

A proposal for partnership with Makerere University towards addressing fading interest in science education in rural western Uganda

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Abstract – In the summer of 2004 three electrical engineering faculty members from Pennsylvania went on a study tour of western Uganda in response to an invitation from community leaders in the Bunyoro-Kitara region. The goal of the visit was to assess needs and challenges in science education. The team visited secondary schools, elementary schools and two universities, and identified a significant number of impediments to the advancement of science education. Follow-up visits and dialogues with Makerere University faculty lead to exploration of strategies for addressing the challenges, as well as initiation of a number of action plans. This paper discusses the challenges identified and the action plans proposed to bring about improvements in the current situation.

Index Terms – International collaboration, partnership, Uganda, science education.

1. Introduction

1.1 Prior initiatives and results

The demand for education in Uganda surged through the 1990s¹. Education is viewed by parents as the most probable avenue for empowerment and advancement. It has been the source of great burden for parents who provide a very significant portion of school finances owing to the government's lack of resources for investment in schools as well as in their operation.

Changes in the way science is taught in Africa have been noted as far back as the 1960s. This may have been influenced by '*curriculum development of the 1950s and 1960s concentrated in the industrial nations*'². The expectation was that teacher behavior (in conduct of classes) and classroom emphasis would be on inquiry rather than memorization, thereby leading to changes in how students view science.

In the mid 1970s the government abandoned the use of the British curriculum³ and implemented a local curriculum. It published most school textbooks locally, thereby making the purchase of books more affordable. The transition was met with large enrollment

increases and excitement. Economic decline and political instability however quickly undermined the progress as basic support infrastructures accelerated towards decline. Buildings deteriorated for lack of maintenance, qualified teachers were scarce, and school supplies and equipment for education were in short supply³.

The universal primary education adopted in January 1997 has increased access and retention of students at the elementary school level bringing percentages of male and female students closer (47% female and 53% male)⁴. The representation of female learners in post-elementary science courses is however still very poor. Female students in advanced sciences are estimated at 18%. The striking imbalance has motivated several constituents towards finding remedies for improving enrollment of female students as well as addressing the larger problems of the entire Ugandan education system. The Association of Women Engineers, Technicians and Scientists in Uganda (WETSU) has proposed and initiated a number of strategies with varying degrees of success. Some of the ideas that have been tested are: shared laboratory facilities funded through community and government collaboration; career guidance and counseling through documentary films; and the election of WETSU members into political offices to influence policies⁴.

One of the extensive studies of Ugandan secondary education system on record was conducted by Black et al.⁵, through sponsorship of the Overseas Development Administration (ODA) in collaboration with the Uganda Ministry of Education and Sports. The study aimed to '*establish the physical, economic and attitudinal states*' of this specific sector of Uganda's education system. '*Survey of informed opinion on the objectives of secondary education*' led to the conclusion that teachers lack the resources to teach science as problem solving. Therefore, students have come to view science as just '*information to be remembered*,' and expectations of innovative ability and logical thinking in secondary school graduates are not realized. The success rate in O-level (ordinary-level) examinations in the science subjects remained low at 50-60%.

1.2 Purpose of the study-tour

The objective of the study tour was to visit secondary schools in the Hoima area; observe students and their classroom settings; tour science laboratories and school facilities; and collect data that would be helpful in determining reasons for the significant lack of interest in studying science, especially among female children. Other goals are to discuss the needs in science education with teachers and local officials, and to visit faculty colleagues at Makerere University and Uganda Christian University (UCU), Mukono to discuss challenges and problems of science, technology and engineering education in the western Uganda region. The plan also includes an assessment of energy needs and alternative energy potentials of the Hoima region.

The desired outcome of the experience is to outline ideas and plans for inspiring children and motivating them to study science.

This paper relates the observations from visits to various secondary schools and highlights strategies proposed for addressing some of the challenges through partnering with faculty colleagues at Makerere University.

