

# **The Science and Technology (S & T) Education Continuum: Investing Strategically in S & T Education for Human Development in Uganda.**

Panel 3 sub-presentation to the PRE-CHOGM symposium on Science and Technology – Mbarara University of Science **and** Technology, 13<sup>th</sup> – 15<sup>th</sup> September, 2007.

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## **1.0. Introduction.**

This is a contribution to the presentation of Panel 3 of the symposium on the topic of the S & T Education Continuum. The contribution assumes that the symposium will have had opportunity to adopt shared meanings of the following structures, concepts and constructs:

- (a) Science and Technology (S & T)
- (b) Research and Development (R & D)
- (c) National Science and Technology (S & T) system
- (d) Education
- (e) Human Resource Development and
- (f) Science and Technology (S & T) sector.

In the contribution Science and Technology (S & T) Education is taken to include all programmes of learning that lead // the individual to the acquisition of behaviours (knowledge, skills, attitudes and practices) that enhance positively sustainable profitable use of resources to maintain and enrich the quality of human life. This takes into account learning:

- (a) At all levels
- (b) Of all manner of skills for positive action in the environment and
- (c) In relation to all sorts of products from nature and human ingenuity.  
The anecdotes and views presented are intended to lead the symposium to further reflection on the main presentation with regards to:
  - (a) How truly S & T Education may be considered to be a continuum
  - (b) How well S & T Education may be delivering on the task it aims to do and

(c) The types of improvements in S & T Education that may be in need of attention in Uganda, and perhaps, in the East Africa region. This is the basis of raising rather many questions in the contribution. These questions relate to:

1. What we have in place as S & T Education in Uganda.
2. Aspects in which S & T Education in Uganda may appear to be a continuum
3. Contributions of S & T Education to the development of society so far, and
4. Likely ways forward or need for action to improve S & T Education in Uganda and perhaps in the East Africa region as a whole.

## **2.0. The S & T Education Continuum**

The symposium is engaged on discussing the topic of the S & T Education continuum. There may be other fora (or forums) where the main concern is just S & T Education. In policy formulation circles we have had difficulties in focusing all stakeholders' ideas on the linkages among all levels and all disciplines of education. There may be need to guide our discussion from a commonly-shared perception of S & T Education itself before it can be visualized as a continuum. What does Uganda have as its S & T Education? In which ways is it a continuum? Is it as it should be or as it need be?

## **2.1 S & T Education in Uganda**

S & T Education in Uganda is well known by its apex: Education and Training at University level. We may, if in doubt, reflect back on the main presentation to check whether the following were included in S & T Education:

- Industry-based research and development (R & D)
- Higher degrees-related research (Education)
- School-based research
- Undergraduate programmes in universities (on-the-job / shop-floor)
- Industry-based training (practicum/apprenticeship) on-the-job training)
- Technical training (job-shadowing)
- School-science instruction
- Play resources in early childhood development (ECD) and education programmes
- Briefs for the sensitization and empowerment of parents of ECD.

- Community-oriented scientific and technological literacy programmes.
- S & T community-based productivity enhancement training programmes and activities (extension / outreach)
- Mass communication-based (press-channel) information dissemination
- Use of libraries and internet.

Universities are always looked up to for the professionals to work in all these areas, but they cannot ignore them. Discussion of the main presentation should, thus, be enriched by including the above facets of S & T Education. We start from the parent and ECD (the child being father to the man) and the community (the client defines the professional).

Then we move up to the ramified university programmes that complete the foundation of the training for future professionals in S & T. In this line-up Uganda's education structure includes branches to the training of undergraduate professional – **the technicians** – in many fields of human endeavour. Universities also participate in the development of this cadre of professionals in various ways, especially in quality assurance through the “teachers” for the level and the awards attached to some of the courses offered at this level. That is a summary of the picture of S & T Education in Uganda now. In it we see features which were not fully described in the de Bunsen report of 1952 that gave Uganda the first definite recommendation on the need to teach sciences in schools. My view of this picture is that S & T Education includes much more than sciences in schools and universities.

