problem related to menstruation. The commercial sanitary napkin used by the rural women poses many disadvantages: confined space of village makes disposal of sanitary napkin impossible, non availability of garbage bins, health risk due to chemicals like dioxin, bisphenol-A and bisphenol-S present in sanitary napkins. A community service based project implemented by the students mentored by the faculty of department of chemical engineering, KARE helped to address these draw backs of commercial sanitary napkins. The students conducted a survey in the immediate neighbourhood and found that rural women lack the knowledge of disposal of commercial sanitary napkins. Hence, the students developed the sanitary napkin (Fig.3) composed of bamboo fiber, rose water, neem oil, butter paper, polyurethane layer and natural adhesive paper.

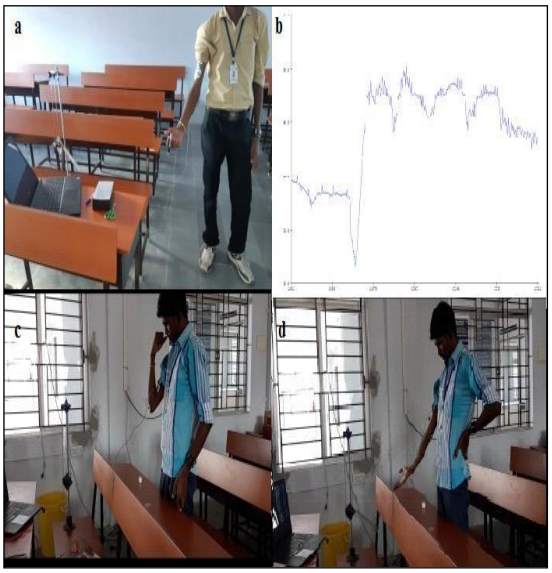

Fig. 2 A prototype mimicking the functions of the human arm (a) developed with introduction of electromyography signal from the body (b) has accomplished the basic motions of the body, such as (c) flexion and (d) extension.

The advantages of the sanitary napkins developed by the students include: low cost making it affordable to rural women, hygienic and eco friendly because of the herbal raw materials used in the preparation of the sanitary napkins, biodegradable and hygienic. This community service project gained national attention from the union government of India which conferred Chhatra Vishwakarma award to the students and the faculty mentor.

Fig. 3 A prototype sanitary napkin developed by the students.

(a) front view (b) back view

C. Low cost bio-fertilizers and bio-control agent for the farmers

A pair of community service based projects implemented by the students mentored by the faculty of department of biotechnology, KARE dealt with the problem posed by high cost commercial chemical fertilizer. Chemical fertilizers have many disadvantages: high cost, low soil fertility, low nutrient availability, less nitrogen fixation, less phosphorous solubilisation, less synthesis of plant and growth promoting substances. Hence, the students mentored by the faculty advisor surveyed the neighbourhood villages and successfully provided the solution to the farmers by implementing the usage of the natural bio-fertilizer developed by them (Fig.4).

Fig. 4 Student distributing the natural bio-fertilizer to a women farmer.

Fig. 5 Bio-control agent developed by the students

Fig. 6 Faculty advisor interacting with the cardamom farmer

The second project implemented by the students addressed the fungal disease of cardamom farmers. The students used a bacterium named *Pseudomonas fluorescens* to address this problem. The bio-control agent (Fig.5) consisting of this bacterium was highly effective and inhibited the growth of fungi in cardamom plants. The faculty mentor played a vital role by interacting with the farmers (Fig.6). Natural bio-fertilizer and bio-control agent developed by the students have many advantages: low cost, high soil fertility, high nutrient availability, high nitrogen fixation, high phosphorous solubilisation, high synthesis of plant and growth promoting substances.

D. Zero energy low cost refrigerators for the farmers

A community service based project implemented by the students mentored by the faculty of department of food technology addressed the issue of post harvesting loss of seasonal fruits like sapotta. Such fruits have high moisture content and as s result easily spoiled at room temperature. The students developed a prototype zero energy low cost refrigerator for the farmers (Fig.7).

