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## Does Science Education in Developing Countries Really Count?

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### Introduction

Although capital intensive, countries that have invested wisely in science education get good returns in human and infrastructural development and achievement. A long-term project, science education does not necessarily translate into immediate breakthroughs, economic returns, and national honors or pride. However, the manpower needs for sustaining the educational sector, industry, and commerce in the short term, and invariably for long-term purposes of social, infrastructural, and economic development, justify investments in science education by developing countries and economies in transition countries. Grappling with a myriad of economic and social challenges, many developing countries have the attitude that science education is the exclusive reserve of rich countries that can afford its capital-intensive nature. This attitude arises from the fact that new technologies resulting from investments in science and technology are quickly mass-produced in Far Eastern countries using optimal labor and infrastructural costs. These products then become readily available at an affordable price in developing countries without their investment in the research and development process. The unfortunate result of this is that science education in most developing countries is poorly financed and developed; at best it allows the brightest students to excel to the extent that they can then leave as part of the brain drain to the developed world. This brain drain brings economic and convenience benefits to the recipient countries, while also allowing many developing country scholars and scientists to access opportunities that enable them to excel in their chosen fields of endeavor. The aim of this article is to explore the relevance and challenges of science education in developing countries and offer some recommendations for meeting the challenges.

### The relevance and challenges of science education in developing countries

Science education in developing countries can be shown to count at any level of peer review or other assessment mechanism. Scientists from developing countries have gone on to win the Nobel Prize, which represents the most prestigious award for their contributions to science; e.g., Max Theiler (1899–1972), the South African virologist who won the 1951 Nobel Prize in Physiology and Medicine for developing yellow fever vaccines in the 1930s that saved millions of lives (Microsoft 2008); Abdus Salam (1926–1996), from Pakistan, who shared the 1979 Nobel Prize in Physics for the unification hypothesis that incorporated electromagnetic and weak interactions between atomic particles (Hamende 1999, Salam 2009); Ahmed Zewail (Egypt–United States) who won the 1999 Nobel Prize in Chemistry for showing the transition states of chemical reactions using femtosecond spectroscopy (Zewail 2002); Indian-born Venkatraman Ramakrishna, along with others, who won the 2009 Nobel Prize in Chemistry for uncovering the structure of the ribosome, the organelle used by eukaryotic cells for protein synthesis; and Hong Kong-based physicist Charles Kao shared the 2009 Nobel Prize in Physics for developing fiber optics and digital imaging <[www.nobelprize.org](http://www.nobelprize.org)>. Also, Amartya Sen of India won the 1998 Nobel Prize in Economic Sciences through his contributions in welfare economics, and Wangari Maathai of Kenya was awarded the Nobel Peace Prize in 2004 for her efforts in afforestation. Although many top scholars in the sciences from developing countries have never made it to Stockholm to receive the Nobel laurels, their outstanding contributions, achievements, distinctions, honors, and awards have been very remarkable in their fields of research and have been a great source of inspiration. This record of

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achievement by some scientists originally from developing countries or economies in transition, in spite of the lack of development of science education in their home countries, indicates the great potential in the vast human resources of the developing world that could be realized by increased development of their science education.

Dzurgba (2004) argues that the objectives of university education include molding of good character, learning through reading and study, provision of labor for production and distribution of goods and services by equipping graduates with theoretical knowledge and practical skills for employment in various fields, and training of leaders with sound judgment in the fields of science and humanities, guided by ethical values of the society. Achieving these laudable objectives can be highly capital intensive, as evidenced by the large budgets of top international universities. In many developing countries, the inability to put in place minimum standards for funding education have led to tensions and conflicts among students, staff, university authorities, and government. Such tensions do not provide a learning environment conducive for science to thrive. In leading universities worldwide, there is more or less perpetual peace, and academic activities are allowed to proceed uninterrupted and to thrive (Dzurgba 2004). The lack of such peace is a major challenge that some developing country universities still face; although not unachievable, it appears to be beyond the control of the university authorities in such countries. Therefore, science education suffers even with the best brains in the country available.

