

GLOBAL STRATEGY FOR HIGHER EDUCATION IN THE 21ST CENTURY

Proposal

For

Training Science-Technology-Engineering-Mathematics (STEM) Faculty through Inter-Institutional Partnerships with Emerging Countries:

(Anil Pradhan – The Ohio State University)

EXECUTIVE SUMMARY: This proposal describes a plan to establish STEM Education and Research (ER) Centers at different universities in countries with less developed STEM research programs worldwide in collaboration with U.S. universities. The goal is to train the next generation of STEM faculty in teaching and advanced research at the level of world-class institutions. Owing to the urgency and immensity of the needs for higher education in these nations, this plan differs from existing degree or exchange programs. It envisages an accelerated time-frame within two years of an intensive ER program for prospective students that would impart basic knowledge and begin an ongoing process, to continue in later years as they embark on careers as STEM faculty. Based on a standardized and accredited platform, the training program would be carried out both at host institutions in the U.S. and at foreign collaborating universities. Research and innovation at the STEM-ER centers would be aimed at laying general scientific infrastructure, as well as to meet specific needs of industry. As an exemplar, we describe an ongoing pilot project under the Obama-Singh 21st Century Initiative supported by the US-India Education Foundation. We also explore the possibility of participation by U.S. universities such as those in the Consortium for Inter-University Cooperation (CIC).

1. INTRODUCTION

Rapidly emerging countries have an unparalleled need for higher education. Great human and material resources exist not only in big countries such as China, India and Brazil, but around the globe in Asia, Africa, and South America. The potential is literally limitless. The governmental and non-governmental agencies are acutely aware of the need to develop this immense potential. Plans are being unveiled, or are already being implemented, on an unprecedented scale in many countries.

Despite this immense potential, the educational infrastructure in these emerging countries currently lacks the capacity of meeting the need: **to train those who would teach**. Indeed, it is the faculty in the newly established or expanding universities that must acquire state-of-the-art knowledge and skills to teach the vast multitude of students waiting to be educated. The young and bright students are eager to learn. Thanks to the internet and its derivatives they are already aware of the most advanced developments in each field, from the smallest scales in

nanotechnology to the largest in the Universe. Therefore, the training of STEM faculty must include not only all that is basic and essential in each area, but also the latest developments. Their students deserve and would be satisfied with nothing less. At the same time, the symbiosis between higher education and research must be recognized and addressed.

American universities have a unique role to play, and indeed, a historic obligation to fulfill. The largest number of world-class universities exists in the U.S. While carrying out the most advanced scientific and technological research in the world, they also specialize in teaching large number of students in the widest possible array of disciplines. The Ohio State University, as well as other CIC universities, are perhaps the best exemplar of such symbiosis. An equal partnership between educational institutions from emerging nations and their American counterparts is both a vital necessity and a great opportunity.

Moreover, the need for training STEM faculty is urgent; conventional graduate programs and timeframes are impractical for prospective faculty members in the new universities in emerging nations. They are already “in the trenches,” teaching while keeping abreast of rapidly advancing knowledge. Traditional doctorate programs that require up to 5-6 years of study and research in STEM subjects are prohibitively expensive and time-consuming. On the other hand, a traditional Master’s program in one subject provides insufficient advanced training or research exposure to STEM subjects. Also, many current faculty members may already possess these degrees from institutions in their home countries. As a result, the world-class and state-of-the-art advanced training is the necessity.

We propose a standardized and streamlined approach with the following salient features.

- Unified proposal from consortia of universities for optimal efficiency avoiding duplication
- Develop new and intensive 2-year graduate degree programs intermediate between a Master’s and a Doctorate
- Combine multi-disciplinary curricula for advanced research and teaching
- Formulate uniform standards across the participating institutions
- Define appropriate metrics for the success of each program
- Implement distance learning internet-based audio-visual interaction mechanisms
- Ensure continuity and follow-through subsequent to the formal degree program
- Establish joint centers of instruction and research at participating universities in emerging countries
- Focus on innovation and research on global problems: energy, environment, healthcare
- Form steering and advisory Committees to oversee implementation

It is of crucial importance to design the degree(s) and courses to be offered appropriately to meet this general framework. A possible outline may be considered as below.

2. DEGREE IN STEM EDUCATION AND RESEARCH (STEM-ER)

The novel degree program would entail the following.

