HIGHER EDUCATION EXCELLENCE FOR DEVELOPMENT IN THE ISLAMIC WORLD
HIGHER EDUCATION EXCELLENCE FOR DEVELOPMENT IN THE ISLAMIC WORLD


Edited by

Mehmet Ergin
and
Moneef R. Zou’bi

Published by

Islamic World Academy of Sciences (IAS)
Amman, Jordan.

Publication sponsored by

ISLAMIC DEVELOPMENT BANK (IDB)
JEDDAH, SAUDI ARABIA

OPEC Fund for International Development
Vienna, Austria
CONTENTS

Contents .................................................................................................................. Vii
Preface ................................................................................................................... 1
Acknowledgements ............................................................................................... 3
Sponsors of the IAS 2006 Conference ................................................................. 5
IAS Ankara Declaration ....................................................................................... 7
Conference Report .............................................................................................. 13

PART ONE: STATEMENTS AT THE INAUGURAL SESSION

Message of His Excellency Recep Tayyip Erdogan, Prime Minister of Turkey ............................................................................................................... 19
Message of His Excellency General Pervez Musharraf, President of the Islamic Republic of Pakistan, and Patron of the Islamic World Academy of Sciences ....................................................................................................... 25
Message of His Royal Highness Prince El-Hassan Ibn Talal of Jordan, Founding Patron of the Islamic World Academy of Sciences ........................................ 27
Address of His Excellency Prof. Abdul Salam Majali, President of the Islamic World Academy of Sciences ................................................................. 31
Message of H E Prof. Ekmeleddin İhsanoglu, Secretary General, Organization of Islamic Conference ................................................................. 37
Address of Prof. İhsan Doğramaci, President, Bilkent University .............. 41

PART TWO: THE KEYNOTES

Changes in the Educational Landscape of Turkey: The Past 25 Years .......................... 45
İhsan Doğramaci

Goals of Higher Education: Knowledge and Critical Foresight, Leading to Societal Responsibility ................................................................. 49
Richard R. Ernst

What is What in S&T and Higher Education in the Arab Region for 2006 ........................................................................................................... 67
Adnan Badran

University Reform For S&T Capacity Building ............................................. 77
İbrahim Badran and Ali Hebeish

Science and Technology for Development of the OIC and Pakistan ...... 97
Atta-ur-Rahman

vii
The Bologna Process .................................................................................................................. 111
   Ignaz Bender

Science Education: a Worldwide Concern .............................................................................. 115
   Yves Quere

Agenda for Change for Higher Education in the 21st Century: Lessons for the Islamic Countries .......................................................................................................................... 119
   Abdel Moneim Osman

PART THREE: HIGHER EDUCATION AND RESEARCH

Higher Medical Education in Turkey: Towards Excellence ............................................... 135
   Sinasi Ozsoylu, Naci Bor and Ugur Dilmen

Creating Centres of Excellence in Islamic Countries: Tapping Expatriate Talent .......... 145
   Ahmad Shamsul-Islam

Science, Technology and Innovation (STI) in Developing Countries: Do Higher Education Systems Produce the STI Knowledge Professionals? .......................................................... 151
   Lee Yee Cheong

Selangor as a Model of a Developed and Progressive Islamic State of Malaysia in Education and Research .......................................................................................................................... 171
   Abdel Latif Ibrahim

Active Learning in Physics: A Way for Education and Development ............................ 183
   Zohra Ben Lakhdar

Data Banks and Databases for Concerted Progress, International Information Exchange and Special Advanced Education ......................................................... 193
   Syed M. Qaim

Research Oriented Curricula .................................................................................................. 205
   Qurashi Ali

PART FOUR: HIGHER EDUCATION: GAUGING EXCELLENCE

Ranking, and Evaluation of Universities Worldwide and the Implications for Universities in OIC-Member Countries: Some Methodological Considerations .................................................................................................................. 215
   Mohd Hazim Shah
Assessment in Higher Education and the U.S. National Research Council Approach to Assessing Research Doctorate Programs .......... 255

Charlotte Kuh

Prospect of Excellent Centers and Universities in Arab Countries: The Iraqi Experience ................................................................. 263

Najih El-Rawi

Excellence of Higher Education Institutions: Some Requirements .......... 273

Mohammad Hamdan

PART FIVE: HIGHER EDUCATION: CASE STUDIES

Towards Research and Education Excellence: Experience from a European University of Technology ........................................................... 289

Kemal Hanjalic

Higher Education in Developing Countries: Inherent Problems and Some Solutions ........................................................................... 311

Hameed Ahmed Khan and Anwar Nasim

US-Pakistan Programe for PhD In Physics at the University of Albany, New York, USA: A Personal Snapshot .................................................... 323

Mohammad Alam

Towards Higher Education Excellence .................................................. 333

Khaled S. Al-Sultan

A Private American University in the heart of the Arab World: The Experience of the American University in Cairo .................................... 353

Earl (Tim) Sullivan

The Story of a University “Par Excellence” in a 3rd World Country: Al-Nahrain or “Saddam University” in Baghdad, Iraq ....................................... 369

Muthana Shanshal

Improving Science Teaching at Tehran University of Medical Sciences: A Researcher’s Viewpoint ......................................................... 379

Mohammad Abdollahi

Higher Education Excellence in Korea .................................................. 385

Sung-Chul Shin

Higher Education Reforms in Qatar: Qatar University and Education City .......................................................................................... 395

Ibrahim S. Al-Naimi
PART SIX: HIGHER EDUCATION: SOME OIC-SPECIFIC ASPECTS

The World Educational Crisis: An Islamic Perspective with Reference to Higher Education ................................................................. 411
  
  Zaghloul El-Naggar

Integrated S&T Curricula: The Present Need of the Islamic World ....... 431
  
  Mazhar M. Qurashi and M. D. Shami

Higher Education Excellence for Development in the Islamic World: A Viewpoint from ISESCO ......................................................... 449
  
  Abbas Sadri

Contribution of Muslims to Science: The Indian Scenario in Brief ........ 355
  
  Mohammad Shamim Jairajpuri

PART SEVEN: APPENDIXES

Appendix A:
2006 Conference Committees ............................................................... 459

Appendix B:
Chairpersons of 2006 Conference Sessions .......................................... 461

Appendix C:
2006 Conference Participants ............................................................... 463

Appendix D:
Patrons, Honorary Fellows, Fellows of IAS ........................................... 471

Appendix E:
Laureates of the IAS-COMSTECH Ibrahim Memorial Award ............... 475

Appendix F:
Council Members and Executive Staff of IAS ....................................... 477

Appendix G:
Deceased IAS Fellows ........................................................................ 479

Appendix H:
Publication of the IAS ........................................................................ 481

Appendix I:
IAS Supporters ................................................................................... 485

Appendix: J
IAS Waqf ............................................................................................ 487
Some of the Participants in 15th IAS Science Conference; Ankara; Turkey, 7-10 November 2006.
PREFACE

Worldwide, higher education is changing, and many higher education institutions and national systems are in a state of important transition. It is both exciting and unsettling that new educational models and means of delivering educational programs and services are evolving at all levels of higher education.

Complex challenges include national regulation, addressing for example for-profit private universities; performance-based or research-driven funding for public universities, and increased calls for definition and review of student learning and for other types of public accountability.

Mindful of these realities, and since only very few universities in OIC countries are ranked among the world’s 500 top universities (according to the Shanghai Jiao Tong University Survey of 2005 and the Times Higher Education Supplement, 2005), the Islamic World Academy of Sciences (IAS) together with Bilkent University in Ankara, Turkey; decided to lead an effort to appraise the performance of the higher education sector not only in member countries in the Organisation of the Islamic Conference (OIC) but also in other developing countries.

Apart from the intellectual value of the meeting, a possible plan of action would be drawn up by the IAS, with help and support from a number of international organizations, to identify 5-10 potential leading universities in OIC countries to discover their difficulties and see what needs to be done to get all/some into the top world ranking over a specific period of time.

This book is the outcome of what many agreed was a timely conference by the Islamic World Academy of Sciences (IAS) in which around 200 participants attended including IAS Fellows and invited speakers from outside Turkey. Academics, decision-makers, scientists, researchers, presidents/representatives of academies of sciences, as well as students, especially post-graduates, from Bilkent University also took part.

This book includes the majority of the papers that were presented at the 15th IAS Conference, which was held in Ankara (Turkey), during November 2006. It is divided into seven parts.

Part One includes the statement of the Prime Minister of Turkey, the statements of the two patrons of the IAS, the statement of IAS President, as well as the statement of Prof. İhsan Doğramacı; the founder of the host institution; Bilkent university. Part Two includes a number of keynotes that were presented at the conference including one by Richard Ernst Hon. FIAS, Nobel Laureate in Chemistry of 1991; an overview paper on the Status of S&T in the Arab World by Adnan Badran, the former Prime Minister of Jordan; a similar overview paper on the S&T in the Islamic World by Prof. Atta-ur-Rahman, who is the coordinator General of COMSTECH in Pakistan. Prof. Bender from Germany
presented a ‘best practice’ paper on the Bologna Process, which was very carefully studied by the OIC decision-makers present at the conference.

**Part Three** addresses the vital link between higher education and research in the various OIC countries and includes papers on medical research in Turkey, centres of excellence in Bangladesh, as well as research and training activities in Tunisia and Malaysia. **Part Four** on the other hand looks in detail on the various methodologies that are used in various parts of the world to rank universities including the world famous methodology developed and used by the Shanghai Jiao Tong university rankings; and how such methodologies may or may not be ideally suited to rank universities in countries of the OIC.

**Part Five** moreover embraces a number of diverse case studies from such countries as the Netherlands, Pakistan, the US, Saudi Arabia, the American University of Cairo (AUC) and the State of Qatar.

**Part Six** is the open science forum section. It includes a compilation of general papers that were presented by IAS Fellows on a number of topics. Finally, **Part Seven** includes the list of conference participants complete with addresses, names and designations of the members of the conference organising committees, the names and nationalities of IAS Honorary Fellows and Fellows, as well as other details about the IAS.

This book by the IAS is an attempt to archive the ideas, thoughts and discussions that took place in an academic forum that addressed a very important topic. It documents a genuine attempt on the part of the OIC science community to evaluate higher education in the Islamic world and map out a strategy to raise standards.

Mehmet Ergin
Moneef R. Zou’bi
ACKNOWLEDGEMENTS

The Islamic World Academy of Sciences (IAS) is grateful to His Excellency Mr Recep Tayyip Erdogan, the Prime Minister of Turkey, for his patronage of the Fifteenth IAS Conference and the IAS. The support and encouragement of His Excellency the President of the Islamic Republic of Pakistan, IAS Patron; and His Royal Highness Prince El-Hassan Bin Talal of Jordan, Founding Patron of the IAS, are also thankfully acknowledged.

The IAS extends its gratitude to all the organisations that sponsored the convening of the conference foremost among which are Bilkent University; Islamic Development Bank (IDB); OIC Ministerial Committee on Scientific and Technological Co-operation (COMSTECH); the Opec Fund for International Development (OFID); the Pakistan Academy of Sciences; and the US National Academy of Sciences.

We are very grateful to all the eminent speakers who participated in the conference and to all the specialists and the various participants who made the effort to take part in this international scientific activity.

The preliminary work done by the IAS Council, and the efforts volunteered by IAS Treasurer, Dr Adnan Badran; IAS Secretary General, Dr Mehmet Ergin; Mr Moneef R. Zou’bi, IAS Director General; Dr Phyllis Erdogan, Vice-President of Bilkent University during the meetings of the scientific committee and the conference itself are gratefully accredited. The IAS Council headed by Dr A S Majali has too done a lot to help realise this activity.

The dedicated staff at IAS Secretariat in Amman including Ms Lina Jalal, who was responsible for the unenviable task of preparing the manuscript, Ms Taghreed Saqer, IAS Executive Secretary; Mr Habis Majali, Mr Saleh Asa’ad, and Mr Abdel Mu’ti Khayyat deserve our thanks and appreciation. So do Mr George Anz, Ms Amal Mizher and Mr Abdellatif Bouab, who have so unwearingly prepared the manuscript of this book.

Mehmet Ergin
Moneef R. Zou’bi
IAS 2006 Ankara Conference

on

Higher Education Excellence for Development in the Islamic World

Sponsors of the IAS 2006 Conference

(1) Islamic World Academy of Sciences (IAS), Amman, Jordan;
(2) Bilkent University, Ankara, Turkey;
(3) Islamic Development Bank (IDB), Jeddah, Saudi Arabia;
(4) Opec Fund for International Development (OFID), Vienna, Austria;
(5) OIC Ministerial Committee on Scientific and Technological Co-operation (COMSTEC), Islamabad, Pakistan;
(6) Islamic Educational, Scientific and Cultural Organisation (ISESCO), Rabat, Morocco;
(7) International Islamic Charitable Organisation, Kuwait City, Kuwait;
(8) Arab Potash Company, Amman, Jordan;
(9) Pakistan Academy of Sciences, Islamabad, Pakistan;
(10) US National Academy of Sciences, Washington, USA; and
(11) International Conference on Higher Education (ICHE), Ankara, Turkey.
IAS 2006 ANKARA DECLARATION

on

Higher Education Excellence for Development in the Islamic World

Adopted at Ankara, Turkey

on

17 Shawwal 1427
9 November 2006

PREAMBLE

WHEREAS the quest for knowledge is a pillar of the Islamic Faith; and knowledge and its pursuit has today assumed augmented importance in an increasingly knowledge-intensive world;

WHEREAS there is increased awareness of the critical role higher education plays in socioeconomic development; and for building a sustainable future for which future generations need to be equipped with new skills, knowledge and ideals;

WHEREAS in OIC countries in particular and developing countries in general; higher education is faced with great challenges related to financing, staff development, skills-based training, enhancement of quality in teaching, research and relevance of programmes;

WHEREAS higher education is being confronted by new opportunities relating to technologies that are improving the ways in which knowledge is produced, managed, disseminated, accessed and controlled;

WHEREAS Vision 1441 declares that OIC-Member countries are committed to become a community that values knowledge and is competent in utilizing and advancing S&T to enhance the socioeconomic well-being of the Ummah;

AND WHEREAS the international science/academic community must lead the way in bridging prevailing civilisational, social, economic, and even political divides between the peoples of the world,

WE, THE PARTICIPANTS IN THE 15TH ISLAMIC WORLD ACADEMY OF SCIENCES CONFERENCE HELD AT BILKENT UNIVERSITY, ANKARA, TURKEY; 07-10 NOVEMBER 2006:
(a) **BEING CONCERNED** by the indifference shown by decision-makers in many OIC countries to the pivotal role of quality higher education in realising national aspirations;

(b) **NOTING WITH CONCERN** that very few OIC universities are ranked among the world’s top 500 universities;

(c) **BEING CONCERNED** at the lack of a comprehensive, objective methodologies to evaluate the performance of universities in OIC countries in terms of quality of education and research output,

**MOREOVER**

(i) **APPRECIATING** that in responding to the growing demands of the market-forces of the K-economy, a fresh look is needed to re-examine higher education systems in OIC and developing countries in terms of quality and relevance;

(ii) **SUBSCRIBING** to the notion that quality in higher education is a multilayered process, which should embrace all its functions and activities including: teaching and academic programmes, research and scholarship, staffing, students, buildings and facilities, equipment, services to the community, and the academic milieu;

(iii) **SUBSCRIBING** to the notion that internal self-evaluation and external review, openly carried out by autonomous specialists are vital for enhancing quality. Independent national bodies, involving all stakeholders, should be established and comparative standards of quality, recognized at the international level, should be defined. Due attention should be paid to specific institutional, national and regional contexts;

(iv) **AGREEING** to the general notion that international higher education surveys such as the Shanghai Jiao Tong University Survey, the Times Higher Education Supplement Survey and other similar studies may not necessarily reflect the true 'assessment' of the university in its catchment area, although they may be indicative of certain criteria in which universities excel;

(v) **EMPHASIZING** that higher education should be characterized by its international dimension: exchange of knowledge, interactive networking, mobility of academics and students, and international research projects, without forfeiting national cultural values and circumstances;

(vi) **EMPHASIZING** that to attain and sustain national, regional or international quality in higher education, certain components are particularly relevant; notably careful selection of staff and continuous staff development, in particular through the promotion of apposite programmes for academic staff development, including mobility between countries, between higher education institutions, and between higher education institutions and society/industry, as well as student mobility within and
between countries. Information and Communication technologies (ICTs) are a main tool in this process, owing to their impact on the acquisition of knowledge and know-how. Moreover, the Bologna Process—adopted by many European countries—represents a good model to follow for harmonising academic degree standards and quality assurance standards throughout OIC countries/universities.

ENDORSE THIS DECLARATION AS A PROPOSAL FOR THE ATTAINMENT OF HIGHER EDUCATION EXCELLENCE IN MEMBER COUNTRIES OF THE ORGANISATION OF THE ISLAMIC CONFERENCE (OIC) AND OTHER DEVELOPING COUNTRIES, AND

(a) **ASSERT** that the core mission of higher education should be to contribute to the sustainable development and the improvement of the wellbeing of societies;

(b) **EMPHASIZE** that higher education must endeavour to advance, create and disseminate knowledge through research and provide, as part of its service to the community, relevant expertise to assist societies in cultural, social and economic development, promoting and developing scientific and technological research as well as research in the social sciences;

(c) **ENDORSE** the notion that higher education must help in understanding, preserving, enhancing, promoting national, and global cultures, in a context of pluralism and diversity;

(d) **REITERATE** that higher education should aim to cultivate and enhance societal values by training young people in the values which form the basis of democratic citizenship and by providing critical and detached perspectives to assist in the reinforcement of humanistic perspectives;

(e) **EMPHASIZE** the key roles played by contemporary applied and basic sciences education for gaining mastery in the transformational technologies of information technology, biotechnology, nanotechnology; as well as environmental and even cultural technologies;

(f) **REAFFIRM** the commitment to the implementation of specific actions at the national and international levels including, *inter alia*, commitment at the highest level to S&T; sizeable increase in R&D expenditure, and the promotion of the central role of the university as originator of scientific output. New approaches are necessary to enhance greater linkage between the government, the university and industry;

(g) **COMMEND** the success of Turkey in achieving an advanced ranking in terms of the number of scientific and engineering articles published in the world’s leading scientific and technical journals, and urges universities and research centres in OIC countries to help and encourage researchers to increase their quality contributions to the world’s scientific output;
(h) **CALL FOR** intensifying cooperation among countries, especially involving countries and institutions that have developed significant expertise in S&T policy development, S&T infrastructure, biotechnology, information technology, and nanotechnology,

AND

**CALL UPON** OIC countries to ensure that the pursuit of science must not only focus on the attainment of knowledge but also on realising socioeconomic goals;

**CALL UPON** the concerned agencies to implement the necessary practical modalities for the implementation of the recommendations of this Declaration in close co-ordination with the relevant OIC bodies and other agencies, and through:

1. Setting up of virtual working groups on higher education; to develop a methodology of ranking of OIC universities; to peer review project proposals submitted for financing; to co-ordinate fund raising nationally, regionally and internationally to help leading OIC universities come up in world rankings over a specific period of time;

2. Activating virtual working groups on ICT, biotechnology and nanotechnology, to be hosted (it is proposed) by Malaysia, Tunisia and Pakistan with a view to implementing the relevant OIC recommendations related to the promotion of these transformational technologies;

3. Setting up a study group to prepare a position paper/action plan entitled "Brain-Gain: Concept and Possible Remedies" for the benefit of OIC countries. This, as one means to understand this phenomenon and help turn the current "Brain-Drain" into a possible "Brain-Gain;"

4. Accelerating the provision of a quality core ICT infrastructure, increased access and reduced costs, and increase connectivity and physical access to ICT infrastructure, including the development and use of low cost hardware and software,

**CALL UPON** the leaders and decision-makers of Islamic countries to:

1. **ALLOCATE** more resources to science education, with a view to building up a scientific and technological human resource base capable of adapting and developing new technologies;

2. **FACILITATE** opportunities for scientists of the countries of the South in terms of under-graduate, post-graduate and post-doctorate studies in the North and other parts of the South as a means of building up the critical mass of scientists and technologists in poorer countries;

3. **ESTABLISH** national academies of sciences in their countries, or where such independent entities exist strengthen them, so that they may act as independent advisory bodies to their respective governments, and
strengthen academic and scientific links with international science academies, and other scientific bodies worldwide;

4) **ENCOURAGE AND SUPPORT** leadership in science at all levels, and to promote leadership training centres, and nurture future leaders who would contribute to better understanding and tolerance between the world's countries and civilisations.

**AND FURTHER URGE THE RELEVANT NATIONAL EDUCATION AGENCIES TO:**

1) **PROMOTE** and enhance inborn curiosity and inquisitiveness among the young through developing a "creativity movement" at national levels to create conducive environment at the home, at school and the university, and to develop OIC-wide creativity programmes;

2) **DEVELOP** financial, business, and entrepreneurial skills through education and hands-on experience through in-school and after-school programmes, and through developing specialised post-school business skills programmes,

**FURTHERMORE, THE PARTICIPANTS IN THE 15TH ISLAMIC WORLD ACADEMY OF SCIENCES CONFERENCE**

**REAFFIRM** their support to the science community in Iraq and urge the international community to take all possible measures to ensure the safety, security and well-being of Iraqi scientists, educationists and academics, within Iraq and internationally; and

**EXTEND** their appreciation to the Republic of Turkey and the Prime Minister, to Bilkent University and its founder Prof. İhsan Doğramacı Hon. FIAS for hosting the 15th IAS Science Conference; to the Islamic Development Bank, COMSTECH, ISESCO, the OPEC Fund for International Development, and the Pakistan Academy of Sciences for generously financing this international meeting.
IAS 2006 Ankara Conference

on

Higher Education Excellence for Development in the Islamic World

7-10 November 2006
Bilkent University
Ankara, Turkey

Conference Report

General

Under the patronage of H E Mr Recep Tayyip Erdoğan, Prime Minister of Turkey, the Islamic World Academy of Sciences (IAS) convened its fifteenth international science conference in Ankara, Turkey, during 7-10 November 2006. The conference addressed the theme of Higher Education Excellence for Development in the Islamic World.

Held at Bilkent Hotel in Ankara, the conference was an open scientific activity in which over 150 participants representing over 30 countries participated.

The conference was organised and sponsored by the following organisations:

(1) Islamic World Academy of Sciences (IAS), Amman, Jordan;
(2) Bilkent University, Ankara, Turkey;
(3) Islamic Development Bank (IDB), Jeddah, Saudi Arabia;
(4) Opec Fund for International Development, Vienna, Austria;
(5) OIC Ministerial Committee on Scientific and Technological Co-operation (COMSTECH), Islamabad, Pakistan;
(6) Islamic Educational, Scientific and Cultural Organisation (ISESCO), Rabat, Morocco;
(7) International Islamic Charitable Organisation, Kuwait City, Kuwait;
(8) Arab Potash Company, Amman, Jordan;
(9) Pakistan Academy of Sciences, Islamabad, Pakistan;
(10) US National Academy of Sciences, Washington, USA; and
(11) International Conference on Higher Education (ICHE), Ankara, Turkey.

The 15th IAS Conference, which coincided with the 20th Anniversary of the Islamic World Academy of Sciences (IAS), was primarily an S&T platform that
addressed a number of issues related to higher education in OIC countries. It sought to engage the widest range of institutions and individuals involved in higher education in Turkey, the region, the OIC; as well as some international agencies.

The conference also attempted to link development in the higher education sector to the broader S&T sectors.

The conference reviewed a number of contemporary attempts that aimed to evaluate the performance of universities. It moreover looked at some experiences in this endeavour from a number of countries.

The conference included a number of sessions for contributed papers by IAS Fellows that addressed a wide of range of scientific issues and topics.

**Presentations**

In addition to an outstanding keynote by Prof. Richard R. Ernst Hon. FIAS, Nobel Laureate from Switzerland entitled *Goals of Higher Education: Knowledge and Critical Foresight, Leading to Societal Responsibility*; Prof. Atta-ur-Rahman FIAS, Co-ordinator General of COMSTECH, presented a keynote on *Excellence in Higher Education - Some Recent Initiatives in Pakistan*. The founder of the host institution Prof. İhsan Doğramaci, in his keynote address, presented what many described as a concise history of *Higher Education in Turkey* in which he outlined some of the factors that lie behind the success of Turkey in establishing private non-profit universities; foremost among which is Bilkent University which hosted the conference.

A further 7 keynotes were also presented at the conference that addressed such issues as *What is What in Higher Education in the Arab Region for 2006* which was the title of a paper presented by Prof. Adnan Badran FIAS (Jordan); and *Ranking and Evaluation of Universities Worldwide and its Implications for Universities in OIC-Member Countries* presented by Dr Hazim Shah (Malaysia).

A lot of interest was shown in the various case study lectures presented by the representatives of some universities from the region including the AUC in Egypt, the King Fahd University of Petroleum and Minerals (KFUPM) in Saudi Arabia; as well as the representatives of the UNESCO, the ISEESCO, and the UNDP.

Two broad-policy presentations were also made at the conference by the representatives of the US National Academy of Sciences as well as the Korean Academy of Sciences and Technology, and both received a lot of attention form the Fellows of the IAS attending.

At the conclusion of the three-day conference, which also included a number of special presentations by Prof. A. A. Azad entitled ‘Drug Discovery and Development in OIC Countries’ and IAS Director General Moneef R. Zou‘bi on ‘Twenty Years of the IAS;’ as well as site visits, the IAS adopted the IAS 2006 Ankara Declaration on *Higher Education Excellence for Development in the Islamic World*. 
Declaration

The declaration stressed that the quest for knowledge is a pillar of the Islamic Faith, and that there was increased awareness of the critical role higher education plays in socioeconomic development. The declaration highlighted that very few OIC universities were ranked among the world’s top 500 universities; and the lack of a comprehensive, objective methodologies to evaluate the performance of universities in OIC countries in terms of quality of education and research output. The declaration emphasised that to attain and sustain quality in higher education, certain components are particularly required; notably careful selection of staff and continuous staff development and mobility, as well as student mobility within and between countries. It also reiterated that Information and Communication Technologies (ICTs) might facilitate such a process, owing to their impact on the acquisition of knowledge and know-how. A special mention was made in the declaration of the Bologna Process – adopted by many European countries – which represents a good model for harmonizing academic degree standards and quality assurance standards throughout OIC countries/universities in this domain.

The declaration reaffirmed its support for scientific and technological cooperation among developing countries and called for the exchange of scientific experiences with a view to delivering real benefits, especially involving countries that have developed significant expertise in S&T policy development, S&T infrastructure, biotechnology, and information technology.

The declaration proposed a number of strategies to invigorate the innovation climate in OIC-Member countries.

Moreover, the declaration commended the success of Turkey in achieving an advanced ranking in terms of the number of scientific and engineering articles published in the world’s leading scientific and technical journals, and urged universities and research centres in OIC countries to help and encourage researchers to increase their quality contributions to the world’s scientific output.

In its operative component, the declaration invited OIC organisations to activate study groups to analyse the possible impact of transformational technologies on scientific development, and joint programmes that could be implemented by OIC countries in this field. It also assigned the IAS to address the question ‘Brain Drain’ from OIC countries, initially through commissioning a study on the subject.

The declaration also reaffirmed the support of the participants to the science community in Iraq and urged the international community to take all possible measures to ensure the safety, security and well-being of Iraqi scientists, educationists and academics, within Iraq and internationally.

As part of the follow-up action to the conference, the Academy will circulate the IAS 2006 Ankara Declaration to concerned individuals and relevant agencies throughout OIC and developing countries, so that measures are taken to put the ideas proposed at the conference into action. The Academy will also
publish the complete proceedings of the conference in a quality volume that will be distributed internationally.

Through IAS Fellows, personal contact and correspondence, the IAS will promote the concepts promulgated at the conference among the decision making circles of the Islamic world, and will provide OIC countries with whatever help it can to get the various recommendations implemented.

An underlying objective of the IAS would be to raise the level of a number of OIC universities so that, within a short period, some are included in the world’s top 500 universities.
PART ONE
STATEMENTS AT THE INAUGURAL SESSION
Message of
His Excellency Recep Tayyip Erdogan
Prime Minister of Turkey

Distinguished Academics
Distinguished Guests

I take great pleasure in being with you and addressing you on the occasion of the 15th Science Conference of the Islamic World Academy of Sciences (IAS).

We all know that science is the key to development and there is no end to the scientific progress that shapes our lives.

Today more and more areas are opening in science and science is becoming ever more specialized. New technological discoveries and inventions are affecting our lives at a faster pace than ever. Humanity’s progress in science is awe-inspiring. But it is a fact that the world’s peoples experience this progress to very different degrees.

Every country profits from this progress in proportion to its economic and social development, its power to compete on a global scale, and its capacity to acquire, absorb and apply technological advances.

In today’s world, we have the following situation:

On the one hand we have countries which are producing science and technology. On the other hand, we have those which use this new knowledge to the extent that they can acquire and apply it and also those that are able to add new science and technology to others’ findings.

Distinguished Guests

We see that the member countries of the Organization of the Islamic Conference (OIC) have quite different economic and social structures. In this respect the difference between them can be great even in the case of two adjacent countries. In reality, almost all of the problems of development are the same. For this reason, the methods of struggle need to be the same.

In my opinion, the situation of science and technology is the following:

It is with sorrow that I must admit that all Islamic countries, albeit to differing degrees, are dependent on others for science and technology. They are all trying to industrialize. Of course, there are some, which in some sectors, have gained experience and lessened their dependence on external sources for technology.

* Delivered by Dr Phyllis Erdogan; Vice-President, Bilkent University; Ankara, Turkey.
But it is thought-provoking to realize that none of the Islamic countries is yet among the “science and technology producing” nations. This, despite the fact that the Islamic countries’ scientific tradition from history and from Islam is full of successes.

Distinguished Guests

It is certainly unfortunate that the members of a religion for which the first commandment is “Read” should be in a state so contradictory to their own history. You are all aware that during some of the brightest periods in humanity’s history, Islamic science was at the lead. For this reason, the heritage of Islamic civilization has played an important role in bringing science to where it is today.

During the first centuries of Islam, approximately through to the end of the 6th Hijri century, Islamic science enjoyed a Golden Age. During those years, the learned people living in Islamic states in the Middle East and belonging to different religions and ethnic groups made important contributions to science. They translated works from other civilizations and enriched them with new and original additions; they made discoveries in scientific and technological fields such as astronomy, mathematics, medicine and engineering.

The Islamic world experienced its second period of leadership from the 8th to the 15th centuries in Andalusia. Within the multicultural richness of Andalusia, the works of Islamic learned men were translated into Western languages and circulated in Europe. This enormous work of translation, as admitted by all historians of science, gave rise to the Renaissance in Europe. Thus we can comfortably say that the Islamic world was the producer and promoter of science in the Middle Ages.

During the Ottoman period following, scientific work continued in the centers and madrassas of Istanbul, Anatolia and Eastern Europe.

Following the Industrial Revolution of the 19th century in Europe, the Islamic world moved from producing and exporting science and technology to importing it, whereas it was our civilization which had produced the Avicennas of medicine, Averroeses (or Ibn-i Rushd) in philosophy, Ibn-Khalduns in sociology and Piri Reises in geography.

In my opinion, for the Islamic world, which created such a grand civilization from Samarkand to Cordoba, which made Cairo, Istanbul, Damascus and Baghdad centers of science and culture, a revival that suits its history is possible.

Distinguished Guests

As you know, recent times have witnessed the most rapid development of science and technology in history. In this new era, which we call globalization, interdependencies of countries have increased in science as in all other fields. Thus, in today’s world the expression “knowledge is the believer’s forgotten wealth” is much more important and much more meaningful.
An academic understanding, which is limited by geographic or cultural boundaries, cannot be a good basis for scientific progress. Experience has shown this to be the case.

Since science is universal, it does not change according to geography, culture, race or religion. If that is true, our universities and our academic intellects must be open to the world. Again today, the leading countries and groups of countries in the production of science and technology are grouped in several regions. Thus in this multiregional environment with multi-centers, the sharing of experience, exchange of technology and cooperation in scientific training are ever more important. In particular, Islamic countries which have developed their economic and cultural cooperation in almost every area also need to collaborate in this domain.

Thus, I am confident that the 15th Science Conference of the Islamic World Academy of Sciences (IAS) will yield extremely beneficial results in this respect. I believe that there is much we can do to help each other in science education, the theme of this conference. For this reason we, as Turkey, give great importance to collaboration among the members of the Organization of the Islamic Conference in science and technology, as has been the case in economics, culture and social subjects.

We have been involved in these activities since the beginning. I would like to state that we are ready to share our experiences in the production of science and technology with the higher education institutions of the Islamic countries. In my opinion, approaching the theme from different angles in each session of the conference of the Islamic World Academy of Sciences will prove extremely fruitful. It will ensure that the various situations and peculiarities in each member country are understood.

As you know, in this conference beginning today, emphasis will be given to higher education. In fact, as is the case in Turkey, the targets of the development plans in general, among all the Islamic countries there is a mutually beneficial relationship between science and technology and higher education.

**Distinguished Guests**

In this political framework, for the last ten years, certain targets have been adopted such as:

- Increasing public funds allotted to research and development;
- The development of research in engineering and medicine, especially in “pure science” and “applied science,” and
- Increasing the number and quality of scientists and researchers.

In addition, when it was realized that scientific research was not being reflected in the economics of the country, technological research and development took its place in the development plans.

As in the industrialized countries, in the developing countries also, a Science and Technology Policy has been recognized as a major component of
development. Now policies of this sort are organized so as to encompass the educational institutions and industry as well as the government bodies which are responsible for the coordination of their research and development.

Distinguished Guests

How unfortunate it is that at present the Islamic countries are not at the same level as the industrialized countries, which are producing science and technology, although without a doubt, every one of the Islamic countries is undertaking its own national development in this field.

I believe that the Islamic World Academy of Sciences will provide a forum for Islamic countries to exchange experiences, problems encountered and propose paths to their solutions.

Within this framework, particularly in higher education, there are measures that can be taken which will serve those goals, such as:

1. To increase the capacity to understand, assimilate, apply and generate science and technology and to train manpower with these skills;
2. To support research and development activities being carried out, in large part in institutions of higher education;
3. To examine and spread the application of advanced technology;
4. To establish international knowledge networks and international technical cooperation; and
5. To encourage the establishment of technology centers and museums to support university-industry cooperation.

Of course, the distinguished experts attending this meeting will be discussing ways to reach these aims.

Distinguished Guests

As the government, we are striving to achieve a balance between policies for science and technology, and policies for industry and education. In order to overcome the deficiencies in this matter, we are trying to establish a national academic network to include industry, the private and the public sectors as well as research and development institutions and universities. Additionally, we are taking serious steps on the road to becoming a scientific society. We are aiming to increase interest in science and to expand the culture of science.

From this point of view, we take pleasure in noting advances in fields such as:

- The distribution of university students among the various fields;
- The distribution of the subjects in which publications are being made; and
- The citations to the scientific publications.

To me, these are developments that show an increasing interest of our society in science and technology. Yet there is still a lot to be done in these
fields. For that reason, we as Islamic countries must speed up our efforts and join together.

As you are aware, at this meeting, the contribution of higher education to scientific development will be considered within the framework of those fields to which the development of science is directly related, such as all branches of engineering, the hard sciences, mathematics and medicine. At the same time, various branches of the administrative and social sciences can also stimulate interest in and a feeling for science. Thus we need to take advantage of this.

We know, for example, that scientific development with the leadership of institutions is something to be realized with the participation of society. For this reason, in our countries and societies, we must continue to support all institutions that are working to regain our rightful high status vis-à-vis science.

