

DEVELOPMENT OF A PERSONAL WATER PURIFICATION SOLUTION IN NAGCARLAN, PHILIPPINES

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Session 3: Incorporation of Service Learning into engineering education in the digital age

Abstract:

The number of those who need basic life services increases throughout the world as the world's population continues to grow. One such example is the community of Nagcarlan, Philippines. There is a need for potable water, free of harmful contaminants and diseases, in this disadvantaged region. With a concern such as this in mind, it is important for up and coming engineers in the 21st century to realize that it is our responsibility and our ethical duty to address these issues. Therefore, through a course in service learning, young engineers will put to use what they learned in their studies and apply them to address this community's problem. Students will apply their knowledge to develop a cost-effective and efficient personal water purification system for the people of Nagcarlan. Tests have shown that the water supply in the area is contaminated with heavy metals, volatile organic compounds (VOCs), and high levels of Coliform bacteria. In attempts to remove these contaminants, students will research the natural materials in the area that may be helpful or useful in their removal. Materials like coconut waste to derive activated carbon and Malunggay, which are readily available throughout the Philippines, will be tested for their contaminant removal capabilities. Not only will this research and development project help the people of Nagcarlan, but also other rural, disadvantaged areas, where water contamination is of great concern. This research and service learning will also be beneficial to the students, who will grow from this experience and provide an example for engineers to come.

Introduction:

In an age where information and news are constantly being updated and found at the click of a button, it's easy for certain struggles to be forgotten. One such story is the availability of potable water in the rural areas of countries like the Philippines. Data from UNICEF shows that only 82% of the people living in these rural areas have access to potable water. Many of the people who inhabit these rural areas have little to no income, thus making difficult to find or afford clean drinking water. Much of the water available is obtained from streams or springs that are contaminated with runoff from farms or the careless dumping of garbage by individuals. With little spendable income, for most it becomes impossible to properly filter the water, thereby increasing the risk of waterborne infections and diseases. It is therefore necessary that something be done to help those in need.

One way is through the use of Service Learning. This method of teaching is meant to have a two-fold outcome. First, it gives students the opportunity to help others in need, while helping them become more aware of serious socio-economic and quality of life issues.

Secondly, it helps the students to continue to learn with hands on experience, by taking what they have been taught, and applying it to real world situations.

To initiate this Service-Learning project, students and professors from two schools: Manhattan College in Bronx, NY and De La Salle University in Manila, Philippines, have formed a collaborative team to design and build low cost, easy to produce personal water purification filters for the people of Nagcarlan, Philippines. The materials for these filters will be easily obtained from natural materials available in the area. One of these materials is coconut husk. The husk can be made into activated carbon, making for a low cost and easily accessible filter material. The Philippines is the largest producer of coconuts in the world [1]. In addition to the design and constructions of these filters, the students will begin a non-profit startup company to ensure that the efforts to provide these filters to the local people will continue beyond the development stage and will not be viewed as a short-lived venture.

Project Scope:

This specific Service-Learning project will be broken into two major parts. First is the design and construction of a low cost, easy to construct personal water purification system using natural materials found readily available to the surrounding area of Nagcarlan. To start the project, the students will perform a literature review as well as a patent search to discover and understand current technologies and materials that can be used for water purification. The literature review will serve as a preliminary guide to help the students determine if the materials they plan to use have been found effective in contaminant removal.

After the literature review is completed, preliminary testing and design will take place at Manhattan College. The primary filtration medium of the filter will be activated carbon derived from coconut waste, which is the husk or the outer shell of the coconut. Several studies have shown that the activated carbon produced from coconuts has been a useful, low cost filter material [2]. The students involved in the project will test coconut-derived carbon for its capabilities in the removal of materials such as heavy metals and certain organic compounds. Experiments will be run to help determine the maximum length of time that the coconut-derived carbon can absorb contaminants.

Tests on the local water supply in Nagcarlan have shown that the water is contaminated with several heavy metals and volatile organic compounds. In addition, the available water contains high levels of coliform and other biological materials. Therefore, part of the design project is to find natural materials that aid in the removal of these contaminants. Students will perform experiments using materials such as sand and Malunggay. The use of sand has shown to be a useful material for the removal of bacteria while the Malunggay has shown to significantly reduce turbidity in drinking water [3].