1. Bear the **imprimatur of participating universities** in the U.S., and partner consortia of universities in emerging countries.
2. Fundamentally different from traditional Master's or Doctorate program in content
 - Maximum 2-year duration
 - Flexible course schedule and timetable
 - Continuation beyond the required degree phase
 - Joint mentoring and research collaboration
3. Degree requirements would be commensurate with those of the particular university where a given student pursues the coursework.
4. Emphasis on both educational coursework and research project
5. Prospects for continuing research under chosen advisors
6. STEM-ER curricula would be designed in coordination with Colleges of Education and individual colleges and departments in STEM subjects at participating universities

3. COUNTRY-SPECIFIC PROGRAMS

The needs of each country are different. While the general requirements, standards, and pathways outlined above may be the same, partner universities and educational institutions in each country would have specific priorities. At the same time, the participating universities from the U.S. would also desire **country-specific flexibility** in designing their programs according to existing resources and future plans. For example, environmental problems, healthcare issues, alternate energy generation, basic scientific research, etc. may find different focus, emphasis, and level of activity at each institution in each country. At the same time, common global imperatives also need to be considered since they affect each country..

One solution to the issue of diversity is to identify and form **bi-lateral institutional arrangements** under joint partnerships between the U.S. university and a university or institute in other countries for the training of STEM faculty and related programs with strengths in different areas. While such programs may involve only two or a few institutions, they would still attempt to adhere to the general guidelines to maintain quality control, avoid duplication, share resources, foster collaborations, and approach potential funding sources, as envisaged in the general criteria outlined earlier.

Therefore, bi-lateral arrangements need not be in conflict with the general aim of this U.S. global STEM-ER initiative. Rather, they should strengthen the overall proposal vis-à-vis potential funding sources by exemplifying programs that would contribute to the goal of STEM education and research. All universities have their areas of strength, usually manifest in centers of excellence or specialized institutes. Since STEM education and research are both emphasized under this proposal, prospective students could choose to pursue STEM-ER degree programs at the appropriate participating U.S. universities. This should correlate with students' area of specialization, and one in which they would remain engaged following the completion of formal requirements, presumably towards a full-fledged doctorate.

The link between education and research under the STEM-ER program should be flexible. This may also reflect national priorities such as education in rural areas, as opposed to urban areas which tend to have more than sufficient concentration and opportunities for higher education. Students may select an emphasis on teaching over research by enrolling in coursework that teaches skills necessary for undergraduate classes. Graduate level research may be less of a priority.

In the next section, as an example, we sketch out a possible framework for a US-India program. Similar programs may be drawn up with respect to other countries.

4. US-INDIA INITIATIVE

The existing situation with respect to higher education in India presents a great challenge, with dimensions of supply, demand, resource, and quality. On the one hand, the established universities are over-burdened with exceedingly heavy demand and lack the resources to meet it. On the other hand, a multitude of small for-profit colleges and universities have sprung up with extremely narrow and commercially oriented curricula without adequate quality control. Indeed, the numbers tell the story: there now exist over 20,000 colleges and universities in India, about ten times the number in the U.S. The uneven standards are detrimental to future prospects of the vast majority of young students seeking higher education in most of these institutions. In addition, a number of profit-motivated business organizations from foreign countries have moved into the higher education arena. Finally, and despite the dearth of qualified world-class faculty, some private Indian universities have begun opening campuses in other countries outside India, in the Mid-east, Asia, and Africa. This then is a global issue as manifest in the Indian environment. **A major combined effort on the part of U.S. universities can help tremendously. Whereas the resources of a member university of the consortia in the U.S. or India may be inadequate, a well-coordinated program should be able to address the problematic issues outlined herein.** There is, indeed, an illustrious example of the connection between U.S. institutions and the genesis of the highly prestigious Indian Institutes of Technology. The Kanpur Indo American Program (KIAP) was instituted in 1962 by President Kennedy and Pandit Jawaharlal Nehru. A consortium of nine premier American universities and institutes, led by MIT and including the Ohio State University, was formed to assist the formation and development of the Institute of Technology Kanpur. Since then, "IIT-K" has flourished by leaps and bounds, with many alumni as members of faculty at U.S. universities.

Driven by similar motivations and intended on a much larger scale, following the general criteria outlined earlier, the Ohio State University would like to suggest the preparation of first such proposal from CIC Universities to the **University Grants Commission (UGC) and the Department of Science and Technology (DST) of the Ministry of Human Resources and Development of India**. This would be in response to solicitations by the Government of India, specifying a timeframe concordant with the implementation of the 12th 5-year Plan in 2012.