## **2.2. S & T Education as a continuum**

The view that S & T Education should include all the facets introduced in 2.1 can be a basis for considering S & T Education to be a continuum in terms of providing exposure to the individual for developing into a well-rounded S & T professional in the National science and technology system. The facets consider the preparation of the individual for S & T Education by the community, the encouragement of the same individual in self-actualisation through programmes offered by education institutions and the promotion of the application of the skills acquired by industry, community and the market place. S & T Education can, indeed, and should always, be a continuum. Uganda's S & T Education may not necessarily be a continuum. Again reflection on the main presentation should lead us to ask the following questions:

- (i) Does Uganda's S & T Education aim at developing all components of the national S & T system? Are we agreed that we know which components S & T Education should be

- (a) aiming at (b) giving highest priority? What spectrum represents this continuum in the S & T system.
- (ii) What does it cost Uganda to support its S & T Education? What seem to be the benefits that Ugandan communities have been getting from this investment in S & T Education?

Under question (i) we may call for indicators (figures/statistics, evidence and indices) of the achievement of our S & T Education to date. Cross examination of such indicators could reveal how we have performed with regard to:

- (a) Producing highly qualified S & T oriented professionals to work in advancing our knowledge and skills in S & T (R & D)
- (b) Development of leaders, policy makers and managers of R & D / S & T effort in the national economic set up.
- (c) Developing highly skilled human resources in all fields of S & T relevant to the national economy
- (d) Producing skilled human resources to meet explicit national policy guidelines on the development of a science-led, technology-driven national economy and
- (e) Preparing all Ugandans for vocational problem-solving in using S & T to attain high quality life with the resources and occupations most appropriate in their surroundings.

And (d) above may appear to be the same but they are different as we as know that (c) emphasizes innovation and (d) depends on clarity of strategic policy formulation processes. The five orientations of S & T Education make its essence as a human resources development effort. The temptation to mistake scientific and technological training at university level for S & T education engages us more in debate and less in passing on production skills. (a) Cannot be all, there should be in S & T Education, but it a strong lynch-pin for it. The same should be said of (b) It is through (e) that S & T Education could build a context for the other four orientations. The professionals (a) should be the type demanded by the clients (e) the leaders (b) should be the type deserved by the community (e), the skilled workers (c) and (d) for the economy should be the type desired by the owner (e) of the economy. If we define the national S & T system correctly or coherently we may find that its components will also align themselves along the same orientations (a) to (e). I have chosen to call these orientations the dimensions of the S & T Education continuum. They should be seen as five separate continua and are driven by different centres of action. My view is that

- Technocrats in organized institutions are the driving force for (a) ..... the production of “critical mass” of professionals / scholars / research expertise.
- Political leaders and economic analysts tend to champion (b) and (d) that is, managers and skilled labour of the economy, but rarely ever succeed in mobilizing resources for (d) in its full version.
- Technocrats as innovative agents tend to dabble in (c) ..... the free exercise of creativity of the individual worker / learner / scholar / performer, but are often constrained by lack of patronage to cover high costs involved.
- All of us tend to preach sweetly about (d) and (e) ;some innovative programmes come up in the same dimensions, either as community-based or as community-oriented, but sustained national efforts are hard to maintain as institutional set ups. Ugandans can recall the struggle of keeping up with District Farm Institutes (DFI), even when they changed to District Agricultural Training and Information Centres (DATICS) and when the NAADS (National Agricultural Advisory Services) programme overrun them. We talk much, and well, about (e) ... some S & T Education for all ..... but there are few success stories to cite as best practice.