I would like to thank the members of the Islamic World Academy of Sciences, the distinguished participants and the host, Bilkent University, for serving this worthy purpose. I am confident that the conference will contribute to science and to the Islamic World, and I salute you once again with affection and respect.
Message of
His Excellency General Pervez Musharraf
President of the Islamic Republic of Pakistan
Patron of the Islamic World Academy of Sciences

This annual scientific conference of the Islamic World Academy of Sciences (IAS) offers an important opportunity to its Fellows to discuss some of the fundamental issues confronting Islamic nations today. Choosing "Higher Education Excellence for Development in the Islamic World" for the fifteenth International Scientific Conference in Ankara is timely and well suited to our current state of affairs.

The lack of high quality education, particularly at the tertiary level, has always been a weak area for the Islamic World and one of the key reasons for our deteriorating scientific output. This is apparent from our wildly disproportionate per capita resource distribution for the education sector in the OIC region.

To open the doors of higher education to all students regardless of income, OIC member states must first assign a significant share of their resources to this essential sector of our development. We also need to nurture our economics through emphasis on science and technology and linkages with industry. The OIC member countries must provide strong financial support to such programs and use COMSTECH as the platform to address the issues of socio-economic development through transforming our economies into knowledge economies.

The purpose of higher education should be to encourage curiosity, exploration and enhance the quality of life. These are some of the more important qualities that distinguish developed societies from the educationally undernourished and underdeveloped cultures. The task of the Fellows of this august body assembled in Ankara today should be to deliberate and discover ways to formulate a strategy for implementing quality higher education programmes relevant to the needs of the citizens of OIC member states.

I earnestly hope that the Fifteenth Conference of the Islamic World Academy of Sciences in Ankara will mark the beginning of a new era, reflecting a positive shift in our thinking on higher education.

May Allah give us the courage to cope with these challenges in accordance with the teachings of Islam and Bless us with a true and genuine commitment to advance the cause of education, scientific research, technological advancement and prosperity for all. Ameen!

* Delivered by Dr M. A. Mahesar, Assistant Co-ordinator General, COMSTECH, Islamabad, Pakistan.
Message * of
His Royal Highness Prince El Hassan Ibn Talal of Jordan,
Founding Patron of the
Islamic World Academy of Sciences

The first word of the Holy Qur’an, revealed to the Prophet Muhammad (PBUH), as can be seen on the very logo of the Islamic World Academy of Sciences, is “Iqra!” “Read!” — a seminal exhortation to learn if ever there was one — and a famous hadith instructs his followers to “seek knowledge, even unto China,” which was a lot harder in the age of camels than that of transcontinental tourism!

It has long been recognised that education is, without exception, the most important tool for the development of civilization, empowerment and, ultimately, for liberty. It is also the greatest gift that we can bestow upon our younger generations. By educating children at the primary level, we can introduce moral and ethical principles to new minds at the earliest opportunity; and by educating teenagers at the secondary level; we should sustain the acceptance of these ideas throughout the formative years. However, it is only by offering the chance of tertiary education to young adults, that we can train those that will follow us to analyse problems, to accept and improve methods of governance: in essence, to think for themselves. Education is not only a method for moral and ethical instruction but can be used to nurture every aspect of the younger generation: to support the human being, as a whole, throughout the transition into adulthood.

The second of the UN’s Millennium Development Goals is to “Achieve Universal Primary Education” (by 2015). But this cannot be the end result. I would also like to see unanimous secondary education, as well as universal opportunities for higher education, by 2050. Education is not only about imparting knowledge to younger generations, but it carries the utmost responsibility and the greatest opportunity for eliminating prejudice, promoting tolerance and mutual understanding, and demonstrating a model for cohabitation to be emulated in the future. Irresponsible pedagogy, on the other hand, is an enormous risk that must be avoided at all costs.

The Islamic World is part of a global village that grows smaller and closer every day, and quality, higher education must become more-readily obtainable

* Delivered by Prof. Adnan Badran FIAS, former Prime Minister of Jordan and IAS Treasurer.
to prevent isolation and estrangement from our ever changing world. Isolation leads to marginalisation, which, in turn, can have tragic and often disastrous consequences. Abusing education to promote religious prejudice (أعمال التعصب الدينى من خلال الثقافة الشرقى) must be prevented and replaced with open-minded teaching and the tools to accommodate others, and accept their differences. After all, it is from the east (الشرقى) that the idea of ‘illumination’ (الإشراق) arose, centuries before the concept of ‘enlightenment’ was recognised by Europe.

Reconciliation between conflicting ideas, such as modernising traditional values whilst recognising tradition (alongside modernity) must be attempted in all fields. Although when reconciliation is impossible, we must learn to peacefully agree to disagree. Meanwhile, we should re-examine our own, as well as each other’s texts, heritage and history to establish universal shared values, because learning about the other can teach us volumes about ourselves.

Such learning by analogy, and by putting ourselves “in the shoes of another”, is an invaluable experience. Exchange programmes such as Socrates, Minerva and Erasmus afford students the opportunity to learn about each other from each other.

My friend, Ilshan Doğramaci, is a true ally to education, not to mention the valuable contributions made by him and his wife to youth education, and the work of Bilkent University. The nascent Centre of Mediterranean Humanities, in Bilkent, should include a graduate facility to further exchange and mutual education opportunities in the higher education of the region, and beyond.

West Asia – North Africa is the poorest, most dangerous, and most populous region in the world (even more so than China) and it is my wish that Jordan, and all other countries in the region, might have the opportunity for education at all levels, in even the poorest and least accessible segments. Investment is sorely needed in the educational sector: in research, development, teacher-training and practices and, particularly, focusing upon science and technology. There is great wealth in the region, and great poverty. As the chasm between rich and poor widens, so too does the regional human dignity divide. It is projected that the number of Arab students enrolled in higher education will rise from 3.6 million to 5.6 million in the next decade. A further 250,000 university teachers will be needed, and we must utilise the very best minds that we have to teach future generations. This is an issue that needs to be addressed without delay.

It is manifest that a strategy for education and communication is long overdue in our region, and we would surely benefit from the international input and experience of other regions. Six OIC countries are currently at the very bottom of the list of 177 countries, in the UN’s Human Development Index (HDI), with an alarming seventeen Islamic countries in the low HDI category. Increased south/south cooperation among the Islamic countries, especially in the training of researchers at the post-doctorate level, should be utilised in a creative and innovative manner.

The Islamic World Academy of Sciences (IAS) provides an umbrella for the scientists of the Islamic countries to meet annually, in this conference. Let us prioritise what is desirable, what is needed and what must be immediately dealt with. Many of our commonalities lie within these priorities and to share ideas

28
and practices among scientists and research & development centres can only be beneficial. Let us deliver the outcome of our conference to the decision makers. Academia should not exclude itself from society to only talk to each other, but also to “the other”, particularly the policy and decision makers in order to introduce change in the Muslim *Ummah*.

Not only is education the best way of working through our regional problems from the grass-roots up, it is also a long-term solution that will secure the future of our region and the future of generations unto whom we will bestow this world, when our time is done.
Address of
His Excellency Prof. Abdel Salam Majali FIAS
President of the
Islamic World Academy of Sciences

Allow my first to pay my condolences to the people and government of Turkey on the passing away of Mr Bulent Ecevit, the former prime minister. We also pay our condolences to the Prime Minister Mr Erdoğan who cannot be with us today for that reason.

Your Excellency Prof. Mehmet Aydin, Minister of State, deputising for Mr Recep Tayyip Erdogan, Prime Minister of Turkey,
Our Eminent Host Prof. İhsan Doğramacı, Founder and Chairman of Bilkent University,
Fellows of the IAS,
Excellencies,
Ladies and Gentlemen,

لاسلام عليكم و رحمة الله و بركاته

It is a distinct honour for me to be able to pay tribute to Prime Minister Erdogan for his patronage of this activity, here, at the 'city of science and knowledge,'... Bilkent University. The scientists and technologists of the Ummah appreciate the strides that Turkey has made under his leadership, and the role it has carved out for herself as a bridge between the East, with its deep roots in history; and the West with its technological advancement.

Let me also pay tribute to my dear friend and our eminent host, a man whom I have known for over 35 years, a man who dedicated his life for the betterment of his country through contributing to its educational development; Prof. İhsan Doğramacı.

Ladies and gentlemen

We meet here at Bilkent to try to take stock of the higher education scene in OIC countries. To define what went wrong with our efforts to give the generations of tomorrow the higher education they are entitled to, that is comparable to what is offered at international seats of learning.

Experts today speak of a divide between the South and the rich and advanced North. They and we forget that 1000 years ago, there was a divide between the
technologically advanced South and a North very much living in the dark ages. Thus, our meeting here aims to shed a light on how we can move forward in the realm of higher education for the benefit of member countries of the Organisation of the Islamic Conference (OIC) and humanity at large.

The distinguished participants gathered here represent the local science and academic community as well that of the OIC; as well world-class scientists and educationists. We are keen to further engage the representatives of countries with large Muslim communities in our neighborhood such as India and China; as well as the countries of central Asia. That, we are actually doing. We are also carefully nurturing a collaborative effort with the US National Academy of Sciences, and indeed the French Academy of Sciences, both organizations of which have a proven track record of helping out, and for lending a hand, especially in the area of science education.

I cite this to “break any potential ice,” or dispel any uncertainty that might arise in the minds of people about the Islamic world, or indeed Muslims. When we say “Islamic world,” we are referring to that geographical area that spans from Indonesia to Morocco and from Kazakhstan to Uganda. That includes all the races, creeds and religions that live within it and without excluding peoples of other faiths that live, and have lived in that area since the dawn of time. A closer look at the problems and ills, scientific and otherwise, in Islamic countries reveals that they are trans-religious, and cut across the barriers of religion, language, colour, gender or creed….

**Excellencies**

When we talk of higher education, we all want to see a system that provides a world class education of the highest standard for our students. A system that provides the knowledge and the skills that employers will seek for the jobs and professions of the 21\textsuperscript{st} century. Universities that create new knowledge to underpin our innovation and competitiveness, that are accountable for their performance, transparent in their operations and efficient in their administration.

That means the development of a diversified higher education sector, made up of universities which differ from each other in terms of discipline mix, course offerings, modes of delivery, management and academic structure.

This is the objective that we should all pursue.

**Excellencies**

In our pursuit of reform we should be guided by four objectives: quality, equity, sustainability and diversity. At this conference, we will gauge the achievements that some of our universities have made in these areas. We will learn what the shortcomings are and how to proceed.

Worldwide, higher education is changing, and many higher education institutions and national systems are in a state of important transition. It is both exciting and unsettling that new educational models and means of delivering educational programs and services are evolving at all levels of higher education.
Complex challenges include national regulation, addressing for example the for-profit private universities; performance-based or research-driven funding for public universities; review of student learning and for other types of public accountability.

Mindful of these realities, and since only very few universities in OIC countries are ranked among the world’s 500 top universities, the Islamic World Academy of Sciences (IAS) together with Bilkent University decided to lead an effort to appraise the performance of the higher education sector not only in member countries in OIC but also in a number of other countries.

**Excellencies**

When we talk of **equitability** and **accessibility** in our system of higher education, we have to ask ourselves if the unmet demand - that is the number of people who wanted but couldn’t get into university - was within acceptable international measures. In terms of **equity**, we have to know what is the target that we have to achieve in terms of the participation rate of low socio-economic status students in higher education.

**Sustainability** is another major issue that we have to address. How can we realize a sustainable higher education system that works and what is the role of governments in this?

The need for **diversity** is obvious. We talk of 57 countries with over 1600\(^1\) public and private universities. We have the population and the sufficient high-quality academic staff to maintain comprehensive universities which are all undertaking teaching, scholarship and research across a broad range of disciplines.

**Excellencies**

We have no Harvard or MIT in the OIC, nor do we have their great tradition of philanthropy that supports such institutions with the capacity for well-funded risk taking. But we also lack many of the specialized high quality education institutions which exist with fewer resources in the more diverse systems.

Not all systems of Western institutions would be appropriate for the Islamic world. Some of them would not find a market here. But others would flourish, and meet the needs of students which are only being half-met through our “one-size-fits-all” obsession.

There is obviously a place for fully comprehensive, generic universities which meet the skills needs of nations and regions across a broad range of disciplines. There is a place for perhaps a dozen universities like that, particularly in the major metropolitan cities and some distinct regions.

\(^1\) In 2009, the figure is closer to 1800 universities.
Excellencies

As we move into an era of competition for students both domestic and international, with the prospect of online universities, and the advent of efficient private sector institutions, our universities must reinvent themselves.

And while the higher education sectors of our region, notably China, Singapore and Korea, are investing heavily and building powerhouses of tertiary education, it is time for us try to grow smarter and innovate, keeping ahead of the pack in our own unique, practical and dexterous ways.

I strongly encourage universities to come up with visions for their future, visions that involve some tough decisions of what to pursue, and what not to pursue.

Our objective should be to create a more vibrant, diverse and responsive sector that will best meet the needs of future generations and the hopefully safe and exciting world they will inhabit.

Excellencies

The IAS is twenty years old this year. This is the exciting beginning of adulthood for an institution that still believes that often ‘words speak louder than action! It is the age when attempts are tirelessly made to reach out to new realms of creativity and constructive change.

As its mission statement declares, the purpose of the Islamic World Academy of Science is “to provide an institutional set up for the utilisation of science and technology for the development of Islamic countries and humanity at large.” I would emphasize the word utilisation. Since its launch, the IAS has addressed many issues facing the Islamic world, with a view of not only benefiting the Islamic nation, but also of benefiting all humankind by means of a well-informed, co-operative, pragmatic and humane approach.

Decision and policy makers have benefited over the years from the Academy’s publications of conference proceedings and journals. The IAS has so far discussed – among other topics – energy, nanotechnology, biotechnology, information technology, science education, water, the environment, technology transfer, and S & T policy. In each case, the Academy has been concerned above all with the question of development – that is, with the practical measures that can be taken by individuals and organisations within the scientific community to maintain values alongside innovative change.

Excellencies

Distinguished Scientists

The Islamic World Academy of Sciences believes that it is time that we extracted a sound development policy from the mass of information accumulated to our planners, decision-makers and scientists. An S&T template that our decision-makers can study, appreciate, and implement. This development policy should be realistic and implementable, one that could be jump-started in months rather than years. A policy that we can adopt using our own human resources, and one which gives
priority to inter-Islamic collaboration without closing the door in the face of help and assistance by industrialized countries.

The IAS realizes that it has a serious role to play in raising the awareness of the decision-maker and the public, and in helping people to understand the importance of development and scientific advancement, and indeed helping in achieving socio-economic progress.

Excellencies

For academies of sciences to flourish, they need full independence and long-term financial security, and the status that they deserve. Only through making available such conditions would academies of sciences fully realise their potential as think tanks or brain reservoirs of their respective communities.

Dare I say that in Jordan, the Islamic World Academy of Sciences has enjoyed unprecedented support and total freedom to operate and implement activities that fall within its mandate. Jordan has truly been an ideal base from which we have reached out, often at times of political uncertainty, to our counterparts all over the world, without undue hindrance. For that, we are ever so grateful to our host country. We are also grateful to all the countries that have hosted us in the past. Most of all we are grateful to our Fellows for their endless and unwavering support.

Thank you.
Message* of
His Excellency Professor Ekmeleddin İhsanoğlu
Secretary General
Organization of Islamic Conference (OIC)

بسم الله الرحمن الرحيم

Your Excellency Mr Recep Tayyip Erdoğan, Prime Minister of Turkey,
Your Excellency Prof. İhsan Doğramaci, the founder of Bilkent University,
Your Excellency the President of the Islamic World Academy of Sciences
(IAS)
Your Excellency the Director General of the Islamic World Academy of
Sciences (IAS)
Distinguished Guests and Participants in the 15th Science Conference of the
Islamic World Academy of Sciences

السلام عليكم ورحمة الله و بركاته

On behalf of the Organization of the Islamic Conference and on my own behalf I
would like to express my profound gratitude to His Excellency Mr Tayyip
Erdoğan, the Prime Minister of the Republic of Turkey, for his patronage of this
event. His support is a clear manifestation of his keen interest in the activities of
the Islamic World Academy of Sciences and the OIC in general and in the
development of higher education, science and technology in particular. We, in the
OIC have always appreciated the consistent patronage of the Government of
Republic of Turkey of all important issues affecting the interests of the Muslim
Ummah. On this auspicious occasion of the 15th IAS Science Conference, I would
like to express my heartfelt felicitations to the Fellows of the Islamic World of
Academy of Sciences, to the Members of the IAS Council, Conference
participants and also to the Members of the Academic Council and Staff
Members of Bilkent University for the success of this conference. My
appreciation goes also to the Islamic World Academy of Sciences (IAS) for
choosing the theme of ‘Higher Education Excellence for Development in the
Islamic World.’

* Delivered by Dr Razley Mohd Nordin; Director of the Department of S&T, OIC
General Secretariat, Jeddah, Saudi Arabia.
A special mention is dedicated to Prof. Ihsan Dogramaci, the most eminent Turkish educationist and the founder of Bilkent University.

Excellencies,
Distinguished Guests and Conference Participants,

This conference presents us with the opportunity to discuss and address some of the most important issues in the OIC, namely Higher Education, and Science and Technology in the Islamic World for the benefit of the Ummah.

Indeed, it is known fact that education, be it formal or informal, primary or tertiary, is an important contributor to development and progress, in particular in the era of the knowledge economy. There is also unanimous agreement that knowledge, science, technology and innovation are the basis for economic growth, development and poverty eradication.

The Republic of Turkey is blessed. Several of its universities are ranked among the top world universities. Besides the Republic of Turkey, the Arab Republic of Egypt and Malaysia are the other two OIC countries with universities ranked in the top world universities.

I congratulate these universities and call upon them to continue to maintain their excellence. I would like to call upon them to share their experience and knowledge to elevate and position other universities from the OIC region in the top 500 world universities.

Excellencies,
Ladies and Gentlemen,

The OIC Kings and Heads of State at the Third Extraordinary Summit Session of the Islamic Summit Conference held in Makkah al Mukarramah on 7 to 8 December 2005 adopted the OIC Ten-Year Programme of Action to meet the Challenges of the 21st Century. They recognized that higher education is a tool and a major foundation for the advancement and progress of the Ummah. Therefore, highest consideration should be given to higher education, science and technology; otherwise the Ummah would continue to suffer from backwardness in education.

Following the adoption of the OIC Ten-Year Programme of Action, in March 2006, I called for a meeting of the all the OIC institutions. A Framework of Implementation of the OIC Ten-Year Programme of Action was prepared. In this respect, I call upon all the OIC Member States, all OIC institutions including the Islamic World Academy of Sciences to co-operate and work closely to implement all the activities identified. I also call upon the Islamic World Academy of Sciences and its Fellows to come forward with brilliant and excellent ideas to effectively and efficiently implement those activities, hence contributing to the development in the Muslim World.

One of the challenges posted by the OIC Ten-Year Programme of Action is to effectively improve and reform educational institutions and curricula in all levels, link postgraduate studies to the comprehensive development plans of the
Islamic World. At the same time, priority should be given to science and technology and facilitating academic interaction and exchange of knowledge among the academic institutions of Member States, and to urge the Member States to strive for quality education that promotes creativity, innovation, and research and development.

Among the tasks identified to effectively improve and reform educational institutions and curricula in all levels is to elevate at least 20 universities within the OIC region to be ranked among the top 500 world universities. A challenge that could not easily be achieved without the full cooperation of all OIC countries, network of universities in the Muslim world and of course we look forward to the cooperation from the Fellows of the Islamic World Academy of Sciences.

Excellencies,
Distinguished Guests and Conference Participants,

The Putrajaya Declaration issued at the 10th Session of the Islamic Summit Conference in October 2003 stated that we must recognize the leading role of science and technology for the advancement of the Ummah and the need to bridge the gap between the Islamic and the industrialized countries. Taking this opportunity, I would like call upon all the OIC member states to fulfill their pledges to achieve investment in research and development of at least 1.4 percent of GDP and to increase their R & D activities. These actions will contribute to the improvement of the quality of human capital and reduction in the technology gap between the OIC community and the developed world.

It was also recognized that there is an urgent need for the Muslim countries to enhance cooperation among themselves by creating linkages and establishing environments conducive for partnership. I hope that we will undertake more coordinated, focused and regular interaction between the OIC Member States on important issues of concern to the Ummah such as higher education, and science and technology.

The 10th Session of the Islamic Summit Conference also adopted a Vision 1441 H on Science and Technology, a vision on the need for the Muslim World to rededicate itself to mastering Science and Technology to ensure that it can face the challenges of the global economy with confidence. The OIC Member countries are committed to become a community that values knowledge and competent in utilizing and advancing science and technology to enhance the social-economic well-being of the Ummah.

It is imperative upon all of us to take the challenges for joint actions within the framework of the OIC, based on common values and ideals so as to revive the Muslim Ummah’s pioneering role as a fine example of tolerance and enlightened moderation, and a force for international peace and harmony. The glory of Muslims in the scientific fields has to be revived. Therefore, the emphasis given by the 15th IAS Science Conference on Higher Education Excellence for Development in the Islamic World is very timely. I am confident
that, as you move forward with your deliberations, you will continue to
challenge minds, and change our world, for the better.

Your Excellencies,
Ladies and Gentlemen,

Before concluding, I would be failing in my duties if I do not put on record the
invaluable services put in by all those who were and are still associated, directly
or indirectly, in the conception, promotion, development and organization of
this important scientific conference. In this context, I would like to express my
profound gratitude to all the OIC Member States and the Islamic World
Academy of Sciences for their continued support and cooperation in the
implementation of the OIC Ten-Year Programme of Action.

Finally I would like to thank you all present in the inaugural session of the
15th IAS Science Conference for giving me a patient hearing.

Wassalamu Alaikum Wa Rahamatullahi Wa Barakatuh.
Address of Prof. İhsan Doğramacı
Founder and Chairman of the Board of Trustees of Bilkent University

Mr Prime Minister
Excellencies
Distinguished Members of the Islamic World Academy of Sciences
Ladies and Gentlemen

Please allow me to express our gratitude to the Islamic World Academy of Sciences for accepting our invitation to host this 15th IAS Science Conference here at Bilkent. I also want to thank our Prime Minister, H.E. Recep Tayyip Erdoğan, for graciously agreeing to act as the patron of this conference. It is a privilege and an honor for me to be addressing you at this opening session.

The theme “Higher Education Excellence for Development” is timely, especially in Turkey where revolutionary changes have taken place during the republican period, in particular during the last two decades. Let me give you some rough figures about these developments.

Twenty-five years ago enrollment in higher education in Turkey was 6.3% of the four million members of the age group 20-24. Today this age group numbers six million, and enrollment in universities is 32.9%, on a par with western Europe. Research activity has developed at the same pace. According to the internationally recognized Citation Indexes of the Institute for Scientific Information in Philadelphia, 25 years ago Turkey ranked 44th among the world’s countries in publications listed in those indexes. Today, Turkey is in 19th place.

During the last three years, Turkey has increased its investment in higher education remarkably. State support to Research & Development went from 270 million liras in 2002 to 1200 million liras in 2006, that is, from about $180 million to $800 million, more than four times greater. Of this amount, support to university research went from 8.8 million liras in 2002 to 90 million in 2005, or from some $5 million to $60 million, an increase of more than ten times. This meant that whereas only 580 doctoral candidates had been supported in 2002, this number rose to 6750 in 2006, more than ten times the earlier number.

During the three days of our conference, we shall be examining the situation of higher education in the OIC countries. What has been accomplished? Have we lagged behind the countries outside the OIC group?

We shall be following with interest the reforms and advances in higher education in different countries of the Conference. We are also delighted to have distinguished participants from countries outside the OIC, who will tell us
about their own experiences. I want to extend my thanks to them for being here with us. I am confident that all the participants will benefit from hearing about the situations outside their own countries.

I want to take this opportunity to extend my heartfelt gratitude to the Islamic World Academy of Sciences, and notably to my dear friend of nearly 40 years, Dr Abdul Salam Majali. Hacettepe University in Ankara is proud to have bestowed upon him one of the first honorary doctorates of that institution, 32 years ago. I also thank IAS Director General Moneef Zou’bi for his valuable support in the preparations for this conference.

In addition to what we will learn from the deliberations over the next three days, we are going to have the opportunity to make new acquaintances and friendships among the members of the conference, which promises to be an invaluable gain.

I wish you all a pleasant stay in our country.
PART TWO
THE KEYNOTES
Changes in the Educational Landscape of Turkey: The Past 25 Years

İHSAN DOĞRAMACI*
President of the Board of Trustees
Bilkent University, Ankara
Turkey

In 1933, during the tenth anniversary of the establishment of the Republic of Turkey, Mustafa Kemal Atatürk decided to introduce radical reforms in the higher education system. This began with the reorganization of the Darülfünnun, then the leading institution of higher learning, which became Istanbul University. Eleven years later, the Higher School of Engineers became Istanbul Technical University. In the meantime, several independent institutions of higher learning were established in Ankara, the new capital. All these schools were subsequently joined together as the University of Ankara, which was chartered in 1946.

Several other institutions offering tertiary education had been established in Istanbul towards the end of the 19th century to teach fine arts and engineering, economics and commerce. Similar schools were opened in Izmir, Ankara, Eskişehir, Adana, and Bursa and in 1969; they were renamed, becoming state academies.

Since 1863, there had been one highly regarded private institution of higher learning, Robert College, founded by the Americans in Istanbul. Then, a century later, in the early 1960s, several private so-called “higher schools” were opened in Turkey. These were profit-making institutions.

However, in 1971, the constitutional court ruled that private institutions of higher learning were in violation of the constitution, which required that universities be established by acts of parliament. Following that ruling, the private higher schools were all affiliated with the existing state academies, thus becoming state institutions.

In Turkey, in 1980, enrolment in higher education was extremely low. Research activity was also far below its potential. Then, in 1981, revolutionary changes occurred.

All tertiary education, including the state academies, was brought under the aegis of the universities. A council of higher education composed of 25 members was established to serve as a national board of trustees. The council

* Presented at the 15th Science Conference of the Islamic World Academy of Sciences, Ankara, 7-9 November 2006. Prof. İhsan Doğramacı has subsequently been elected as an Honorary Fellow of the IAS.
was to be responsible for administration, coordination, and evaluation of higher education. Of the council members approximately one-third were representatives of universities nominated by the interuniversity council; another one-third were nominated by the council of ministers. The nominations were all subject to approval by the President of the Republic, who personally appointed the other one-third of the members. The President of the Republic also appointed the president of the council, who reported directly to the head of state.

In 1982, the Turkish Constitution was amended by the addition of two articles, thanks to which not-for-profit private universities were allowed to be established by foundations, with the provision that they be established by an act of parliament. They would be free to manage their own administrative and financial affairs but would be required to adhere to standards laid down by the council of higher education in academic matters. In other words, they would be under the supervision of the council of higher education. The laws which followed on those constitutional amendments required that each private institution has a level of education and research no lower than the level of the geographically closest state institution. At the time of its establishment, a private university must sign an agreement with one of the state universities to the effect that should the council of higher education deem that the levels of education and research of the private university were inferior to those of the state institution, all properties of the private institution will be turned over to the state university, which in turn agrees to accept all the students of the private university.

In 1984, Bilkent was established by three foundations as the first private university and admitted its first students in 1986. In 1992, eight years after Bilkent’s founding, the next private university was started in Istanbul, Koç University, and then Başkent University in Ankara. Others followed rapidly.

What has happened since 1980 in Turkish higher education? The number of universities has increased from 19 to 93. Of these 25 are private. Fifteen of those state universities have recently been chartered, and are opening in rapid succession.

The number of students enrolled in higher education has grown from 230,000 in 1981 to 1,500,000 in 2006. When the nearly 800,000 students enrolled in the so-called “open university” are included, the total number of enrollees in higher education reaches 2,300,000 or ten times the number in 1981. In contrast to the 6.3% of the 20-24 age group enrolled in higher education in 1980, that figure is now 32.9%, despite an increase in the tertiary age population from four million to six million. This enrolment ratio is close to figures in Western Europe.

The number of teaching staff rose in the same period from 21,000 to 85,000, an increase of 400%. Research activity, as rated by the number of publications listed in the Citation Indexes of the Institute for Scientific Information (ISI), has demonstrated a remarkable expansion. Turkey, which in 1980 was 44th among publishing countries, had risen to 19th in 2005 and continues to improve. Here, the contribution of the private universities has been substantial.
Admission to higher education in Turkey is administered by an organ of the council of higher education. Admission to all universities, whether state or private, is based on a national examination given each year in different parts of the country and in certain cities outside Turkey. According to the laws governing private universities, a certain percentage of those admitted have to be given scholarships by the university. Thus, applicants for university may apply for scholarship-funded places when listing their preferred departments. At Bilkent University one-third of all students are on scholarships, some granted at admission as described and others granted yearly on a merit basis determined by grade point averages.

Statistics available on the web page of the council of higher education show that research activity at the private universities has been in the upper brackets in Turkey. Of the 93 universities, by publications per faculty member, private universities occupied five out of the top 10 places in 2005. Another example of academic achievement can be seen at Bilkent University, the first private institution, through the graduate record examination, known by its anagram “GRE.” This is the exam required by most US universities for admission to postgraduate study. Many students graduating from Bilkent continue their studies abroad, and those who take the GRE receive scores that rank them at the same level or ahead of the students admitted to the highest-ranking 25 US universities.

In the Turkish experience, provided that the academic standards are assured by a central organization and a certain percentage of the candidates for admission are given scholarships to cover their tuition costs, private universities are a positive influence on the higher education scene. We believe that the private schools provide impetus to the state institutions to improve their teaching and research, and to make efforts to publicize their achievements in a climate of constructive competition to attract the best candidates at all levels for both students and teaching staff.

We have to improve the educational status and health of our populations, especially children and young people. It is time for the global community to find ways of sharing better the benefits of scientific and technological knowledge. We need to create a brighter future for all people. We need to invest more in education and health to improve the hope of many to rise above poverty. We need to make sure that education and health are highest on the political agenda of all countries working to reduce poverty and promote peace.
Goals of Higher Education: Knowledge and Critical Foresight Leading to Societal Responsibility

RICHARD R. ERNST*
Laboratorium für Physikalische Chemie
ETH Zürich
Wolfgang-Pauli-Strasse 10
8093 Zürich, Switzerland

1 ABSTRACT

This paper summarizes the author’s view on the role and responsibility of universities in a difficult world which seems to have lost its beneficial track, in many respects. Universities with their independence, open-mindedness, and their obligation to educate future generations of citizens, including societal leaders, possess the means to significantly influence the longer term societal development. Certainly, exploring the scientific foundations of nature is important for acquiring the knowledge to address urgent issues of our common future. But in addition, we academics are obliged to develop wisdom for comprehending the trans-disciplinary and trans-cultural connections between issues that might determine the fate of mankind. This may help us to conceive novel avenues that may lead to long-term prosperity and happiness for all citizens on our globe.

2 KEY CONCEPTS

2.1 General

Few issues receive more general agreement than the need for first class education within our schools and universities. The level of education worldwide will determine the fate of our globe and the fate of its population. We often mention our ‘Knowledge Society,’ emphasizing the importance of knowledge for success in business and in life. Those who know more are expected to accomplish more and to earn more. And, in the end, they are expected to live a happier life than the rest. Is this really true?

* Nobel Laureate, Physics (1993); and Honorary Fellow of the Islamic World Academy of Sciences (IAS); 2006.
2.2 Knowledge

At first, we need to clarify the term ‘knowledge’, knowledge that, apparently, is so desirable and defines the ambitious programs of our schools. What do we have in mind in this context? In Wikipedia, The Free Encyclopaedia, we read: “Knowledge is information of which a person, organization or other entity is aware. Knowledge is gained either by experience, learning and perception, or through association and reasoning. The term knowledge is also used to mean the confident understanding of a subject, potentially with the ability to use it for a specific purpose. The unreliability of memory limits the certainty of knowledge about the past, while unpredictability of events yet to occur limits the certainty of knowledge about the future. Epistemology is the philosophical study of the nature, origin, and scope of knowledge.”

I am not a philosopher and my knowledge in epistemology is minimal. So what entitles me to speak about knowledge? My age, my Nobel Prize, my concern about today’s frightening trends, or just my naivety? Probably the latter two!

![Process of Gaining Knowledge and Wisdom](image)

**Figure 1. The process of gaining knowledge and wisdom.**

Following the scheme by John Jan Popovic (modified from Wikipedia), knowledge is gained from experiments and measurements, followed by a process of perception. Knowledge is just ‘known information.’ It fills heads, books, or computer memories, and can be retrieved by sophisticated information retrieval systems.
However, the ultimate goal is not knowledge but attaining wisdom. The term wisdom is much harder to comprehend than knowledge. It moreover cannot be easily measured and quantified.

2.3 Wisdom

Wisdom is defined in Wikipedia as follows: “Wisdom is the ability, developed through experience, insight and reflection, to discern truth and exercise good judgment. It is sometimes conceptualized as an especially well developed form of common sense. Most psychologists regard wisdom as distinct from the cognitive abilities measured by standardized intelligence tests. Wisdom is often considered to be a trait that can be developed by experience, but not taught. When applied to practical matters, the term wisdom is synonymous with prudence. The status of wisdom or prudence as a virtue is recognized in cultural, philosophical and religious sources. Some define wisdom in a utilitarian sense, as foreseeing consequences and acting to maximize the long-term common good.”

3 THE FUNCTION OF SCHOOLS

In our schools and universities, we carry the ambition to convey more than just knowledge. Our goal is to render the students fit for life, hopefully for a happy and rewarding life. We know that intelligence, brainpower, and factual knowledge are insufficient for behaving as a human being. Hopefully, we can convey at least parts of what wisdom encompasses, according to the definition above.

To me, the definition of wisdom, given above, is not comprehensive yet and demonstrates how difficult it is to be attained. It becomes evident that wisdom must be developed through years of personal experience. One might argue that such experience cannot be gained in formal schooling, and that schools may safely restrict their function to providing knowledge and skills. In other words, to the training of well functioning professionals. Indeed, this is what is being pursued all too often at universities by educating specialists who know an incredible amount of details about very little. This seems to be indispensable in many professions, particularly in the scientific world, if one wants to succeed and to advance to the front line where the current innovation takes place.

I would like to argue differently: Life is too short and too precious for one to spend a preparatory twenty or even twenty five years in school, just memorizing facts and recipes, in the hope that they can once, in the future, be applied fruitfully to ‘real life.’ One often uses the metaphor of tying up a backpack of knowledge for life. The backpack contains plentiful seeds of knowledge, fertilizers, and prescriptions describing their proper usage.

I am convinced that the schools shall not be merely preparatory stages for life; they must be regarded as an integral part of life itself where a lively community of students and teachers is the source of enjoyable, despairing, and
lasting experiences. These will help in shaping the student’s personality. Even fragments of wisdom could be acquired. In this sense, the schools shall provide a realistic setting for gaining experience valuable for life.

It is well-known that experience can not be gained without doing experiments. ‘Learning by doing’ is in this context of utmost importance. The learning efficiency in a lecture room with unidirectional teaching can be frightfully low. It is advisable to reduce class room activities to a minimum. Lectures might be useful for conveying fascination and enthusiasm to the students in view of what they are supposed to learn, but the learning must be done by the students themselves in the laboratory, in nature, in discussion groups, in the library, or in a quiet room by reading and writing.

Project-oriented learning has a particularly high efficiency. Projects provide a realistic environment where many unforeseeable incidences can occur, just as in real life. In project-oriented learning, the students select themselves those study subjects that are relevant for solving the problems encountered in the course of the project. In this way, student researchers are naturally filled with motivation to study the relevant subjects in depth. They develop personal initiative to structure their own learning process. Frequently, the curiosity, excited in this way, carries the researcher to completely different subjects, off the main road, and might even lead to an unexpected invention or to novel insights. Here, serendipity might indeed take place.