2. Development of plan for study tour - logistics and definition of goals

In the summer of 2004 a study tour was conducted in the western Uganda in response to an invitation from community leaders in the Bunyoro-Kitara region. A productive and meaningful visit and appraisal of the state of science education in Hoima region would pose a tremendous logistical challenge to even the most experienced of tourists. A number of details had to be well coordinated, including travel to remote locations, communication needs, lodging, meetings and conferences with interest groups, etc. The study tour was preceded by prior affiliation of Duda and Lauffer- members of the team, with the Encounter Uganda project spearheaded by a faith-based ministry in Pittsburgh, Pennsylvania. The group has committed to a ten-year partnership (1999 – 2009) with the Hoima-Kitara region of western Uganda on various projects, including economic development, medical clinic, clean water supply, law enforcement, education, and retirement planning. The Encounter Uganda project administrators have become skilled in managing logistics that involves moving large numbers of partners from their base in Pittsburgh, PA through various project destinations in Uganda. They have gained access to high-level contacts and a network of people critical to the success of Encounter Uganda's mission. It was through Encounter Uganda that vital linkages were forged with the local community, leading to the invitation from community leaders to educators. The idea of forming a team and considering the possibility was initially discussed with Duda at the ASEE 2003 conference in Nashville, Tennessee.

Clearly, working within the structures of an organization (Encounter Uganda) with demonstrated success in forging linkages in the Hoima area was pivotal in carrying out a meaningful study in the area. Linkages with individuals (Ugandans as well as foreign nationals) that are long time residents of the area and are quite familiar with the local region made the field trips efficient, and offered access to dependable and accurate information. Trusted and dependable guides were highly valued during travel in dangerous regions near the war in northern Uganda. The team lodged in three places: Namirembe Guest house, Kampala; Hoima Hotel, Hoima; and Windsor Lake Victoria Hotel, Entebbe. These locations serve as conference centers, and transit points for many on short visits to Uganda seeking answers to many challenges in Uganda. Our stay in these crossroad places offered the added benefit of networking with several personnel on health and development related visits to Uganda. Radio Hoima – a local radio station granted a 30 minute live interview to enable the study team to introduce themselves and alert the community to the purpose of the visit and to urge cooperation. Radio Hoima reaches 500,000 residents of the region. Communication infrastructures were quite adequate in remote villages, as well as affordable due to extensive deployment of mobile phone technology.

The team received an invitation to the dedication of Uganda Technology Park at UCU, Mukono. The event was attended by the President of Uganda and several other government ministers. This afforded us the opportunity to network with high-level contacts.

3. Schools in the rural western region – the problem with science

The team visited 12 secondary schools, three elementary schools, two government-accredited universities and another currently in the process of being established (Hoima area is shown on Figure 1). Prior to the trip the team drafted a series of questions to serve as a springboard for discussions with school teachers and community leaders. Highlights from the team's interaction with educators and community leaders, as well as observation of the facilities are recorded in this section of the paper.

- a. Failure rate at O-level is high in physics, chemistry and biology. The O-level examination is taken at the conclusion of the secondary school education.
- b. Most schools have no access to clean water for drinking or conducting science experiments.
- c. Some schools show evidence of very creative ways for handling economic difficulties. These include the operation of agricultural farms to sustain boarding school children and the construction of deep wells to ensure a good supply of water.
- d. There is a severe shortage of qualified science teachers. Many science teachers who hold the Certification Diploma seek opportunities to complete a Bachelor of Science program. It requires six semesters (3 years) to complete the program at the approximate cost of one million Ugandan Shillings (Ush) per semester. Approximately 1700 Ush converts to \$1. Full-time study is required to enroll in the sciences at the university while part-time study is possible in the arts and humanities. The school districts do not and cannot provide any kind of financial support or sponsorship for teacher development.
- e. Schools fall into two categories: private and state-assisted. An alliance between the Church, government and parents is crucial to the survival of most state-assisted schools. The Church provides land to build on. The parents and the Church sponsor major projects such as building dormitories, science laboratories, classrooms, digging wells for water, and installation of solar electricity to enable night time study in the library, and to conduct science experiments if a laboratory is in existence. The government puts a majority of teachers on payroll, provide some science equipment and a small percentage of textbooks which are placed in the library for students to borrow (no textbooks are taken home). The Church provides teachers for religious education and some social sciences when possible, while parents fund some of the uncovered teaching positions and supplement teachers' meager salaries. The Church actively solicits resources on behalf of schools and provides moral leadership.