The main presentation of the panel should, thus, be re-examined to show how S & T Education remains a continuum if it has five separate spectra (dimensions). My view is that S & T Education is a continuum in each dimension. In this way, I put together all the output of tertiary education in (a) i.e. the professionals, and the spectrum is readily definable; I keep the leaders/ managers (b) in a spectrum concerned with the disciplines of education, training and intellectual inquiry at higher education level only; leave (c), the highly endowed creative people, in all areas of academic/intellectual pursuits, in the hands of higher education and industry-based researchers; I see (d) as the field driven by students and school managers through their interpretation of the labour-market opportunities and prospects, this leaves (e) with no serious driving force.

If no attention is given to (e) Uganda’s highly skilled S & T human resources could be no better cherished by society than migrant labour. Note that the view does not reflect negatively on their competence nor on their merit for the positions they occupy now.

From the above remarks it is possible to see why I would wish to see the main presentation on the S & T Education continuum discussed at length. I am aware the symposium might not have ample time for this but we should all have the following concerns with us in all our future work, debate and discussion:

1. What are the strengths and weaknesses of Uganda's S & T Education? What are most significant missed opportunities of neglected prospects for its improvement?
2. What modifications for improvement could the existing resources support for better S & T Education? What is its main focus? What changes in that focus could be for the better and remain still affordable in the existing resources?
3. In what other respects is S & T Education in Uganda a continuum? Is this clear in policy / practice / infrastructural capacity?
4. Does the Ugandan society really appreciate its S & T Education? Is this evident from how society values the benefits it has got from its S & T Education?

### **3.0 Effects achieved in our S & T Education seen as continuum**

There have been some achievements scored through our S & T Education. There are also some noticeable draw-backs. There must be some modifications that we can try to do, by policy, practice and increased investments in education and industry. The symposium could examine the case for each of these if covered in the main presentation. My view focuses on the strengths /weaknesses of the current set up of S & T Education and the potential for improvements.

### **3.1 Strengths / weaknesses of our S & T Education: the current score-card.**

A. Among the strengths of our S & T Education the following could be included:

- (i) Low, but constantly increasing, output of S & T related technocrats of acceptable quality world-wide.
- (ii) Growing subscription to all S & T Education programmes.

B. Among the weaknesses the following compel attention:

- (i) Greater emphasis on the "engineers" cadres and less on the "technician" cadre

- (ii) Tactical policy guidelines on S & T Education that are not based on strategic analyses of national economic prospects.
- (iii) Lack of institution-based cultures of promoting innovation.
- (iv) Low belief in (a) the power of interdisciplinarity and (b) the value of outreach or client researcher interface.

Some of the indices of strengths of the S & T Education efforts are

- The numbers that enroll and complete various courses and
- The variety of courses offered and the increases in students taking up such courses. The weaknesses are a cause of some undesirable consequences, such as the following
- Low technical support of innovation in practical production ventures.
- High investment (in time, money, technical resources) on the search for a vision or goal for national development.
- A lot of technical knowledge locked away from potential practical users (low trickle down rate of skill transfer especially by the language used for storing the knowledge)

### C. Concerns for reappraisals

Among neglected prospects or missed opportunities the following should be included:

- (i) Re-packaging “technical” training in a wider variety of fields to provide skilled labour in middle-level innovative ventures.
- (ii) Providing room for individual innovation abilities in all study programmes
- (iii) Including greater learner/community interfaces in study programmes.

Discussion of this area should be about what educators in other countries may have done that give us lessons to learn from but it could also touch the type of resolutions we could adopt to push more strongly for the following challenges:

- (a) Starting innovative study programmes that inform more strategically the national policy formulation process.
- (b) Acclimatizing students to work within communities on wealth creation or employment generating ventures and investment and
- (c) Preparing future technocrats in fields that are still beyond our national horizons and current technologies.

S & T Education may be doing well now in passing on knowledge and skills to students. It is important to follow that up and get this education to put

emphasis on getting people to use the knowledge and skills to produce for the market – place in a competitive world.