One critical area for assessing the impact of scientific contributions from developing countries is science communication through journals, books, workshops, and international conferences. Because the idea of “it’s not science until it is published” and the pressure to publish for personal career development are both hindered by the dearth of infrastructure, equipment, and grants, the result is few articles in leading science journals. However, through collaborative research, it is commonplace to encounter joint publications with one or more authors from the developed world. A further challenge to publication in the journal of choice is the peer-review process; presumably, a double-blind review by an ethnically and culturally diverse team of reviewers could remove the perpetual criticism of bias that follows a rejection or multiple corrections (Tyokumbur 2008). Although a general problem, the possible bias of referees making their assessment based on the identity of the author, geographical origin, place of work, or even gender could be affecting contributions by developing country scientists more significantly. As a result of either the real or perceived biases in the review process of leading science journals, developing country scholars have often opted to float their own local specialist journals reclusively, to the detriment of their careers (O’Hara 2008).

Developed countries have very often invested in encouraging talented individuals from developing countries to take up merit-oriented opportunities such as scholarships and fellowships that will help them realize their full potential in science and other disciplines. In fact, a look at the biographies of the Nobel Laureates in Science from developing countries (see previous examples) almost invariably shows at the least a stint in a developed country at some point in their careers. Also, as indicated by many ambassadors from Western developed countries, foreign aid given to developing countries is not a show of extravagance nor affluence, but rather and equally in the best interest of the donor countries, both in the short and long term. In terms of global politics, the best unofficial ambassadors for many developed countries are very often the beneficiaries of past fellowships and grants in diverse fields of research, especially in science. Upon their return to their home countries, they help improve the image

of their benefactor countries through their own positive experiences. From the ecological perspective, research in global climate change, pollution of the marine ecosystem, ozone depletion, and groundwater contamination are some of the areas where collaboration and support is often mutual.

At the institutional level, several funding organizations have recognized the relevance of scientific scholarship in developing countries to the global community by creating opportunities for their advancement in science. This underscores the major challenge faced by universities in developing countries of the lack of funding for infrastructure, laboratory supplies, remuneration for academics and support staff, lecture theatres, tenure, and pensions. The provision of fellowships and grants to scientists in developing countries has made it possible for some graduate students and senior scholars to be at the cutting edge of science. However, as a result of competing priorities, there is generally a minimal commitment by developing country governments to funding for science education and research, a situation that could endanger the survival of scientific scholarship in developing countries. The onus may perhaps be on the developing countries to make science a priority for funding through a change of attitude of policy makers and providers of science education in both the public and private sectors. Institutional motivation could be achieved through a rigorous peer review of published scholarly papers, and balancing this with the competing interests of promotion purposes and advancement of knowledge, reconciling the criteria of accessing productivity at all levels, minimization of bureaucracy in funding science-related projects, popularization of science, and the creation of an environment conducive to study and work in the universities.

A further challenge for developing countries is the emigration of highly educated and skilled workers to developed countries. A United Nations Conference on Trade and Development (UNCTAD) report as early as 1987 estimated that about one million academics had entered the North American market between 1967 and 1987. The Least Developed Countries (LDCs) Report 2007 (UNCTAD 2007) again estimated that some one million skilled persons from LDCs lived and worked in developed countries in 2004; considering that there are some 6.6 million people in LDCs who have university-level educations, this represents a brain drain of 15%. The world's 50 (now 49) LDCs (UNOHRLLS 2009) are more affected by the brain drain than are developing countries in general, where the rate of such emigration is below 8%. Viewed from a developing country's perspective, a significant proportion of their science-based intellectuals are lost to emigration. While reversal of the brain drain has been successfully pioneered in South Korea, India, and Singapore following their great developmental strides in industry, commerce, and education, these countries have at best become the new destinations for the brain drain from developing countries.

Mentoring is a vital tool for transferring research, teaching, and leadership skills from senior colleagues to junior scientists or scholars. Needless to say, the level of job satisfaction determines to a large extent the effectiveness of mentoring. Those who feel short-changed may be unwilling to be "cheated" again by the very system for which they have sacrificed so much by helping the development of reputable scholars and manpower for humanity in general. Mentoring is as much a challenge to science education in developing countries as it is in the developed ones. According to Olayinka and Taiwo (2005), the prime responsibility of a postgraduate teacher is to nurture the next generation of academics. The postgraduate teacher is therefore expected to see their students as colleagues and often friends, securing their confidence and forging relationships that, in many cases, become lifelong.