The best education motivates the student, stimulates his curiosity, and the learning will follow by itself.

Many students learn exclusively what they have become fascinated by. Other subjects have no chance to enter their brains. Frequently, one’s own children put this fact clearly into evidence, often to the dismay of inexperienced parents with preconceived ambitions, trying to teach their children a particular subject with nearly zero effect. Later, they might be surprised how eagerly the same children learn topics they had selected themselves.

Project-oriented activities and learning are invariably inter-disciplinary and often go beyond the scope of a single faculty. Nature does not classify the problems to be solved by man according to anthropomorphic disciplines! Innovation and creative problem solving happen most frequently at interdisciplinary borders.

4 THE FIELD OF NUCLEAR MAGNETIC RESONANCE: AN EXAMPLE OF INTERDISCIPLINARITY

4.1 How NMR evolved?

The field of science in which the author was active before his retirement, nuclear magnetic resonance, is an excellent example of the inter-disciplinary approach. Many atomic nuclei possess a built-in magnetic moment. Applying a strong external magnetic field leads to a precessional motion of the magnetic moments about the direction of the field with rates determined by the magnetic
field strength. The precession of atomic nuclei in a magnetic field is called nuclear magnetic resonance (NMR). It is a fundamental phenomenon of physics that reveals most enlightening applications of quantum mechanics for demonstrating basic principles.

By pure accident, it was found in 1950 that the chemical environment of the nuclei has a magnetic shielding effect on the magnetic field at the nuclei and is reflected in the measured NMR frequencies. Each nucleus exhibits a different resonance frequency, and each molecule shows a characteristic spectrum of frequencies. This allows for powerful applications to the chemical analysis of substances. Each of them leaves its ‘fingerprint.’ In this way, NMR became an indispensable analytical tool in chemistry.

Experimental NMR became truly a high-tech field, in many respects, at the limits of current possibilities. Extremely high and stable magnetic fields are needed. The emitted NMR signals are very weak and require advanced high-frequency electronics for their reception. In addition, complex computer routines became indispensable for the analysis of the highly informative experimental data.

Fourier spectroscopy has lead to a revolution in the experimental NMR procedures. The Nobel Prize citation of the author mentions this achievement as a major breakthrough. The recording of the inherently low sensitivity NMR spectra could be speeded up several orders of magnitude by a pulsed excitation of all resonances in parallel. With a mathematical Fourier transformation, the various resonance frequencies can then be disentangled. The gained sensitivity achievement was seminal for the application to complex bio-molecules and for entering the medical field.

Later, it was found that the three-dimensional structure of biological macromolecules in solution could be determined by NMR spectroscopy, making great impact on molecular biology. Instead of one-dimensional NMR spectra, two- and three-dimensional spectra are needed for this purpose. They visualize the neighbourhood of nuclei within the chemical bonding network of the molecules. Also inter-nuclear distances can be determined in this way. Based on two complementary types of two-dimensional spectra, it is possible to triangulate the positions of the magnetic atomic nuclei within a biological macromolecule. This then allows the determination of accurate three-dimensional models of biological macromolecules. The obtained molecular structures became indispensable for studying the function of many biologically relevant molecules.

Three decades ago, an exciting possibility was discovered for medical applications. Magnetic resonance imaging (MRI) beautifully reveals the inner secrets of patients in a clinical environment. By the application of magnetic field gradients, it is possible to localize the origin of an NMR signal emitted from an organ in a human body and to derive fascinating images that reveal much about healthy or diseased tissue. This is invaluable information for a clinician planning surgery. Today, MRI provides the most powerful and universal diagnostic tool for clinicians being interested in the health condition
of soft tissue. Especially in the context of cancer diagnosis, the method is of undisputed value.

Most recently, functional MRI (fMRI) procedures were developed that allow a detailed study of brain functions. Today, most of the functions of a brain can be localized accurately in the brain matter. This allows for revealing insights for psychologists who can study in great detail the human reactions and the interplay of various senses. For numerous brain diseases, diagnostic markers have been developed already. Much further development can be expected in the near future, improving our understanding of the most complex and most fascinating human organ, the brain.

In this way NMR has taken advantage of mathematics, physics, and electronics for solving problems in chemistry, biology, and clinical medicine. And in the near future, even clinical psychology becomes unthinkable without access to functional MRI. Indeed, NMR became truly a multi-disciplinary enterprise.

A close interaction between academic institutions and industry was seminal for the design of the required sophisticated NMR spectrometers. The development started in the 1950s within the Stanford Industrial Park that was the birth place of the famous Silicon Valley. The latter became a metaphor for the benefits of university-industry collaboration. The development of NMR spectrometers at Varian Associates in Palo Alto, California, presents an excellent example for such fruitful interaction. The author was personally involved in this effort in the 1960s. He also took advantage of the stimulating environment for his own personal development. A similar collaboration between academia and industry, on a somewhat smaller scale, took place a little bit later in Switzerland between ETH Zürich and the company Trüb-Täuber, leading, finally to the foundation of Bruker-BioSpin, the present worldwide market leader in NMR. The author was also actively involved in this interaction.

4.2 Multidisciplinarity

NMR is a particularly spectacular example of multi-disciplinary research activities. But many other examples spring to one’s mind, as well. In this context, it turns out that collaboration between narrow-minded experts, knowledgeable in one field only, is futile. Collaboration is efficient only when the involved researchers are acquainted with several fields. Without a strong overlap of knowledge, interaction will be difficult if not impossible.

The consequences for university teaching are obvious. Multi-disciplinary education is a must for those who desire to work at the frontier of science. Obviously, the wide range of inter-disciplinary demands on the students and researchers is enormous. Nevertheless, disciplinary detail knowledge, in at least on field, is indispensable. All-rounders without depth will achieve little or nothing. One may summarize the situation in the aphorism: Focusing is indispensable for understanding, while widening the scope is needed for comprehension.
5 THE QUEST FOR WISDOM

5.1 What is Wisdom?

We may ask, at this moment, whether multidisciplinary competence has something to do with the ‘wisdom’ we are longing for, as mentioned at the beginning of this paper. Remotely, perhaps yes, but in reality there is rather little connection! Instead of creating more explanatory prose on ‘wisdom,’ let us resort to the visions of a few sages:

*Wisdom ceases to be wisdom when it becomes too proud to weep, too grave to laugh, and too selfish to seek others than itself.*  
Khalil Gibran

*In eloquence there is magic,  
in knowledge ignorance,  
in poetry wisdom,  
and in speech heaviness.*  
Muhammad (pbuh)

*Knowledge is proud that it knows so much;  
Wisdom is humble that is knows no more.*  
William Cowper

*Knowing others is intelligence; knowing yourself is true wisdom. Mastering others is strength; mastering yourself is true power. If you realize that you have enough, you are truly rich.*  
Tao Te Ching

*Great doubts... deep wisdom. Small doubts... little wisdom.*  
(Chinese proverb)

What could we ever add to these sayings in our attempt to find a definition for ‘wisdom?’ Sages often remain silent for the remainder of their life - *Wisdom does not brag.* Fortunately, I am far from being a sage, and I am not forced to stop my paper at this point! I would regret a premature ending because I did not convey yet my message on academic responsibility in today’s world. A message that ‘burns’ my tongue.

5.2 Humanities and Social Sciences

We should not forget how much in our world is beyond the realities explored by the exact, natural sciences. The sciences impose on themselves restrictions for exploring exclusively phenomena of nature that can reproducibly and quantitatively be measured. The humanities have a wider scope and deal with all conceivable human and inter-human aspects. They try to comprehend human reactions and thoughts, our feelings, our anxieties and our happiness, perhaps even love and hatred. And the social sciences provide clues for understanding the functioning and malfunctioning of human communities. Their fascinating conclusions cannot be disregarded, when seeking wisdom.
Many phenomena in the human sciences cannot be quantified accurately. Nevertheless, the human sciences are under pressure to apply methods similar to the ones of the natural sciences in order to be taken serious. Sometimes, one is struck by the feeling that the powerful methodology of the natural sciences is running like a steamroller over the human sciences. Many of the relevant subtleties of the humanities are swept under the carpet in this way. A stronger resistance against the rational and materialistic attitudes of the natural sciences is probably in order to save some of the humanistic spirit.

There is little doubt that we, ‘the exact scientists,’ can learn much from the humanities and social sciences. On the other hand, they are dependent on our discoveries and insights for their functioning. Obviously, there is an urgent need for breaking the long-standing barriers between natural sciences, humanities, and social sciences in our universities. We need combined projects addressing questions that cannot be solved by a single discipline alone; and many questions concerning our global future are of this kind. In addition, we need discussion groups and think tanks that combine the knowledge of all faculties in order to progress, perhaps, towards the ‘wisdom’ necessary for developing visions of our, hopefully beneficial, future. I am coming back to this point a little bit later.

5.3 The Arts

Sometimes, the humanities attempt to encompass the arts as well. We know fields such as musicology, art history, literature, and many more related disciplines. But in fact, the humanities rather act as external observers of the arts and concentrate on a descriptive view and classification of their products. This may open avenues to access art. But the essence of the artistic miracles is not touched nor revealed. The most inner artistic message can only be emotionally experienced by a devout, patient, and humble observer and by artists themselves.

Art is beyond a down-to-earth scientific analysis. Let us read, as an example, some beautiful words, written by Jalaluddin Rumi:

\begin{quote}
The morning wind spreads its fresh smell.
We must get up and take that in,
that wind that lets us live.
Breathe before it’s gone.
\end{quote}

Twenty five unpretentious words that span a poetic world, full of life! A true revelation! Here, we seem to be not far from what we aspire by the term ‘wisdom.’

How shall we scientists deal with the arts? Shall we just ignore them or try to integrate them into our scientific edifice? Shall we take advantage of artists’ gifts to enhance the appeal of our products and revelations for better performance on the intellectual market? I am convinced that true art can never be “useful” in this sense. The points of contact between the arts and the sciences happen very deeply within our personal sense of life, which we might call our
soul, the domain where all experiences and emotions unite to our-self; the self that defines our identity and that renders our life meaningful and unique. Here, in the union of arts, humanities, and science, finally, we find the true origin of all encompassing wisdom. Wisdom is often transitory. It may be experienced just as brief glimpses or flashes of revelations that reveal eternal insights and lead to moments of comprehension. Devout people might experience these rare events as the opening of a door to a supernatural world, speaking then of a revelation of divine wisdom. Such mental experiences have enormously stimulated the development of all human activities from the arts to religion, and to science.

In fact science and the arts have much in common. It is being said that those humans who maintain some of their youthful curiosity and spontaneity become later scientists, or in the best case artists.

5.4 The Two-Legged Person

In this context, I am invoking sometimes the metaphor of a two-legged person for describing my vision of a well-balanced human being. The first leg stands for his (or her) professional activities which might have been developed to near perfection. But still, it remains difficult for a professional to hop on a single leg towards a distant goal along the long and dusty road. Indeed, he needs symbolically a second leg, representing his complementary passions. They may be and should be centred far outside the professional realm, forcing him into a nearly painfully wide spreading of his legs - painful, for example, due to the lack of time needed to pursue all interests simultaneously. His passions, irrespective of their particularities – they must not be artistic - provide him a safe stand.

The spare-time passions provide more than just relaxation and enjoyment. They are often a rewarding source of professional and human creativity. Analogies between remote subjects, brought into juxtaposition within our mind, are most inspiring and invaluable for inventive searchers and researchers.

Indeed, I consider myself also as a two-legged, perhaps even a three-legged person. My early personal interest for science, particularly for experimental chemistry, developed during my teens in parallel to my active enthusiasm for music, having played the violoncello and composed music. Chemistry and music formed my indispensable legs for my first 35 years. And indeed, they were complementary in many respects; my knowledge of NMR opened the avenues to the wide world; and music laid the foundation to a very harmonious family life, my wife playing the violin and me the cello already on our very first encounter. In addition, I experienced how mentally similar the activities of a scientific author and of a musical composer are. Having written a piece of complex music is equally rewarding as writing a complex scientific paper. Both evoke a mix of pride and inadequacy; in retrospection, I was hardly ever satisfied with my own products.

There are indeed close analogies between science and writing music. For example, a sonata and a scientific paper are similarly structured with an
‘introduction,’ an ‘exposition,’ ‘development,’ ‘recapitulation,’ and ‘coda’ (musical term). The parallel voices in a musical composition find their analogy in the harmonious or disharmonious cooperation of several authors on a research work. Musical compositions are full of symmetries and broken symmetries that are so essential in fundamental physics as well as in nature. Symmetries radiate special appeal to the human mind. They act on us like rhymes in poetry.

We all know that three legs are needed for a stable stand. Indeed, I acquired in the later sixties a third leg that became very precious and important to me. I discovered my love for Tibetan painting art. Tibetan painting art is unique in the way it blends with the entire daily and spiritual life of Tibetans. Through fascinating and most colourful paintings, called thangkas, one easily gains access to virtually all aspects of their culture and habits. Everything is represented highly skilfully in this great art of Central Asia. Tibet is special by its position between the different Asian cultures originating from India, China, Persia, and Mongolia. All these cultures left their traces in Tibetan painting art. Nevertheless, the latter developed a very particular style of its own kind.

Tibetan painting art can not be separated from Buddhist philosophy and spirituality. Even for a rational Western scientist, Buddhism is easy to comprehend due to its simple philosophical and ethical rules that are in no contradiction to our basic scientific principles. The colourful surface of Tibetan painting art and the complexity of the Tibetan pantheon might be disturbing (and fascinating) on the first sight. But soon one realizes that the multitudes of displayed deities have been conceived as metaphors for philosophical principles and are in no way assuming or even frightening.

It is the author’s experience that the deeper one digs into the fundamentals of a particular religion, the more similarities between religions one discovers. In fact, all the great religions have common foundations and only their superficial and, after all, irrelevant manifestations differ. Such irrelevancies are indeed responsible for many of our sad clashes of cultures. If we would take them less serious in claiming infallibility, the coexistence of cultures could be much more harmonious.

6 THE WORLD TODAY

6.1 Societal Responsibility of Academics

Based on the thoughts presented so far, one might get the impression that the attainment of a comprehensive view on the way towards wisdom has, so to say, an end in itself. It helps individuals, and we are speaking her particularly about academics, to become well balanced human beings. But nobody, least the academics, are just luxury plants, nurtured by society, for their own pleasure.

The candle is not there to illuminate itself.  
Nawab Jan-Fishan Khan
The academic community has a mission and a function within human society that alone justifies the great public expenses for universities. First of all, and most importantly, universities have an educational function, educating a next generation of citizens, specialists and functionaries. Education is by far the major obligation of universities. Students must be educated in as broad and comprehensive manner as explained above. We do not need mere experts knowing everything about very little. Those are better replaced by computers or computerized robots. Society is in need of creative citizens who are ready to assume responsibility.

Before going into more details, let us have a candid look at today’s world.

6.2 A Sober View of Our World Today

Our world seems to be in a process of disintegration, despite all available means of communication and inexpensive means of transport. In our world, fairness and compassion are ebbing, leaving behind plain ruthless egoism and shroud money-mindedness.

Perhaps, the most frequently declared political goal today is to install universal ‘human freedom’ for all in all countries, freedom from all conceivable restraints. Its attainment appears to sanctify nearly all, even detestable means to reach this goal. No question, freedom is one of the most precious human rights. In the Universal Declaration of Human Rights of the United Nations of the 10th December 1948, the term ‘freedom’ appears fourteen times in the thirty Articles and seven times in the Preamble.

Article 1.

All human beings are born free and equal in dignity and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood.

Article 2.

Everyone is entitled to all the rights and freedoms set forth in this Declaration, without distinction of any kind, such as race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status. Furthermore, no distinction shall be made on the basis of the political, jurisdictional or international status of the country or territory to which a person belongs, whether it be independent, trust, non-self-governing or under any other limitation of sovereignty.

Article 3.

Everyone has the right to life, liberty and security of person.

Despite of the existence of this invaluable document, a number of major wars have recently been started and, unfortunately, not yet ended. It is claimed that bringing freedom to an alien country gives the aggressor limitless blessings
but by whom? Certainly not by the UN or by the World community or by God? It would have to be a very oddly conceived God, just tailored to suit the purpose, if He would give aggressors his blessing for committing crimes against humanity!

But in most cases, ‘bringing freedom’ is just a pretext for extending the domain of influence and power. Often, power is disguised in a rather sweet and seducing form, leading to commercial dominance, opening new markets for otherwise unsalable products. The argument is also being used today for getting access to scarce energy resources.

Today’s events have their history. Often, the chain of arguments, based on past accidents for justifying the present situation, is broken at an instance suitable to leave all guilt in the bad intents of an adversary, in order to justify committing another crime. Instead of listening to our politicians, let us listen to Mahatma Gandhi:

An eye for an eye - makes the whole world blind.                Mahatma Gandhi

A most powerful weapon in this context is the ideology of the ‘free market economy.’ It is related to a misunderstood interpretation of ‘freedom.’ It implies freedom for the stronger, the more successful entrepreneurs. It gives the stronger ones the ‘freedom’ to dominate by all legal means the weaker ones, making their grandiose profits on the account of the needy. This process further enriches the rich and impoverishes the poor. Today, success of business is measured exclusively in monetary units, using the shareholder value as a well accepted indicator. Right is what pays out!

Free market economy is conceived as a freely running system under the only constraint of optimizing profits. The principle is highly functional, and, at first sight, also to the advantage of the consumer when, under competitive pressure, prices drop (usually, quality drops as well!). But the consumer’s advantages are illusionary because the large and powerful international companies decide on the products the consumer has to consume. Psychological marketing, exploiting the naivety of the consumer, is of enormous importance. Conscientiously or sub-conscientiously, we became obedient consuming slaves, following the advertisements and the role models set by our, even more obedient, neighbours.

Perhaps the most disturbing aspect of the free market system is the disrespect of possible long-term damage of the environment and the plundering of the finite natural resources. Well before the damaging effects of our selfish misuse become apparent, the gains are dissipated in luxury. The claimed self-correcting features of a free-market system are ineffective in the longer term; they just serve to optimize the short-term profits. Here control mechanisms by impartial authorities are indispensable.

The consequences of the ruthless usage of misunderstood ‘freedom’ become frightfully apparent today. Our world splits in two halves, the affluent half and the suffering, turbulent, despaired, and violent poor half. Obviously, a split world is inherently unstable. The strong gradient of wealth and (apparent) happiness leads to a strong surge to commit crimes caused by anger and
suffering. This gradient can only be maintained by brute force, for example by the building of separating walls and barbed wire fences. The first known example is the Great Wall in China, and the most recent one is the wall between Israel and the deplorable remainders of Palestine. Many real walls have been erected in the time between these two events, but even more mental walls existed and still exist, separating social groups, such as the segregation in South Africa or a little earlier in the US. And certainly, the worst walls are those in our own heads. They lead to preconceived notions and to racial hatred. Even in peaceful Switzerland, much hatred is being spread by the extreme right- wing parties which would be most pleased if they could get rid of all foreigners. A very recent public vote demonstrated the adverse feelings of the average Swiss towards refugees.

6.3 A Sober View of Our Lives

Our daily lives become more hectic every day. In order to succeed, we have to run faster. We scientists have to produce more inventions and to write more papers per unit time in order that industry can produce more (often useless) consumer products. The consumer has to buy and consume more to keep industrial productivity up. Indeed, the term ‘consumer’ is a very ugly, but accurate designation of our function. We just serve as black holes to consume in order to empty the shelves in the supermarket. Occasional abdominal pains are quite natural and further stimulate the sales of pharmacies and visits to medical doctors. A well functioning feedback system! We produce in this way an awful lot of waste, and in the evening before sleeping, we ask ourselves: what sense do all these busy activities make? We will hardly find a reassuring answer. But nevertheless, next morning, we continue to operate our senseless treadmill.

Ethics has no longer a place in our world, except when it can be exploited for money-making purposes. Even ethical principles serve today a handsome purpose.

7 OUR ACADEMIC MISSION: ROLE OF UNIVERSITIES

In this sick world, the academic community is obliged to fulfil a rescue mission. It is essential to realize that this mission is truly long-term. An immediate beneficial result can hardly be expected. Universities and their community possess no executive power. Their influence is through conviction, through public teaching, and by giving good advice.

By far, the most powerful means universities possess to steer our global space-ship is through education of students. Today’s students are tomorrow’s leaders in politics and in industry. The positive seeds that are implanted into their brains might germinate after one or two decades. But many more societal obligations have to be satisfied by our universities:
7.1 Life-Long-Learning

We all know how essential learning and re-learning remains during the entire life span. Obviously, everybody has his personal responsibility to remain up-to-date. But the universities are encouraged to offer opportunities to refresh one’s own knowledge. Academics in industry and public life must obtain opportunities to return regularly to the university to refill their back-pack, to get acquainted with the most modern technology, and, particularly, to critically reflect on the present course of industry, society, and our world today. The preparation of suitable courses and seminars by the faculty is quite demanding. Often, the academics in industry have gained more experience and know more than the university professors, detached in their ivory towers. For this reason, it is indispensable that all university professors spend at least one period in their career in industry or in a public institution outside of the university. Only in this way, they can develop a proper understanding of life outside of their realm. I have spent nearly five years in industry in the US after finishing my studies, and I profited enormously for my entire career. Without that, I would not have even received my little prize in Stockholm!

Life-Long-Learning applies to everybody, and universities should also offer courses for non-professional citizens. Many possibilities exist for implementing this demand: from TV broadcasts to articles in the daily, weekly, or monthly newspapers, to public lectures, courses on special subjects, and open days at university institutes.

In this context, let me just mention two recent activities at ETH Zürich in which I was personally involved.

In 2005, ETH Zürich celebrated its 150 years jubilee. On that occasion, 150 professors were asked to talk to the public in the streets of Zürich. Small pavilions were erected at some busy crossings in downtown, equipped with PowerPoint projection and screens, and seats for about 80-100 participants. Here, 430 lectures were presented in three weeks on subjects freely selected by the professors. Most of the lecture events were overcrowded. The public interest was enormous and the response very positive. I hope that we will be able to continue this kind of teaching activity in the near future. A major goal was to stimulate the discussion with the public in order to provide also valuable input to the university faculty and to give the public the certainty that its opinions are taken seriously. The exercise went very well. The professors were excited about their positive experiences and expressed willingness to do it again.

Another, still on-going activity is “ETH in Dialogue.” It consists of an open-ended offer of ETH faculty members to present lectures at varied occasions all around Switzerland. For this purpose, a web page was developed to list possible titles of lectures, and at which requests for (free) lectures can be placed (http://www.ethimdialog.ethz.ch/dienstleistung/index_EN).

In this way, it becomes possible to adorn any planned event with a fascinating lecture by an ETH faculty member, perhaps even a birthday party for Grandma! This is an attractive way of spreading knowledge and reflection to the general public. Last but not least, it presents good opportunities to stimulate young people for studying sciences.
7.2 Conceiving a Beneficial and Sustainable Future

Who else, if not the universities and the academic community, has an obligation to reflect on our common global future? We cannot expect much long-term reflection from our operators, the politicians and business leaders. They are busily solving today’s problems in the hope of surviving themselves in their chairs and of making short-term profits for their companies (and for themselves). The short-term responsibilities on their shoulders weigh heavily and leave them little room for impartial planning of a global future.

The academic community at universities does not suffer under this kind of constraints. They are not only free to conceive novel, unheard ideas; it is one of their primary obligations. To some extent, they are paid for serving as critical voices that, at the same time, offer alternative visions of a better world.

The universities shall serve not as ivory towers of knowledge, but rather as incubators of novel concepts. From the outside, they shall be regarded as radiating cultural centres that stimulate the discussion in the general public and that offer solutions to the world’s major problems. Let me mention a few issues of global importance that should be discussed in university circles:

7.2.1 Cooperation and Regional Unions

International collaboration is functioning rather poorly today. The European Union, however, is a shining positive exception in a dark world. Just compare the state of Europe sixty years ago with the present! Nobody could have imagined that peaceful cooperation and coexistence of former enemies would ever be possible. Despite all difficulties, the European Union functions very well, and another major war in Central Europe is virtually inconceivable. The original idea focussed on economic collaboration in a competitive world, but slowly, a political unification is also taking place. Europeans consider themselves truly as ‘Europeans.’ The experiment has worked better than was to be expected.

Why not use the EU as a role model also in other regions of the globe? In none of the regions, it will be simple to find a common denominator, but the example ‘Europe’ shows that it is not impossible. For example, an East Asian Union is imaginable, unifying Japan, Korea, Mongolia, and hopefully also China. A South Asian Union could bring together peacefully India, Bangladesh, Nepal, Bhutan, Sri Lanka, and even Pakistan.

In today’s context, nothing lies nearer than to conceive an Islamic Union in the Middle East. As is well-known, it had its predecessors with the United Arab Republic and some other minor attempts to unify. Their failure is no excuse for not trying it again. Indeed, there is an urgent need of collaboration among Islamic or Arabic countries. Without a unified voice, the area has no chance of facing the devastating pressure from outside, mostly from the US. Unless Arab countries take coordinated action, they make themselves co-responsible for today’s tragedies in and around their countries.

Such thoughts might be worth discussing in conscientious university circles in order to prepare the public opinion for moves in the proper direction.
7.2.2 International Organizations

Regional unions would be beneficial but are insufficient. Strong international organizations and binding international agreements are needed, in addition, to define the rules of peaceful cooperation and problem solving. Democracy is advocated as the best system for internally organizing a state. Each individual has the same rights and obligations, defined and guaranteed by the state laws. On the international level, similar principles should apply as well. Each state should be entitled to the same rights and obligations, warranted by international laws.

Unfortunately, the most powerful state in our globe blocks the instalment of an efficient network of international laws and organizations that implement these laws. Selfishness prevails in the international relations that seem to reflect a state of development several hundred years behind the rules well accepted within modern democratic states. The US is the most active promoter of inner democracy, but at the same time the greatest stumbling block for reshaping, in a democratic manner, international relations. It is urgent to develop a new spirit at universities that, finally, may diffuse to political bodies.

Let me mention just a few cases of international regulatory agreements that have been rejected by the US:

(1) Resistance to the Kyoto Protocol;
(2) The vote against the Human Rights Council;
(3) The vote against the Convention on Cultural Diversity;
(4) The violation of the Agreement on Reduction of Nuclear Weapons;
(5) Blocking the Anti-Landmine-Conference;
(6) Rejecting the Convention on the Rights of the Child; and
(7) Rejecting the rulings of the International Criminal Court.

The most recent rejection occurred on March 15, 2006 with a vote against the UN Council on human rights abuse. The difficult relations between the US and the UN are well known, indeed.

Joseph E. Stiglitz, a US 2001 Nobel Laureate in economics said: “We cannot go back on globalization, it is here to stay. The issue is how we can make it to work. And if it is to work, there have to be global institutions to help set the rules.”

7.3 Energy Problem

Finding solutions to the threatening global energy problem is of immediate academic concern. Our future may crucially depend on a conscientious usage and fair distribution of available energy resources, and on making new sustainable energy sources available. Major technological breakthroughs are needed towards this goal, but, in addition, the present misuse of energy must be minimized. Again, binding international agreements are needed, together with an energy-conscientious education of the population. Indeed, universities have a great responsibility in this respect.
7.4 Converting the Free Market Economy into a Responsible Market Economy

It is apparent that an unlimited free market cannot solve the long-term problems of mankind. Short-term thinking and egoistic reasoning prevail. Adam Smith characterizes the human motives by his well-known saying:

“It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity but to their self-love, and never talk to them of our necessities but of their advantages.” (The Wealth of Nations, Book I Chapter II).

Indeed, his words reflect facts about ‘natural’ human behaviour that we experience daily. But he seems to disregard the constraints imposed by society and by our responsibility for their beneficial long-term development. This responsibility can not result from human instincts to which his words refer. Only by conscientious education and by convincing role models that it would be possible to motivate people to behave in a compassionate and unselfish way to help others.

My preferred (perhaps utopian) model of an economic system is a ‘responsible market economy.’ in contrast to the ‘free market economy,’ where the personal profits or the shareholder value are the driving forces. In a responsible market economy, the actor acts out of conviction that certain actions are needed for the sake of society today or tomorrow. And he does not ask for his own personal gains, whether directly or indirectly. Altruistic behaviour is the basic drive in such a model. Perhaps, this sounds too idealistic, but still I think it is a goal that is worth pursuing. Certainly, universities are the proper place to further discuss the consequences and how to reach such a goal.

7.5 Help for the Poorest on the Globe

For easing the fate of the poorest people on the globe, it seems to me indispensable to implement a responsible market economy. Indeed, they need help and support to be able to live a humane life. A free market economy cannot provide this perspective. It invariably leads to exploitation.

Joseph Stiglitz, the 2001 Nobel Laureate in economics, writes:

“International humanitarian assistance is a form of collective action that springs from a shared compassion for others. As efficient as markets may be, they do not ensure that individuals have enough food, clothes to wear, or shelter. Poverty can lead to environmental degradation, and environmental degradation can contribute to poverty.”

Helping the poorest has much to do with ethics. I think that ethical principles should be articulated more in our university courses. They are the basis of a well functioning human society. Afterall, it is immaterial where we draw our ethical principles from. They are virtually identically found in the foundations of all our diverse philosophical and religious systems. From Christian to Islamic, to Buddhist, and Hindu thoughts, the same principles of charity and compassion prevail in all great traditions.
7.6 Respecting Cultural Diversity

The clash of civilizations is in full swing today, partially because of the shortsightedness of certain leading politicians and their self-cantered advisors that led to the disastrous consequences that we experience today. Following the theme touched above, indeed our world cultures have more in common than is apparent on the first sight, and their coexistence and mutual enrichment should cause no major difficulties. This is also what we experience daily in our universities where fruitful collaboration is possible across all racial and cultural barriers. In this sense, life at universities might serve as a metaphor for peaceful human coexistence. The university is an ideal meeting place for different cultures, for becoming acquainted with each other, and for understanding each other. When we actively take advantage of this unique situation, we could contribute significantly to the inter-cultural understanding and to world peace.

We should not forget that our cultures are treasures of heritage that we must preserve. Cultures are our living grounds that give us confidence and stability. Some of those who have lost their cultural roots might become terrorists, as they have nothing left that they could lose, except their own life.

Many more subjects could be mentioned that should form part of the academic obligations. We are encouraged to constantly question our value systems in the hope of finding universal values that better reflect the needs of our own and the future society.

8 CONCLUDING REMARKS

When we step back and impartially observe the course which our world has taken, we might be tempted to develop a frightening doomsday scenario that leads sooner or later to a technological and societal dead end. The energy dilemma clearly reveals that we are irreversibly depleting resources. But in many other respects, we are depleting other things as well. For example, we are depleting goodwill and societal balance. We are depleting the significance of compassion in favour of personal monetary enrichment. When all these precious resources are gone, human culture is gone, and we endanger our own existence.

In this situation, universities share the responsibility for a beneficial and sustainable future of our globe and of the human community. Besides our basic research efforts, we need to spend time to clarify our dangerous global situation and to find avenues for improving the chances of a happy continuation of human culture and its valuable traditions. We need the courage to articulate our views, peacefully of course. And we have to sensitize and train our students in a way that they can contribute actively to a beneficial future. Our responsibility is great and unique. Let us recognize our role and improve our performance, even if the direct profits for us, teachers, might be small. Certainly, we will at least get the satisfaction that we have contributed all we ever could to save our beautiful world and our precious living grounds.
What is what in S & T and Higher Education in the Arab Region for 2006

ADNAN BADRAN*
Former Prime Minister
President of Petra University
Amman, Jordan

1 ABSTRACT

Emphasis on quality and relevant higher education and building capacity in S&T have become a benchmark for development in an interdependent competitive world – economy. Market forces for quality, new materials and innovations have put a lot of pressure on science and technology to react positively to demands, particularly in the frontier areas of science. Although, the Arab region is spending 5.4% of its GDP/year on public universities, compared to 5.0% in industrialized countries and 3.8% in developing countries. Tertiary students represent 25% of eligible population, higher than developing countries. However, the quality and relevance of the delivery of higher education is low and not competitive. It lacks creativity and entrepreneurship.

Also, the expenditure on R & D has declined from 0.4% to 0.2% of Arab GDP, compared to world average of 1.7% world GDP. Arab scientific papers total 1.1% of world production. 90% of Arab R & D is still done by public sector.

The Arab region is still structured around turnkey technology and characterized by low investment in building endogenous capacity in R & D, and producing its own technology.

Below is a self-explanatory PowerPoint presentation that attempts to describe the status of S&T in the Arab world, and to propose a possible course of action for decision-makers to follow to try to correct the situation.

---

* Professor of Biology; and Fellow and Treasurer of the Islamic World Academy of Sciences (IAS).
2 THE PRESENTATION

Arab Region at a crossroads

- Building Capacity
  - Merit-based systems to promote excellence
  - Quality education linked to the marketplace
  - Creativity and innovation
  - Science-based education
  - Delivery of entrepreneurs
  - R&D linked with industry: Creating demands

Figure 1. Arab Region at a crossroads.

Merit-based systems to promote excellence

- Nurturing excellence through scholarship from childhood to career development
- Special education for gifted students
- Promote leadership
- Inspire excellent students into careers in research and development (R&D)
- Boost morale for building skills and excellence
- Avoid isolation and marginalization
- Awards and prizes to excel

Figure 2. Merit-based systems to promote excellence.

Quality education linked to the marketplace

- Continuous assessment of education delivery at every stage of development
- Use of international yardstick for rating institutional and disciplines of education
- Join international agencies of accreditation and quality standards of outputs of education (i.e. QAA in Britain, abbot, etc.)
- Aptitude test of graduates at the university level for rating individuals and institutions to create competition
- Decentralized governance to create competition among educational institution
- Encourage private quality-learning schools and universities

Figure 3. Quality education linked to the marketplace.
Creativity and innovation

- Change of schooling from disseminators to facilitators of knowledge
- Learning to structure knowledge from avalanche of information
- Learning to learn, to think, to analyze, and solve problems – to create the analytical mind
- To develop the inquisitive mind to discover the unknown
- To integrate ICT in the learning process
- Self-learning and long-life learning
- To transfer knowledge into application and technology

Figure 4. Creativity and innovation.

Science-based education

- Brain-intensive, knowledge-driven
- Renovate educational system
- Motivate bright students to take up careers in science
- Science for all
- Assistantships, fellowships and training
- North-South and South-South post-doctoral programs
- Brain-gains into brain-bank to work on South problems for building capacity and excellence

Figure 5. Science-based education.

Entrepreneurs

- Stimulate educational environment to create entrepreneurs
- Provide co-op education
- Access to incubators of creative ideas
- Graduation projects
- Provide time and space to nurture entrepreneurial trends
- Provide access to information through networks
- Access to venture capital

Figure 6. Entrepreneurs.
Figure 7. R&D linked with industry: Creating demand.

- Create business parks around the university campus with bis-community
- Contractual research: university – bis-community
- Create patents and registration procedures for R&D delivery
- Create culture of research for solving problems
- Provide incentives and rewards

Figure 8. Expenditure on Higher Education.

- Arab Region average US$ 2,400 per student (Spain 14,200)
- Arab region spends 5.4% of GDP per year on public universities compared to 5.0% in industrialized countries and 3.8% in developing countries
- Arab region tertiary students represent 25% of eligible population higher than developing countries
- There is now gender balance in higher education
- Private sector has taken the initiative to create private colleges and universities to help the public sector in financing higher education

Figure 9. Drawbacks of higher education in the Arab region.