### **3.2 Lesson from the wider world and opportunities through CHOGM.**

We can learn from countries where

- (a) Universities continue to develop without eroding the training of technicians
- (b) Programmes include not only job-shadowing but also community – shadowing.
- (c) Universities run exchange programmes of students, (or universities and countries)
- (d) Higher education puts into practice strong student counselling on career development within a study programme, and not just by qualification from a course of study.

Discussion should focus on how to increase possibilities for technology transfer through exposure of our students in training processes in other countries.

### **4.0 Suggestions on lines of action**

This contribution may have missed many, and some glaring, weakness of Uganda' S & T Education. Both the main presentation and the symposium discussion will not miss to point out more disturbing weakness. Action to redress the shortcomings needs to be proposed for discussion. In my contribution to this exploration I have drawn attention to some procedural and investment.. (Innovative) interventions which we should continue to adopt and polish up gradually to make the desired impact on the overall output of the S & T Education. The results of such action could then reflect the S & T Education as a continuum, with indicators of the components of its spectrum in any one of the dimensions mentioned earlier. These are the lines of action I wish to subject to critique by the symposium.

**4.1. Process lines of action intervention.** In this group I wish to suggest the following clean-up actions:

- (a) Standardised input-output accountability- this calls for annual publication of the numbers by category of human resources released on the labour market by tertiary / higher education institutions after specified courses for skills development. Thereafter, the figures can be adopted and analysed by the National Council for Higher Education (NCHE) and be reflected in the National S & T Indicators which is to be developed and

published by the Uganda National Council for Science and Technology (UNCST). This will be good accountability to Uganda for its investment in S & T Education. We may not know the host of benefits from this before we do the first reporting back to NCHE. It is promising that this Council has started to design the procedure of calling for the needed data. Immediate pay-off: S & T Education becomes a visibly compelling tool for national Human Resources Development planning.

(b) Educational Institutions links – this calls for promotion (advertising) of what is done in “Our school / college / institute / university / factory training unit” in all other schools / colleges / institutes / universities / training units. For today’s Uganda the use of brochures (fliers / kipeperushi) is suggested as these are cheap, once-off or occasionally updated tools. We have learnt to flock to advertise websites, but not all of us are located windward to the internet. We also know some direct us to empty websites. As we develop S & T more, then we can all use the web. Immediate result: Graduates at any level will know how to target better for job-utilisation of their skills or for training into a skill-demanding career / occupation.

(c) Refining course designs to accommodate trends into multidisciplinary inquiry. This is an intervention bordering on the investment / innovative type lines of action. It requires us to acknowledge cases of there being “Professors of law in S & T policy analysis” in some university elsewhere, and centers for continuing education being used to start employers; demand-driven practical skills development courses in other universities. This is an indicator that some compartments can be made porous or be broken down among study disciplines. That may be the costly end. The cheaper side is where we can make the effort and define (re-define) S & T properly so that the following will not continue to happen:

- (i) Ugandans not knowing they have an S & T system at their disposal [sell S & T to all Ugandans]
- (ii) Key national action centers, e.g. Parliament, state ministries, the Judiciary, Employers and manufacturers, statutory institutions, educational institutions, farmers and scholars not knowing that they are components and stakeholders of the national S & T system [teach every one his/her part in S & T]
- (iii) The finance ministry allocating huge funds to NGO’s doing poverty monitoring traces but putting nothing into the S & T fund that was established by statute in 1990 [sensitise all S & T technocrats]

- (iv) Failure to show-case national successes in S & T through publication of “Indicators” just because we have not defined what S & T indicators include [Do this before the symposium closes]. This gives only a few of the flws which can be corrected if we choose what S & T should mean to Uganda. Let us do that today.