Once initial experiments have been performed on these materials the design stage for the filter will take place. Experiments will need to be performed to find the optimum amount of each material to use to maximize filtration results, while keeping overall production costs to a low. In addition, materials for the casing of the filter must also be taken into consideration. One possibility that students are pursuing is the use of bamboo as the filter housing.

The second part of the service-learning project is to begin a non-profit startup company. The company will be scheduled to startup once a final design for the personal water filter is complete. The purpose of the company is to help find a way to ensure that the production of the filters continues and helps those in continual need of clean water. In order to complete this part

of the project, students must first create a business plan that the company will follow. The business plan will consist of a mission statement, fully addressing the needs of the community they are helping and detailing the service goals of the organization. Following the creation of the business plan, students will generate the appropriate non-profit business components which will include creating Articles of Incorporation, filing for tax exemption status, and applying for an Employer Identification Number (EIN) with the United States Internal Revenue Service.

Once the business model has begun and the final design of filter prototype is set, final testing of the filters efficacy in removing contaminants will be assessed. Testing will take place by students at both Manhattan College and De La Salle University. After final design and testing is complete, the filters will be mass manufactured in the Philippines at De La Salle University. Distribution and training to local residents and officials will be the final step. The representatives from the company will be in place to ensure the filters are functioning properly over time and it is anticipated that they will be in charge of replacing spent filters. To obtain a sense of whether or not the filters are meeting the people's needs, data for incidences of water borne illness will be collected before the filters are put into use and one year after initial use to ensure that the number of cases decreases.

Current Work:

Work for this service-learning project has already begun. The students partaking in the project have already finished the necessary literature review. It has been found that numerous papers have been published dealing with contaminant removal using activated carbon derived from coconut material, as well as other naturally occurring materials. In addition promising results for the use of Malunggay have been published as successfully reducing water turbidity.

The students from Manhattan College have begun and are currently in the process of running experiments using coconut-derived activated carbon to obtain and examine its removal capabilities of selected heavy metals. The activated carbon used was produced at De La Salle University in the Philippines from local coconut waste and shipped to the students at Manhattan College for experimentation. With respect to the non-profit start up company, students have successfully obtained the necessary Employer Identification Number (EIN) and have created a company name. After much deliberation the students have decided the name for the company is "Just Tubig". "Tubig" is the Tagalog (the official language of the Philippines) term for "water".

In addition to the required laboratory work, the students participating from Manhattan College have also had the opportunity to travel to Nagcarlan to see the area and to meet the people they will be helping as well as their corresponding participants at De La Salle University. The students that went had the ability to meet with local residents and officials to discuss their plans for the design and construction of the filters. By participating in the trip, the students were able to obtain a sense of connection with those they are helping.

Goals and Conclusions:

There are several goals for the students after completing this Service-Learning project. The students taking part have already obtained a bachelors of science degree. One goal is for them to use the knowledge they have obtained through their years of education and learning and apply it to real world situations. Throughout undergraduate education, few of the classes taken provide any 'real world' experience and generally rely on examples or purely theoretical

scenarios. Most classes lack a “hands-on” approach. By taking part in this project, it gives young engineers the chance to use what they have learned in the classroom by applying it to a hands-on, real world situation.

Another goal is to help the participating students with the opportunity to broaden their problem solving skills. As engineers, most employers will rely on and expect such. The opportunities afforded by this project allow students to broaden their problem solving skills through the real world application of the principles and techniques of Engineering. Issues are sure to arise throughout the design of the filters, giving the students the ability to work through problems and reach their end goals.

A third goal of the project deals the establishment of a non-profit company. This aspect helps to give the participants the ability to learn about and partake in entrepreneurship. It gives young engineers a look into the practical aspect of the business world they may have never taken notice of or had the opportunity to experience in their academic careers. Most engineering curriculums forgo any business training aspect. This project helps to give these students a look into the world of business, which they would not normally encounter in the classroom.

The ultimate goal is that by taking their time, their talents, and their education and putting it towards helping those who are in need and less fortunate is they will understand that they can use their abilities and education to help others, while realizing how fortunate they are to be in the position that they are in. It will help them grow as individuals and as engineers, and stay with them for the rest of their lives.

References:

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