- Universities lack autonomy, competition and merits
- No clear admission policy
- Lack of quality faculty member
- Rigid curricula and regulations which kill creativity and innovations to meet changing needs in k-economy
- Shortage of e-learning and integrating ICT
- No bridging with professional experience and workplace
- Lack of R&D
- Lack of incubators and business parks to bridge with the industry
- Outputs of education are of low quality and relevance
Investment in Science

- ArabDeclinedfrom0.4%to0.2%worldshareand0.2%of
gDP
- ArabInvestmentisUS$1,200million
- ArabR&D,educationandhealthcombinedlessthan
expenditureonmilitaryneeds
- Israelinvests4.4%,Sweden3.8%,EU1.9%andhassett
arget3%by2010,India0.8%andhassettarga
2%by2007
- 1.7%ofworldGDPwasdevotedtoR&D,OECDspends
80%ofworldshareinR&D
- Brazil,CostaRica,Cubaspends0.9%ofGDPonR&D

Figure 10. Investment in Science.

R&D expenditure as % of GDP 1996 - 2003

Figure 11. R&D expenditure as % of GDP 1996-2003.

R&D expenditure as % of GDP 1996 - 2003

Figure 12. R&D expenditure as % of GDP 1996-2003.
Who funds what in R&D?

- R&D in the Arab region
  - 3% private sector
  - 77% universities
  - 20% govt. sector

- R&D in the OECD
  - 70% private sector
  - 3% non-profit sector
  - 17% universities
  - 10% by govt. sector

Figure 13. Who funds what in R&D?

Who funds what in R&D?

- R&D in the US
  - 70% by enterprise sector
  - 25% by government and universities

- R&D in Korea
  - 75% by enterprise sector

- R&D in China
  - 60% by enterprise sector

- R&D in Japan
  - 75% by enterprise sector

- R&D in Sweden
  - 75% by enterprise sector

- R&D in Israel
  - 75% by enterprise sector

Figure 14. Who funds what in R&D?

Arab scientists and engineers

- Arab research scientists and engineers per million population surpasses only Africa (124 FTE)
- Developing countries average of 313 scientists per million population
- University scientists over-occupied with teaching loads and little left to science
- Most scientists in Egypt are in agricultural and health sectors
- Arab scientists have not yet taken on the third wave of brain-intensive ICT and K-economy
- Research groups are made of MSc and PhD holders, and expenditure go to salaries and wages

Figure 15. Arab scientists and engineers.

72
Figure 16. Researchers in the Arab region.

Figure 17. Scientific and Technical publications.

Figure 18. Scientific and Technical journal articles published (1996-2005).
Figure 19. Scientific and Technical Journal Articles Published (1996-2005).

Figure 20. Scientific and Technical journal articles published in 2005 per million people.

Figure 21. Scientific and Technical Journal Articles Published in 2005.
Figure 22. Technology output of the Arab region as compared to others.

Figure 23. Share of High Technology Exports out of Total Manufactured Exports.

Figure 24. Conclusion.
University Reform for S&T Capacity Building

IBRAHIM BADRAN*
Former President of Cairo University
Academy of Scientific Research and Technology
Cairo, Egypt
and
ALI ALI HEBEISH**
Emeritus Professor, National Research Centre,
Former President of Academy of Scientific Research and Technology
Cairo, Egypt

1 A HISTORICAL PERSPECTIVE

1.1 The chronology of the development of science

Long ago and for centuries, history witnessed the birth of science in the far, near and Middle Eastern civilization:

- **The Far East:** China and the Indian subcontinent witnessed the birth of physical sciences, exploring nature and creation with particular interest in mathematics, chemistry, developing paper and printing machines and medicinal sciences;

- **The Near East:** Persian, Babylonian and Phoenician civilizations witnessed the evolution of basic sciences adding some restrictive means through legislation and penalization to errors, using legal and ethical rules [illustrated in the Babylonian Laws of Hammurabi].

- **The Middle East and Mediterranean civilizations:** witnessed further developments mixing between the pharaonic, Coptic and later on Islamic civilizations and assimilating the knowledge of the Greco-Roman era. People those days were concerned with astronomy, architecture, water management and pharmaceutical sciences. All such sciences were flourishing on the bases of physical, chemical and biological knowledge.

Such sciences were disseminated during the Islamic epoch, when the Indian, Persian and Greco Roman literature was translated to Arabic language and later to European languages, this crowned the Renaissance epoch in the West.

Then came the steam revolution which was followed by electricity and later on the western civilization came to be dominated by the electronics era.

---

* Professor of Medicine; and Fellow of the Islamic World Academy of Sciences.
** Fellow of the Islamic World Academy of Sciences.
Progress crossed the Atlantic Ocean after World War II, where spearhead sciences flourished and where electronics, I.C.T., new materials and nuclear sciences flourished and now biological sciences. Nowadays the journey of science seems to have settled in the Far East again.

Many modern technologies are flourishing in Japan, China and India and the newly industrialized countries.

Could it be that the journey of science is completing its cycle around the globe?

1.2 An end or a continuum

Fukuyama before the end of the 20th Century posed a daring question:

- Can the world be living the end of history? Some philosophers added as a corollary…
- Has science reached an end?”

Here the answer is utter objection, expressed in the meaning of the following notion: Long ago quoting Shakespeare, “Life is an unceasing contest which yields only to those who toil and persevere.”

Centuries later Hubble, early in 20th Century, discovered that the universe is ever expanding.

This thesis today objects the notion of Fukuyama and confirms that so long as life is continuing, science will continue to progress, through brain power. Science will continue to conquer famine, disease, drought, and disaster; natural or man-made.

This battle was settled through the gifted brain power, which through knowledge and its creative faculties continued to explore the unknown and answer questions of; “Who? When?.. and How? This is achieved through wisdom, experiment and research traits.

Here it is a place to quote a wise dictum by the Honourable "Mahathir Mohammed," the great Moslem reformer: "That the only question that can not be answered is "Why?"

Since this can only be graciously answered by the supreme heavenly power "GOD" settling as the Almighty in all human beliefs.

1.3 Evolution and development of modern education

**Quality Education** was a prominent feature during the Arab Islamic epoch in Spain and Sicily for more than 4 centuries during the 2nd half of the 1st Millennium evidenced by four characteristics:

1. Schools of thought and learning flourished;
2. Libraries were developed for the 1st time in history to become major learning centres;
3. The progress of translation wave of the older documents; Greco Roman, Indian, Persian and Arabic were the source that paved the way for later achievements and progress in Europe; and
4. Also this epoch was crowned by the start of healthy debate between monotheistic religions for the first time in history.

The tragic end of this epoch, which marked the decline of Arab civilization in Spain, started with the invasion of Toledo in 1085. This was accompanied with demolition of higher learning institutions, libraries, translation facilities, and the arrest of inter-religious debates.

Immediately after this educational disaster in Spain, a group of students searching to continue the quest for knowledge, in Italy, recruited scholarly teachers and researchers to create a new model of higher education institution that was called the "University."

This venture was illustrated in the birth of the University of Bologna in 1088, and later the University of Oxford in 1096.

1.4 Education influx and massification

With the progressively increasing desire and need for higher education, governments, societies and benevolent NGOs and rich donors began to support such endeavours, and teachers were recruited to bear responsibility of continuing the evolution and development of higher education.

The prime reason for the increased applicants and influx was the proved value of education in social escalation. At the same time the birth of the industrial revolution was the prime factor for the influx to satisfy its needs for trained manpower and for capable scientists and engineers to solve problems of production and services.

The student's influx continued, universities increased in numbers and also quality teachers and trainers were looked after, and at the same time fees progressively increased.

Success attracted venture capital and the phenomenon of emigation of students and professors in search of quality learning in foreign countries increased.

Later the industrial revolution which was growing at a tremendous rate attracted many instructors and students, to industry seeking position in different companies, thus a new phenomenon masked the scene, that came to be known as "Robbing Intellectual and Scientific Fire Power" from universities to industry, this continued for many decades.

Centuries passed with progress and increase of numbers of institutes of higher education, and influx of students searching for excellence and quality learning to acquire knowledge, targeting opportunities in the newly developed competitive society. Against the backdrop of globalization and democracy, this phenomenon was called "Massification."

This continued for many decades till the 2nd half of the twentieth century that culminated in the “Knowledge Dependant Industrial Society.”

This progress continued to 2004, when the World Bank expressed statistically the phenomenon of influx and massification in higher education:
<table>
<thead>
<tr>
<th>1.9 Million</th>
<th>Universities and higher institutes of learning around the world</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 Million</td>
<td>University students learning in or out of home</td>
</tr>
<tr>
<td>3.5 Million</td>
<td>Professors and research instructors</td>
</tr>
<tr>
<td>300 Billion</td>
<td>Dollars are spent yearly on higher education</td>
</tr>
</tbody>
</table>

With this rapidly progressing influx, education got exposed to the risks of overgrowth. So much so that the numbers of students exceeded the capacity of some institutes. Mexico and Cairo universities host more than 200,000 each, while Rome University today hosts 150,000 students. Now the risks of overburden are quite visible.

2 THE PROBLEMATIQUE OF HIGHER EDUCATION TODAY

2.1 To stop deterioration certain moves are mandatory

1. Limiting student capacity, per university, to 10–20 thousands maximum.
2. Grading universities at 2 levels (an American formula):
   • *Liberal university education, graduating masses of useful citizens, who preserve their rights and are able to earn their living;*  
   • *Elite university, for those seeking distinction and excellence, a precious national asset.*
3. Resort to digital electronic education where large masses can benefit through measurable standards. This however proved to lack two elements needing correction:
   • *Loss of contact and direction of the teacher, instructor or advisor;*  
   • *Lacking hands on training.*

2.2 After World War II, certain added values in education were explored

1. Excellence of higher education if combined with innovative research can prove to be the prime driver for industrial development and competitiveness.
2. Also digital administrative reform of higher education fosters progress through:
   • *Favouring better control mechanisms;*  
   • *Conforming with the world pace of progress; and*  
   • *Abiding with world education systems, standards and ethics.*
3. Diversifying financial resources to eliminate complete dependence on state support, and relying more on the services delivered to the productive sectors.
4. Networking with foreign world class higher education and research institutes to transfer advanced knowledge resources and foster exchanges that secure the flow of benefits, ideas, techniques.
5. Fostering relations with service and productive sectors that are research dependant, offering lavish incentives.

2.3 Challenges to education in the age of globalization

It is accepted today that the target of education is not only to develop brain power, but it entails personality development, to become an added economic and social value. Also it acts as an agent of change in productivity, benefiting of the continuous academic and technical, progress, thus keeping pace with the world standards.

Nowadays the challenges are summarized as follows:

1. Today, a citizen should not be considered to be a local product of education for local consumption only, but should be valued as a universally active ingredient able to interact with the world events and be able to bear the accepted world standards of thought and skills to become an economically added value.

2. The concern of education today is to prepare for the graduation of a global citizen who can live and deal with global cultural, social and economic environment and at the same time keep his own specific cultural and belief identity.

3. The needed standards of knowledge and technical skills should conform to world standards through active transfer systems. This needs world cooperation and ability of adaptation to the new global environment.

4. To catch up with global standards, the cost became much higher for a citizen in the developing world. Thus a gap should be expected, to grow.

5. This widening gap between the haves and the have-nots confers risky damage to both partners of the game. The have-nots will continue to suffer ailments: an increase of poverty, under nourishment, illiteracy, unemployment, and disease. With time, deterioration will continue and the gap would widen. Today, diseases and epidemics are also globalized with consequent socio-political unrest and violence.

3 BRAIN POWER AND CAPACITY BUILDING

3.1 Brain power

Modern civilization rests mainly on brain power that is expressed in its perceptive-creative capacity enforced through education. Excellence in educational systems stimulates brain power development and this in turn boosts the economy. This phenomenon today is used to categorize the societies into the haves and the have-nots. The influencing factors in this discriminative meaning rest on many factors that energize development.

It should be mentioned here that science education (as related to hard sciences, medicine, engineering, agriculture, etc), should be humanized and
delivered in a mixture of soft protective sciences (law, ethics, sociology, economics and management sciences). Also the system of education should keep kindling the spirit of research and innovation, so that it can keep pace with progress. The boundary for imagination and freedom of thought should never be allowed to suppress talent and excellence in the institutes of learning.

In today's world, the role of excelling in science education has become a sine qua non for any technology development, being thus the most tormenting option looming in our minds. The model of tertiary education in the Third world, hosting huge numbers of students with limited resources, makes it a continuum of secondary education.

All these facts stimulate the desire to search for a new formula to change and innovate in higher education and capacity building.

3.2 What is capacity building?

3.2.1 General

It is a concept or process of securing a package of actions to induce human and institutional development through skills enhancement to foster abilities needed for socioeconomic development.

It is thus considered a top priority for the long term development dealing with three variables: The being (man), the capabilities (efficiency) and the environment (political, economic and cultural).

Capacity building today starts by policy analysis addressing:

- *Macro-economic management;*
- *Civil service reform;*
- *Private sector development;*
- *Optimally utilizing the available means and technical assistance resources to foster local capabilities and national abilities for better implementation.*

3.2.2 Concepts

- *Thinking new, by avoiding repetition of past failures or importing foreign solutions to solve local problems. In other words, thinking globally while acting locally.*
- *Personal commitment, willingness and devotion are imperative.*
- *Choosing key areas for effective intervention through securing information, effective execution and evaluation.*
- *Securing resources through commitment of supporters and donors.*

3.2.3 Implementation means

- *Encouraging transformation through consultation and participation.*
- *Targeting policies for restructuring value systems:*
  - Building human capacity.
  - Institutional capacity transforms.
Restructuring organizational and managerial capacity.

Resort to digital reform technology through:
- Multimedia education, concept and practice.
- Targeting student populations in remote areas.
- Securing multimedia software at affordable price.
- Securing examination questions bank.
- Self instruction modalities, particularly directed to continuing education for career enhancement.
- Interacting with instructors at the personal level.
- Making hardware and all software available at affordable prices (through arrangements with producers).

3.2.4 Obstructive difficulties

- Political and economic deficiencies.
- Crises in education.
- Functional and structural elements disconnect.
- Risk of dependence on doubtful foreign assistance.

3.3 Education and capacity building

Education’s role in capacity building stresses the value of fostering progress and excellence, this being achieved through upgrading and defining the human resource and tailoring capacities needed at three levels:

- Supply of graduates at all levels of service that secures cadres for information, engineering, planning, economics and management technologies. This infrastructure forms the essential basis for development.
- Support indigenous master’s degrees and doctoral certification. This will open the door for promotion and control faculties of personnel serving the R & D goals of the production sector.
- Field, post-doctoral missions for training locally or in advanced countries.

This direction not only serves development of the university itself but adds to the vision, capability and the creative research and problem-solving talents that reflect on the service and production sectors.

3.4 Technology development and adaptation programmes

This is achieved through:

- The provision of laboratory facilities needed for training personnel in the fields of production.
- Securing technology and industrial databases.
- Creating specialized centres of excellence especially through co-operation with advanced industrial countries, or in collaboration with multinational agencies and companies. All this helps in transferring and sharing experience through assisting in re-engineering, technology transfer,
negotiation technology and repacking technologies. This is secured through virtual education platforms created in networks built between the south and north Countries as well as through south-south cooperation.

3.5 Developing centres of excellence

A centre of excellence is considered a focus initiated through the available capacity to strengthen needed priority areas in a world-class pattern. These centres inject perfection in the working power through; securing needed facilities for training, added to research in priority areas of real need as related to the promising industrial complex. It should match the best quality in advanced countries and should invite world-class specialists and expatriate nationals to assist its maintenance and progress.

These should be considered as focal points hosting large numbers of scientists and engineers at the PhD and post doctoral levels within the university premises or outside.

Enhancement funding can be secured on the basis of critical review of proposals that have strong relevance to requested programs.

The work in these centres should be planned as programs according to the top priorities of the country and defined through local and international consultation and can be directed to concentrate on local or regional problems e.g. food security, health, energy, water and environment, or it can be concentrating on frontier sciences.

4 UNIVERSITY REFORM

4.1 Physical reform

a) Placement: Distribution in different regions of the country. A university is a development energizer.

b) Spacing of building housing laboratories equipment and facilities.

4.2 Instructional reform

a) The system: Liberal–specialized or research universities.

b) The philosophy: Mass-production versus elite education for leadership development.

   o Dominance of political orientation (as Lumumba University in the former USSR).
   o Theological orientation (as the Azhar and catholic universities).

c) Specifying identity: through predilections as seen in different schools of thought:

   o The British model (academic ties as in Oxford and Cambridge universities).
   o The French model (managerial excellence as the ENA).

84
o The American model (The land grant university for regional
development, and the research university seeking technical
excellence).

o The German and Japanese models aiming at talent development
(talent development as in von Humboldt institute and Tsukuba
University respectively).

d) Instruction system: whether dictative, deductive learning, or enhancing
specific problem solving faculties. Electronic, digital and virtual reforms
dominate today.

e) Accreditation based on quality; ensuring excellence and evaluation
abiding by international standards.

5 RESEARCH UNIVERSITY

5.1 What is a research university?

This is a new education model, which stood the test of time after World War II,
and achieved the merit of success. This formula was developed in the USA to
perceive the future and foster scientific research development to maintain
national scientific superiority and security.

5.2 The evolution of an idea

After World War II, a bill from the US Congress allowed the admission of a
large number of veterans seeking higher education in 1946. After 10 years,
evaluation of this process revealed its weak return. It was concluded that higher
liberal education offers little impact on society and concluded that an alternative
model should be introduced.

It happened that, at that same time, the Soviet Union succeeded through
scientific advances to invade outer space. Hence, the American scientific
supremacy was endangered. The idea to create a university model to focus on
advanced research aiming at excellence was therefore highly desirable.

Here, 75 elite higher education institutions were chosen from the existing
3600 higher institutes and universities, in the USA. Here, advanced talents and
competencies were recruited to assure the added value effect of quality
education for specified deliverables. These outputs necessitated industrial
collaboration and concentration on frontier technologies.

The essence was to study problems with futuristic prospects stemming from
cold war conditions and race. This new idea was mandatory to initiate a critical
mass for research trusting specialized, fulltime reputable scientists to focus on
military research, (studying radar systems and applications of nuclear energy).
Also, at the same time, these institutions were to cover societal problems such
as poverty, diminishing income, health problems and needs to bolster
agriculture and industry.
The severity of the cold war challenge was an imperative drive to establish this new research modality. Recruiting advanced competencies was mandatory to provoke an added value effect.

This same policy can be pursued by countries seeking to acquire proficiency in frontier technologies and to compete globally. These universities should initiate major programs for development in frontier technologies that include:

1. Nanotechnologies and new materials.
2. Biotechnology: This rapidly progressing sphere includes: Bio-saline agriculture, Biopolymers, Bionurosciences, and stem cell research.
4. Information technology.
5. The leading industrial technologies in chemical, industrial and pharmaceutical sciences, molecular drug design, development of manufacturing engineering, metallurgy, satellite and defence technologies.

5.3 Characteristic role of research universities

1. Scrutinising societal ailments, problems and needs, searching for causes, resorting to scientific approaches, and posing new solutions.
2. Emphasizing social interest in defining work criteria and choosing best solutions for basic needs.
3. Selecting high quality staff members, and motivating them by incentives, as well as resorting to new approaches, such as forming specialized study groups dedicated to rigorous advanced research, while using innovative procedures.
4. Critical evaluation and selection criteria when recruiting excellent prospective students. Student selection to be determined on regional basis, covering different regions of the country, thereby expanding the pool. Selecting the best, and perusing problem solving research by graduates, to serve all regions to be served without discrimination.
5. Concentrating, at least in the early phase, on graduating students through MSc and PhD programmes and on post doctoral research. The selection of projects must be determined by needs of industry and production. Later, regular undergraduate students could be accepted, aiming to develop a new experience to reform undergraduate institutes, programs and the recruitment of capable staff to upgrade their efficiency, to the needed standard.
6. Emphasizing here, the importance of securing information resources, digital resources and libraries as well as on-line search facilities.
7. Federal Government support was needed to achieve the following targets:
   - Improving quality control mechanisms and improve vocational training.
   - Defining future community needs and ultimate demands and objectives through socio-economic research.
   - Securing financial resources.
Engaging scientists in decision making at top levels.
Exempting capable staff from retirement irrespective of age.
Linking education and research centres to industry and business, integrally (as the Fraunhofer-Gesellschaft pattern in Germany).

8. Introducing the anti-institutionism law to liberate the university by discretion and freedom of action away from the government bureaucracy.

9. Defining specific objectives through research universities:
   Developing high-calibre cadres of scientific research.
   Graduating elite quality administrators prepared for leadership in the government and productive fields.
   Spilling managerial excellence through developing staff and faculty members to lead research institutes and other university centres.
   Postponing the over crowding with under-graduate students, for later stages, in spite of their being the source of lavish funding.

5.4 The outputs and achievements of research universities

1. The immediate achievements (for USA) were gaining the outer space contest reaching the moon 3 years before the specific target date (Armstrong Mission).

2. The permanent influences followed consequentially.

3. Speeding up the innovative faculties through supplying the production sectors with researchers trained on the spirit of enquiry, truth and registration to explore and solve problems.

4. Production of lots of qualified graduates who added a rigorous creative power serving the competitive target to their industries.

5. Putting the university, for the first time, to be of value for research in socioeconomic and defence responsibilities.

6. Generating a large number of technical breakthroughs, and advanced scientific achievements that added to the nation’s wealth, progress and security.

7. This experiment gave a successful model furthering the notion of continuing education in different sectors, and thereby stimulating progress at all levels, of the service and productive sectors.

5.5 Philosophy

The philosophy of the research university (quoting the example of the Nile University in Egypt) is "To be a component of an advanced technopolis fostering socio-economic development".

The vision formulated was: Educating leaders for technology driven economy.

The mission defined is; to create a world-class educational research environment through:

Providing: a leading-edge graduate program.
6 EDUCATION FOR THE FUTURE

6.1 Education reform for the Knowledge Economy

Knowledge is growing so fast it has become the key factor in economic and social development worldwide. Rapid innovation in science, communications and computation technologies are opening up new opportunities for countries to harness the power of knowledge and participate more fully in the global economy.

Developing countries that successfully make the transition to knowledge economy will have unprecedented possibilities to become more competitive in world markets and to participate in the global transformation especially for needy segments of the society and thus help other countries close the gap of new technologies that can have boundless benefits in upgrading living standards among their citizens.

A knowledge-based economy could be defined as the one where knowledge is created, acquired, disseminated, and used effectively by enterprises, organizations, communities and individuals. It does not necessarily focus narrowly on high technologies, but rather presents a framework comprising a range of policy options in education, information infrastructure and innovation systems. This can help users understand the essence of the knowledge economy. It also makes the case for better coordination among the government, the private sector and civil society in the hope to enhance competitiveness and foster economic and social development.

6.2 Making the transition

Increasing overall productivity through knowledge acquisition proved to be fundamental for any nation's transition to the knowledge economy. Developing the appropriate human resources will be the linchpin of such a transformation. Ensuring the flexibility of the education system, both formal and informal, is critical for developing creative, knowledgeable and better-skilled citizens needed for the 21st century.

To cope with the above, the Muslim Ummah needs to make its education system more flexible and more relevant to the new global environment.

This can be achieved through focusing on learning rather than schooling, creating an enabling environment for promoting creativity. This is achieved through improving the quality of higher education and providing opportunities
for lifelong learning. A reformed education model is, therefore, necessary to integrate and update the existing education and training systems and facilitate E-learning by anyone, any where and at any time to achieve the goals.

The life-long learning approach is centred on considering the learner to be defined to include the individuals but, as well as the active spheres such as the enterprise, the economy and the society at large. The objectives of education policy in such new environment need to be defined in the broader social and economic context.

In addition to the foregoing, the following issues should also be considered in reforming university education:

1. Strategic gender concerns: This refers to the need to increase the numbers of women who can participate fully in business enterprises. This must include the desegregation of academic fields by gender. At all school level, teachers, curricula should be adapted to avoid gender biases and expectations, and to secure career opportunities to be available for girls. At the tertiary level, women should be encouraged to take up science and technology courses, through grants and scholarship; initiating quotas for women and ensuring equal opportunities for overseas training.

2. There is a need to orient the existing curricula and teaching pedagogy to include training in the needed skills, e.g. communication skills, capability to utilize ICT, problem-solving capabilities and social skills to cooperate with others marketing, etc.

3. Revision of the curricula to improve the balance between practical and theoretical subjects, and incorporate new technologies, to secure skilled and up-to-date graduates. This will require free access to computer-based training materials and to the use of electronic mailing, distance learning and so on.

4. Greater stress should be directed to developing more concern and varied forms of university-industry partnership. Such improvements would lead to more efficient university system. Such measures foster the exchange of benefits and mutual interaction between universities and enterprises.

5. Improving the formative abilities in university education, considering instruments and modalities including:
   o **Encouraging double major courses; or double qualifications;**
   o **Adopting more open-end evaluation and testing methods;**
   o **Facilitating students and teacher mobility both nationally and internationally;**
   o **Integrating field training in the curricula, such as compulsory traineeship in private enterprises; and**
   o **Formalizing credit transfers among institutions.**

6. It is also important to adopt effective mechanisms to encourage healthy competition among professors and teachers, while using new technologies. This goal can be served through sharing of experience and best practices, probably by creating a new education academy hosting qualified teachers.

7. Encourage the expansion of the exchange programs between different countries. This is useful and highly effective in opening the education
market to be accelerated through resort to foreign providers of ideas and systems in tertiary education.

8. Global experience of joining research to education reform shows that an improvement in both activities through measurable indicators. This is achieved through setting up a system evaluating the standard of national qualifications, providing information on outcomes and quality.

9. Improving teacher training, encouraging industry-university partnerships, dealing with issues of equity and investing more in public education.

6.3 The Ten Commandments for university reform

1. Restructuring value system
2. Knowledge: A tool for decision making
3. Research for enhancing capabilities
4. Intellectual capital gain
5. Benchmarking for best practices
6. Governance through participation
7. Societal change-agent
8. Globalization agent
9. Relationship with society
10. Creating capabilities and competencies

6.3.1 Restructuring value system

In the early fifties, Nehru of India defined 3 systems that influence development. The first and most needed was:

(a) The human value system.
(b) Also, the manpower development and utilization system.
(c) The social organization system.

These three pivots still hold true in capacity building for development. Human values, as devotion, loyalty, perfection added to values of beliefs, character, ethics, religion and patriotism, are considered the governing factors in the systems controlling capacity building when crowning the knowledge needed for performance and decision making, in manpower development systems.

The imperativeness of values in policy analysis and decisions for capacity building emphasize the commitment of leadership, stressing the culture that accepts science as a useful ally rather than a threatening tool.

6.3.2 Knowledge: A tool for development and decision-making

This is an imperative input challenging university reform. Knowledge is rapidly developing to be not only as a resource of information but it constitutes the major factor in policy formulation as part of capacity building. The universities have undergone a major change in the ways of knowledge transfer and utilization to cope with the global quest for information to compete, trusting that procurement and creation of new knowledge, creates opportunities and jobs.
6.3.3 Research for enhancing capabilities

Research capabilities as an integral university function are a responsibility that is destined to enhance knowledge creation. This is achieved through strategic planning to train scholars to solve problems. Nowadays, problem-solving is considered a source to develop theories. Also it promotes the possible development of alternative products, i.e. to produce safer competitive, commodities.

6.3.4 Intellectual capital gain

The university utilizes its pursuit of knowledge in areas of interest where research results make a capital gain translated to effective source of benefit to the society. Also the graduation of scholars has a major influence on the public, illuminating dark corners through spilling benefits of their research, knowledge and creative capabilities.

6.3.5 Benchmarking for best practices

This is an essential element in university reform, exploring and defining its mission, against accepted best practices as seen globally. These best practices should be well identified and analyzed; efforts must be exerted to emulate the university, targeting to achieve global standards.

6.3.6 Governance through participation

This is a major concept to be considered in university reform. Governance entails the active participation of all stakeholders in managing the university. Also it is more important, in deciding its vision and goals, achieved through the strict abidance to:
(a) Defining the clear objectives and policies.
(b) Conforming with laws, regulations and standard managerial programs abiding to government practices.
(c) Transparency in decision making and adhering to basic features of university procedures preserving its rights and values with equitable treatment for all stakeholders.

6.3.7 Societal change-agent

This is an essential conceptual issue whereby the university acts as a driving force for societal reform. Actually each graduate should be prepared to act a reform agent spilling new thought in the society.

This responsibility is considered an imperative input, in the changing globalized world environment. Accordingly citizens and societies can benefit from the rapid changes of the scientific, social, economic and political attributes of the new world order.
6.3.8 Globalization agent

In an era where limitations, borders, boundaries, identities and values are blurred, certain changes need comment:

(a) To accept that in the present trend of internationalization of education, knowledge transfer and research for services have no restrictive limits.

(b) At the same time, possibilities of cross border migration and transfer of manpower, capital, skills and projects, are increasing, all necessitating continuous upgrading of the work force to become adaptable and competitive.

(c) People should accept and adapt to the value of debate and controversy embracing different views, cultures and managing diversity with all its consequences.

(d) Benefiting from existing networks, available on the electronic resources, of science and technology, whether local, regional or global.

(e) The university to be truly oriented globally should adhere to the basics of education on accepted norms of scientific research, standards and ethics.

All these features are imperative for the present era because isolation is no longer an accepted strategy.

6.3.9 Relationship with society

Universities should assume the role of concern, sharing responsibility and stewardship to the society, and should have cross-boundary contribution to the different social activities, e.g.:

(a) Communicate with different regions of the country, through people and local government agencies.

(b) Set relation with the business society at large.

(c) This is an essential hallmark of modern universities especially in case of research universities. This involves a role in education and research in a collaborative fashion. Also, efforts should be devoted to solve problems of production and services. This is achieved through securing a rich source of information for benefiting the institutions to be served. Also concentrating on training and evaluation of the available manpower to enhance their competitive attributes.

On the other hand, the university should create, relationships to offer benefit of its vision responding to societal needs and problems, while the society can also secure donations and funding. This creates an active sustained demand for service and research.

6.3.10 Creating capabilities and competencies

In the present era, certain prerequisites for excellence and sustainability have become imperative. These are summarized as follows:
1. Extra concern with innovative processes (which should be augmented) aiming at discovering new techniques, new resources, and materials needed for sustainable development projects.

2. Creative talented individuals should be searched for, sponsored and encouraged to take their responsibility in creating new inventions, trusting collaboration and networking. Teams acquiring the creative talents drive their organizations and societies to excel in performance. In reform of the university, the lead should be taken to encourage and stimulate the qualities of creativity of the skilled personnel.

3. Changing the system of knowledge procurement from the tacit (personalized) to the explicit mode (published), through the modern systems of disseminating knowledge. This spirit of transformation, dealing with knowledge, will provide organizations and societies with a wealth of information which would otherwise be prevented and withheld unused. This move augments the global universalization of benefit.

4. Leadership development schemes:

(a) At times of crisis, lack of enough capable scientists, engineers and technologists is threatening. This feature is described as the "aging and shrinking work force" and labour shortage as seen in the West. Here the resort to a proactive scheme to develop science and technology leaders is imperative. Here, technical and managerial skill development is mandatory. This entails concentrating on the research package and practice including ethics, laws and new techniques in management, and finance. All make a difference in leading the research teams.

(b) Leadership qualities and prerequisites:

i. A leader should have a strategic vision, looking forward to build an infrastructure and explore modalities for funding and finance.

ii. To act as a task builder, capable of composing teams and making coalitions that co-operate and network at all levels locally and globally.

iii. To be able to master listening, advising, helping associates and be a talent and brain hunter.

iv. To be dignified with values of high standards foregoing personal benefits in favour of institutional ones and be honest, fair and reasonable in correcting errors.

v. To be trained to abide by local laws and regulations, having political sense and avoiding pitfalls.

vi. To look to the future, at least 10 years ahead, to become a long-term thinker, whose vision master minds the process of training and adapting young workers that shall live many decades to come, and exercise living in a different world.

vii. To accumulate benefits of permanent relations and partnerships with other resources, universities and research institutes.
CONCLUSIONS

1. Reform of education in general and specifically for universities is mandatory to face the increasing problems of the present. The most serious among these, is the menace of coexistence of ignorance and poverty side by side with knowledge and affluence which endanger the efforts for development especially in the agitated developing world of today.

2. Capacity building is an imperative value in the development of society and universities.

3. Illiteracy has a deleterious effect on further education systems through the existence of a weak spot in the standard infrastructure, serving industry and government with all attended risks.

4. Universities after reform should bear the responsibility of participation in upgrading pre-university schooling systems and be concerned with societal reform.

5. Developed countries have the chance to lift up life standards in the developing world, either directly or through using media developed as intermediate agents to transfer benefits to the underprivileged. In this case the benefits of globalization will be proven and valid to the three partners of the world, the rich, the medium and the poorest. This can prove the success of globalization.
REFERENCES


Science and Technology for Development of the OIC and Pakistan

ATTA-UR-RAHMAN*
Coordinator COMSTECH
Islamabad, Pakistan

1 ABSTRACT

COMSTECH, the Organization of the Islamic Conference (OIC) Standing Committee on Scientific and Technological Cooperation (COMSTECH) was created in 1981 to promote cooperation among OIC member states in science and technology. It provides human and material resources to further the scientific and technological capabilities of Muslim countries, including inter-library networks and grants for young scholars.

This paper intends to shed a light on the activities of COMSTECH at the levels of the OIC and Pakistan.

2 THE PRESENTATION

![Why Science and Technology?](image)

Figure 1. Why Science and Technology?

* Atta-ur-Rahman is Fellow of the Royal Society (UK), Fellow of the IAS and of TWAS.
The Magic of Science

- Biotechnology
  - Agricultural Biotechnology
  - Health Biotechnology
- Information Technology
  - CERN
  - E-Commerce
- Material Sciences
  - Nanotechnology
  - Bucky Balls
- Pharmaceuticals
  - Ageing
  - Medicinal Plants

Figure 2. The Magic of Science.

New biology is decoding the blue print of life, learning to manage the placement and expression of genes and mobilizing microorganisms to do our work for the production of new products.

New innovations are altering and expanding the notions of development.

*the only constant is change!!*

Figure 3. Challenges of a Changing World Innovation Determines Progress.

VISION

Socio-economic development is no longer dependent on natural resources (eg. Japan, European countries)

**KNOWLEDGE** has now become the main driving force of world economies and hence the basis of socio-economic development

**INDUSTRIALIZATION** is the key to high GDP growth (through innovation / production of high value-added goods (engineering goods, pharmaceuticals, IT, Biotechnology, etc.)

Figure 4. Vision.
Overarching Approach

- Simultaneous Bi-Modal Approach
  Required
  - **Bottom-Up**
    - Basic Health, Primary Education, Water …
  - **Top-Down**
    - Higher Education
    - Emphasis on Science & Technology
    - Industrial Linkages

Figure 5. Overarching Approach.

Imperatives for Socio-Economic Development

- Central Role of Higher Education
- Linkages Between Applied Research
- Technology Development
- In National Plans
- VISION
- Govt. Facilitating Policies
- Budgetary Allocations
  - Min. 2% of GNP
- To catch-up game
- Quality/Relevance
  - O.E. Education/Research
  - STANDARDS!!

Figure 6. Imperatives for Socio-Economic Development.