#### **4.2. Investment (innovative) types of lines of action.**

This group of actions includes those already being started at all levels of education and at shop-floor level in factories to improve skill acquisition by future workers / trainees, to prepare human resources in some strategic areas or to take advantage of training attachments to gain transfer of some technologies. Even exchange of students to further the interests of “cultural exchange” between peoples / countries is a welcome tool for S & T Education. I wish to suggest specific areas where innovation by teachers / faculty should be encouraged. These are only cases to initiate discussion and information sharing. The few examples I may highlight here include

- (a) New designs of courses for strategic purposes in national development policy / practical prospects, such as
  - (i) Industrial chemistry including petrochemistry
  - (ii) Energy development (not only focusing on nuclear)
  - (iii) Oceanography (even if we are land-locked now!)

We have started on Biotechnology and we dare not look back. We have started on industrial chemistry and we have to do more to get the chemical industry started.

- (iv) Technician skills development training. The Community Polytechnics programme has started with promise, though humbly, but could be easily drowned in the well-known academic snobbery of Ugandans.

- (b) Innovative courses tailored to students’ needs / demands .....we know of ways secondary schools students initiated “revolutions “ in subject combinations at advanced level. Every level has bought into that. If they dare at university to ask for Bio-Geology shall we offer it? Why not? Depending on funds for the course! Depending on opportunities for employment at exit! We have, previously, had some of these as good reasons for the “no” answer to the request. But some unusual course packages have in the past, given us good workers in some areas though such courses may have been discontinued. Now, a few novel packages have been made and more

new ways of doing things will be needed tomorrow. Let faculty innovate. The above reflects my view that we should not stifle academic freedom and we should promote innovation in every course offered. Course names should not seem to have been patented as preserves of specific institutions. The content of courses and its relevance to the aspirations of our communities in their social development concerns should be the major attributes on which to make critiques of the courses and of their value as competitive lines of investment in S & T Education.

- (c) Revival of non-graduate student exchange with educational institutions in other countries. This sort of investment would not be an innovation. Before the 1970's we had a bit of it, generally supported by countries with strategies that included learning about us through our students. We were tools for their purpose. Its revival should be for our purpose, which we should define well before approaching any country, whether before or through CHOGM, and also well after CHOGM. This suggestion is not about placement of students for higher degrees and post-graduate courses. The exchange desired most, however, could include job-shadowing by workers still on shop-floor level training in firms that are in search of technology transfer by this method.
  
- (d) Community – shadowing by students in some of their fieldwork / projects. In some courses students do this as if they are tourists. That may not diminish their alienation to their roots, leaving the illiterate peasants to continually nurture progeny that shuns its roots and the production technologies that supported their intellectual development. What can S & T Education do to redress this shortcoming?

### **5.0 Concluding remarks**

S & T Education is a continuum in many ways: Producing professionals at different levels (from peasants to professors), tackling technocrat-training in all fields of human endeavour, and handling all knowledge needed by society. It is, however, regarded highly mainly in terms of the professionals and technocrats whose development it emphasized. Policies on S & T Education tend to adopt the same emphasis, with marginal attention to S & T skills development by the general populace.

The “literacy” of the general public in all areas pertaining to their production preoccupation is a major concern for national development purposes and S

& T Education should put in its fair share of effort. This can be possible if S & T Education sheds some of its weaknesses by including in its programmes innovative ways of learning about and from the economic development preoccupations of the general populace. This calls for changes in course designs and learning experiences. It also needs innovations that improve multidisciplinary approaches to learning about the peoples' interests, means of production and capacities in putting skills to use in working with resources available to their communities.

S & T Education pursued with the needed innovations can be a true continuum in all its dimensions, with clear leading edges in each spectrum. In this endeavour we may need help, but we need to determine its purpose before we seek help from friends, especially through CHOGM.

*Reference for general reading on definition of productivity measures and the poverty line.*

*Uganda's Recovery: The role of farms, firms and Government, Ritva Reinikka and Paul Coller (Editors)*

*The IBRD / The World Bank*

*Washington DC 2001*