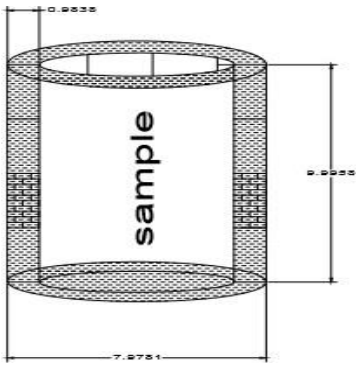

Fig. 7 A schematic model of the refrigerator

This refrigerator is composed of three major parts: an outer transparent cover, an outer absorbing vessel and a mounting stand. This refrigerator does not require electricity or any source of energy thereby beneficial for the rural farmers.

As a result shelf life of the fruits harvested by the farmers has been increase d to 7-8 days compared to room temperature. The zero energy low cost refrigerator was implemented by the farmers (Fig. 8).

Fig. 8 Students demonstrating the working zero energy low cost refrigerator to a rural women farmer

E. Student survey and result analysis

The students were surveyed and result analysis was carried out at the end of the implemented projects. All the students felt comfortable with yearlong project. All the students had developed empathy for rural community. All the students were convinced about their innovative practical solution. A majority of the students were comfortable with the time duration of the project. A majority of the suggested sustainable solution was implemented effectively in the community (Fig.9).

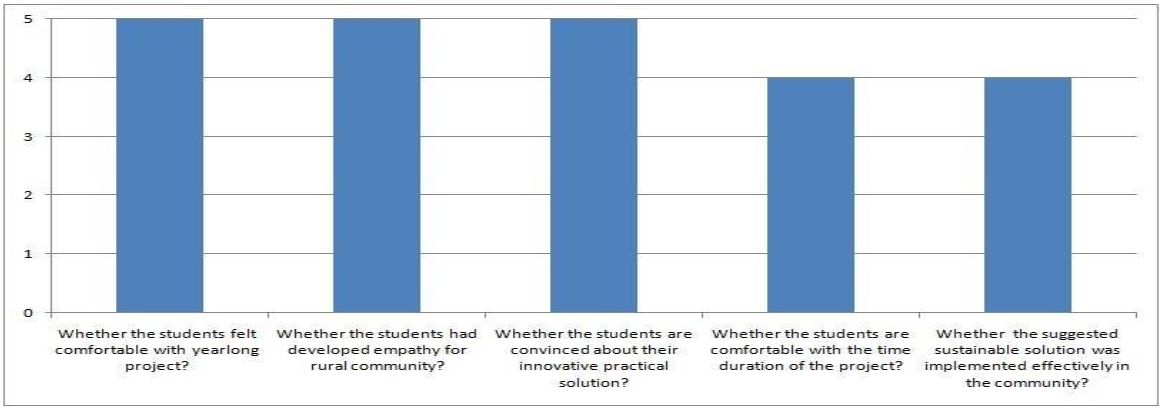

Fig. 9. Students survey result

5. Conclusion

Community service based projects play a vital role in the upliftment of the day to day well being of the disadvantaged individuals like amputee as evident in the project executed by the students of KARE. Similarly, many educational institutions have promoted the community service projects as a tool for solving the mobility aspect of the disadvantaged physically handicapped with the help of advancements made in science and technology. The technology used by the students of KARE helped for developing prosthetic limbs for amputees in the developing world.

Wellness of women in particular rural women is essential for the upliftment of them in the society. Menstruation and the resulting challenges posed by it has played spoilsport in the life of rural women. The students of KARE have developed affordable and eco friendly sanitary napkins for the rural women and thus have provided the basic necessity of health and hygiene of rural women.