GDP of Islamic World

- THE TOTAL GDP OF ALL OIC MEMBER COUNTRIES IS ONLY USD 1200bn---LESS THAN HALF OF GERMANY (USD 2500bn) AND LESS THAN A QUARTER OF JAPAN (USD 5000bn))!!!---INSPITE OF OUR HAVING OVER 70% OF THE WORLD’S ENERGY RESOURCES AND A QUARTER OF THE WORLD’S POPULATION

- JAPAN HAS VIRTUALLY NO NATURAL RESOURCES BUT OVER 1000 UNIVERSITIES (OVER 120 IN TOKYO ALONE)---IN CONTRAST ONLY ABOUT 500 UNIVERSITIES IN ISLAMIC WORLD!!

Figure 7. GDP of Islamic World.
Figure 8. Expenditure on Defense, Health and R&D (Arab OIC Counties).

Nature (2\textsuperscript{nd} November 2006)

- Points out the deplorable state of affairs of S&T in most Islamic countries
- Corrupt and illiterate leadership responsible
- COMSTECH---total grants provided by 57 Islamic countries each year (besides Pakistan) only US$ 400,000----Sweden and WHO give more than even the oil rich states!!!!!!---shameful!!!!

Figure 9. Nature (2\textsuperscript{nd} November 2006).

Impact of just one institution----MIT

- MIT graduates and faculty have founded 4000 companies
- Employ: 1.1 million people
- Annual Sales: $232 billion
- Collectively these companies are the 24th largest economy in the World!

Figure 10. Impact of just one institution …MIT.
Pakistan---A Promising Program

- Higher Education / S&T budget increased several thousand percent in 4 years
- Full support from President of Pakistan
- A real beginning after 50 years of lip service

Figure 11. Pakistan, A promising program.

HEC Plan of Action
ACCESS / QUALITY / RELEVANCE

- Faculty Development
- Infrastructure (Free Access to Literature, Free Access to Sophisticated Instruments, Technology Assisted Learning)
- Focused Support in Key Areas
- Linkages to the Economy
- Quality Assurance

Figure 12. HEC Plan of Action.

STRATEGY

1) BASIC SCIENCES
   Physics, Chemistry, Mathematics, Biology

2) APPLIED SCIENCES
   (Engineering, Agricultural sciences, Biotechnology, Information Technology, Pharmaceuticals, New Materials, Communications, Renewable Energy)

3) SOCIAL SCIENCES

4) ECONOMICS, FINANCE, MANAGEMENT

5) LINKAGES WITH INDUSTRY

6) EMPHASIS ON "K-ECONOMY"---HIGH TECH INDUSTRY!!

Figure 13. Strategy.
**Figure 14. Attracting the Brightest.**

- Change in Salary Structures—under “Tenure Track” system salaries of Professors raised to 3 times of Federal Ministers in government!
- Research Productivity Allowance—based on Cumulative Impact Factors during the preceding year
- Reversing the Brain Drain—under “Foreign Faculty Hiring Program” 270 eminent ex-patriot/scientists attracted to return to Pakistan

**Figure 15. Attracting the Brightest.**

- Research Funding (upto US$ 600,000 per international linkage program)
- Guaranteed Jobs to fresh Ph.D.s with higher salary structures under tenure track system
- 75% Reduction of Income Tax for all academics

**Figure 16. Training the Brightest.**

- Massive Foreign Scholarship programs initiated---500-1000 students being sent abroad annually to top universities in Europe, USA, China
- Indigenous Ph.D. programs—expansion of the existing Ph.D. output to 1500 per year
- Huge Local Scholarship Programs for Undergraduate level studies initiated---Rs.1 Billion to be spent!
Figure 17. Training the Brightest!

- Local Ph.D.s being offered opportunities for postdoctoral training in top foreign institutions (175)
- Linkages being established with top Western Institutions—50 with British Universities, many others
- US$ 150 million Fulbright program for MS/Ph.D. level training in top universities with USA—largest in world!

Figure 18.

Figure 19. Using Technology to Leap-Frog.

- Pakistan Educational Research Network
- Digital Library Program PAKSAT 1 (Pakistan’s Educational Satellite)
- Pakistan’s Video-conferencing Network
Figure 20. The IT Strategy.

Figure 21.

Figure 22. Information Technology.
PAKSAT 1 – A major opportunity

- PAKSAT 1
- A MAJOR COMMUNICATIONS SATELLITE WITH 34 TRANSPONDERs
- CAPABLE OF CARRYING 250 TV CHANNELS! (4 New TV Channels for Education!)
- BACKBONE FOR PERN (Pakistan Educational Research Network)

Figure 23. PAKSAT 1.

Figure 24.

Figure 25. PERN.
Figure 26. Pakistan Education and Research Network.

- Information highway exclusively for universities
- Promote collaborative research and the sharing of domain knowledge
- Platform for launching aggressive distance education programs
- Platform for Digital Library service for all universities

Figure 27. Virtual University.

- 4 Digital Satellite (PAKSAT) TV Channels for content delivery (License for 2 granted)
- Satellite Earth Station
- 2 Recording Studios
- Potential for providing high quality training in remote areas of Pakistan

Figure 28. Distance Learning.

- MIT Open Courseware
- University of California Television
- E-Books Program
- Virtual University
Figure 29. Supporting Private Sector Education.

- Matching Grants for New institutions established in public sector universities
- Funding for development
- Land on long term lease
- Sharing faculty salaries
- Access to Digital Library
- Access to Research Funding

Figure 30. Results.

- 120% in ISI abstracted publications over last 3 years—rate of increase highest in Islamic world
- Young men and women have started opting to adopt careers in S&T subjects as first choice
- Landscape of Universities has begun to change

Figure 31. Innovation/Entrepreneurship.

- Impregnating Innovation/Entrepreneurship in University programs
- STED: Access to Venture Capital
- Technology Parks/Business Incubators
- Islamabad Technology Estate
Figure 32. Linkages with France.

- 323 Scholars in 51 leading French institutions
  - Engg. & Technology 174
  - Physical Sciences 42
  - Life Sciences 56
  - Business Education 31
  - Social Sciences 17
  - Arts & Humanities 3

Figure 33. Demographic Changes in Europe—A Major Opportunity!

- Diminishing younger populations of scientists & engineers in Europe
- Companies looking for countries with high engineering skill base/lower manpower costs to outsource future high tech industries
- A major opportunity for Pakistan, if we can have highly qualified engineering manpower trained to top European standards

Figure 34. UESTP – France.

- Consortium of leading French Universities formed
- Fully funded by Pakistan
- French Rector, Deans, Heads of Departments
- Joint Degree
- French examination/quality assurance
- Complete equivalence
- Classes commence in October 2007 !!!!
Figure 35. Education with Employment

Education with Employment

- Key to success is to link 'education with employment'.
- The transfer of skills seamlessly to employment in technologically-advanced industry close to the University is planned.
- Ideas to products and wealth creation via research and development is an aim.
- Manpower for partner University's ideas and industrial ventures is another potential benefit.
- Trained manpower for partner country's industry based either in Pakistan or abroad may be a benefit.
- Low-cost, high-quality manpower will fill the gap of expensive and scarce manpower resources overseas.

Figure 36. Benefits of Foreign Partners.

Benefits to Foreign Partners

- Will enhance income and international status.
- PhD students from Pakistan will contribute significantly to the base level of research and enhance their opportunities to gain research funding.
- Highly-qualified labour attracted from Pakistan will overcome demographic factors and shortage of labour force.
- International experience in Pakistan will benefit some students and staff.

Figure 37. Benefits of Pakistan.

Benefits to Pakistan

- Pakistan's industry will benefit by rapid increase in technologically-trained manpower.
- Education with employment will not only enhance the knowledge base but also national wealth.
- High-technology activities will stimulate local suppliers and improve infrastructure and local standards.
- Inward foreign investment will help Pakistan's economy.
- More employment for Pakistanis will be an outcome.
- Expatriates will be attracted back to Pakistan.
- Help build the knowledge economy of Pakistan.
Our Children---with a population of 156 million, about a 100 million below the age of 25. Pakistan is blessed with a huge pool of creativity.

Challenge is to empower them with quality education and skills----and provide them opportunities to contribute to the process of socio-economic development.
The Bologna Process

IGNAZ BENDER
Chancellor of the University of Trier, Germany
President of the International Conference on Higher Education (ICHE)

1 ABSTRACT

This paper summarizes the Bologna Process that has helped unify the education systems of different European countries. The process was started in 1999. Its effects are discussed up to the present.

2 THE BEGINING

When the University of Paris celebrated its 800th anniversary in May 1998, the higher education ministers of France, Germany, Italy and the United Kingdom signed the “Sorbonne Declaration.” They agreed that the European higher education system should be more coherent and compatible. As there are remarkable differences in Europe between for example the French two year, four year and six year cycles and the German Diploma, Magister and Staatsexamen. The Declaration called for a two-cycle System (undergraduate/postgraduate), a common degree structure and the use of credits.

One year later, in June 1999, the higher education ministers of 29 European countries met in Bologna and signed the “Bologna Declaration” to establish a European Higher Education Area (EHEA) by 2010. They initiated the “Bologna Process” to remove obstacles to student mobility across Europe, to strengthen the attractiveness and competitiveness of the European higher education worldwide, to establish a common structure of higher education systems across Europe, and to facilitate the speedy entrance of graduates into the job market.

To achieve these goals the Bologna Declaration called for:

- The adoption of a system of easily readable and comparable degrees;
- The adoption of a degree structure based on two main cycles; the degree for undergraduates should be the “bachelor” degree and for graduates the “master” degree. A credit system to enable students to transfer credits from foreign institutions was introduced; and
- The elimination of obstacles that hinder mobility of students and job seekers.

Since 2003, the doctoral qualification has been considered as the third cycle of higher education. Most universities are traditionally familiar with doctoral
programmes and degrees. There will have few problems to implement this third cycle.

To control the progress of the Bologna Process, it was agreed that the higher education ministers of the member countries would meet every two years together with the new countries that are prepared to join the process, representatives of the European Commission, the Council of Europe and observers of UNESCO. Thus meetings took place in Prague (2001), in Berlin (2003) and in Bergen/Norway (2005). At each ministerial meeting, new member countries would be welcome.

3 THE MEMBER COUNTRIES

The Bologna Process started in 1999 with 29 member countries. All 25 member states of the European Union (2006), except Cyprus, joined the process at the Bologna Conference accompanied by Norway, Iceland, Switzerland, Romania and Bulgaria. Shortly thereafter Liechtenstein joined. In 2001, at the Prague Conference, Cyprus, Croatia and Turkey joined. In Berlin in 2003, seven more countries were admitted bringing the number to 40 member countries. The seven were Albania, Andorra, Bosnia- Herzegovina, Holy See, Russia, Serbia- Montenegro and the former Yugoslav Republic of Macedonia. At the Bergen meeting in 2005, five new members joined: Azerbaijan, Armenia, Georgia, Moldavia und the Ukraine. Thus the number of member countries increased to 45.

With the membership of Russia, the Bologna Process now stretches from the Atlantic to the Pacific. When it is completed in 2010, the European Higher Education Area will include member countries with about 750 million inhabitants, 12 million students and 4000 universities across Europe. A similar educational reform movement never happened before in and around Europe.

The importance of education and educational cooperation for the development and strengthening of stable, peaceful and democratic societies is universally acknowledged. Therefore neighbour regions of Europe should be encouraged to join the Bologna Process and establish cooperation with its member countries.

4 FIRST RESULTS OF THE BOLOGNA PROCESS

Until the summer of 2006, the majority of the participating institutions have started to implement the Bologna reforms (53 percent). One third (36 percent) are still planning. 11 percent of the institutions have announced that they are not willing to adopt the two cycle system.

At present, all Scandinavian countries are in the process of introducing bachelor’s and master’s degrees. Denmark, for example, will soon adopt the two cycle system in all disciplines, including medicine and chemistry. Italy gave up its traditional laurea degree system and adopted the 3+2 structure which means three years to achieve the bachelor degree, two additional years for the master degree. The Netherlands is currently replacing its one cycle-system by a
bachelor and master system. In Austria, legislation has been passed requiring all academic programmes to follow the new two-cycle-system. Germany has introduced the two-cycle system on an experimental basis and offers a three-year bachelor’s degree alongside the traditional one-cycle system. The faculties of law, chemistry and medicine have the strongest reservations against the new two cycle system. They see difficulties in graduating lawyers or doctors of medicine after a three years cycle. The United Kingdom and Ireland have always had education systems based on bachelor and master degrees and therefore will not have to implement significant changes.

Spain and Portugal have endorsed the Bologna Process in theory, but in practice they still have not implemented many reforms. Greece has rejected the two-cycle system and Switzerland has rejected the two-cycle system although the Swiss legislature recently passed a law laying the foundation for the implementation of a new degree structure that is compatible with the Bologna reforms. Other corners of resistance exist under local student organisations and institutions of higher education.

Although student organisations and universities play an integral role in implementing the reforms, local members of these groups consider the Bologna Process as a possible manifestation of market-driven globalisation. Others express a certain amount of xenophobia fearing the loss of the traditional university identification, their emblems of history and national pride – in favour of an imported system imposed from top down. Bologna supporters argue that the Bologna Process will foster compatibility among Europe’s different higher education systems while maintaining respect for cultural and linguistic diversity.

To facilitate mobility and to make study programmes easy to read and comparable for local and foreign students, an instrument was needed to help universities to revise and reorganize their structure of studies. This instrument is the European Credit Transfer System (ECTS) including the Diploma Supplement (DS) that makes European higher Education more attractive, in particular for students from abroad.

5 THE EUROPEAN CREDIT TRANSFER SYSTEM (ECTS)

ECTS is based on the principle that 60 credits measure the workload of a full-time student during one academic year. The student workload of a full-time study programme in Europe amounts in most cases to around 1500-1800 hours per year. One credit stands for around 25 to 30 working hours. The workload consists of attending lectures, seminars, independent and private study, preparation of projects and examinations. Learning outcomes are sets of competences expressing what the student knows, understands or executes after a process of learning.

Credits in ECTS can only be obtained after successful and appropriate assessment of the work required. Credits are allocated to all educational components like modules, courses, placements, dissertation work etc. They
reflect the quantity of work in relation to the total quantity of work necessary to complete successfully a full year of study.

The performance of the student is documented by a local or national grade. In cases of credit transfer, it should be oriented or added by an ECTS grade. The ECTS grading scale ranks the students on a statistical basis, a prerequisite for applying the ECTS grading system. Grades are assigned among students with a pass grade as follows:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>best 10 %</td>
<td>next 25 %</td>
<td>next 30 %</td>
<td>next 25 %</td>
<td>last 10%</td>
</tr>
</tbody>
</table>

A distinction is made between the grades FX and F that are used for unsuccessful students. FX means: “fail – some more work is required to pass” while F means: “fail – considerable further work is required.”

6 THE DIPLOMA SUPPLEMENT (DS)

In the Communiqué of the 2003 meeting of ministers in Berlin, the following statement was made: “Every student graduating as from 2005 should receive the Diploma Supplement automatically and free of charge. It should be issued in a widely spoken European language. Institutions and employers shall make full use of the Diploma Supplement, so as to take advantage of the improved transparency and flexibility of the higher education degree systems, for fostering employability and facilitating academic recognition for further studies.”

The Diploma Supplement is a document attached to a higher education diploma. It is designed to provide a description of the nature, level, context, content and status of the studies that were successfully completed by the individual named on the original qualification to which this supplement is appended. It promotes fair and informed judgements about qualifications.

The Diploma Supplement is composed of eight items of information identifying the person, the qualification, the level of qualification, the contents and results obtained, on the function of the qualification, additional information, certification of the Supplement, information on the national higher education system. When information on one or more of the eight sections is not provided an explanation should give the reason why.

The Diploma Supplement is produced by national institutions according a proposal that has been developed by a Joint European Commission – Council of Europe – UNESCO working group that tested and refined it.

7 CONCLUSION

An increasing number of mobile citizens are seeking a fairer recognition of their qualifications. Since often local credentials alone do not provide sufficient information, it is very difficult to estimate or appreciate correctly the level and function of a qualification without a detailed and an appropriate explanation.
Science Education: a Worldwide Concern

YVES QUÉRÉ

French Academy of Sciences
IAP Co-Chair, Paris, France

This has been a complete surprise, for Georges Charpak, a Nobel prize winner in Physics, Pierre Léna, an astrophysicist, and myself, a solid state physicist – the three of us being members of the French Académie des sciences, a significant point later-on in this paper – to learn, in 1996, that only \( \approx 3\% \) of teachers were still teaching science in French primary schools, this figure being given by the Ministry of Education itself. Immediately after visiting Hands-on schools set by Leon Lederman, another Nobel Prize winner, in the suburbs of Chicago, we decided to meet the French Minister of Education and proposed to him to start a renovation of the science education in French schools. In the same time, we obtained a unanimous vote, in the Académie, to support our action (July 1996). We started, as a small scale experiment, with 440 teachers (out of a total of \( \approx 340,000 \)), all volunteers, with whom we decided to work. What did we propose to them?

We all know that there are, quite generally, two main ways of teaching (plus all the possible hybridations between both). I call “vertical” a pedagogy where the knowledge is poured down from the mouth of the teacher (or the pages of the book) into the brain of the student, with the necessity, for the latter, to keep in his memory what he has received. This is fine, and we cannot imagine another way to learn the names of the planets or of the organs of the human body. But knowing words does not mean that there is, behind these words, some kind of thinking and, a fortiori, of understanding. Then there is what I call “horizontal” pedagogy; a way of teaching where the student is taken into Nature, his/her hand in teacher’s hand, in a kind of studious walk into knowledge. Marie Curie was practicing a classical vertical pedagogy with her students in the Sorbonne and a marvellous horizontal one with 7-9 years old children of her neighbourhood\(^1\). Considering that we had nothing original to say to the teachers in the first instance, we concentrated on the second one, calling it \( \text{La main à la pâte} \), which our Swiss friends translated into a better \text{Penser avec les mains} which clearly indicates that, here, the child has to think while practicing and learning science.

---

\(^1\) Marie Curie, \textit{Leçons de Physique}, EDP Science, 2003.
A typical *Main à la pâte* lesson takes place as follows:

1) Everything starts from some question from one of the children (Does a plant grow faster or slower in salted water? What is the "rhythm"? How does one measure the radius of the Earth? Has the sugar which we dropped in water completely disappeared or is still there? etc…).

2) Unexpectedly (the parents are sometimes not so happy with this), the teacher does not answer, but he/she sends back the question to the children: “You, what do you think? What would be your own answer to this question?”) provoking them to invent hypotheses, by which their imagination is stimulated. Those are, of course, at least naïve, or approximate, most of the time wrong; but never mind, they are welcome as a mark of children’ thinking and mind’s opening.

3) In order to find out the truth, an experiment is set, the children being generally grouped by 4 or 5 around small tables and the experiment being designed with extremely simple devices.

4) The result of the experiment then makes it possible to choose among the hypotheses, then to discover the truth and to open a critical discussion about the various scientific questions linked to the result obtained (experimental precision, link with mathematics – especially with numbers and geometry…– and most of all, about the new knowledge to be learnt and known.

5) All that has been done during the lesson, especially the experimental procedure, is written in proper language into an exercise book that will be kept and implemented all along the primary school period of the student.

The main problem to which we are confronted is the fear of many teachers in front of science: “science is too difficult for me” is the refrain which we have heard from thousands of teachers for whom science is just “big” science – the one which they see on TV (inauguration of a huge telescope in Chile, Man in space, Genome…) – forgetting or ignoring the existence of a domestic-scale science for children (presence of air in a plastic bottle, electrical circuit of a pocket torch, origin and nature of shadows…). This fear is the main reason of the quasi-disappearance, mentioned above, of science in schools, most of teachers having received, in university, a training in literature, foreign

---

languages, arts, pedagogy… rather than in science; another reason being the priority given by the ministry, at primary level, to the trilogy of “lire, écrire, compter” (reading, writing and counting) which is sometimes interpreted, wrongly, by teachers as non-priority for other subjects, i.e. a possibility to leave more or less the other subjects in the dark.

This is why we created, as early as 1997, a website for teachers, with 3 main objectives: (i) Giving resources to teachers (setting of simple experiments, advice, explanations, good practices…); (ii) Opening a forum between teachers themselves so that they may put their questions dealing with pedagogy, receive answers from teachers all over the country and participate to discussions and debates; (iii) Opening a forum between teachers and scientists: we “enrolled” ≈ 150 high-level scientists who accepted to answer, in very simple words and within 48 hours, to scientific questions of teachers (Why is the sky blue? What is a gene? Why do not gastric acids destroy our stomach?), all the answers being available to anyone.

This website (www.lamap.fr) is now largely used by teachers (250 to 300,000 hits per month). This, plus a number of sessions, lectures, books, plus of course the complete support of the Ministry, has helped many teachers to come back to science. Here, the glass is fortunately half full, but unpleasantly still half empty: half full since we have reintroduced science in schools at the level of ≈ 40 % (starting from the initial 3 %), a proportion slowly going up; half empty since ≈ 60 % of teachers are still afraid, thus reluctant, to teach science. For the former, the involvement of academicians has often played a very decisive role, the civil servants of the Ministry, the teachers and the parents having often taken this question much more seriously than any other, as it comes – unexpectedly, from their point of view – from such an institution as an Academy.

All this would be of only local (French) interest if the problems tackled here were not more or less universal: in many parts of the world, industrialized or developing, science is either ignored (remember the fear of the teachers) or taught in such a unique vertical way that children often know something, without comprehending. Therefore, many contacts were soon established between La main à la pâte and a number of foreign educational systems in such a way that, in many cases, the relations became rapidly quite symmetrical: a number of teachers came to France to be trained but, very soon, we gained from our foreign partners as much as we gave. A number of bi-lateral agreements were signed. Among the most vivid collaborations which we have internationally, let me cite Afghanistan, Argentina, Brazil, Cambodia, Chile, China3, Colombia, Egypt, Germany, Iran, Malaysia, Mexico, Morocco, Senegal, Serbia, Sweden, Switzerland, USA, Vietnam…, whereas 12 European countries are gathered, since 2005, in a project called Pollen, initiated by the European Commission around La main à la pâte.

As far as Academies of sciences are concerned, their global assembly, called the InterAcademy Panel (IAP), a network of 93 academies, has set – as early as

---

3 As a recent example, a Chinese-French symposium took place during October 23-27, 2006; in Souillac, South-West of France.
Year 2000 – a programme called *Science Education of Children*, which tends to involve the academies of sciences worldwide into this problem. Prof. Jorge Allende, of the Chilean Academy, is the leader of this programme. A number of seminars have been organized\(^4\), and an increasing number of academies of sciences became involved, the presence of scientists (high level scientists as well as university students, engineers...) in the neighbourhood of teachers reassuring the latter, as mentioned earlier. The IAP will issue in December 2006 a report on the difficult question of Evaluation of IBSE (*Inquiry Based Science Education*). The above-mentioned website is now, at least partially, being translated in Arabic, Chinese, English, Portuguese, Serbian and Spanish, while a few experiments are being performed by students of a network of more than 20 countries, like the measurement of the radius of the Earth via Erathosthene’s method\(^5\).

What, finally, may children get from an inquiry-based science education, aside from learning some initial elements of science? An introduction to experimental science, added to mathematics, is expected to strengthen their mind – not only for their childhood but for their whole life – by introducing them in concrete terms to the concepts of reality (against virtuality), of truth (against mental confusion), of modesty (against arrogance), of imagination (against conformity) and of freedom of thinking (against inertia and sluggishness).

Does one know any better way towards democracy?

\(^4\) Only in 2005, international conferences, or seminars, or summer schools on science education of children were organized in Islamabad, Beyrouth, Zlatibor, Erice, Canberra, New York, Stockholm, Berlin, Edmonton, Saint-Etienne, Kampala, Vatican, Paris, Penang (list probably incomplete). Ten years earlier, there was practically none.

Agenda for Change for Higher Education in the 21st Century: Lessons for the Islamic World

ABDEL MONEIM MOHAMED OSMAN
Director of UNESCO Regional Bureau for Education in the Arab States
UNESCO Representative to Lebanon & Syria
Beirut, Lebanon

1 ABSTRACT

During the last hundred years or so, higher education systems and institution worldwide witnessed three waves of profound change which brought in their tails challenges, opportunities, problems which in turn shaped and influenced greatly their roles, functions, policies, their internal and external working systems, structures and relations as well as governments policies towards them.

The third wave of change which is to be dated to the mid 80s of the last century was the result of the compound workings of the three processes of: globalization, the emerging knowledge-intensive society and what Hans Van Ginkel describes as the “…growing importance of ethics and values, commitment and engagement.”

On the basis of the above conceptualization and argument, this paper attempts to outline and assess the agenda for change for higher education in the 21st Century and the lessons that could be of benefit to the Islamic countries.

The first part of the paper will identify and outline the three processes of change that are shaping higher education systems. In the second part of the paper socioeconomic context of higher education in the Islamic countries will be examined and the final part of the paper will be devoted to the examination and analysis of the challenges, opportunities and emerging trends in higher education.
2 THE PRESENTATION

Introduction

- Waves and Process of Change.
- The Socio-economic Context & Higher Education Status in the Islamic Countries (ICs).
- The Challenges, Lessons & prospects for higher education in ICs.
- UNESCO’s role and actions.

Figure 1. Introduction.

Background

- At no time in human history did the welfare of nations depend in such a direct manner on the quality & outreach of their higher education systems & institutions.
- Developments and actions in higher education are shaped not only by national contexts & interests but also by the local, regional, sub-regional and global ones.
- Cooperation and networking: the local, regional, sub-regional and global levels are crucial for higher education systems.

Figure 2. Background.

The Waves and Process of Change: The larger context

- The 3 waves of change:
- The 1st. wave (End of 19th Century-Early 1940’s).
- The 2nd. wave (Post 2nd World War – early 1980’s)
- The 3rd. wave (Mid 1980’s – to present)

Figure 3. The Waves and Process of Change: The larger context.
The 1st wave processes

- Emerged & Developed as result of:
  - The Industrialization, economic and political competition and processes.
  - The emergence & dominance of norms of the power of science and of the limitless development.

Figure 4. The 1st wave processes.

The 1st wave impact

- More government involvement and funding.
- Increased diversification of disciplines, specializations and types of higher education institutions (HEIs).
- Transplantation and cultural borrowing of HEIs worldwide.

Figure 5. The 1st wave impact.

The 2nd wave processes

- Emerged & Developed as result of the 3 explosions characterized the post 2nd, W W:
  - The Explosion of Knowledge.
  - The Explosion of expectations.
  - The Explosion of population.

Figure 6. The 2nd wave processes.
The 2nd wave impact

- New definitions of the roles, functions and philosophies of higher education.
- Increase & expansion of both demand & supply.
- Massive increased diversification of disciplines, specializations and emergence of new types of higher education institutions (HEIs).
- Development of systems for finance, planning & accountability.

Figure 7. The 2nd wave impact.

The 3rd wave processes

- Emerged & Developed as result of:
  - The globalization of economies, trade, finance, services, labour and of other domains including education, culture and communication;
  - The growing role of the production, advancement, dissemination & application of knowledge as the driving force of development

Figure 8. The 3rd wave processes.
Figure 9. Knowledge Economy Index.
The 3rd wave processes (cont.)

- The phenomenal advance of ICTs and their pervasive role in the emerging knowledge societies (accompanied by advances in the cognitive sciences & in learning theory);
- A newly evolving relationship between HE, the state, the market, the society.

Figure 10. The 3rd wave processes (cont.).

The 3rd wave processes (cont.)

- Constant social and political change.
- Increased importance & concern about ethics, values and norms related to scientific practices, human rights-based governance, participation.
- Shifts in world demographic trends.

Figure 12. The 3rd wave processes (cont.).
The 3\textsuperscript{rd}. Wave impacts

- The increasing trade in education services.
- Created problems related to the preservation of national HE systems & retention of key elements of national cultural traditions & identities.
- Increased the technological gap between & within countries.

Figure 13. The 3\textsuperscript{rd} wave impact.

The 3\textsuperscript{rd}. Wave impacts (cont.)

- Drastic decline of national state role & involvement in HE.
- Emergence & expansion of new types & providers of HE. (The trans-boarder, on line, distance...etc)

Figure 14. The 3\textsuperscript{rd} wave impact (cont.).

The 3\textsuperscript{rd}. Wave impacts (cont.)

- Needs, systems & mechanisms for Accreditation, quality control & assurance & certification.
- Advances in teaching & learning methodologies.
- Greater expansion and role of private involvement in HE.

Figure 15. The 3\textsuperscript{rd} wave impact (cont.).
The Socio-economic Context of ICs:

- a great conglomeration of diversities of races, languages, cultural traditions, educational systems and colonial experiences.
- different in their socio-economic levels of development and welfare. The group gathers some of the richest countries of the world and some of the poorest and least developed ones.

Figure 16. The Socioeconomic context of ICs.

The Socio-economic Context of ICs (cont.):

- Out of the world total population of 6.2 billion in the year 2003, the total population of OIC members for the same year was 1.38 billion.
- The population growth rate ranged from low –0.8 percent for Kazakhstan during the period 1995-2004, to high of 4.2 percent for Palestine, for the same period.

Figure 17. The Socioeconomic context of ICs (cont.).

The Socio-economic Context of ICs (cont.):

- The life expectancy rate at birth for the year 2003, range from high 77 in Kuwait, 74 in Albania, 73 in Tunisia to very low 41 in Mozambique, 43 in Djibouti and 43 for Uganda.
- The GDP per capita in member countries range from high over US$ 28,000 per year in Qatar to a lowest US$ 166 per year in Sierra Leone. For example the combined GDP for all Arab states in 2002 was US$ 712.3 billion and that of Italy was US$ 1183.3 U.S. dollars.

Figure 18. The Socioeconomic context of ICs (cont.).
Figure 19. The Socioeconomic context of ICs (cont.).

The Socio-economic Context of ICs (cont.):

- Adult illiteracy rates for the year 2002 fluctuated from low in Uzbekistan 1%, Kazakhstan 1% and Maldives 3% to very high of 83% for Niger, 61% for Senegal and 60% for Benin.
- Among the 177 countries classified on the UNDP Human Development Index, Mali, Burkina Faso, Niger and Sierra Leone were the lowest 174, 175, 176 and 177 respectively. The highest of IOC member states was Brunei 33, followed by Bahrain 40 and Kuwait 44.

Figure 20. The Socioeconomic context of ICs (cont.).
Figure 21. The Socioeconomic context of ICs (cont.):

- Between 1990 and the year 2002, expenditure on education as percentage of overall government expenditure have increased in most Islamic states with the exception of Iran, Kyrgyzstan, Tajikistan, Togo and Cameroon which witnessed a decrease in the share of education from government allocations. The sharpest decreases were recorded in Togo from 26.4% to 13.6% and Gambia from 14.6% to 8.9%.

Figure 22. The Socioeconomic context of ICs (cont.):

- The expenditure on various levels of education, as a percentage of public expenditure on education, varies between countries, depending on the priority attributed to each level of education. For example, UAE, Oman, Kazakhstan, Azerbaijan, Guyana and Bangladesh allocate more than 80% of their budgets to pre-primary, Primary and Secondary Education and less than 20% to tertiary education. Only Malaysia and Turkey allocate more than 30% to tertiary education.

Figure 23. Higher Education Status in the ICs:

- There are two types of higher educational institutions in the Muslim countries, the contemporary ones which are modeled on their European and North American models and patterns, and the original institutions that carry all the characteristics of the institutions that were born during the early years of the coming of Islam.
- They have small scientific communities and poor quality universities, have only one percent of its scientists who contribute barely 0.1% of the world original research discoveries each year.
- They spend, on average, less than 0.5% of their gross domestic product on research and development each year, compared to 2–4% spent by industrialized countries.
Higher Education Status in the ICs:

- The diversity of systems of higher education is not only attributed to the political ideology that dominates the countries, but also to the financial and human resources available for these systems.
- Future development of systems of higher education in the ICs will not be affected only by internal factors such as the gradual vanishing of the welfare states, the diminishing of state funding to higher education and the explosion in student numbers but also with changes in the global environment.

Figure 24. Higher Education Status in the ICs.

Higher Education Status in the ICs:

- Statistics on higher education enrolment for the ICs for the year 2002/2003 indicate that the total number of students enrolled is approaching 19,000,000 students which represent little less than one fifth of world total which is approximately 110,000,000 for all regions.
- The gross enrolment ratios (GER) for same years fluctuated between high in Libya, 58%, Kyrgyzstan, 49%, Lebanon, 45% and low in Burkina Faso 1%, Chad 1% and Djibouti 1%. The average for the United States 81%, Finland 86% and Sweden 74 percent.

Figure 25. Higher Education status in the ICs.

Higher Education Status in the ICs:

- The percentage of GDP expenditure on higher education also varies greatly between Muslim countries. The highest are 2.70 in Malaysia, 1.45% in Tunisia and 1.42% in Libya and the lowest are in UAE 0.04%, Azerbaijan 0.19% and Indonesia 0.28%. The public expenditure on higher education per student for the year 2002/03 the highest were in Malaysia US$ 11,000, Oman 7,500, Senegal 4,900, Tunisia 4,600 and the lowest are Tajikistan 278 and Kyrgyzstan 244. The averages for Europe 5353 and North America 9366.

Figure 26. Higher Education Status in the ICs.
Higher Education Status in the ICs:

- In the ICs it is estimated that the number of full fledged universities has exceeded 450; both public and private, 233 of them are in the Arab states region. The number of postsecondary non-university institutions and colleges are in thousands. However no precise figure can be cited on these categories.

Figure 27. Higher Education Status in the ICs.

Higher Education Status in the ICs:

- It was estimated that a number of ICs in Africa and Arab region had lost between 60 – 70 % of their scientists and professionals who graduated abroad, between the fifties and eighties, due to the brain drain.

- The African report to the UNESCO World conference on higher education in 1995 indicated that 40% of faculty positions in the Universities and 60% of polytechnics were vacant in 1998. Nigeria, as one of the Muslim countries reported 50% vacancy for the same year.

- This situation prevails in most Islamic systems of higher education resulting in high rates of faculty/student ratios which adversely affect the quality of teaching and learning. The same effect goes for research and development activities.

Figure 28. Higher Education Status in the ICs.

The Challenges, Lessons & prospects for higher education in ICs. (Cont.)

- Strengthen COMSTECH institutionally and financially.
- Encourage creative, innovative and critical thinking within the education system.
- OIC to develop standard high school curriculum in order to remove all prejudices about each other and the Secretary General to approach the western countries to remove the bias against Islam and Muslims from their curricula.

Figure 29. The Challenges, Lessons & Prospects for Higher Education in ICs. (Cont.).
The Agenda for Higher Education in ICs. (Cont.)

- A need for new definitions for HE roles, goals & functions.
- Reform & renewal of HE systems at both macro & micro levels to accommodate demand & efficiency.
- New means & setups for finance.
- Accreditation & quality Assurance.
- Trans-boarder and new types & providers.
- Cooperation & networking.

Figure 30. The Agenda for the Higher Education in ICs. (Cont.).

UNESCO’s role and actions

- UNESCO’s role:
  - Assisting in capacity building, & the formulation of policies & strategies on higher education.
  - Serving as a platform for dialogue, & for the exchange and sharing of experience & information on salient aspects of higher education in the 21st Century.

Figure 31. UNESCO’s role and actions.

UNESCO actions

- The World Conference on Higher Education (WCHE).
- Partnership, cooperation and collaboration within UN system & with concerned International, Regional organization, agencies & associations.
- The higher Education forum.
- UNTWIN/UNESCO chairs programme.
- Conventions and declarations.
- Cross-boarder higher Education.
- Accreditation and Recognition of academic degrees.

