Relevance of Student Input in Globalization Of Engineering Education

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Abstract

Technologically developing countries lag far behind the leading nations, such as the United States, in many aspects of national interest; technology is one such area. In their effort to develop, these nations are faced with improving their technical support for running their countries. Technologies being employed in the leading nations are at the cutting edge; for a developing nation, catching up means a major jump in their technical applications to the cutting edge. This forces many developing nations to be user nations by simply acquiring the technologies employed in the first world nations for their own use.

To provide relevance for students, there is the need to position them at the point where the cutting edge technology can be assimilated. This is necessary if they are not only going to operate the pieces of equipment, but if they are also going to service and maintain equipment in good working order.

As the student in a developing nation graduates and enters the work environment, a question that comes up is, "What contribution can I make to the ongoing process of development?" For the telecommunications student, one obvious answer is ensuring that people in rural and remote areas can also have access to information that those in urban areas have access to for development. This paper discusses the endeavor between Pennsylvania State University Wilkes-Barre and a class of students in a telecommunications program at Kwame Nkrumah University of Science and Technology (KNUST) in Ghana. The approach used engages students in projects that focus on the appreciation of their unique role in helping with the development of their nation.

Introduction

It is always an exciting period when one gains admission to a university to start a college education. At first, one does not think of the responsibilities that one will have to carry by just beginning the college experience. This may be just as well since the responsibilities may be daunting. But as one matures through college, one becomes more conscious of

the society and the needs of the society. This situation becomes even more evident in a developing country when some rural and remote areas that are not easily accessible are taken into consideration. Their needs, though modest in some cases such as ordinary drinking water, become magnified because of the prevailing conditions in which they live. The people find local approaches to resolve the problems that their needs present, and the solutions may not be the best that can be devised. However, in their environment, the solutions seem adequate.

The engineering program offers alternatives that may be technically sound compared to the local approaches. As the student becomes aware of these alternatives, the tendency is to try out the alternatives to see what works and how well. The engineering program, therefore, should broaden the students' perceptions to allow them to critically analyze a problem and determine a technical approach to solving the problem. A major hurdle of technologically developing nations, however, is the financial support for experimentation.

A student may want to see that the younger people who come after him or her have opportunities to continue their education through college, and that presents yet a different problem. It is common for some college students to use their holiday periods to help their younger brothers and sisters advance in their school work. The above discussion presents some of the factors that the engineering student faces.

Discussions in class with a group of students have led to two factors that need to be addressed. One of these is the fast pace of growth of technology in the developed countries. While this is positive globally, it presents a major technological divide between developed and developing countries. The other is the most effective means for the developing nations to bridge the gap, so as to become technologically on par with the developed nations. While this may be a major undertaking that may take years to achieve, the consensus is that efforts can be made to initiate closure of the gap. One approach agreed on by the class as the most effective is electronic learning (e-learning).

E-learning offers students the opportunity to access educational material through use of computers and allows each individual to learn at his or her own pace. It can also be managed in a classroom situation by a teacher. Students can, therefore, receive lessons in the classroom environment and do extra work on their own. The Internet best delivers this mode of learning. In the Ghanaian environment, the Internet can be deployed in one of two ways. One is broadband power line communication (BPL) in which data is transmitted on the power line [1]. This is a viable approach because Ghana has an electrical grid that covers most of the country. This technology will ensure that most of the schools in the nation can have access to the educational programs that may be transmitted at any given period. The other is by wireless, and this will ensure that all parts of the nation can be reached through the radio space. Whichever approach is taken, provision of the equipment will require an initial capital outlay.

The appropriate teaching content is always an issue in education, and one concept is to write the curricula such that it would incorporate ideas that the students will find easy to identify with. In other words, the content should be based on the environment in which

the student lives. It may be argued that the students will find the material useful if it pertained to them and that would make the learning process easier, as the content will not appear as abstract. The African environment is replete with objects, events, and concepts that the students will be aware of in their daily lives, and hence, involving such material in the classroom will provide a rich local content that will induce the students to learn.