- f. The average school fees charged per term is Ush 25,000 in rural and poor locations, and up to Ush 400,000 in 'affluent' Kampala city.
- g. In some schools science teachers have very large class loads. The condition could not be improved because there is a cap on teacher recruitment due to the lack of funds from the government.
- h. The "science allowance" has been suspended for lack of funds, and in some places has been eliminated because of contest of the idea. It is viewed negatively as discriminatory by teachers in other fields. The allowance is traditionally offered by the government to augment poor salaries paid to science teachers and to attract more educators to the field.
- i. Female students usually drop out after the second or third year of secondary school education. Some schools are addressing the problem by building hostels for female students to promote better study habits, minimize distractions and time of commute, which is usually long, strenuous, and sometimes hazardous.
- j. Some libraries have shelves of books donated from some western countries which proved to be useless. Donors were apparently unaware of the educational practices in Uganda wherein textbooks used in the secondary schools are carefully structured to enable students to perform well on the national O-level examination. The books donated were not relevant to the learning objectives.
- k. Some teachers hold the view that the government budget allocation for education is negatively affected by the war in the northern Uganda. They further speculate that students are hesitant about selecting science because they know that the infrastructure is grossly inadequate. Also, there is limited university space for science freshmen. Therefore, in order to be assured of space in the university the safe or logical option is to forgo science.

4. Makerere University's department of electrical engineering – the challenges

The scale of the challenges facing providers of science education in secondary schools are large and appears to have economic, social, and political dimensions. There were no obvious solutions that could be gleaned from visits to schools and discussions with educators and community leaders. The outlook over the long horizon is simply bleak. A number of organizations or individuals find it prudent to focus on one institution at a time for channeling resources such as books for the library, science equipment and supplies, or computer laboratory. This will undoubtedly solve the immediate problem for two or three graduating classes before the books are worn and equipment discarded for lack of a maintenance program. The team would consider another approach that will complement these quick-fix and stop-gap solutions: "Strengthen the electrical engineering program at Makerere University sufficiently to enable them to lead the outreach into the remote locations of western Uganda to promote science." For this to be successful the team needs a clear assessment of the interests, priorities and challenges of the engineering faculty at

Makerere University and other potential institutions that would be interested in collaboration. Members of the team opted to work with the electrical engineering (EE) department because they are in an identical field.

Three meetings between members of the team and some faculty members quickly revealed issues and areas of mutual interest. The Faculty of Engineering offers undergraduate and graduate programs in architecture, civil, electrical, mechanical engineering, survey, and urban planning. Recent years have witnessed migration of faculty from Makerere University to government and industry where there is the prospect of doing better than the average \$300 monthly university compensation of the member of faculty. The EE program offers concentrations in telecommunications, electric power systems, machines, control and electronics. Student interest in power engineering has declined in recent years as it has in the USA and many other countries. There has however been some growth in research funding from private and non-government organizations for projects in alternative energy systems and rural electrification. This made the founding of the Center for Research in Energy and Conservation (CREEC) possible in 2004. There is a lack of funds for resources to support innovative approaches for teaching engineering classes, such as computer simulation software or up-to-date laboratory equipment and instruments. The EE faculty cannot afford to participate in professional development opportunities as these typically would require travel out of the country and high registration costs. Students cannot afford to purchase engineering textbooks, and the department library has very few books or journal titles. The burden of maintaining the programs at the Faculty of Engineering is quite substantial; it would be pointless making other demands such as suggestions to engage them in outreach to motivate children to study science. The current consuming burden and professional challenges must be eased for the faculty before they could be expected to be partners in the outreach initiative.