Figure 32. UNESCO Actions.
PART THREE
HIGHER EDUCATION AND RESEARCH
Higher Medical Education in Turkey: Towards Excellence

ŞINASI ÖZSOYLU* FIAS,
NACI BOR† FIAS
and
ÜĞUR DILMEN‡ FIAS

1 ABSTRACT

We believe that education should be separated from formal learning and teaching although these are the main components of education. Educated people can control their behaviour, attitude, and direct their motivation in positive direction. As an example, a very knowledgeable physician can help his or her patients but if he or she smokes he/she may not be considered as an educated person though they might be extremely intelligent and up to date in science.

In this paper, the history of medical education in Turkey will be summarized and the present situation will be described in detail. Our hopes for the future medical education will be open for discussion with the participants.

2 SHORT HISTORY

Several medical institutions were established shortly after Seljuk Turks entered Turkey in 1071. Turhal, Amasya, Kayseri (Gevher Nesibe) medical institutions became famous in Anatolia as well as in other countries in a relatively short period of time. As a result, Anatolia became an attractive destination for higher education and many young physicians from Endulus (Spain) came to Turhal for further education.

Şerefettin Sabuncu, who was the editor of Cerrehiyet el-Haniyye, lived in Amasya and made extraordinary contributions to medical science and technology. Among several discoveries, he performed a cystoscopy before 1468 which was much earlier than the discovery of electricity. In his book, he not only described how to perform cystoscopy but also drew a picture of the human bladder of an alive person showing details of bladder trabeculae. Almost at the same time Altuncuzade was performing bladder catheterization in prostate hypertrophy cases.

* Affiliation
† Affiliation
‡ Affiliation
Later, several medical institutions were established in Anatolia during the Ottoman period; in Ayaş near Ankara and in Istanbul.

The first medical school in the Western tradition was inaugurated in the Ottoman period in Istanbul in March 14, 1827 with the name of Tibhanei Amire with the help of teachers of Vienna Medical School. It became Darul-Funun which was reorganized in 1933 upon the orders of Mustafa Kemal Atatürk as Istanbul University. Some of the Jewish professors this university were brought from Germany. They introduced big changes especially in the medical faculty of this university. Hülsü Behçet and Hasan Reşat Şiş invalı were well known in the Western for their discoveries at that time.

3 CONTEMPORARY DEVELOPMENTS

The most important accomplishment in medical research, training, technology, administration and education occurred in Turkey with the establishment of İhsan Doğramacı Children’s Hospital in 1957 which became Hacettepe Medical Faculty in 1964 and Hacettepe University in 1967. İhsan Doğramacı Children’s Hospital’s developments and achievements wereextraordinary in patient care, research, training methods and administration. In addition, this institution used social approaches to medical problems of Turkey, which was also one of the first in the world.

When young Dr Doğramacı returned to Ankara in 1947 following his paediatric training in the USA, he started to work at the department of Paediatrics at Ankara University Medical Faculty which was a small 36 bed clinic, depilated and deficient. Two or even 3 babies to be in one bed and cared by untrained attendants. Residents were mostly unpaid; some were volunteers whose work was not encountered. Therefore they had second job to support themselves. For that reason one resident only was on duty at night for emergency arrivals as well as inpatient care.

All these depressing conditions inspired Dr Doğramacı to develop a new children’s hospital with advanced techniques of care of children and effect with social approach to decrease over 300 per thousand infant mortality. At the same time he had meticulous planning to reform higher education. Although his plans were obstructed by the Turkish medical and higher education authorities. He was a dedicated and a visionary leader of medicine and higher education and he did not give up.

When he became a full professor, he was offered half of the beds in the paediatric department. Since he was convinced that his ideas could not come through in such place, and under these conditions, he launched an association called the Ankara Child Health Society through which he could establish a trust to finance his projects in the future. He proposed to establish the Institute of Child Health which started its activities in a two-room outpatient clinic in a slum area in Ankara (Figure 1). At the same time, he convinced people that he would someday find a plot of land to build his dream Hacettepe University, a dream he had since his residency years in 1939.
Despite its bad reputation, he chose Hacettepe area for his ideas which was a slum area. A new modern children’s hospital opened its doors for admissions in July 1957 (Figure 2). More importantly in the meantime he selected some 25 promising graduates of Ankara and Istanbul medical schools and arranged for them to have rotating internship in Ankara Medical School for a year while they attended intensive English courses set up in Ankara by Georgetown University (USA). Dr Doğramacı then arranged to send most of them to some of the best centres of learning in the United States. In this way he introduced new concepts of medical training to Turkey and build up an advanced group that would create future teaching staff. In addition a professor and few paediatricians were invited to give new concepts in patient care and teaching. Residents of this children’s hospital were full time and stayed in the hospital with every other night duty. The hospital worked on a 24 hours a day basis for the first time in Turkey together with the blood bank of the hospital and laboratories.
Figure 2. Children’s Hospital.

Figure 3. Hacettepe Children’s Hospital organized an international meeting in this building six months after the fire.
Figure 4. Children’s Hospital built after the fire.

In addition to hospital based activities, houses near the hospital were visited by the residents accompanying a consultant and children were taken care of and admitted when necessary to the babies’ clinic. Later these social medical activities were extended to Bismil town near Diyarbakır in south-east Anatolia. All the children of Bismil were screened for different diseases and social medical activities were extended with immunizations and nutritional recommendations and follow up.

All these approaches were completely new for Turkey. Much more importantly every person including the administrator at this new hospital became completely patient oriented. A pediatric journals in Turkish and in English started to be published.

On the 16th of March 1961, at a time when every improvement was going ahead, the two story building caught fire and burnt down. But the new six story children’s hospital was erected within 6 months (Figure 3-5).

Soon afterwards, nurses fluent in English were invited from Germany to work with their Turkish counterparts. New established nursing school students were also used for patient care. Around this time the first university degree programme in nursing in the country was started, raising the prestige of the nursing profession and giving an important measure of help for the shortage of nurses.
Figure 5. Entrance of İhsan Doğramacı Children’s Hospital.

A strictly full-time system, prohibiting private practice outside of the hospital was well accepted. In this medical school, students were exposed to patient care and each was being assigned to a pregnant woman or an infant. With this system, each student had the chance to follow a child at least for six years including visits to patients’ at home. The students were also motivated by journal club presentation in small groups (6-7 students). Motivation of the students was supported by asking their opinions in the solution of the problems. Demand the best from students and not settle for less was injected to their minds. Interns were given a chance to take care of their inpatients under the residents which was also a first in Turkey. Classes were large and there were little discussions but much memorising was essential in the other medical faculties. When everything was going in full-speed in medical school, Hacettepe University was established in 1967 by separation of Hacettepe Faculty of Medical and Health Science from Ankara University. A new Beytepe Campus, was also organized for the other faculties of Hacettepe University.

Such enormous accomplishments at Hacettepe influenced other medical schools in Turkey. Several countries in America and Europe, more specifically England and the Netherlands, showed their admiration to these approaches in their medical education. Today, several private medical schools and universities
are basically following the footsteps of Hacettepe Medical School. We suggest that all Islamic World Universities, more specifically medical schools, should study the achievements made at Hacettepe.

<table>
<thead>
<tr>
<th>Table 1. Number of universities and medical schools in Turkey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universities</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>Medical Faculties</td>
</tr>
<tr>
<td>47</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. Number of teaching staff and students in medical faculties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professors</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>Assoc Professors</td>
</tr>
<tr>
<td>Assist Professors</td>
</tr>
<tr>
<td>Students</td>
</tr>
<tr>
<td>Residents</td>
</tr>
</tbody>
</table>

In 1982, the Higher Education Council (YÖK in Turkish) was established again by the support of Professor Doğramacı. By the motivation of YÖK, research and publications were stimulated in whole country. As a result, without an increase in spending, Turkey was elevated to the rank of 24th in 1992 after being 45th in 1982, in terms of publications.

After Professor Doğramacı resigned from the presidency of YÖK, the Higher Educational Council tried to run and administer universities (including private ones); thus changing its established role of coordination between the universities.

**4 FUTURE EXPECTATIONS IN MEDICAL EDUCATION**

Medical teaching has changed following the introduction of molecular biology research since 1960s. Bed side teaching should be essential in patient care and social medical approaches and prevention should not be ignored. But physicians are getting involved more and more with the laboratory based medicine, sometimes even without physical examinations. Often, several very expensive laboratory tests are ordered by physicians in the developing world. It seems that clinical investigation is no longer the norm, and social and humanistic aspects are given less importance.

It cannot be denied that “capture of market share” is affecting more teaching staff who are and should be role models for the residents and students. As a result of these changes, two types medical teachers are appearing on the scene prominently;

a) Some attendants spend very limited time seeing patients and thus showing their clinical skill, since practice is a secondary activity in their careers;
b) Other medical teachers have little familiarity with modern biomedical sciences but instead they have their busy practice in their offices and less time for teaching.

Active learning requires clinical skills, both cognitive and procedural. That should be under the guidance of experienced teachers. Since dedicated physicians are getting less and less in number, it would be difficult to integrate the new skills, knowledge and attitude. Because of above reasons, alternative or complementary medicine is flourishing despite the recent and very important developments in for example molecular biology.

We have to take into consideration that effective interventions are not translated from molecular research into every day patient care as evidence based medicine. In addition we admit that more emphasis should be placed on social, economic aspects of health care delivery. But curriculum reforms are never simple or easy and Doğramaci-type reformists are rarely found.

Without ignoring patient care in its highest standards, preventive medicine should be planned and applied on a bigger scale in our countries. For this approach, medical personnel should be mostly catalysts and coordinators. Health care should depend on school teachers, religious leaders, administrators who should be responsible for the primary health care and immunization. NGOs, housewives and volunteers should be coordinated under the local authorities with the help of medical doctors.

Molecular biology findings should be discussed by the second or third year residents in the presence of consultants to facilitate their accommodations of research findings for the clinical applications. Residents of different specialties in medicine should also be scheduled to discuss their patients’ basic research findings in molecular biology, haematology, cardiology, nephrology, pathology etc. to inject their basic science knowledge and researches to the clinical medicine with their critical thinking and consultations. These discussions may facilitate residents’ to be critical concerning evidence based medicine approach.

5 CONCLUSION

For better teaching of students in medical schools and residents in the hospitals, an interdisciplinary approach seems to be essential. Difficulty depends to find non-selfish teachers and researchers, for the education rather than private practice.

It brings us education of the teaching staff. Therefore we have to ask what is education once more. It is teaching, learning, training, creative science and technology and moral are the parts of the education to change the attitude of the teaching staff, towards to benefit of their society and countries. Educated teachers not only transfer knowledge and technology but in the meantime would be creative in science and technology for the sake of the students and residents, society and country at large. We believe that such teachers could be stimulated by religious, rules on this project.
REFERENCES

Creating Centres of Excellence in Islamic Countries:
Tapping Expatriate Talent

AHMAD SHAMSUL-ISLAM*
Department of Molecular, Cell and Developmental Biology
UT, Texas, USA

1 ABSTRACT

This article urges governments in Muslim countries to form a ministry of non-resident nationals except where they already exist. To motivate the policy makers and administrators, the scientific community may launch a website, more or less on the same pattern as was established by the author two years back. The website is called, “Global Network of Bangladeshi Biotechnologists” (GNOBB: www.gnobb.org). This presentation will attempt to shed a light on this endeavour.

2 BRAIN DRAIN IN SOME DEVELOPING COUNTRIES

Brain drain started towards the middle of the eighties of the last century and still continues in most of the developing world. India and Pakistan have halted this tendency by creating the ministry of non-resident nationals. In India it is called the Ministry of Non-resident Indians (NRI) and it is the Ministry of Non-resident Pakistanis in Pakistan. Bangladesh has a ministry called the Ministry of Expatriates' Welfare and Overseas Employment (http://probashi.gov.bd/). This ministry is not comparable to NRI and NRP because its focus is on training people for jobs overseas to generate foreign exchange through remittance inflow. The object of both NRI and NRP can be summarized in the following word, “to create educational talent pools so that prominent academicians working overseas can come to their respective countries and teach at different universities for a limited time in a multitude of fields in science, medicine, engineering, advanced technology etc.” Along with the establishment of the above ministry, facilities to carry out cutting edge research in various fields have been extended and salaries of scientists enhanced. Although it is a fairly new ministry in these two countries, the brain drain has been partially halted.

These two examples should serve as an eye opener to the developing countries in general and Islamic countries in particular where brain drain has accelerated.

* Fellow of the Islamic World Academy of Sciences.
3 NEED FOR ACTION: GNOBB AS AN EXAMPLE

Government in Muslim countries are urged to form a ministry of non-resident nationals except where they already exist. To motivate the policy makers and administrators, the scientific community may launch a website, more or less on the same pattern as was established by the author two years back. The website is called Global Network of Bangladeshi Biotechnologists (GNOBB: www.gnobb.org). The author was motivated by some young biochemists, whose request can be summarized in the following, "a large number of Bangladeshi Biotechnologists are working in laboratories/companies scattered all over the world and we have no knowledge about them; i.e., in what biotech areas they are working, their names, positions they hold, their important publications, email addresses and their current and future programs of research or plan in case of a non-researcher."

Such a medium would not only help a scientist establish contact/liaison with fellow brothers/sisters working in the same area but it can also be used as a forum to express our views on important issues on multi-faceted biotechnology. And finally when it would develop into a sizable forum, it would be in a position to advise the Government on such important issues as suitability of planting GM crops in Bangladesh, vaccine biotechnology, transgenic animals, poultry and fish biotechnology, diagnostic kits, guidelines for framing of biosafety rules and publish articles on intellectual property rights. At the beginning, the enrolment was slow but before the end of 2005, the membership was nearly 90 and now it has almost doubled.

One of the main reasons that this site has become popular is that GNOBB maintains individual pages for each of its members with a picture (if provided), the position they hold and their main achievements, future plans, five of their important publications which are regularly updated. Another attraction is that GNOBB highlights the achievements of the involved scientists and the distinctions they receive, quotes of their articles that are published in a peer-reviewed prestigious journals or a popular article on biotech, and the international meetings they attend etc..

4 GNOBB

4.1 GNOBB at Present

GNOBB has introduced a number of special features such as "search engine." It allows a browser to retrieve information such as the number of Bangladeshis carrying out cancer research, or immunology, photobiology, plant and animal transgenics etc. Supposing the browser enters the word, 'cancer' in the box provided on the right hand side of the website and hit 'go.' Ten names will appear, each with a hyperlink describing the details of his/her expertise. Choose any name and click and you will see the details. Some influential local newspapers adjudged GNOBB as the science organization of the year after
describing its objectives and the kind of activities it has embarked upon. This
boosted up the image of GNOBB before the government machinery and public.

4.2 Impact of GNOBB on the Government

The Bangladesh Ministry of Science & Technology consults individual scientists
of their choice, when they feel such a consultation will help them arrive at a
decision. Unlike developed countries, the government does not give due
importance to learned bodies such as the Bangladesh Academy of Sciences
(BAS), Bangladesh Association for the Advancement of Sciences (BAAS), and
mono-disciplinary societies to ask their advice on an issue of vital importance.
For instance, the national biotech policy on biotechnology has been released
recently. Neither BAS nor BAAS or for that matter none of the following:
Bangladesh Biochemical Society, Bangladesh Botanical Society, Bangladesh
Zoological Society, Bangladesh Agricultural Society was consulted before such
an important document was released. On the other hand, the Indian Government
invited opinion to comment on their biotech policy not only from all concerned
scientists but also from public; and for six weeks the draft was on display in
their website. They received 300 comments that were incorporated in the final
document before it was released.

GNOBB could not remain a passive spectator, while the implementation of
the biotech policy got off on the wrong foot. It took up the issue and prevailed
upon the S&T Ministry that they need to consult this forum before it is
implemented. The government agreed and invited GNOBB to send in their
views on the biotech policy. In response to this invitation, GNOBB convened
two workshops to have in-depth discussion on the policy and prepare a set of
recommendations for the government with the object of giving the policy a
format so that biotech research both in basic and applied fields in Bangladesh
attains a level of excellence comparable to neighbouring countries. For the
government to give in to the wishes of GNOBB is a very welcome sign as it
ushers in a new chapter of cooperation between the government and scientific
bodies.

4.3 How is GNOBB helping promote biotechnology in Bangladesh?

Close contact with some expatriate GNOBB members revealed that the majority
of them would like to serve the country, either as full time or part time
scientists, if a proper environment in the form of research facilities and adequate
pay are created in the country. Knowing their sentiment, GNOBB announced
through its medium whether they would like to give seminar lectures or short
courses in any institution/university when they visit their country on vacation.
A database was generated requesting the GNOBB members visiting Bangladesh
to fill up the form created for this purpose. The response was immediate. Taking
advantage of their visits, lecturers by two expatriates were arranged in the
auditorium of Centre of Excellence, Dhaka University.
The scientist from CSIRO, Australia gave a lecture on plant biotechnology and the other scientist from a UK university on bioinformatics under the title; “Can Young Scientists in Bangladesh Play an Active Role in the Global Biotechnology Revolution?” The first workshop took advantage of the visits of four expatriates in the last week of December, 2005. The participants to the first workshop on biotech policy will be GNOBB members in addition to a number of local scientists, representatives from pharmaceuticals, NGO’s, and the news media. Thus the idea of utilizing the services of expatriates during their visits to Bangladesh materialized in a fruitful way.

4.4 Yahoo Group of Young Bangladeshi Biotechnologists

Since university students make the next generation of scientists of a country, GNOBB helped in the formation of Yahoo Group of Young BB and provided a moderator who is one of the cofounders of GNOBB. This group has become more and more conscious of the value of research and through exchange of email, students of almost all universities, where genetic engineering is taught, are getting benefit. This is not all. They organize seminars and invite expatriates by making prior arrangement when the news of their visits are published in the GNOBB website. In the last month’s DU seminar on bioinformatics by Dr. Parvez Haris from UK, the majority of listeners were students. Young BB Yahoo group at Khulna University arranged a seminar where Dr. Abed Chowdhury from CSIRO, Australia spoke on a very modern topic, namely, epigenetics. The student science magazines are being enriched by articles contributed by students and teachers across the country.

4.5 Cost of running GNOBB

Unbelievable may it seem, the cost of running this site has been as little as $500 each year. The items of expenditure include hiring of a domain, annual subscription to the server, and $120 to the webmaster whose job is to maintain the backups and to help in the design of new features and creation of databases whenever we require any.

5 ROLE OF IAS

If there is a consensus that launching of such a website is essential for the promotion of science and technology in as much as it can influence governments’ decisions to utilize science for the benefit of their people, then the IAS may be requested to help each member country create GNOBB-like website by providing the service of a web designer and some initial cost to launch it. It may simultaneously suggest OIC countries to create the Ministry of Expatriate Nationals backed by a website more or less on the pattern of GNOBB (www.gnobb.org).
Such an action will help them discover and mobilize the great expatriate resources for the promotion and development of S&T in Islamic countries which is for sure the ultimate goal of the IAS.

6 CONCLUSION

I think by now I have been able to bring home to the learned Fellows the fruitful results that such a website as GNOBB is capable of generating in the course of only two years. It has been able to create a network connecting almost 200 Bangladeshi Biotech workers working in various disciplines of biotech all over the world. It has inspired the young to emulate their expatriate counterparts especially as they know now that in every field of biotech there are some expatriates producing world-class science.

Another fact, GNOBB has garnered, is that most of the expatriates are interested in helping their country, if not on a full time basis then certainly in the short term and they can also offer their advise without physically being present within the country. That is through email, video conferencing etc.

GNOBB is influencing the Government, which for so long took no notice of the existence of learned societies. It has now recognized that GNOBB, as a cohesive body, can offer sound advise as to how Biotech policy needs to be formulated and harnessed for the economic benefit of the country, as well as how to develop it to a level of excellence comparable at least to India, Pakistan, Thailand, Malaysia etc. In the future, Bangladeshi scientists need to launch GNOBB-like websites in every discipline of science and technology to have their say in the formulation of policies in all fields.

Another enormous benefit that will accrue from such websites is that Bangladesh would not need in the future to hire any foreign nationals on an extraordinarily high pay except on rare occasions because GoB will find Bangladeshi expatriates doing the job not only as efficiently as a foreigners but with much more care.
Science, Technology and Innovation (STI) in Developing Countries: Do Higher Education Systems Produce the STI Knowledge Professionals?

LEE YEE CHEONG
Senior Fellow, Academy of Sciences Malaysia
Former President, World Federation of Engineering Organisations
Board Member, InterAcademy Council 2001-2005
Co-Chair, UN Millennium Project: “Science, Technology and Innovation,”
Task Force 2002-2005

1 INTRODUCTION

The theme of this conference, “Higher Education Excellence for Development in the Islamic World,” is most timely in the context of urgent development issues in developing countries with priority to achieving the UN Millennium Development Goals (MDG) by 2015.

Whilst the educational MDG only concerns itself with universal primary education, there was a consensus in the UN Summit General Assembly of September 2005 that science, engineering and technology (S.E.T) are critical for the achievement of all the eight MDGs and their associated targets. Thus higher education, especially S.E.T education, in developing countries in general and Islamic countries in particular, is one of the vital cornerstones of social and economic development.

2 THE WORLD TODAY

By the turn of the 21st Century, world population has exceeded 6.0 billion roughly be divided into three classes based on the criterion of GDP in US$ per capita (Purchasing Power Parity corrected) of >16,000, 4000-16,000, and < 4,000 respectively:

- The rich (0.8 billion);
- The transitional (1.2 billion); and
- The poor (4.0 billion).

The rich have nine times the wealth, eight times the energy consumption and eight times the carbon emission of the poor. 20% of the world’s richest people account for 86% of world consumption of energy and materials and the poorest 20% account for only 1.3%.
• 1.3 billion live in abject poverty, subsisting on a daily income of less than US $1.00;
• 3.0 billion have a daily income of less than US$ 2.00;
• 800.0 million suffer from food insecurity;
• 50.0 million are HIV positive;
• 1 billion suffer from water scarcity; and
• 1 billion have no access to commercial energy.

It therefore bears emphasizing that our world is a world of inequity.

3 THE UN MILLENNIUM DECLARATION AND THE UN MILLENNIUM PROJECT

The UN Secretary-General Kofi Annan realised that the urgent problems confronting the world at the dawn of the 21st century, namely poverty, hunger, diseases, illiteracy, environmental degradation etc. could only be solved by collective global political will and resources. In the United Nations Millennium General Assembly, during September 2000, the world’s leaders adopted the UN Millennium Declaration, committing their nations to stronger global efforts to alleviate poverty, improve health and promote peace, human rights and environmental sustainability. The Millennium Development Goals (MDGs) that emerged from the Declaration are specific, measurable targets with a timeline of 2015.

Unfortunately, the global development agenda was sidetracked by the attacks on the World Trade Centre in New York and the Pentagon in Washington DC on September 11 2001 and the subsequent wars in Afghanistan and Iraq.

To regain the development momentum, a UN initiative, the Millennium Project (UNMP), 2002-2005, then proceeded under Project Director Professor Jeffrey Sachs of Columbia University with the overall guidance of UN Secretary General Kofi Annan and then UNDP Administrator Mark Malloch Brown. The purpose of UNMP was to propose the best strategies and operational plans for meeting the MDGs. This included reviewing current practices, prioritising policy reforms, identifying means of policy implementation, and evaluating financing options by 10 task forces comprising some 250 eminent scholars, policy makers, and practitioners, with broad representation from both developed and developing countries and high-level participation of the United Nations agencies.

4 UN MILLENNIUM DEVELOPMENT GOALS (MDG)

The MDGs are as follows:
• **Goal 1**: Eradicate extreme poverty and hunger;
• **Goal 2**: Achieve universal primary education;
• **Goal 3**: Promote gender equality and empower women;
• **Goal 4**: Reduce child mortality;
• **Goal 5**: Improve maternal health;
• **Goal 6**: Combat HIV/AIDS, malaria and other diseases;
• **Goal 7**: Ensure environmental sustainability; and
• **Goal 8**: Develop a Global Partnership for Development.

The 8 MDGs and the 18 associated Targets are listed in the Annex.

Correspondingly, the 10 MP (Millennium Project) Task Forces are constituted as follows:

• **Task Force 1** Poverty and Economic Growth (Goal 1 & 8, Targets 1, 13, 14, 15, 16)
• **Task Force 2** Hunger (Goal 1, Target 2)
• **Task Force 3** Education and Gender Equality (Goals 2 & 3, Targets 3, 4)
• **Task Force 4** Child Health and Maternal Health (Goals 4 & 5, Targets 5, 6)
• **Task Force 5** Expanding Access to Essential Medicines (Goal 6 & 8, Targets 7, 8, 17)
• **Task Force 6** Environmental Sustainability (Goal 7, Target 9)
• **Task Force 7** Water and Sanitation (Goal 7, Target 10)
• **Task Force 8** Improving the Lives of Slum Dwellers (Goal 7, Target 11)
• **Task Force 9** Trade and Finance (Goal 8, Target 12)
• **Task Force 10** Science, Technology and Innovation (Goal 8, Target 18)

5 UN MP “SCIENCE, TECHNOLOGY AND INNOVATION” (STI)

**TASK FORCE**

STI Task Force addressed MDG No. 8 “Building Global Alliances for Development” and Target 18, “In cooperation with the private sector, make available the benefits of new technologies, especially information and communications.” Thus, the STI Task Force would need to engage global business and industry in the application of technology for development in developing countries. Besides ICT, the STI Task Force also highlighted the importance of biotechnology, nanotechnology, material science, remote sensing and spatial information technology in achieving the MDGs.

In its Report “Innovation: Applying Knowledge in Development” published in January 2005, the STI Task Force emphasized the following areas of focus for developing countries:

• Improving the STI policy environment, including STI advice mechanism, technology management training for top policy makers in government, industry and civil society;
• Building STI human capacities, including strengthening STI educational institutions and reorienting the role of universities in development, graduating job creators rather than job seekers;
• Promoting entrepreneurial and innovation activities, with incentives for enterprise development, industrial extension services, government technology procurement, and venture capital market;
• Investing in research and development, building scientific and technological capabilities, supporting under-funded research in design and innovation including research in manufacturing and product marketing;
• Technology foresight for developing countries to find niches in the global production chain; and
• Forging regional and international STI partnerships.

STI Task Force scouted the world for success stories and best practices in STI. Many are documented in the STI Task Force Report. The STI Task Force was convinced by the successful development processes in Asia Pacific and S.E. Asia that:

For least developed countries to lift themselves out of poverty and achieve MDGs by 2015, they need:

• Basic infrastructure i.e. roads, schools, water, sanitation, irrigation, clinics, telecommunications, energy etc.
• Basic industries, namely small and medium enterprises (SMEs) for supply of goods and services to agricultural and natural resources exploitation industries. This means indigenous operational, repair and maintenance expertise and a pool of local technicians.

Without the SET base, especially the engineering and technology base, indigenous industries cannot upscale, economy cannot uplift and foreign direct investment (FDI) will not come.

To implement the above, the STI advice systems in developing countries need reorientation, with more government support and funding for establishment and nurturing of academies of sciences, academies of engineering and professional scientific, engineering and technological associations, industrial and trade associations and the like. These human resource and institutional supporting framework in the private sector and in NGOs would spur sector-wide innovations in the development process.

As a Malaysian interacting with African S&T Ministers, top African SET officials and academics, I have been struck by their widespread despondency that the STI chasm between the developed countries in North America and Europe and African countries is too wide to them to bridge. I have advocated strongly to them to look instead to Asia Pacific and Malaysia where macroeconomic stability, self-reliance, hard work, thrift and investment in education have transformed the economic landscape in the short span of three decades. Official development assistance (ODA) from the North is tied to supply of goods and services from the donors with numerous conditionalities.
like labour standards and human rights etc. I have as a consequence advocated genuine South-South cooperation with high and middle income countries like Malaysia, China, India, Brazil, Mexico and others as donors in the MDG process. The “Look East and Look South” orientation for Africa is reflected in the STI Task Force Report.

I consider my two contributions to the UN Millennium Project are:

- To emphasize the importance of basic infrastructure as the foundation for development in developing countries; and
- To include high and middle income developing countries as donors in helping less developed countries in achieving the MDGs.

The UN MP report and all UN MP Task Force reports were launched by the UN Secretary-General Kofi Annan in New York on 17 January 2005 followed by national launches in more than 100 countries. The MP and Task Force reports and supporting documents are posted on www.unmillenniumproject.org.

6 UN SECRETARY GENERAL’S REPORT “IN LARGER FREEDOM: TOWARDS DEVELOPMENT, SECURITY AND HUMAN RIGHTS FOR ALL,” 21 MARCH 2005

The UN MP reports formed the developmental basis of the above UN Secretary-General’s report to UN member states for the UN Summit General Assembly September 2005. I am most gratified to note that our UN MP STI Task Force recommendations have carried the day by his emphasis on S.E.T in his report, particularly on scientific R&D, capacity building for engineers and engineering, infrastructure and SME development.

Quote

- Development successes cannot take place overnight and many countries suffer significant capacity constraints. It takes time to train the teachers, nurses and engineers, to build the roads, schools and hospitals, and to grow the small and large businesses able to create the jobs and income needed.
- Sustainable economic growth will require significantly increased investments in human capital and development-oriented infrastructure, such as energy, transport and communications.
- Governments should establish scientific advisory bodies, expand science and engineering faculties, and stress development and business applications in science and technology curricula.
- Scientific advances and technological innovation have an important role to play in mitigating climate change and in facilitating adaptation to the new conditions. In particular, research and development funding for renewable energy sources, carbon management and energy efficiency needs to increase substantially.
• Significantly increased global effort is required to support research and development to address the special needs of the poor in the areas of health, agriculture, natural resource and environmental management, energy and climate.
• Two particular priorities should be to mount a major global initiative on research in tropical diseases and tropical agriculture.

Unquote

The UN Secretary-General’s Report is available from www.unmillenniumproject.org

7 UN SUMMIT GENERAL ASSEMBLY, SEPTEMBER 2005

The UN Summit General Assembly of September 2005 endorsed most of the UN Secretary General’s recommendations with respect to the MDGs. Global political leaders recognize the critical role of STI in achieving the MDGs. The Outcome Statement of the UN Summit General Assembly is available from www.unmillenniumproject.org.

The top global science, engineering and technological (S.E.T.) community submitted a joint statement “Science, Technology and Innovation in Achieving the MDGs” to the UN Summit General Assembly dated 13 September 2005. It was issued in the names of IAC; IAP; UN MP; ICSU; the Academy of Sciences for the Developing World (TWAS); the InterAcademy Medical Panel (IMAP); the Council of Academies of Engineering and Technological Sciences (CAETS); and the World Federation of Engineering Organisations. I was very pleased to sign the joint statement as WFEO President.

Quote

Stronger worldwide capacities in science and technology will greatly enhance humanity’s ability to achieve the UN Millennium Development Goals. A concerted global effort among the world’s scientists, engineers, and medical experts is needed to identify successful strategies and to help implement effective programs. Sustained progress in reducing poverty and related problems will require strengthened institutions for science, technology, and innovation within the world’s developing countries.

We, representing the world’s scientific community, commit ourselves to working with appropriate partners towards these urgent goals.

Unquote
There is now unanimous global political will for the MDGs. There is also consensus that STI is fundamental to achieve the MDGs. The voice of the global S.E.T community in the UN and in the global development community in support of the MDGs is getting louder and is being heard.

The US National Academies organized the first annual international conference “African Science Academy Development Initiative: Improving Public Policy to Achieve the Millennium Development Goals in Africa: Harnessing Science and Technology Capacity,” Nairobi, November 7–8, 2005. In my paper, I argued that as the deadline for the MDGs was only ten years away, it is very late in the day to explore the potential role of African science academies in development. It is not enough for African academies of sciences to have merely offered and continue to offer their advice, they should have been partners to their governments and communities on matters related to human health, quality of life and development well before the UN Millennium Declaration of 2000. I appealed to all African national academies of sciences to urgently engage themselves and their members in many of the urgent S.E.T-related projects in their National Poverty Reduction Strategy Programme (PRSP).

Another avenue for hands-on engagement of S.E.T professionals in MDGs is through the Millennium Villages of Professor Jeffrey Sachs. The Millennium Villages are based on a single powerful idea: impoverished villages can transform themselves and meet the MDGs by 2015 if they are empowered with proven practical technologies. It is simply a "bottom up" approach to lifting villages in developing countries out of the poverty trap that confines more than one billion people worldwide. The concept is doing all of it at once. Goals can be achieved by bundling critical yet straightforward solutions in a comprehensive investment strategy and working directly with the poor. By investing in health, food production, education, access to clean water, and essential infrastructure, these community-led interventions will enable impoverished villages to escape extreme poverty once and for all. Once these communities get a foothold on the bottom rung of the development ladder they can propel themselves on a path of self-sustaining economic growth. The concept was developed by a team of scientific experts at The Earth Institute at Columbia University and the UN Millennium Project. Millennium Promise is working in more than 75 villages in ten different countries: Ethiopia, Ghana, Kenya, Malawi, Mali, Nigeria, Rwanda, Senegal, Tanzania and Uganda. Professor Jeffrey Sachs is currently working on spreading Millennium Villages to Cambodia, China, India, Malaysia and the Middle East. www.millenniumpromise.org.

I am getting the US engineering community through the American Society of Civil Engineers ASCE and the engineering communities in developing countries through WFEO to work on physical infrastructure facilities like rural roads and rural electricity supply in Millennium Villages.
I know it is very difficult to shift the well entrenched paradigm of S.E.T academies and organisations from holding more and more talk shops as their action agenda. Nevertheless, I persevere in this conference as in many other international conferences and workshops by outlining some action oriented MDG initiatives with the hope that you and your academies and organizations will join in and get your hands dirty.

9 HIGHER EDUCATION EXCELLENCE FOR DEVELOPMENT IN DEVELOPING COUNTRIES

There is no doubt that STI knowledge professionals underpin the achievement of the MDGs in developing countries. As I have pointed out, the UN Millennium Project STI Task Force Report emphasizes human resource based and institutional and enterprise-related capacity building in developing countries. Since institutions and enterprises are run by human beings, it all boils down to STI human resources capacity building. Priority must therefore be focused on education, especially higher education.

The key questions for this Conference are:

- Do the higher education systems in developing countries produce the STI knowledge professionals required to achieve social and economic development as envisioned by the MDGs?
- Does higher education excellence, especially S.E.T education excellence, in developing countries contribute to the above objective?

9.1 Higher Education Systems for Development

In the light of the lack of progress to date in the MDGs in developing countries, I would argue that higher education systems in developing countries do not produce the requisite indigenous STI professionals for development. Developing countries are instead plagued by growing unemployment of university and college graduates on the one hand and the increasing brain drain of STI professionals abroad on the other hand.

In the face of such dilemma, the UN MP STI Task Force Report argues that universities in developing countries must act as the fount of knowledge for economic development. For this to happen, policy makers need to realize that knowledge per sey does not create wealth. It is the application and commercialization of knowledge, scientific or otherwise, into useful devices, installations, services and systems that create wealth. Therefore, turning out innovative and entrepreneurial graduates must be the mission of the universities in developing countries.

In my opinion, staffing universities in developing countries with PhDs is not the route to innovation and competitiveness for the economy. Academics should not continue to be recruited on PhD degree, research experience and publications only. Instead, they must have working experience in industry and
in the marketplace if they are to understand the needs of the economy and the community. I would strongly advocate that successful candidates as academics should have demonstrated some prior and continuing involvement in community service, especially MDG-related.

Universities in developing countries must be graduating job creators rather than job seekers. Universities should re-orientate themselves to serve the development needs of their region and their nation. They should establish undergraduate incubators that assist students to venture into knowledge based enterprises suited to the needs of the economy. Such undergraduate enterprises will attract industry participation as they are the most fertile recruiting ground for industry. If such undergraduate enterprises succeed beyond graduation, they will create jobs and add to the successful knowledge enterprises in the country. Even if they fail, the graduates would have been well schooled in the hard knocks of business life and well adapted to the needs of industry.