Student Project Activity

The discussions with the students led to research ideas, one of which, the BPL technology, has been taken on as a student project. The power grid, which is the basic infrastructure needed, is already in operation provided by Volta River Authority (VRA), and it covers urban and rural areas. To achieve the same coverage with cable, DSL, or wireless will be extremely expensive financially, and to use satellite will be equally expensive. These other applications are all in their infancy in Ghana because the infrastructure to support any of them is not as advanced as is the national grid. Even though electrification is well established in Ghana, it is still being further improved [2].

Compared to other technologies, BPL is relatively new, but it is ideal for a developing country in which the national grid is uniform and controlled by one authority. Also, an existing power line infrastructure is already familiar to all the people; hence, a development based on that will only be an extension of a system that the people are already used to. Therefore, they will have to adapt only to the addition. This eliminates the initial capital outlay for providing the supporting infrastructure for the BPL system. The initial outlay of capital for the additional application will be for the additions necessary to access the system, which will be a small percentage of what will be needed to create a new infrastructure.

The BPL Technology

Three major technologies, electrical power transmission, travelling-wave antenna, and data transmission combine to provide the selected application. The primary function of the grid is to supply power to various destinations; this is done mostly using medium voltage (MV) overhead power lines in Ghana. This subject has been studied and reported in the literature [3], and so has the related area in low voltage (LV) [4]. Electromagnetic compatibility (EMC) and electromagnetic interference (EMI) are important issues [3, 4], among others such as how signal is coupled to the lines and the propagation constant of the line itself.

The problem can be described as wave propagation on a transmission line [5] for which the traveling wave can be analyzed by use of the voltages and currents travelling in opposite directions on the line. Due to the finite conductivity of the line, losses will be observed in the waves that propagate along the line. The line will also radiate, as well as absorb electromagnetic energy, since it behaves like an antenna. It is therefore important to evaluate the electromagnetic effects on the structure.

In transmitting data along any medium, it is essential to ensure that its integrity is not seriously impaired. All sources of electromagnetic interference can adversely impact the transmission as noise [6]. Therefore, it is important to assess the combined (both internal and external) effect on the transmission. As part of the external (man-made) noise, sources of electromagnetic waves, such as radio and TV transmissions, will be evaluated. Another form of external interference, atmospheric effects, which can be significant along the equator and within the tropics, will also be evaluated. Heating effects within the system have to be considered, and in line with this, the high ambient temperature in the environment can add to the problem to be resolved.

Inclusion of Local Environmental Conditions

As stated before, the engineering principles involved in the project are not new to manufacturing or design processes. The environmental conditions and the electromagnetic radiation in the radio space can, however, impact the performance of the system. These form the local content that needs to be emphasized in the curriculum, as they impact the design of the BPL system.

Additive noise can be a major problem [6] in all electrical and electronic systems, and where there is a high ambient temperature as experienced in the equatorial region, temperature effects can exacerbate the problem of noise. Electromagnetic radiation from sources such as radio and TV transmissions in the region of the system will also contribute to the overall noise problem. Also, possible atmospheric noise may be encountered in the equatorial region, which should be evaluated. The fidelity of the received signal is a function of the type of modulation, among other factors such as noise. Thus, the receiver will have to perform other functions, such as filtering and noise suppression. These factors can be influenced by the conditions in the equatorial region.

In addition to the analytical work that can be done, experimental work can be done by collecting data that will confirm solutions derived from analysis. One such experiment is using an RF analyzer to collect data on radio and TV broadcast stations in the selected area for experimentation to characterize the electromagnetic radiation presence in the radio space at the site. The magnitude of each emission will be determined, and the result will be used to determine the impact of that particular source.

Torrential rainfalls are prevalent in the tropics. The aspect of importance here is the level of humidity that is experienced and the effect this will have on the system.

Factors Involved in the Project

The project derives from the engineering program, with further emphasis on the engineering principles that are directly affected by the equatorial environmental conditions. These conditions will, therefore, impact the technology. In addition to these, the societal needs that the project can serve need to be highlighted. This demonstrates that the project is intended to produce a product that can be deployed to serve a need of the people. This point is highlighted because it provides one of the essentials to the

development program of the nation. Once in place, the BPL can be used to disseminate information that will directly support the peoples' aspiration towards development. The following flow diagram depicts the format described.