In a country like India, agriculture forms the backbone of the economy. Thus, farmers play a vital role in the day-to-day economic prospects of the country. Farmers face numerous problems like drought, insect pest, high cost of chemical fertilisers and pesticides and lack of storage facility for the farm products like fruits and vegetables. Students of KARE have developed products to address the above aspects. The products namely low cost bio-fertilisers and zero energy low cost refrigerators will greatly help the rural farmers.

The main challenge of implementing any community service project is in sustaining the enthusiasm of students to work beyond the duration of the project to achieve the ultimate goal of developing a product / process that will help to address the different needs of the rural community such as health, hygiene, water supply, sanitation, quality air and solid waste management. This was achieved in KARE by developing empathy in the union governments of India available to recognize and support such endeavour. Hence, it is recommended that all the education institutions should create an avenue in their under graduate engineering curriculum to facilitate students' involvement with the underprivileged community.

6. Acknowledgement

Authors thank Dr. C. Sivapragsam, Director, Internal Quality Assurance and Compliance, KARE for providing the valuable suggestions and inputs for this manuscript. Authors thank Dr. J.T. Winowlin Jappes, Dean, School of Automotive and Mechanical Engineering, KARE for his motivation for writing this manuscript. Authors thank Dr. K. Sundar, Dean, School of Bio and Chemical Engineering, KARE for his continuous support. Authors thank present and former Head of the Departments of Chemical engineering, Biotechnology, Biomedical Engineering and Food Technology for their support. Authors thank the students who had actively participated in this study. Authors thank the management of KARE for providing infrastructure facility for this study.

7. Reference

[I]. Tharakan, J. (2012). Integration of Student-Centred and Community-Based Service Learning Experiences into Engineering Curricula. Journal of Engineering Education Transformations, 25(4-1), 57-63.

[II]. Sharma, M., Kumar, A., Bachhar, A., & Unnisa, A. (2018). Project under EPICS I2P Air Purifier for an Old Age Home. Journal of Engineering Education Transformations.

[III]. Kumari, T. A., Sunitha, K., & Unnisa, A. (2018). Learning By Doing from EPICS (Engineering Projects in Community Services). Journal of Engineering Education Transformations.

[IV]. Oakes, W., Zoltowski, C. B., & Huff, J. (2014). Engineering Service-Learning: A Model for Preparing Students for Engineering Practice While Meeting Needs of the Underserved. Journal of Engineering Education Transformations, 27(4), 46-56.

[V]. Adi, R., Revankar, S. G., Joshi, G., & Kavale, S. M. (2017). Project Clinic: An approach to project mentoring. Journal of Engineering Education Transformations, 30(3), 292-298.

[VI]. Irfan, M. M., Rajamallaiah, A., & Ahmad, S. M. (2018). Paradigm shift in the engineering curriculum: design thinking. Journal of Engineering Education Transformations.

[VII]. Hinds, T., Buch, N., Delgado, V., & Morgan, J. (2020). Development of a Peace Engineering Initiative within a First-Year Engineering Program. Journal of Engineering Education Transformations, 33, 112-117.

[VIII]. Kulkarni, M. (2016). Clean Village and Project Based Learning. Journal of Engineering Education Transformations, 30(1), 9-16.

[IX]. Anderson, L. S., Schleien, S. J., & Green, F. P. (1993). Educating for social responsibility: The effectiveness and ethics of a community service project with persons with disabilities. Schole: A Journal of Leisure Studies and Recreation Education, 8(1), 17-35.

[X]. Ulloa, G. D. F., Sreenivasan, N., Bifulco, P., Cesarelli, M., Gargiulo, G., & Gunawardana, U. (2017, December). Cost effective electro—Resistive band based myo activated prosthetic upper limb for amputees in the developing world. In 2017 IEEE Life Sciences Conference (LSC) (pp. 250-253). IEEE.

[XI]. Rao, K. S. S., Dhineshkumar, A., Jeeva, A., Sathish, C., & Kumar, T. S. (2017). lot Based Intelligent Sanitary Napkin Disposer. Advances in Natural and Applied Sciences, 11(10), 32-41.