Effective strategies for engineering and technological capacity building in developing countries should link curriculum in university engineering courses and undergraduate and post graduate training directly to infrastructure projects. Innovations in maximizing the use of indigenous goods and services will be needed in the design and implementation of infrastructure projects.

A very positive trend in recent years has been the blossoming of Engineers Without Borders (EWB) in university campuses across North America and Europe. Whilst the bulk of EWB members and volunteers are undergraduate engineering students, many EWBS are supported by their universities and engineering faculty members. EWBs from developed countries partner their counterparts in developing countries in MDG-related and infrastructure-based community projects in the latter. Incidentally, on 14 November 2006, the New York Academy of Sciences launched Scientists Without Borders in New York linking scientists and researchers, young and old, to voluntary service for the Millennium Villages.

The high end of the STI human resource development is the staffing of R&D institutions in developing countries. There exists an almost universal misconception that the necessary path to economic development in developing countries is through more emphasis and investment in science and scientific research. This view has consistently been championed by development banks and by the scientific communities in developing countries themselves. Postgraduate research departments of universities and basic research institutes have been set up prematurely in the least developing countries with their graduates and researchers finding no local gainful employment and migrating to the developed world, aggravating the brain drain. Yet more of the same is being advocated. What an irony it is that developing countries are training highly skilled manpower for the developed world, whilst insufficient resources are devoted to lift the countries out of poverty!

R&D in developing countries should be focused and applied to enhance their indigenous advantages. For example, R&D in rubber, oil palm and forestry technology in Malaysia has immensely added value to the production chain of such products. What is even more encouraging is that R&D is industry wide and
funded by industry in the case of biofuel. In high technology, the success of the Industrial Technology Research Institute (ITRI) in Taiwan is well worth emulating by developing countries. ITRI is a primary R&D centre for industry in Taiwan. In 1973, when ITRI was founded, there was very little high-tech industry in Taiwan. Today, Taiwan is a world-class player in semiconductors, personal computers, and many other high-tech sectors. ITRI has played a significant role in this transformation.

9.2 Brain Drain

Currently, there is a disturbing worldwide trend that enrolment in engineering courses in universities is declining. This has been particularly evident in developed countries with the related phenomenon of closure of engineering departments in universities and institutions of higher learning. The situation of science courses is no better. As a result, developed countries have been exercising the prerogative of the “Rich” by recruiting scientists, engineers and technologists from the developing countries. The Western-oriented higher education systems in developing countries are thus ideal for developed countries.

Most developing countries thus suffer on three counts. First, they do not produce enough scientists, engineers and technologists for their own requirement as their education and training infrastructure is inadequate to cope with the growing demand. Secondly, they expend scarce hard foreign currency in sending their students for expensive S.E.T courses in developed countries. Thirdly, there is the constant S.E.T drain, usually the best and the brightest, to the developed countries.

According to WTO, towards the end of the 20th century, a significant number of individuals with tertiary education have been leaving countries such as Iran, Chinese Taipei and the Philippines. In many cases, developing countries are losing talented people who go abroad to study without returning home. In 1988, it was estimated that around 1,350 Koreans with PhD were working as scientists in the United States. The U.S. Senate cleared the way for an expansion of the number of visas for highly skilled foreigners by more than 300,000 over the period 1999 to 2001. The bill was aimed at meeting the acute shortage of staff in high technology industries. In 1998, the annual allocation of 65,000 visas was exhausted by May, reflecting strong demand in the computer industry and a decline in the number of U.S. undergraduate degrees in key science disciplines. By 2002, Western Europe is expected to face a potential shortage of 1.6 million staff in information technology sectors. With such scenarios of acute shortage of knowledge workers in the developed world, I am afraid brain drain from developing countries cannot be prevented.

In my opinion, solutions to overcome this critical shortage of S.E.T professionals in the developing world cannot be North-South but must be South-South. We can achieve this S.E.T South-South mobility, tapping from those countries where large population and large geographical spread or both, require the production of large number of S.E.T professionals to satisfy their
own development needs. Such countries include South Africa, India, China, Mexico and Brazil to name but a few.

Taking the mobility of professional engineers as an example, there are more than 2.0 million engineering students in universities in China with some 600,000 graduating as engineers each year. To increase this number by 10% would not strain the engineering educational resources of China but would be of great help to other developing countries. When the engineering qualifications from the above-mentioned major producers of engineers and technologists are accepted first regionally and then worldwide, these countries will provide accessible and affordable engineering education and training facilities for students from other developing countries. It is thus very much a win-win situation for the whole developing world.

However, accreditation and certification remain very much within the purview of government in developing countries. Barriers against South-South mobility of S.E.T professionals are formidable. South-South and global mobility can only be achieved through WTO, as WTO decisions are binding on member nations. On behalf of WFEO, I approached WTO, offering to work with them for worldwide mobility of professional engineers in relation to Agreements on Trade in Engineering and Construction Services. The General Agreements on Trade in Services (GATS) are very much part and parcel of the WTO Doha Trade for Development Agenda 2003-2006. This WFEO offer has received absolutely no response from WTO. We urgently need WTO member nations to put the mobility of S.E.T professionals as priority on the WTO negotiating table.

9.3 Higher Education Excellence in Developing Countries

In any discussion of higher education excellence in academies of the developing world, the benchmark is that of the best in the developed world. This is a natural and understandable human aspiration especially for university dons who were themselves graduates of Western university education. There is constant advocacy to turn vocational institutions into polytechnics, polytechnics into technical universities and technical universities into research universities and research universities to be ranked amongst the top research universities in the world. This is the great developmental disconnect between the educated elite and the stark reality of joblessness for post graduate researchers and graduates, aggravating the brain drain.

I would like to suggest that every developing country benchmarks its higher education excellence against its relevance and success in meeting the critical development challenges of the nation. Such “Fit for Use” measurements will be much more meaningful for employment creation and economic uplift of the developing world.

There must be corresponding financial encouragement and social recognition for such community based and development focused STI excellence in higher education, research and development and commercialization of innovations. The award of the Nobel Peace Prize to Professor Muhammad Yunus and his
Grameen Bank for the pioneering innovation of microfinance in poverty reduction in Bangladesh may well be the beginning of a new paradigm.

10 US NATIONAL ACADEMIES REPORT
“RISING ABOVE THE GATHERING STORM”

The US National Academies in 2005 published a report on the US competitiveness in the world economy, entitled “Rising above the Gathering Storm,” [www.nap.edu/catalog/11463.html](http://www.nap.edu/catalog/11463.html). The Report in its Executive Summary expresses deep concern that the scientific and technological building blocks critical to US economic leadership are eroding at a time when many other nations are gathering strength. Although many people assume that the United States will always be a world leader in science and technology, this may not continue to be the case inasmuch as great minds and ideas exist throughout the world. Because other nations have, and probably will continue to have, the competitive advantage of a low wage structure, the United States must compete by optimizing its knowledge-based resources, particularly in science and technology, and by sustaining the most fertile environment for new and revitalized industries and the well-paying jobs they bring.

The deep concern in the US National Academies is based on the following facts and statistics in higher education and research:

- In South Korea, 38% of all undergraduates receive their degrees in natural science or engineering. In France, the figure is 47%, in China, 50%, and in Singapore 67%. In the United States, the corresponding figure is 15%.
- Some 34% percent of doctoral degrees in natural sciences (including the physical, biological, earth, ocean, and atmospheric sciences) and 56% of engineering PhDs in the United States are awarded to foreign-born students.
- In the US science and technology workforce in 2000, 38% of PhDs were foreign-born.
- Estimates of the number of engineers, computer scientists, and information technology students who obtain 2-, 3-, or 4-year degrees vary. One estimate is that in 2004, China graduated about 350,000 engineers, computer scientists, and information technologists with 4-year degrees, while the United States graduated about 140,000. China also graduated about 290,000 with 3-year degrees in these same fields, while the United States graduated about 85,000 with 2- or 3-year degrees. Over the past 3 years alone, both China and India have doubled their production of 3- and 4-year degrees in these fields, while the US production of engineers has been stagnant and the rate of production of computer scientists and information technologists doubled.
- About one-third of US students intending to major in engineering switch majors before graduating.
There were almost twice as many US physics bachelor’s degrees awarded as in 1956, the last graduating class before Sputnik, than in 2004.

More S&P (stock-market companies) 500 CEOs obtained their undergraduate degrees in engineering than in any other field.

In 2001 (the most recent year for which data are available), US industry spent more on tort litigation than on research and development.

In 2005, only four American companies ranked among the top 10 corporate recipients of patents granted by the United States Patent and Trademark Office.

Beginning in 2007, the most capable high-energy particle accelerator on Earth will, for the first time, reside outside the United States.

Federal funding of research in the physical sciences, as a percentage of GDP, was 45% less in FY 2004 than in FY 1976. The amount invested annually by the US federal government in research in the physical sciences, mathematics, and engineering combined equals the average increase in US health care costs incurred every 20 days.

The study report puts forth the following four recommendations with appropriate action plans:

- Increase America’s talent pool by vastly improving K–12 science and mathematics education.

- Sustain and strengthen the nation’s traditional commitment to long-term basic research that has the potential to be transformational to maintain the flow of new ideas that fuel the economy, provide security, and enhance the quality of life.

- Make the United States the most attractive setting in which to study and perform research so that we can develop, recruit, and retain the best and brightest students, scientists, and engineers from within the United States and throughout the world.

- Ensure that the United States is the premier place in the world to innovate; invest in downstream activities such as manufacturing and marketing; and create high-paying jobs based on innovation by such actions as modernizing the patent system, realigning tax policies to encourage innovation, and ensuring affordable broadband access.

When the most powerful nation on earth sets itself the above objectives to maintain its STI leadership, the rest of the world will be profoundly impacted in terms of brain drain to US. The divides, whether wealth, STI, digital etc., will become wider. We in the developing world would do well to take note. Perhaps through collective South-South collaboration in emulation of the recommendations and action plans of the Report, we can arrest the widening of the divides.
11 MALAYSIA STI INITIATIVES FOR DEVELOPMENT

Malaysia has been advocating and practising the "Prosper Thy Neighbour" policy for many years. It is an ardent advocate of South-South Cooperation. It is therefore very easy to convince Professor Jeffrey Sachs to lobby Malaysia to be a donor in MDGs. Professor Sachs has been in regular touch with the Malaysian Prime Minister, Dato Seri Abdullah Ahmed Badawi, who is the Chair of the Organisation of Islamic Conference (OIC).

In STI, I have a committed ally in the Malaysian Minister of Science, Technology and Innovation, Dato Sri Dr Jamaluddin Jarjins who is also the Chair of the STI Committee of OIC.

I enumerate in this paragraph some STI initiatives to seek your support.

11.1 Promotion of History of Islamic S.E.T as the Heritage of Humankind

In line with developed countries, developing countries also face the serious problem of declining enrolment in science courses in secondary schools and universities. In this connection, I note with concern the negative attitude of male Muslim youth as they perceive S.E.T as western.

UNESCO mounted an impressive exhibition "Golden Age of the Arabic Sciences" in Paris 29 October 2005-19 March 2006 (www.unesco.org/pao/exhib/islam.htm). The exhibition has been widely praised, including in a special article in Time magazine. In conjunction with the Exhibition, UNESCO has been organizing a series of workshops on Arabic Science and Technology. As WFEO President, I wrote in 2005 to UNESCO with the proposal for an International Symposium on the History of Islamic Science, Engineering and Technology (S.E.T) on the back of the Paris Exhibition. The developing world has a glorious history and heritage in S.E.T, be it Islamic, Chinese, Indian, Egyptian or the Incan etc. Indeed, it was Islamic S.E.T with its algebra, astronomy, architecture and medicine etc. that sparked the European Renaissance through Islamic Spain. I argued that there is an urgent need to acquaint male Islamic youth of this glorious S.E.T heritage to revitalize their interest in S.E.T as important tools for poverty reduction, economic development and competitiveness. I further asserted that history is most useful when it can be used to point the way to the future. In S.E.T, it is important to also highlight the eminent Islamic scientists, engineers and technological industrialists that are carrying on the glorious Islamic S.E.T tradition. The symposium should therefore feature eminent Islamic scientists and engineers as role models for Islamic youth.

UNESCO accepted my proposal. The Symposium on the History of Islamic Science, Engineering and Technology was successfully held in UNESCO, Paris 16-17 March 2006 as the closing event of the Paris Exhibition. The Symposium was strongly supported by the Islamic World Academy of Sciences (IAS), IAP, IAC, TWAS, the Nobel Museum, and WFEO. Above all, Dato Seri Dr Jamaluddin Jarjis threw the support of the Malaysian government behind this initiative. He was the keynote speaker at the symposium.
In the opening address, Dr Walter Erdelen, UNESCO Assistant Director-General for Natural Sciences, stated that “This symposium is in line with the activities being implemented by UNESCO and its partners in the field of "dialogue among cultures and civilizations." The contributions of Muslim scholars are poorly understood in the West; that is also true in the Islamic world itself. Many people do not know, for example, that it was a leading Moslem scientist, Ibn Al-Haitham, who pioneered the pinhole camera, thus proving that light travels in straight lines. He also proved that vision occurs by means of light travelling into the eye and forming a point for-point image of a visual scene.

This symposium also aimed at agreeing on ways and means of sensitizing as wide an audience as possible about the significant contributions of Islamic civilization in various scientific and technical fields. The Islamic civilization was an important link in the cultural and scientific history of the occident. From the eighth century AD to the end of the fifteenth century, Islamic civilization was the leader in all fields of science, technology and medicine. The transfer of Arabic Islamic sciences to the West through various channels paved the way for the Renaissance and the scientific revolution in Europe. One of the objectives of this symposium was to bridge this knowledge gap and to present in an effective and visual manner the major achievements of civilization.”

In his keynote address, the Malaysian STI Minister pledged Malaysia’s commitment through his Ministry to follow through on the outcomes. IAP Co-Chair, Professor Yves Quéré, in his speech praised and welcomed this important initiative.

The Symposium drew together a most impressive array of international experts of the history of Arabic and Islamic science, engineering and technology. They included:

- Professor Len BERGGREN, Professor of mathematics and history of mathematics, University Simon Fraser, Burnaby, Canada;
- Professor Ahmed DJEBBAR, Professor of mathematics and history of mathematics, University of Sciences and Technologies of Lille, France;
- Professor Yvonne DOLD-SAMPLONIUS, Professor of Algebra and Islamic Architecture, Germany;
- Professor Mohamed EL FAIZ, Professor of History of Science, University Marrakech, Morocco;
- Professor Yusuf Al-Hassan GABARIN, Professor of History of Sciences, past Director of the Institute of History of Arabic Sciences, Aleppo, Syria;
- Professor Robert HALLEUX, Professor of History of Chemistry, University of Liege, Belgium;
- Professor Danielle JACQUART, Director of Research, C.N.R.S. France;
- Professor David KING, Professor of History of Astronomy, University of Frankfurt and Director of the Institute of History of Sciences, Goethe University; Frankfurt, Germany;
- Professor Jean-Claude MARTZLOFF, Director of Research, C.N.R.S. France;
• Professor Christian POCHÉ, Specialist of Arabic Music;
• Professor Georges SALIBA, Professor of Arabic and Islamic Sciences, Columbia University, USA;
• Professor Julio SAMSO, Professor of History of Astronomy, University of Barcelona, Spain; and
• Professor Jacques SESIANO, Professor of History of Mathematics, École Polytechnique, Lausanne, Switzerland.

The above experts richly and freely shared their knowledge and views on the contribution of Islamic civilization to the S.E.T heritage of the world. They expressed their deep concern on the current lack of interest in the study and preservation of this wonderful heritage of Islamic and Arabic S.E.T as well as on the sad state of S.E.T in Islamic countries in contrast to their rich S.E.T heritage.

The symposium concluded with a roundtable that was organized in close cooperation with the World Federation of Engineering Organizations and the Islamic World Academy of Sciences (IAS) entitled "From Scientific Heritage to Contemporary Science and Beyond." The roundtable was chaired by Dr Mustafa El-Tayeb, UNESCO Director of Science Policy and Sustainable Development, and myself as WFEO President, The Roundtable emphasized the importance of building upon such a glorious heritage a prosperous S.E.T future in Islamic countries.

The deliverable outcomes from the symposium were:

• To incorporate the rich Islamic S.E.T heritage and the present day role models into the textbooks and curricula both in the developed world and the developing world, particularly Islamic countries;
• To incorporate historic Islamic S.E.T experiments in the IAP La Main a la Pate hands-on primary science education programme;
• To have a travelling exhibition of Islamic History of S.E.T. from the collection of Professor Fuat Sezgin, Frankfurt, starting with Kuala Lumpur in December 2006. There will also be a follow-up symposium of the History of Islamic S.E.T in Kuala Lumpur;
• To rescue research centres in History of Islam S.E.T in Western universities from closure. Malaysia is establishing the Professor Fuat Sezgin Chair of Islamic History of S.E.T in University Technology Malaysia;
• To organize subsequent conferences on North East Asian (Chinese, Japanese, and Korean), Indian, African and Latin American S.E.T heritage; and
• To encourage developing countries to nominate their significant S.E.T installations for UNESCO heritage listing.
11.2 UNESCO International South-South Centre for Science, Technology and Innovation, Kuala Lumpur, Malaysia

During the above Symposium in Paris, Dr Walter Erdelen and Minister Jamaluddin Jarjis discussed the possibility of closer collaboration between UNESCO and Malaysia. It appeared that Heads of States and Governments of the Group of 77 and China, who met in Doha, Qatar, from 12 to 16 June 2005, on the occasion of the Second South Summit of the Group of 77, adopted the Doha Plan of Action. The Summit urged UNESCO to develop and implement a programme for South-South cooperation in science and technology with the objective of facilitating the integration of a development approach into national science technology and innovation policies; capacity building in science and technology through providing policy advice and the exchange of experiences and best practices; and creating problem solving network of centres of excellence in developing countries as well as supporting exchange of students, researchers, scientists and technologists among developing countries. Dato Sri Dr Jamaluddin Jarjis subsequently agreed to host an UNESCO International South-South Centre for Science, Technology and Innovation in Kuala Lumpur, as the Doha Plan of Action in STI conforms to Malaysia’s STI initiatives of promoting a strategy aiming at encouraging the uptake of science and technology in OIC and developing countries through the adoption of appropriate S&T policies, strategies, plans and programmes for human resources development.

Malaysia believes that UNESCO is well-placed to serve as a platform of international cooperation in science, technology and innovation policies. Malaysia therefore welcomes that STI activities in this area be conducted under the auspices of UNESCO. The UNESCO Centre is scheduled to be approved by UNESCO in April 2007. The Centre will be hosted by the Academy of Sciences, Malaysia.

11.3 UN Global Alliance for ICT and Development GAID and the Cyber Development Corps (CyDevCorps)

For basic infrastructure development and the nurturing of indigenous SMEs, developing countries would need a new paradigm in development focusing on appropriate technologies that favour indigenous resources. This approach would mean the development and utilisation of small-scale accessible and affordable installations, systems and services. In this endeavour, the key enabling technology is ICT.

The ICT revolution has heralded the dawn of the global knowledge economy through the Internet and E-commerce and related applications. The capital that matters most in the digital revolution is intellectual capital. Hardware costs are declining. The shift from hardware to software as the cutting edge of the industry helps to overcome what has been a major impediment to development - the shortage of finance. It improves the chances for poor countries to leapfrog some long and painful stages in the development process. Clearly the requisite
intellectual capital is not universally available, but it is far more widespread in the developing world than finance capital.

The UN has devoted considerable attention to ICT in recent years with the holding of two World Summits on Information Society (WSIS) first in Geneva 2003 and then Tunis 2005. At Tunis, the UN decided to establish the multi-stakeholder UN Global Alliance of ICT and Development (GAID) www.gaaid.org. YB Dato Seri Dr. Jamaluddin Jarjis decided in Tunis that Malaysia should take a leading role in GAID. He offered to host the UN GAID Launch in Kuala Lumpur. On 19 June 2006, GAID was duly launched in Kuala Lumpur by the Prime Minister of Malaysia in the presence of UN Deputy Secretary-General, Mark Malloch Brown. Dato Seri Dr Jamaluddin Jarjis was elected co-chair of GAID Steering Committee with Malaysia spearheading the pioneering GAID initiative, the Cyber Development Corps (CyDevCorps). CyDevCorps is designed to send ICT savvy volunteers to set up ICT and Internet facilities in rural communities in the developing world.

At the first GAID Steering Committee meeting at the UN New York on 27 September 2006, the CyDevCorps was designated as a GAID Flagship project with secretariat in Kuala Lumpur. The meeting was opened by UN Secretary-General Kofi Annan and chaired by Craig Barrett of Intel.

I arranged for Dato Sri Dr Jamaluddin Jarjis to meet up with Professor Jeffrey Sachs in New York. They agreed to explore the engagement of CyDevCorps volunteers in Millennium Villages in Africa.

12 CONCLUSION

Developing countries need to review their STI higher education systems to fit the development needs of their own countries in employment and wealth creation and general social and economic uplift. Their higher education excellence should be benchmarked on the success in meeting the above challenges.

The top STI professionals in developing countries as represented by academies of sciences, engineering and medicine should take a leaf out of the US National Academies in offering pertinent STI advice to their governments on issues of STI competitiveness, brain drain and South-South collaboration. Above all, they must engage themselves hands-on in MDG-related development projects.
## ANNEX 1
### Millennium Development Goals and Targets

| Goal 1: Eradicate extreme poverty and hunger | Target 1: Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day  
  Target 2: Halve, between 1990 and 2015, the proportion of people who suffer from hunger |
| Goal 2: Achieve universal primary education | Target 3: Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling |
| Goal 3: Promote gender equality and empower women | Target 4: Eliminate gender disparity in primary and secondary education, preferably by 2005, and to all levels of education no later than 2015 |
| Goal 4: Reduce child mortality | Target 5: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate |
| Goal 5: Improve maternal health | Target 6: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio |
| Goal 6: Combat HIV/AIDS, malaria and other diseases | Target 7: Have halted by 2015 and begun to reverse the spread of HIV/AIDS  
  Target 8: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases |
| Goal 7: Ensure environmental sustainability | Target 9: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources  
  Target 10: Halve, by 2015, the proportion of people without sustainable access to safe drinking water  
  Target 11: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers |
<table>
<thead>
<tr>
<th>Goal 8</th>
<th>Develop a Global Partnership for Development</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Target 12:</strong> Develop further an open, rule-based, predictable, non-discriminatory trading and financial system</td>
</tr>
<tr>
<td></td>
<td><strong>Target 13:</strong> Address the Special Needs of the Least Developed Countries</td>
</tr>
<tr>
<td></td>
<td><strong>Target 14:</strong> Address the Special Needs of landlocked countries and small island developing States</td>
</tr>
<tr>
<td></td>
<td><strong>Target 15:</strong> Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term</td>
</tr>
<tr>
<td></td>
<td><strong>Target 16:</strong> In co-operation with developing countries, develop and implement strategies for decent and productive work for youth</td>
</tr>
<tr>
<td></td>
<td><strong>Target 17:</strong> In co-operation with pharmaceutical companies, provide access to affordable, essential drugs in developing countries</td>
</tr>
<tr>
<td></td>
<td><strong>Target 18:</strong> In co-operation with the private sector, make available the benefits of new technologies, especially information and communications</td>
</tr>
</tbody>
</table>

Selangor as a Model of a Developed and Progressive Islamic State of Malaysia in Education and Research

ABDUL LATIF IBRAHIM
Universiti Industri Selangor
Malaysia

1 ABSTRACT

Selangor is the first state in Malaysia to have fulfilled Malaysia VISION 2020 when Malaysia is projected to be a developed country by the year 2020. As a developed state within Malaysia, Selangor plans to become the centre for education and research in science and technology by focusing on biotechnology, life sciences and information technology. Selangor has implemented a range of activities aimed at developing Selangor as the centre for biotechnology and life sciences especially for the Islamic world. In this respect, Selangor has established an International Islamic Academy for Life Sciences and Biotechnology (IIALSBI), an organization that will foster, facilitate and coordinate the participation of Islamic scientists and students in biotechnology and life sciences through existing resources, facilities and infrastructures in Selangor.

The Academy has been established as a virtual organization made up of a consortium of both public and private universities and research institutions and industrial organizations in Selangor. The term virtual refers to that the academy has a main office which acts as clearing house. The academy is managed by Bio-IT Centre Selangor in collaboration with the Life and Environmental Sciences Division of University of Oxford under the Selangor - University of Oxford Bioalliance Programme (SOBA). The result of the collaboration between Selangor and the University of Oxford illustrates and highlights the desire and willingness of distinguished and outstanding international institution to share experiences and expertise for the advancement of Islamic scientific communities. This project is part and parcel of Selangor’s plan to develop the state as a leading international centre for Islamic education, research and business. The ultimate aim of the programme is to enable Selangor to participate in harnessing the benefits of biotechnology and life sciences for the benefit of Islamic Ummah.

* Fellow of the Islamic World Academy of Sciences.
2 INTRODUCTION

H.E. Tun Dato’ Seri Dr Mahathir Mohammed the former Prime Minister of Malaysia in his speech at the Congress entitled ‘Towards Reviving the Golden Age of Islam’ organized by IKIM stated – quote:

If at one time Islam could create an outstanding civilization, can Islam today once again create another civilization just as outstanding? Those who are rational are confident that this is not an impossible task. Its achievement is surely not easy. It will definitely take time. But then no targets can be met if no attempt is made to reach it. Everything begins with the first step. The first step that needs to be taken is to determine our target, which is to define what is meant by success and prosperity.

Every Muslim is surely keen in reviving the golden age of Islam. The problem lies in how we can achieve this objective. It is certain that if we continue our present practices, and if we do not strive towards that direction, there is the chance that we will be left far behind.

Life sciences and biotechnology are widely recognized as the next wave of the knowledge economy. The knowledge base of life sciences and biotechnology are creating new application in health care, agriculture and food production, environmental protection as well as new scientific discoveries. The expansion of the knowledge base is accompanied by transformation of scientific discovery into practical use and products. This will bring about new wealth creation, regenerating old industries and offering new jobs to sustain the knowledge based economies. It is essential that the Muslim communities develop skills and capabilities in harnessing the potential of life sciences and biotechnology for food and water security, better health and wealth creation. This can be achieved through the collaborative efforts of the international Islamic life sciences and biotechnology community by creating mechanisms that can bring them together. Life sciences and biotechnology will be the science and technology that will promote the scientific and technological advancement of the Muslim community.

3 SELANGOR: A MODEL OF A DEVELOPED ISLAMIC STATE

Selangor as one of the 13 states in Malaysia plans to play an important role in the development of biotechnology and life sciences in Malaysia by capitalising on existing strengths and opportunities. Selangor will develop the climate for wealth creation and social well being and provide the complementary and catalytic role for the national science agenda. Selangor boasts world class communication, transport and energy infrastructure as well as educated population and skilled multilingual workforce. Selangor is not only a great place to live but also a perfect location for biotechnology research and education particularly in agriculture. Selangor has an impressive research and education infrastructure which includes 7 universities.
including Selangor State University, Universiti Industri Selangor, 5 research institutes and a number of world class hospitals. Selangor is the first state in Malaysia to achieve Malaysia VISION 2020 when Malaysia is projected to be a developed country by the year 2020.

Selangor plans to develop a vibrant biotechnology industry by focusing not only on education and research but also on entrepreneurial development skill. It is the mission of Selangor to make the state as the centre of excellence for education, research and entrepreneurship in biotechnology and life sciences. Our main strategy is the training of our future entrepreneurs and managers who can turn science and technology into commercial outcomes. Selangor will implement a range of activities aimed at developing entrepreneurial skill among the SME and biotechnology firms through:

1. Entrepreneurial skill programs and business planning;
2. Technology incubators; and
3. Support for the development of industry clusters and international strategic alliance.

In order to achieve the vision, Selangor as the centre for biotechnology education and business in Malaysia, Selangor Government in 2003 approved a policy document known as Selangor Biotechnology Strategy (SBS).

The mission of SBS is:

- To capitalize on the biotechnology opportunities that are available in the public and private sector and to utilize these opportunities for the development of the economy of Selangor for wealth creation and improvement of the quality of life.

The goals of the SBS are:

- To attract investors and partners to participate in the development of the biotechnology industry in Selangor;
- To facilitate the commercialization of biotechnology-based products developed at universities and government agencies through networking and partnership with industry, and products developed by the SME through entrepreneurship development programme.

The SBS focuses on 5 strategic areas:

- The formation of state Biotechnology and Biodiversity Council, networking of biotechnology institutions in Selangor and creation of a biotechnology innovation and entrepreneurial centre – BioIT Selangor;
- Promotion of entrepreneurship and commercialization;
- Generation and exploitation of knowledge through R & D;
- Strategic alliance;
- Sustainable utilization of genetic resources.
The government is committed to working in partnership with industry in Selangor to ensure the commercialization of research into new products and services. This will include attracting international organizations to undertake research, development and commercialization projects on a large scale on their own behalf or attracting companies to collaborate with local companies and universities. To facilitate the participation of the industry in Biotechnology, Selangor will develop a biotechnology park known as Selangor Biovalley Corridor which is located next to the former Biovalley Malaysia. One of the main activities of Selangor Biovalley Corridor is the establishment of BioIT Centre Selangor, an integrated Biotechnology and Information Technology Park. BioIT Sel is an innovation and enterprise centre established by Universiti Industri Selangor (UNISEL) under the SBS with ICT infrastructure to facilitate and accelerate the development of biotechnology.

It will be a centre for education and learning, research, entrepreneurship and business development for the small and medium enterprise, information and networking. The objective of BioIT is to develop the manpower requirement of the biotechnology industry in Selangor through learning, education, research, strategic alliance and outreach program and to facilitate the participation of SMEs in biotechnology in Selangor by providing the necessary infrastructure and services and development of biotechnology. This is part of SBS plan to synergize biotechnology with information technology. The co-location of the Biovalley Corridor and the Multi-Media Super-corridor (MSC) in Selangor will see the convergence of biotechnology and information technology which is unique to Malaysia. The MSC will provide the advanced critical information and communication technologies to support information discovering, modelling and remote partnership essential for advancing life sciences and biotechnology within Malaysia.

Selangor will utilise its marine bio-resources for research and development. Selangor is rich in bio-resources and is considered as one of the twelve mega biodiversity countries in the world. The marine ecosystem is rich in a variety of life forms. The coral community is considered to be very diverse. One can view Selangor as having a large reservoir of assets that has yet to be tapped. These assets require exploration and intensive studies in terms of research and development in order to make available to the rest of the world the benefits of biotechnology such as cheaper and efficacious drugs derived from the marine bio-resource. It is against this background that Selangor has established the marine research station at Pulau Jemor off the coast of Kuala Selangor, an area that has been earmarked for marine biotechnology and biodiversity research and development.

4 SELANGOR INTERNATIONAL ISLAMIC AGENDA

As a developed Islamic state, one of Selangor’s major missions is to revive the glory of the golden age of Islam. This can be achieved by mobilising Muslim scholars, scientists, researchers and students and provide them with an infrastructure and facilities that promote them to advance research and
education in sciences and technology. What is needed is an organization and infrastructure that can offer scientists and students access to advanced research facilities and equipment to conduct leading edge research whose outcomes are essential towards industrial competitiveness of the Muslim countries. To facilitate the development of advanced research and education programs, an International Islamic Academy of Life Sciences and Biotechnology has been established in Selangor. The academy will make use of infrastructure and facilities that are available in universities and research organizations in Selangor. The International Islamic Academy for Life Sciences and Biotechnology will be the coordinating centre to advance research and education for the benefit of Malaysia, the Muslim Ummah and mankind.

The idea of establishing an international network of Muslim scientists in the area of Life Science and Biotechnology was first conceived by Prof. Abdul Latif Ibrahim when he was the Managing Director of the National Biotechnology Director, Malaysia. The idea was further augmented by scientists and entrepreneurs from Selangor, MIT, University of Oxford and the University of Cambridge who recognized the need for an academy to coordinate and facilitate education, training and research in life science and biotechnology for the international Islamic scientific community. The idea was also in line with Selangor development’s agenda which is to be the model of a progressive Islamic economy. The Academy has been established as a virtual organization through a consortium of both public and private universities and research institutions and industrial organizations in Selangor. The consortium will be extended to other institutions in Malaysia. To facilitate and enhance its international activities, the centre will establish and foster networking with international academic and research institutions from the Muslim and Non Muslim countries or individual scientists. The academy is managed by Bio-IT Centre Selangor in collaboration with the Life and Environmental Sciences Division of University of Oxford under the Selangor- University of Oxford Bioalliance Programme (SOBA). The result of the collaboration between Selangor and the University of Oxford illustrates and highlights the desire and willingness of distinguished and outstanding international institutions to share experiences and expertise for the advancement of Islamic scientific communities. The academy will be in line with the concept of ‘Islam Hadhari’ promoted by the former Malaysian Prime Minister Badawi.

5 ELEMENTS OF THE IIALSB

5.1 Vision

Selangor as the centre of excellence for research and education in life sciences and biotechnology for the Muslim Ummah and mankind.
5.2 Mission

To mobilize the talent of Muslim scholars, scientists and students to advance education and research in life sciences and biotechnology for the benefit of Malaysia, the Muslim community and mankind.

5.3 Objectives

a) To serve as the international centre for life sciences and biotechnology where Muslim scientists and students can participate in Malaysia’s research and development and education program;

b) To provide access to advanced research facilities and equipment for world class Muslim scientists to conduct research that is critical to the Muslim world and essential to mankind;

c) To stimulate fundamental and applied research that can lead to discoveries and inventions, and international recognition of Muslim scientists' contributions;

d) To train Muslim scientists and students in areas of life sciences and biotechnology that is critical to the advancement of the Muslim Ummah and mankind;

e) To act as a forum for exchange of ideas among the international scientific community, policy makers, industrialists and international organizations through periodic conferences, seminars, workshops and short training courses.

5.4 Goals

a) To enhance the quality of life of the Muslim Ummah through food and water security and protection of health and environment;

b) To attain international recognition in life sciences and biotechnology for Muslim scientists and scholars and Malaysia - as the host nation;

c) To ensure that both Malaysia and Muslim scientists acquire the expertise and capability in developing and acquiring innovative scientific knowledge and critical technologies;

d) To build collaborative relationships among Muslim and non Muslim scientists.

6 ACTIVITIES

The IIALSB will focus on 3 main activities:

6.1 Research

The IIALSB will facilitate a multi-disciplinary research programme in life sciences and biotechnology with emphasis in agro-biotechnology, nutraceutical
and pharmaceutical biotechnology and molecular biology. The objective of the research program is to stimulate leading edge fundamental and applied research that promotes the participation of the industry. The research activities will be developed on existing strength and facilities that are available in Malaysia and participating international organizations.

6.2 Education

The Academy will provide opportunities for scholarly development in life sciences and biotechnology for the Muslim Ummah. The Academy will promote and facilitate post-graduate and post doctoral research programmes on scientific problems related to life sciences and biotechnology.

6.3 Service

The Academy will provide facilities for use in research in life science and biotechnology through the consortium of universities and research institutions. It will promote outstanding Muslim scientists in research programs that will benefit Malaysia and the world scientific community.

7 PROGRAMMES

To implement the above activities IIALSB has developed two major programmes:

7.1 Selangor BioAlliance (SELBioA)

Selangor BioAlliance (SELBioA) is a national programme to foster and facilitate cooperation among universities in Selangor to advance education and research in life sciences and biotechnology. Each participating university is recognised for its expertise in life sciences and biotechnology. The combined activities of participating universities constitute the Biotechnology Centre of Excellence Network (BioCE Net) Selangor. The main functions of BioCE Net are education, research and outreach to promote collaboration with the industry.