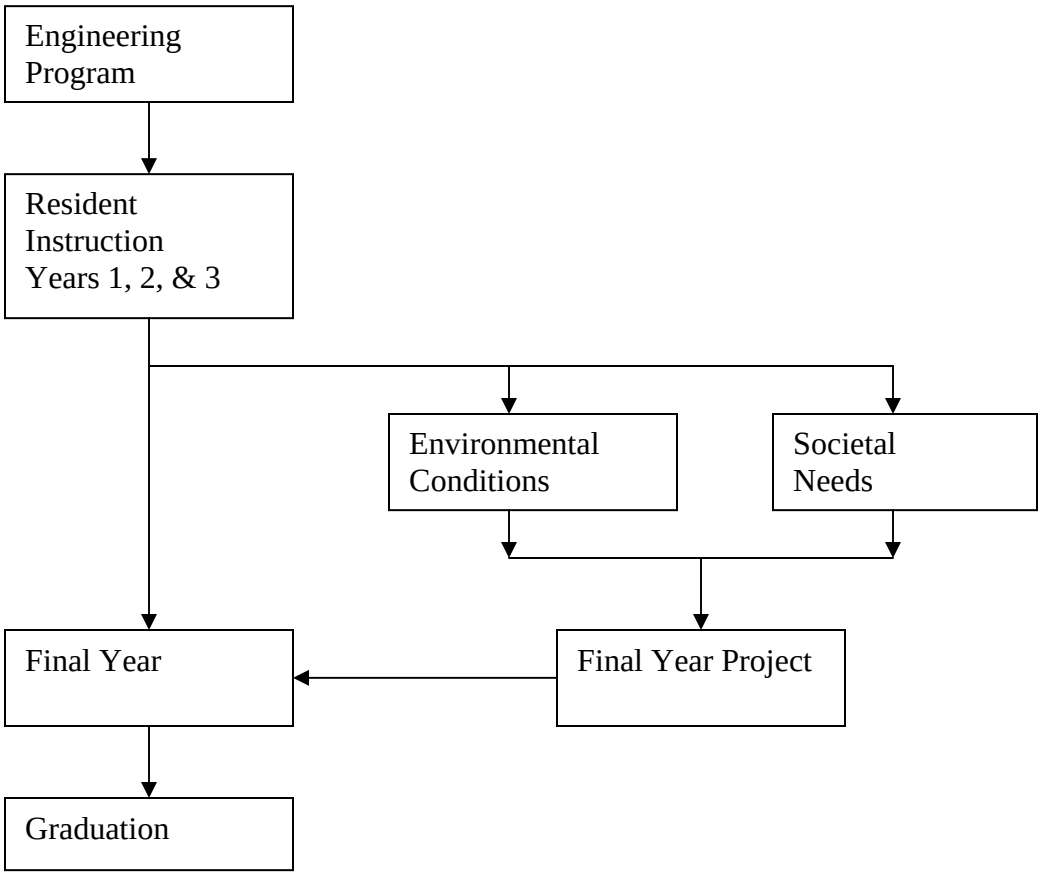

Figure 1. Flow Diagram of Student Project Involving Environmental Conditions and Societal Needs

Development of a product with which a business can be created will enhance the economic status of the people, and a percentage of the proceeds from the business can be donated to the program. The entrepreneurial aspect that can result from the program is important but was not shown in the flow diagram. This leads to industry and college partnerships out of which many benefits can derive. An advantage to the economic aspect is in the improvement in the lives of those involved in the business.

The BPL project will provide connectivity not only to users in Ghana but also to the outside world. This is important since Ghana is engaged in becoming a participant in the global economy. Setting up the BPL to cover urban and rural areas in Ghana will ensure

that all people in the country have access to the outside world, which will support the developmental objectives of the nation.

Conclusion

Students' needs are a result of their desire to advance their academic standing, as well as to be productive members of their community. Their input to curricula can involve the impact of their environment on the daily lives of their people. Including environmental conditions in the curricula personalizes the curricula for the students and this minimizes the abstraction in the curricula. This approach has been used in a student project in BPL. The BPL project will support e-learning, while opening up the Ghanaian community to the global community.

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Biography

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