5. The proposal and plan for action

The recognition of areas of needs as articulated in meetings with the faculty provides a convenient starting point for exploring project ideas that address challenges faced by faculty colleagues. This will ultimately enable and free them to pursue outreach in remote areas of western Uganda. High priority areas of needs includes: library resources; partnering for authoring textbooks; and energy research and education. The specific challenges and the proposed plan of action are enumerated in this section.

- A. Both professors and students have access to a limited number of engineering textbooks. Textbooks are published overseas, and are generally unaffordable. This problem may be addressed through the following:
 - i. Foreign partners may assist the EE department in developing a library by donating current journal issues and engineering textbooks or sponsoring subscriptions to relevant journals.

- ii. Foreign partners may team up with the EE faculty at Makerere University to author engineering textbooks for local publication.
- B. The members of the faculty tend to be isolated in the profession for a variety of reasons. There are limited opportunities and resources to attend conferences, network with colleagues or avail themselves of new tools and techniques for instruction delivery.
 - i. Partnering institutions should explore areas of cooperation with the East African Alliance for Saving Energy or Makerere University's Faculty of Technology. Penn State Harrisburg's School of Science, Engineering and Technology is in the process of drafting a memorandum of cooperation with Makerere University.
 - ii. Partnering institutions may assist in developing and coordinating a network of Ugandan science and engineering professionals in the US to focus on, and address some of the challenges.
 - iii. Since software resources such as circuit and system simulation packages are expensive and unavailable to colleagues at Makerere, US institutions would have so much to offer by sharing information on downloadable freeware to support teaching, outreach and research on energy. The service may be offered through:
 - Creation and organization of a listserve for disseminating information on resources to cooperating East African universities.
 - Creation of an electronic journal for presenting applications and tutorials on software.
 - Donation of time and funds for startup and maintenance of the dissemination system.

This approach will make for efficient delivery of needful information to the faculty at Makerere since time and access to the Internet at sufficient bandwidth is still inadequate.
- C. The EE department at Makerere University will take the lead and partner with foreign institutions in plans for outreach through following ways:
 - i. The BSc. EE program includes a two and half month required industrial training. During this period undergraduate trainees could be encouraged to satisfy the requirement by conducting science fairs in rural communities and secondary schools, focusing on energy, water, and health issues.
 - ii. Explore modalities for developing and operating a mobile science laboratory that could be shared by schools in remote school districts.
 - iii. Set up structures to facilitate linkages between Makerere University and potential donors of science and demonstration equipment for rural secondary schools.

- iv. Set up structures for scouting auction sites (such as eBay) for affordable science laboratory equipments and supplies.

There will be a need for funds to cover supplies for science fairs, transportation, lodging and meals for student trainees.

6. Conclusions

Uganda, like several other developing nations is undergoing struggles in the management of growth in the education sector. The rate of production of qualified science teachers to match the growth is inadequate, especially in the rural areas of western Uganda. These instructors are very dedicated to the profession. Although poorly paid, they remain very resourceful as they work in woefully inadequate science laboratories.

Some of the challenges may be addressed through forging creative alliances between US universities and higher educational institutions in Uganda. This paper proposes that efforts be devoted to strengthening the fledging higher educational institutes to enable them take the lead in outreach to rural communities to promote science.

The study tour to Uganda and the field experience was crucial for developing an awareness of the scale of challenges. Such short-term trips would be very helpful for US faculty members and others that are interested in assisting the emerging nation.

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9. Biography

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Figure 1. Western Uganda (Hoima, Bulindi, Mabaale, Naigana, Kagadi, Kibale, Kafumiro)