[XII]. Lumutenga, N., Khaitsa, M., Muwazi, R., Wakoko-Studstill, F., Naigaga, I., Hossfeld, L., & Ralston, M. (2017). Women Empowering Women Through Reusable Sanitary Pads. Journal of Community Engagement and Scholarship, 10(1), 15.

[XIII]. Paz, C. A., Bajet Jr, M. A., Bajet, N. A., & Bermio, J. B. (2013). Community adoption on research-based technologies of the University of Northern Philippines. Asian Journal of Business and Governance, 2(1), 232.

[XIV]. Sarkar, S. K., & Uddin, M. K. (2013). Community based waste management and its utilization for sustainable environment. Bangladesh Journal of Animal Science, 42(2), 165-173.

[XV]. Trisurat, Y. (2006). Community-based wetland management in northern Thailand. International Journal of Environmental, Cultural, Economic and Social Sustainability, 2(1), 49-62.

[XVI]. Arcilla, R. G., Co, F. F., & Ocampo, S. R. (2011). Correlates of poverty: Evidence from the Community-based Monitoring System (CBMS) data. DLSU Business & Economics Review, 20(2), 33-43.

[XVII]. Lukuyu, J. M., Blanchard, R. E., & Rowley, P. N. (2019). A risk-adjusted techno-economic analysis for renewable-based milk cooling in remote dairy farming communities in East Africa. Renewable energy, 130, 700-713.

[XVIII]. Patange, A. D., Bewoor, A. K., Deshmukh, S. P., Mulik, S. S., Pardeshi, S. S., & Jegadeeshwaran, R. (2019). Improving Program Outcome Attainments using Project Based Learning approach for: UG Course- Mechatronics. Journal of Engineering Education Transformations, 33(1), 1-8.

[XIX]. Sharanya, G., Abhishek, C. S., Reddy, K. M., & Unissa, A. (2018). Human Centered Design Process of Health Monitoring Device under EPICS. Journal of Engineering Education Transformations.

[XX]. Orsak, G., Ndetan, H., Allen, C., Singh, K. P., & McGaha, P. (2019). Colorectal Adenoma Detection Rate in Northeast Texas–Outcome from Community Service Project Using the Fecal Immunochemical Test and Colonoscopy. Cancer Health Disparities.

[XXI]. Mey, M., Werner, A., & de Villiers, B. (2018). Student experiences of service learning through a community outreach project. Development in Practice, 28(6), 764-774.

[XXII]. Ahrumugam, P. (2015). Cooperative Learning: A Case Study on Teamwork through Community Service Project. International Journal of Educational and Pedagogical Sciences, 9(12), 4127-4132.

[XXIII]. Sy, M. V. U. (2013). Sustainability of a community service project of a Catholic University. Asian Journal of Business and Governance, 1(1), 221.

[XXIV]. Young, K., & Goodman, J. (2015). Student Service and Advocacy Learning Through a Community Health Organization Advocacy Project (CHOAP). Journal of Health Education Teaching Techniques, 2(1).

[XXV]. Tan, Y. W. (2010). The use of community service project to teach leadership and team-building in the Asian context. Academy of Taiwan Business Management Review, 6(4), 13.

[XXVI]. Cavallaro, E., Rosen, J., Perry, J. C., Burns, S., & Hannaford, B. (2005, April). Hill-based model as a myoprocessor for a neural controlled powered exoskeleton arm-parameters optimization. In Proceedings of the 2005 IEEE international Conference on Robotics and Automation (pp. 4514-4519). IEEE.

[XXVII]. Maier, S., & Smagt, P. V. D. (2008). Surface EMG suffices to classify the motion of each finger independently. In Proceedings of MOVIC. 9th International Conference on Motion and Vibration Control.

[XXVIII]. Fukuda, O., Tsuji, T., Kaneko, M., & Otsuka, A. (2003). A human-assisting manipulator teleoperated by EMG signals and arm motions. IEEE transactions on robotics and automation, 19(2), 210-222.