The agenda is to address these issues through coordination with a consortium or organization of Indian educational institutions, similar to the CIC, under the aegis of the UGC and DST. As this proposal focuses on STEM-ER, DST could sponsor such an association of Indian Universities under guidelines drawn in consultation with UGC and the CIC universities. The organizational structure could be built up in stages, with the first tier comprising of the major central universities in India (see Section 9 for a list and locations). Subsequently, other universities could be brought into the framework in an order deemed suitable by the Indian and U.S. governmental agencies and participating organizations. The CIC universities would then follow with the groundwork necessary to establish a framework of collaboration with individual Indian universities.

The modalities for an initiative comprising of a consortium of universities seeking to develop their STEM-ER program initiative could comprise of the following elements.

- Form an equitable partnership with a consortium of universities with similar aims, involving major central universities first and state universities later
- Build upon existing connections between U.S. universities and foreign universities of the country developing its STEM program
- Standardize accreditation system for joint or dual STEM-ER degree program
- Enable interested faculty members in each U.S.-foreign university partnership to develop common curricula
- Provide administrative oversight of common education and research programs by partner universities
- Constitute a STEM-ER Board to oversee the implementation of the above elements

5. DUAL OR JOINT DEGREE PROGRAMS

One of the important issues to be addressed is the nature of the two-year degree program to be offered by the U.S. and foreign universities. A dual-degree program might entail a degree awarded by each partner institution on the basis of their existing standard requirements for a Master's or Doctorate course. A joint degree would require a more comprehensive coordination and standardization of course and research work by both partner universities, as well as between the respective consortia of universities in the U.S. and India.

We suggest an initial phase based on the dual-degree alternative. The joint-degree option can be explored as the program develops, with crucial input from the practical experience gained from the first phase. The joint-degree program would be different from the existing framework, and would require approval at various levels at each institution and taking account of programmatic considerations of the envisaged consortia of institutions.

6. PRIVATE UNIVERSITIES AND INDUSTRY

The need of private universities for new faculty may well be the prime focus of the proposed endeavor. At the present time most private colleges and universities have fairly narrow curricula, usually restricted to elementary business and computer courses. Research is generally not a priority, and in any case would require considerable effort, expertise, and timeframe for the development of requisite research infrastructure.

However, large private universities with huge enrollments have embarked upon comprehensive plans not only to expand the reach of their curricula, but also to engage in frontline research. For example, in India, the Manipal University and the Jain University, have several campuses. But in order to bring those up to world-class standards, STEM education and research should be front and center.

At the same time there is growing urgency concerning the needs of private industries. Major business enterprises, whose commercial interests are critically important to local economies, are often unable to function well due to lack of adequately trained recruits in basic science and technology. That, in turn, also inhibits the capability of private industries to expand as rapidly as the local economy demands. There is a vast need for training not only large number of STEM faculty, but also that their training needs to be world-class in order to compete with advanced countries and other emerging nations with relatively more advanced STEM programs.

U.S. universities may also act as catalyst to the establishment of STEM Education and Research Centers of Excellence at private universities in the countries of interest.

7. BACKGROUND: The CIC Universities

Headquartered in the Midwest, the Committee on Institutional Cooperation (CIC) is a consortium of the Big Ten member universities plus the University of Chicago. For more than half a century, these world-class research institutions have advanced their academic missions, generated unique opportunities for students and faculty, and served the common good by sharing expertise, leveraging campus resources, and collaborating on innovative programs. Governed and funded by the Provosts of the member universities, CIC mandates are coordinated by a staff from its Champaign, Illinois headquarters.

CIC Member Universities:

- University of Chicago
- University of Illinois
- Indiana University
- University of Iowa
- University of Michigan
- Michigan State University
- University of Minnesota
- University of Nebraska-Lincoln
- Northwestern University
- Ohio State University
- Pennsylvania State University
- Purdue University
- University of Wisconsin-Madison

8. DESCRIPTION OF RESOURCES: CIC Universities

A comprehensive description of the resources and capabilities of CIC universities will be provided in ancillary material highlighting the strengths of individual member institutions pertaining to this proposal. A brief outline for the Ohio State University is as follows.

The Ohio State University: Founded under the Land Grant Act signed by President Abraham Lincoln, The Ohio State University is one of the leading universities in the world. For more than a century, OSU has successfully advanced the goal of bringing higher education to generations of students on a large scale while maintaining high standards. Continuing to meet that goal here in the U.S., OSU is particularly cognizant of the magnitude of the challenge facing higher education entities in emerging countries. That forms the basis of globalization efforts launched by OSU under its country-specific Gateway programs related to the following general items.

- Size, quality, and diversity of education and research programs at OSU
- Globalization plans under OSU Gateways

For more information contact:, Prof. Anil Pradhan, The Ohio State University,
pradhan.1@osu.edu, 614-292-5850