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Whatever the challenges confronting science academics in developing countries, expanding the frontiers of knowledge, transforming the community through innovative breakthroughs, and ranking highly in the global university system remain the aspiration of all. These realizable goals are captured in the vision statements of some developing country universities in attempts to entrench excellence in all disciplines including science. An excellent example of this is the University of Ibadan's Vision for the 21st Century (2002), which is having an impact on staff, students, stakeholders, and the nation, and by extension other sister institutions on the continent.

Developing countries themselves are not unaware of the impact and challenges of science education; however, it may be worthwhile to make the following recommendations that could benefit their science and technology base:

1. Commitment of funding to science through prioritization by developing countries and the establishment of graduate research institutes driven by local needs and trends in globalization.
2. Sustainable partnerships and collaboration with scientists in developed countries, especially those with ethnic ties to developing countries, who could also be encouraged through creation of a conducive intellectual environment to take their sabbatical or study leave in developing countries and may even encourage them to return eventually.
3. An ethnically and culturally diverse peer review approach in internationally recognized journals to encourage the communication of scientific ideas, regardless of their source.
4. The assistance of international courier companies in the shipment of equipment, laboratory support materials, spare parts, books, and other supplies (often surplus in developed countries) at an affordable rate for the development of science education in developing countries.
5. Facilitation of science communication in developing countries and access to information resources. For instance, some university libraries in developing countries do not have easy access to year-old copies of high-impact-factor journals, either as hard copies or online access. Even with online editions, the paper versions remain relevant and, as such, collaborations between local publishers and others could make them available at affordable rates (Tyokumbur 2008), while local authorities could take the necessary steps to strengthen and enforce copyright laws to protect this support mechanism.
6. Strengthening of existing science efforts and infrastructures.

## Conclusion

Science education in developing countries really counts through significant impacts on the local and international arenas and should be encouraged by private and public institutions, individuals, and charities through diverse funding options and support mechanisms. By mentoring junior scholars, enhancing the stream of science communication, and enhancing the role of government and philanthropists to provide the services of monitoring, supervising, and setting standards of education, science education in developing countries will remain relevant. The Least Developed Countries (LDCs) Report 2007 of the United Nations Conference on Trade and Development (UNCTAD) also suggests that industrialized

countries can help by supporting policies that will help to dampen their demand for those professionals most needed by LDCs through measures such as favoring temporary recruitment rather than permanent immigration, establishing and enhancing programs to assist qualified emigrants in returning to their home countries, and using official aid programs to improve working conditions in specific professions in LDCs, such as education and health. The UNCTAD report also cites the example of the United Kingdom in policies to reduce the impact of brain drain in the health sector through restrictions on the international recruitment of nurses from countries where their emigration would have negative consequences for the home country. Such policies could be adopted by other developed countries. Hira (2009) corroborates the impact of the brain drain; for example, U.S. universities have been a magnet for talented young people around the world interested in acquiring the world's best Science, Technology, Engineering, and Mathematics (STEM) education. Many, if not most, of these people have remained in the United States, become citizens, and made enormous contributions to the productivity of the U.S. economy as well as its social, cultural, and political life. Furthermore, these universities are now beginning to think of themselves as global institutions that can deliver their services anywhere in the world, such as Cornell, which operates a medical school in Qatar at a modest cost for local students. Wadhwa (2009), who studied the impact of reverse brain drain, supports the claim that despite local challenges, returnees are spurring a technology boom in their home countries by expanding their capacity to provide outsourcing services for foreign companies in Research and Development (R&D) capability in knowledge-based industries that are becoming increasingly sophisticated. Science education in developing countries therefore really counts and should be supported. Hartnett (2010), writing about promoting international ecological research and training in the developing world, sheds light on the benefits and challenges of these efforts. Tyokumbur (2010) in his book, *Practising Ecology: Chances and Choices*, has equally and succinctly discussed ecological problems from the perspective of developing countries, the challenges and benefits of managing ecosystem services for the benefit of all.

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