7.2 Selangor –University of Oxford Bioalliance (SOBA)

Selangor –University of Oxford Bioalliance (SOBA) is an international biopartnership programme between Selangor and the University of Oxford to facilitate and enhance the development of life sciences and biotechnology for the mutual benefit of Malaysia, Oxford and Islamic countries. Among the activities that have been identified are post-graduate training, joint research project and an international bioforum to promote cooperation and foster understanding of Muslim thought and perception of life sciences and biotechnology among world scientific communities.
8 BENEFITS TO MALAYSIA AND MUSLIM UMMAH

a) Accelerate the development of biotechnology in Malaysia through the participation of world renowned scientists and entrepreneurs;
b) Attain international recognitions for excellence in research and education in life sciences and biotechnology;
c) Assist Muslim countries acquire capabilities in harnessing the potential of biotechnology to improve the quality of life;
d) Provide opportunities for Malaysia and the international Muslim community to pursue graduate and post-doctoral training in life sciences and biotechnology under the supervision of outstanding scientists and scholars;
e) Increase cooperation and communications between Malaysian scientists and Islamic world scientific community through the consortium programme of the Academy;
f) Develop networking among Muslim countries in life sciences and biotechnology;
g) Generate sufficient highly skilled workforce and a conducive environment that will be an incentive to attract biotechnology and life sciences companies to Malaysia;
h) Create peace, harmony, tolerance and make the world a safer place to live in through science and technology.

9 CONCLUSION

9.1 The International Islamic Academy of Life Science and Biotechnology represents a new initiative for Malaysia’s programme in life sciences and biotechnology. Malaysia through Selangor will take a pro-active approach to harnessing the potential for biotechnology by utilising the expertise that are available among the Muslim Ummah and taking advantage of existing strengths and opportunities of biotechnology in Selangor and Malaysia. The result of this initiative will be the creation of forward looking educational and research programme, accelerated development of education and monitory skills, broadening research and learning environment and enhanced educational quality. Such an initiative will not only benefit Malaysia but also the Muslim Ummah.

9.2 Malaysia has many of the critical success factors that will facilitate the establishment of the IIALSB and this include:

i) Strong support by government on biotechnology through the National Biodiversity and Biotechnology Council chaired by the Rt. Hon. Prime Minister of Malaysia;
ii) A good infrastructure for research and education including the proposed BioValley Corridor Selangor and Multimedia Supercorridor (MSC);

iii) Malaysia’s standing in the Muslim World;

iv) Malaysia’s linkages with outstanding international organization such as MIT, University of Cambridge, University of Oxford, Genome Valley of India; and

v) Selangor as a model of a developed Muslim State

9.3 This initiative will accelerate the development of biotechnology and life sciences through:

i) Training of human resources;

ii) Stimulating local and foreign investment;

iii) Secure intellectual property rights;

iv) Improved infrastructure;

v) Remain competitive, regionally and globally;

vi) International recognition;

vii) Stimulate economic activity, growth and improve and enrich Malaysian quality of life in terms of health, the environment, and social and economic development.

9.4 The initiative will also assist in the progress of biotechnology and life sciences in the Muslim world through:

i) The Academy will act as the seat of learning and education for international Islamic community in biotechnology and life sciences;

ii) To provide opportunities for international Muslim scientists and students to participate in research leading to discovery and invention that can benefit mankind;

ii) To act as forum for interaction among Muslim scientists and between Muslim scientists and world scientific communities to improve the quality of life through sciences and biotechnology; and

iv) To place Muslim scientists in the forefront of science and technology.

9.5 Selangor is committed to working in partnership with international organisations especially universities and research organisations and to play an important role in the development of biotechnology in the Muslim world. It has established a bioalliance with the University of Oxford in education and research and will collaborate with the University of Cambridge in industrial biotechnology research through the application of genome science utilising the principle of green chemistry. It will work very closely with the National Biotechnology Division MOSTI and will participate in MOSTI’s (the ministry) biotechnology programme. Selangor is looking to the Islamic World Academy of
Sciences (IAS) as a partner and mentor in the development and implementation of IIAJSB’s programmes. The ultimate aim of the Selangor Biotechnology and Life Sciences programme is to complement the National Biotechnology Policy and to play a major role in the development of biotechnology and life sciences in the Muslim World.

10 ACKNOWLEDGEMENT

This paper is prepared by Prof. Emeritus Dr. Abdul Latif Ibrahim in consultation with academics associated with SelBioA, and Prof A. Sinskey from MIT, Dr John Archer from University of Cambridge and Prof. M Dawkins from University of Oxford. Prof. Latif could be contacted at alatifbio@yahoo.com. He is senior professor at Universiti Industri Selangor, Malaysia and biotechnology advisor to the Selangor State Government.
REFERENCES


Active Learning in Physics: 
A Way for Education & Development

ZOHRA BEN LAKHDAR
Department of Physics, Faculty of Sciences-
Tunis, Tunisia

1 ABSTRACT

The importance of science in the development of societies is largely recognized as leading to what we call now the ‘Knowledge Society.’

The knowledge, based on rationality and scientific behavior, takes its origin in the experimental approach introduced by Ibn el Haythem (965-1040) in optics. By the end of the last millennium this approach-known as Active Learning has been adopted in most developed countries in physics education programs. UNESCO has decided to extend Active Learning to developing countries and experienced the approach in Ghana, Tunisia and Morocco.

2 SOCIETY OF KNOWLEDGE

Modern life depends increasingly on science-based technology, or rather on physics-based technology (laser systems, computer science, mobile phones,…).

Nowadays, the world is more and more controlled by science:

- Matter is observed from nanostructure to the universe structure;
- Speed is getting more and more rapid trying to reach the light speed; and
- Energy sources are becoming more and more powerful.

Moreover,

- At the start of the second millennium, the Earth was the centre of the universe. Nothing resembling an accurate map of any existing continent. At the start of the 3rd millennium, a hand-held Global Positioning System (GSM) satellite receiver can pinpoint its owner’s location anywhere on the face of the globe!
- Atoms could be seen, their dynamics controlled and new matter is created;
- DNA blueprint of life is decoded. We learn to manage the deployment and expression of genes;
- More than 100 exo-planets are discovered;
- We look for extraterrestrial life.
The world today is a knowledge based society, a society of Know-How; the culture of which is mainly science. This culture, without frontiers is universal with global dimensions. Science is present everywhere in our environment and is at the heart of the functioning of our society.

3 BUILDING SCIENCE CULTURE

Still, it lies beyond all reasonable doubt that no single idea has had a more profound or ubiquitous impact on what the human race has become, or what it has worked upon the face of the planet, than the vesting of authority in experiment. (R. Power (1999)).

How this did happen?

Abu Ali al-Hassan Ibn al-Haythem (965 - 1040), the father of the rise of the experimental method is considered as the scientist of the second millennium (R. Power 1999). Ibn al-Haytham solved a tremendous scientific debate (Euclide, Ptolémée, ..) that had remained deadlocked for more than 800 years about the mystery of vision and its interpretation that light necessarily travels from the eye to the observed object. He invited observers to stare at the sun and the result was: the eye can be burnt. The conclusion was shared by all participants that light starts outside the eye and reflects into it, removing with a single observation the very well established systematic theory. Direct observation, controlled looking, experiment... remain the best ways leading to “Knowledge.”

For if any man who never saw fire proved by satisfactory arguments that fire burns . . . his hearer’s mind would never be satisfied, nor would he avoid the fire until he puts his hand in it ...that he might learn by experiment what argument taught.” F. Bacon (1561-1626).

4 SCIENCE AND DEVELOPMENT

Science is rational thinking with codes of behaviour. This is the way that science functions. In “The Advancement of Learning” (1605), F. Bacon wrote, “If a man will begin with certainties, he shall end in doubts, but if he will be content to begin with doubts, he shall end in certainties.”

Scientists in their quest for new knowledge do not know what is relevant. Scientists are continuously looking for the unknown, for the truth. Their beliefs are: Tentative, not dogmatic; they are based on evidence, not on authority or intuition according to B. Russell (1910). This way leads to the advancement of knowledge, to the development of new concepts, new tools and techniques.

New concept means new truth! Gravity, Relativity, Quantum Mechanics are concepts which have changed the way we think. But this change is shared –
according to Ibn el Haythem- because it was tested experimentally and the predicted phenomena were observed.

These new concepts and new tools lead to development. That means the creation of new technologies that drive scientific research and lead to a constantly increasing control of the material world from the atom to the universe.

This development has changed our environment, and led to a “knowledge economy.” To deal with this change, multinational institutions are increasingly aware of the need for a ‘knowledge focus’ in their new strategies. The World Bank has been reframed as “Knowledge Bank” since 1996 according to D. Stone et al. Moreover, the World Development Report -1998- of the World Bank concluded that: “Knowledge has perhaps become the most important factor determining the standard of living.” This development is not only governed by basic research and technology improvement, but also by involvement of the society.

5 STATE OF SCIENCE EDUCATION IN DEVELOPED COUNTRIES AT THE END OF THE SECOND MILLENNIUM

While modern life depends increasingly on science and technology transfer (mobile, laser systems, multimedia...); we notice, at the end of the second millennium, the following:

- The number of students in Mathematics, Physics and Engineering in the developed countries is decreasing. Figure 1 shows the percentage of students’ evolution in the US according to the National Science Foundation (NSF) records.
- Figure 1 shows also students’ choice oriented to the modern activities sectors close to their environment and directly related to their life needs (telecommunication, informatics, microelectronic, biology ...).
- Figure 2 shows the tendency in the students ‘choice towards the high professional activity income.
- Figure 3 reveals the alarming situation of Physics Sciences students’ enrolment in the developed world institutions (T. Feder) in the 90s.
Figure 1. Relative change in Bachelor’s degrees awards since 1986.

Figure 2. Student choice of scientific disciplines (US Degrees) follows federal R&D funding patterns (1950-2000).
This situation caused reactions from US National Academies of Science, National Research Council, and the CNRS in France. Indeed there is a lack of attention paid to education:

- The Physics teacher career is about 40 years during which physics is changing and developing. Continuous professional training and updating are then required;
- Physics education and research should be popularised as well as other science disciplines; and
- The challenge requires a new methodology of teaching: “Active learning” (inspired by L.C.M.c.Dermott) or “Main à la pâte”, inspired by Nobel Laureate from France; G. Charpak.

6 ACTIVE LEARNING IN PHYSICS (ALP)

Active Learning in Physics (ALP) is an innovative procedure of physics teaching, developed over the last decade. It has demonstrated in the US and other developed countries its capacity to enhance student understanding of basic physics concepts (D.Sokoloff) with a result of a sensible increase of physics students’ enrolment (Figures 2&3) at the beginning of the 3rd millennium.

With this learning strategy, a student is guided to build up his knowledge of physics concepts by direct observations of the physical world with hands-on activity. ALP is considered as the best way for keeping the teaching of physics up to date.
7 ACTIVE LEARNING IN PHYSICS EXPERIENCES IN DEVELOPING COUNTRIES

7.1 General

In 2003, the UNESCO, under its Physics Programme/Division of Basic and Engineering Sciences, launched a Project on “Active Learning in Physics in Developing Countries.” This project, made up by M. Alarcon, aimed at promoting innovation in physics education in the developing countries. It was developed for the benefit of universities and senior high school physics teachers. It aimed at training teachers to use innovative approach of Active Learning in teaching physics through a series of workshops.

After a preparatory workshop in Manila, Philippines, the first workshops in Mechanics and Optics-Photonics took place in Ghana (2003-2004), ALOP (Active Learning in Optics and photonics) 2005 in Tunisia, 2006 in Morocco, 2007 in New Delhi, and 2008 in Brazil.

7.2 Why ALOP?

The project focussed on Optics and Photonics considered as an area of experimental physics adaptable to research and education conditions in many developing countries. Optics has been termed as an “enabling science” because it constitutes the basis of many modern advances in different sectors of technology (communication, information, transportation, manufacturing, environment control, monitoring, health, medicine...). Thus, the new century is entitled the “Age of Photonics.”

The project is developing an activity based on teacher training curriculum covering the following themes:

- Introduction to Light and Geometrical Optics;
- Optics of the Eye;
- Interference Diffraction and Spectroscopy;
- Environmental Optics; and
- Optics in Communication.

Courses include many activities with appropriate instrumentation. Inexpensive equipment and local materials are largely used. A team of experts (from the 5 continents) prepare the courses and materials and supervise the workshops which are organized via an international working group consisting of representatives from the UNESCO, the International Centre of Theoretical Physics (ICTP), International Society for Optical Engineering (SPIE), and the Optical Society of America (OSA).
The workshop is open to different levels of participants: *technicians, high school teachers, researchers, teaching staff from universities.*

![Image of a workshop session](image)

**Figure 4: Active learning session.**

The workshop is held for about forty participants from ten different countries. During the training sessions, participants work in small groups using the equipment and materials available. Each one has to:

1. Predict, present and talk about predictions;
2. Observe, present and talk about observations;
3. Exchange ideas and synthesize

The participants get benefit from ALOP by acquiring new ideas in physics teaching. They do have the opportunity to interact with education experts from...
both developed and developing countries and exchange ideas about the
importance of sharing knowledge. This opportunity can also provide them with
the ways of solving the difficulties that may encounter students in physics.
Active learning workshops led to the conclusion from all participants that this
approach is an efficient process of training people’s minds and abilities so that
they can acquire knowledge and develop skills. They also realise that local
fabrication of materials is feasible and a large number of ALOP courses have
been effectively done without any expensive equipment.

9 CONCLUSION

Active Learning can be considered as the suitable way for teaching efficiently
Physics in most developing countries.
REFERENCES


5. Sokoloff, D., 2006. Active Learning in Optics and Photonics. Training Manuel- UNESCO.
Data Banks and Databases for Concerted Progress, International Information Exchange and Special Advanced Education

SYED MUHAMMAD QAIM*
Research Centre Jülich and University of Cologne
Germany

1 ABSTRACT

Scientific and technological progress can be accelerated through the pooling of all available resources at the national, regional and international levels. Increasing demand for high quality and reliable data calls for the establishment of standardised procedures as well as the development of databases which can be easily accessed by all authorised users. Data banks are establishments for the storage, common management and dissemination of important data. Two types of intergovernmental institutions are considered in this contribution: a data bank of the OECD-NEA in Paris, established primarily for the benefit of advanced countries, and a data centre of the IAEA in Vienna, overseeing databases created for use by all, including developing countries. Data exchange modalities at the international level are discussed and the educational role of international data centres is outlined.

2 INTRODUCTION

A bank is defined as an institution, or a centralised unit of a large institution, for the deposit, storage and refund (or dissemination) of the assets, with some profit or advantage to its benefactors. It could involve monetary transactions, goods for humanitarian use, charity funds for development, standard and reference materials, personal details of employees in a firm, criminal records, or technical know-how and related data. They constitute establishments like a commercial bank, blood banks, international monetary fund (IMF), specimen banks, etc.

An establishment dealing with technological knowledge is often termed as a data bank. In principle, a data bank could be multidisciplinary, i.e. data relevant to all fields of sciences could be handled in one institution. However, in practice, it is more effective to have discipline-oriented data banks, e.g. medical data bank, biological data bank, chemical data bank, nuclear data bank, etc.

A data bank may entail a purely national effort and therefore be exclusively for national use. On the other hand, it is becoming customary to pool resources
together and to establish international data banks. This is expected to be not only more economical but also more effective for concerted progress. In this article, the working of a typical discipline-oriented international data bank in Paris is discussed in some detail.

A database represents a set of data, well organised and documented, that is easily available for use. It generally deals with one specific topic, e.g. physical, chemical, biological or nuclear properties. If a large number of databases are handled by one organisation, with different types of services, the working scope may then be comparable to that of a data bank. As an example, the preparation of databases and their dissemination under the auspices of an IAEA-nuclear data centre in Vienna is discussed.

3 DATA BANKS

3.1 Need for Establishment

The vast majority of data available in original research publications is often scattered throughout the literature and may not be easily accessible. For practical applications, such as the construction of a unit operation in an industrial process, the development of a production route of a chemical product, the construction of an accelerator facility, or the construction of a safe nuclear reactor for research purposes, a large amount of data is needed. The compilation, selection and management of all the relevant data are beyond the capacity of small research and development groups; therefore it is imperative to establish a central depository for the handling and storage of those data.

In this connection, it is necessary to pool together the available resources and to establish data centres or data banks. Large nations like the USA, and to some extent the Russian Federation, have their own data centres, but smaller nations, with less resources, often endeavour to cooperate together. A good example is the Data Bank of the Nuclear Energy Agency (NEA) of the Organisation for Economic Cooperation and Development (OECD) in Paris [1], which was established about 30 years ago and has functioned well since then. The idea was to share nuclear expertise with respect to nuclear power development. Its current membership consists of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan, South Korea, Mexico, Netherlands, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey and the United Kingdom. Most of the members belong to the EU, but other economically developed countries like South Korea and Japan also participate. The OECD provides only an umbrella, and not all the OECD countries participate in the activities of the Data Bank. A notable exception is the USA; which is a very strong member of the OECD, and yet does not participate in the Data Bank. It has its own data centres and banks [2]. Thus, cost/benefit considerations are important when founding or joining a data bank, rather than political affiliation or regional location.

194
3.2 Basic Requirements

The basic requirements for establishing a joint data bank are mutual trust and the strong will to cooperate. Not every nation can allocate the same amount of resources: bigger nations will have to contribute more and smaller ones less. Common will and concerted effort need to exist. There may be differences in the utilisation of facilities, and some countries may use a higher proportion of the services than their due share. Nonetheless, a pragmatic and healthy approach is needed to settle differences that may arise from time to time.

Another important requirement of a data bank is to establish and maintain high standards. Firstly, the computer system should be powerful, and the software, operating system and programming language need to be modern. Secondly, it is imperative that only those data sets that have been carefully evaluated and properly validated are deposited. In general, the user should be able to rely on the data provided by a scientific data bank. In many cases the data sets will need continuous upgrading, and the permanent availability of technical expertise at the data bank is essential.

3.3 Functions of a Data Bank

The functions of a science-oriented data bank, such as the NEA-Data Bank mentioned above, may be divided into four parts:

3.3.1 Compilation of data

Many primary journals publish new scientific information on various topics. A data bank lists the publications on a given topic and prepares a bibliography. It also processes those publications so that the most important data and relevant details are collected in an agreed format, i.e. in a format which is also used by other data centres and banks, so that easy exchange and transfer is possible.

3.3.2 Evaluation of data

Several groups working independently on the same problem may report data which differ slightly (or considerably) from one another. Under such circumstances, all the reported data need to be critically considered, scrutinising in particular the uncertainties, and arriving at some form of mean values (with uncertainty estimates). In this evaluation process, use is often made of theoretical calculations to support the recommended values.

3.3.3 Validation of data

The evaluated data are generally maintained in a data bank as a file or a library. However, before their release for general application, some sort of quality control test is mandatory. This is often done by comparing the data or derivatives of the data with the results of some integral test (termed benchmark) from various laboratories of member countries. The preparation of the
benchmark (with all the necessary specifications) is generally the responsibility of the data centre or the data bank. The coordination of the whole activity as well as the analysis of the results is also done by the staff of the data bank.

3.3.4 Data services

The major aim of a data bank is to provide high-class technical services to member states. These services may include supply of bibliographies of experimental data, dissemination of evaluated and validated data, and provision of computer programs and calculational codes for various applications. Occasionally, it is necessary to offer some training to users of new computer programs. Thus, some educational activities may also be required under the services programme.

3.4 Management of a Data Bank

Because of the international character of a scientific data bank, the management has to be modern, pragmatic and research oriented. Data banks should formulate their own programmes of work, keeping in mind their basic mandate, the primary needs of member states, as well as the worldwide developments in the field. The governing or supervisory body of the bank is generally constituted through persons officially nominated by the member states. This supervisory body meets periodically, reviews the ongoing activities, assigns them appropriate priorities, and after scrutiny, approves the annual budget of the data bank. As an example, the work of the Data Bank in Paris is supervised by an executive group, especially created within the Nuclear Science Committee (NSC) of the NEA for this purpose (see Chart 1). The NSC itself is a technical committee in charge of the NEA activities in the field of nuclear science.

3.5 Perspectives

As discussed above, the function of a data bank does not simply entail the compilation and dissemination of data. The whole effort involves high-class technical work, and hence the staff of a data bank has to be well qualified, versatile and internationally oriented. If the activities of the data bank are to be extended to some interdisciplinary areas, then personnel with expertise in several branches of science will be needed.
Figure 1. Management Arrangement and Functions of the NEA-Data Bank in Paris.

A data bank must undergo constant development to keep pace with the new requirements. For example, the NEA-Data Bank in Paris has emerged in recent years as an international centre of reference for member countries with respect
to basic nuclear tools, such as validated nuclear data, chemical data and computer programs. It also provides a direct service to scientists in member countries. Special arrangements cover the exchange of data and computer codes and programs with USA and the International Atomic Energy Agency (IAEA), which looks after the needs of the developing countries. Thus, the NEA-DB has become an international centre of excellence, and the significance of such a centre is expected to be enhanced in the coming years.

4 DATABASES

4.1 Need for Establishment

It is now common for commercial enterprises to have their own databases that specify and advertise their products. A few well-known databases in the field of chemistry, for example, are given in ref. [3]. They are a tremendous help to chemists and purchasing agents. Similar databases are available for other branches of science and industry. They are generally the result of unified efforts.

4.2 International Management of Databases

In research and development work related to new technologies, the availability of reliable data is a pre-requisite. Since the preparation and, above all, quality assurance of data files and data libraries involve considerable effort, many databases are developed under national programmes and the information is generally available from the national data centres or banks. However, considerable work is also done under the auspices of some international organisations. One such example is furnished by the Nuclear Data Section (NDS) of the International Atomic Energy Agency (IAEA) in Vienna [4, 5]. This establishment endeavours to develop databases related to basic scientific information for peaceful applications of nuclear energy, both for power production and non-energy oriented applications, like nuclear medicine, radioanalytical techniques, etc. A standing committee – the International Nuclear Data Committee (INDC) – provides suitable guidance. Its membership consists of nominees from various member states.

Many of the databases available today in the field of nuclear sciences are a result of collaboration, cooperation and exchange of information between the data centres of the more developed world. However, a unique feature of the IAEA-NDS is that special purpose databases are defined and developed through the coordinated research projects (CRP) and other more modest data development activities in which participation by developing countries is encouraged. The results originating from those projects are subject to stringent validation and quality control tests before placing the database at the disposal of the world nuclear science community. Some of the databases developed in recent years deal with:
• Fusion technology
• Reactor dosimetry
• Activation products
• Medical radioisotopes, etc.

It should be emphasised that a database is not simply a collection of data scattered originally in the literature. Very careful studies on the reliability of each available data set have to be undertaken. The participants and coordinators of a CRP are expected to be well-established experts in their fields, so that they may examine and control such growing databases at each step. Once a database is established, it serves as a useful reference source for all users.

5 INTERNATIONAL INFORMATION EXCHANGE AND SPECIAL ADVANCED EDUCATION

Three major aims of data banks and data centres are:

(1) To supply authentic, reliable and validated data to all individuals and groups working in national institutions, and in case of international centres, to all member countries;

(2) To organise and promote the international exchange of information to the benefit of all concerned; and

(3) To impart special advanced education through organisation of workshops, refresher courses, etc.

The supply of data at the national or regional level, which generally involves dealings between equal partners, has been discussed above in the context of the activities of the NEA-Data Bank.

Regarding truly international exchange of scientific information, which involves also dealings between unequal partners (e.g. North – South), some agreed code of practice needs to be applied. Here, a good example is furnished by the four data centres of the world dedicated to the peaceful uses of atomic energy (see Chart 2). Each centre serves a definite geographical region within its own fields of emphasis. There may be certain overlap of activities but, in order to conserve resources, duplication is avoided through mutual sharing of knowledge and expertise. In such an enterprise, however, it is absolutely essential that each partner contributes substantially to the whole effort.

The activities of the national centres (e.g. those at Brookhaven and Obninsk) are supervised by national committees and those of the internationally oriented centres (e.g. those of the NEA, Paris and IAEA, Vienna, through their international advisory bodies “Nuclear Science Committee” and “International Nuclear Data Committee,” respectively. Four data-centre meetings are held periodically and are co-ordinated by the IAEA-NDS. Users at large are expected to contact the data centre of their region for data services but this approach is not absolutely mandatory; one may contact any other centre as well, especially via its website.

199
By special arrangements, a few services are rendered exclusively by some centres; for example, Nuclear Structure and Decay Data by the NNDC, Computer Programs and Codes by the NEA-DB, and application data (such as medical data) by the IAEA-NDS. Through the well-coordinated activities of the four centres, it is possible for all member states of the IAEA to have full access to the latest and most reliable data sets needed for various peaceful applications of nuclear energy.

As far as special advanced education is concerned, all the four data centres occasionally organise regional workshops for the benefit of beginners in the field and to impart more expert knowledge to persons already working in the related areas. In this regard the IAEA-NDS has been playing a very important role at the international level over the last 30 years. A large number of advanced courses have been organised in cooperation with the International Centre for Theoretical Physics (ICTP) in Trieste, Italy, and thousands of scientists from developing countries have benefited from them. The subjects covered have included nuclear theory, reactor physics, radioanalytics, materials research, nuclear medicine, etc. The dissemination of knowledge is thus also an integral part of the activities of the data centres.
<table>
<thead>
<tr>
<th>National Nuclear Data Centre (NNDC), Brookhaven, USA</th>
<th>Nuclear Energy Agency – Data Bank (NEA-DB), Paris, France</th>
<th>Nuclear Data Centre (CJD), Obninsk, Russia</th>
<th>International Atomic Energy Agency – Nuclear Data Section (IAEA-NDS), Vienna, Austria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Geographical regions</strong></td>
<td>USA, Canada</td>
<td>Western and Central Europe, Japan, South Korea</td>
<td>Russia (and ex-USSR states)</td>
</tr>
<tr>
<td><strong>Special services</strong></td>
<td>• Energy related data</td>
<td>• Energy related data</td>
<td>• Energy related data</td>
</tr>
<tr>
<td></td>
<td>• Nuclear structure</td>
<td>• Computer programs</td>
<td>• Non-energy related data</td>
</tr>
<tr>
<td></td>
<td>• and decay data</td>
<td>• testing and supply</td>
<td>• Education and training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Chemical thermo-dynamics data (TDB)</td>
<td>• (Trieste workshops)</td>
</tr>
<tr>
<td><strong>Cooperative efforts (all centres)</strong></td>
<td>• Compilation of experimental data (EXFOR)</td>
<td>• Preparation of bibliography (NSR, CINDA)</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>• Preparation of databases (activation analysis, medical)</td>
<td>• Preparation of evaluation methodology (nuclear models)</td>
<td>•</td>
</tr>
<tr>
<td></td>
<td>• Preparation of evaluated data files (ENDF, ENSDF)</td>
<td></td>
<td>•</td>
</tr>
<tr>
<td><strong>International exchange of data</strong></td>
<td>Through agreed procedures, serving all member states of NEA and IAEA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2. Major Data Centres of the World Dealing with Nuclear Data for Peaceful Applications.
6 CONCLUSION

Data banks and databases constitute well organised efforts to ensure the provision of authentic and validated scientific data needed in various fields. Their use and support may be at the national, regional or international level. Cooperation between data banks and data centres has led to properly controlled and organised exchange of scientific information for the peaceful uses of nuclear energy between the various member states of the NEA and IAEA. The data centres also contribute to some extent to special advanced education.

7 ACKNOWLEDGEMENT

The author is indebted to C. Nordborg, Head of the Nuclear Science Section of the NEA, Paris, and A. L. Nichols, Head of the Nuclear Data Section of the IAEA, Vienna, for their critical comments on this article.
REFERENCES

4. IAEA-NDS, Vienna, Austria (http://www-nds.iaea.org).
Research Oriented Curricula

QURASHI M. ALI
Dean
National College for Medical and Technical Studies
Khartoum, Sudan

1 SUMMARY

1.1 Aim

The idea of this paper is to look into the curricular philosophies and strategies that target the training on research while students and staff are involved in their professional courses, and suggest course packages that may help institutions in Muslim countries to generate a production line of future researchers.

1.2 Methods

A review of the literature of research departments attached to health science colleges has been undertaken to discover their objectives and achievements in the area of undergraduate education.

1.3 Results

In the last 30 years of the 20th Century, many practicing health professionals and educationists have questioned the ability of the so-called traditional university curricula to prepare students to meet the needs of the profession in solving real-life problems, or to integrate the goals of professional teaching with other societal goals. Over the last four decades, educational innovations in medicine have established themselves as an equal curricular choice.

The number of new community oriented, problem-based curricula doubled or tripled every year, and many claimed proofs for improving technical proficiency. The best support for this innovation has always been a research program or department that involves both academic staff and students. Most research was on the efficiency and acceptability of the innovation and related issues. Much was aimed at moral support for the innovation or in the application of the new domains of educational theories and practices in health professionals training. These included areas such as; (a) Evaluation of innovations in the improvement of medical education, (b) Policy-orientation and leadership training, (c) Using research as a tool in advancing health care education, (d) Grants support of faculty research, (e) Measurement of community participation in health promotion programs, and (f) Classroom activities based on the use of worldwide Web, (g) Community-response to institutional initiatives in providing care, and many more.
Fewer programs, than expected, have considered the aspect of training students to do research in their future career. Biomedical scientists were better off than clinicians and other professionals because the attempts made were scanty and interrupted. The moves were part of a bigger environment of recall and didactic evaluation.

1.4 Conclusions

Research is teachable and better done early in regular courses included in the final grade of students. Special elective blocks may be added for those who have the talent or interest.

2 INTRODUCTION

Harvard has carried out 4-5 major changes in the curriculum during the 19th century [1 & 2]. In 2001 revision, the objective of the change was "... To educate students to be independent, knowledgeable rigorous and creative thinkers. This required a regime of variable doses of breadth of content in many areas and depth in selected areas. It involved what is known as "concentration and distribution." This shows that curricula are in a state of flux. Sticking to what has been inherited is a mistake, because the world in which the university exists continues to change in profound ways.

This example and many others demonstrate that the general trend is to direct students to do their own surveys and investigations to master the technique of self-directed learning and research capabilities.

The Kuala Lumpur Declaration on Science, Technology and Innovation for Socio-economic Development of OIC-Member Countries: Towards Vision 1441, expressed concern the very few universities in OIC-Member Countries were among the world's top 500 universities. 90% of the criteria for ranking are based on quantity and quality of research [3]. Starting early may be one way of fostering research in our countries.

Table 1. Criteria for ranking of universities

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicator</th>
<th>Code</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Education</td>
<td>Alumni of an institution winning Nobel Prizes and Fields Medals</td>
<td>Alumni</td>
<td>10%</td>
</tr>
<tr>
<td>Quality of Faculty</td>
<td>Staff of an institution winning Nobel Prizes and Fields Medals</td>
<td>Award</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Highly cited researchers in 21 broad subject categories</td>
<td>HiCi</td>
<td>20%</td>
</tr>
<tr>
<td>Research Output</td>
<td>Articles published in Nature and Science*</td>
<td>N&amp;S</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Articles in Science Citation Index-expanded and Social Science Citation Index</td>
<td>SCI</td>
<td>20%</td>
</tr>
<tr>
<td>Size of Institution</td>
<td>Academic performance with respect to the size of an institution</td>
<td>Size</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>
This review shows how far curricula of some universities had developed to achieve this in the area of medical education.

3 A VIEW OF HEALTH RESEARCH DEPARTMENTS

3.1 Acquired indirect research skills

The call to change a curriculum used to come from innovative deans or provocative incidents (e.g. the divide over the Vietnam War). Over the last 4 decades, in the field of medical education, a number of new community-oriented, problem-based institutions doubled or tripled every year. In order to claim improved technical proficiency and to convince others that the innovation is worth the trouble of change, they had to show that the process and products are as good as (if not better than) in traditional systems. They established departments of research that involve both academic staff and students with the purpose of investigating the efficiency and acceptability of the innovation, suggest changes on the curriculum on the bases of research and enhance the quality of education and care [4].

The contribution of these schools in curriculum design was enormous. However, in the area of encouraging student to research it is more or less indirect. Because students in their research attempt were clients rather than active players. They are used as respondents to questionnaires and (rather) guinea pigs in the innovators' experiments. The outcome of this flood of educational research reflected the indirect nature of this rather vague research-training, seen in the following new characteristics of the learner: It has (a) Improved reading habits [5], (b) Taught the use of electronic scientific information [6], and (c) Assessed peer assisted learning [7].

The colleges that have chosen innovative methods [8, 9 & 10] have emphasized self-directed learning, as part of the requirements of seminars and assignments. The orientation has taken students to the community to learn on their own a holistic approach to health, rather than wait at the hospitals for selected cases to reach there. The instructional strategy showed the defects of a lecture and the benefits of discussion sessions giving opportunity to students to share their ideas and show ability of discussion what they know, rather than only allowed to regurgitate this in an examination paper. Problem-based learning approximated the after-graduation reality and challenges the inquisitive mind. Early exposure to psychomotor professional skills resulted in automatic proficiency at the time of graduation. Introducing leadership and peer education concepts prepared students to be an effective member of a professional team. The knowledge and skills acquired are of definite use in training researchers who are self-directed learners, motivated and realistic. Students have been sent to the community to enhance the translation of scientific research into evidence-based public health education message [11].
3.2 Recent concerns

Research focus in health professional journals has changed in the last decade [12]. A significant increase has been observed in the use of descriptive statistics, parametric and non-parametric test statistics, epidemiologic statistics, generalized linear models, validation and other statistics. This justifies the need for better quantitatively trained health educators, and adds more responsibility to include a larger volume of basic statistics, a concept weakened by the use of ready-made computer programs.

Evidence-based medicine (EBM) has been incorporated in undergraduate programs in several countries to introduce the skills necessary to use advances in scientific research. A recent trial in a developing country [13] showed that EBM concepts taught through research gave a significant increase in attitudes score and a trend towards a higher score in the knowledge domain.

Many other areas require energetic investigation. Students' knowledge of the health system in their home countries is an important issue that can be properly investigated by students themselves or their response to comprehensive questionnaires. In a particular study [14] students had significant gaps in knowledge concerning the health care system, and most of them attributed the deficiency to inadequate emphasis in the medical school curriculum. This is a serious concern that has to be addressed through newer means of curricular strategies and contents.

4 STUDENTS' RESEARCH EXPERIENCE

Basically, the purpose of introducing research was not to train student researchers but to measure: (a) The success of rural summer studentship in which research is combined with clinical learning [15], (b) Student perception of a research elective which has risen beyond staff expectations [16], and (c) Teaching students scholarly writing to disseminate professional information [17]. Actual involvement of students in publishable research was a voluntary and elective issue, sometimes extracurricular [18]. Even though, it has contributed more than 28% of publications of one institution [19]. In many South Asia universities, students have won awards for their projects and published widely in indexed journals [20].

The discussion continues on whether the research component of the curriculum is elective or obligatory [21]. An elective fellowship has been designed for medical students from US schools with the purpose of increasing the pipeline of physicians pursuing careers in clinical research [22]. 97% admitted that participating in the fellowship was a good decision, and a significant group of 44% who were unsure about pursuing a career in clinical research became committed to it. A research elective in another university [23] has attracted 23% of students, 38% of them succeeded in publishing their results. Students identified poor project management as the most common reason for publication failure, not lack of interest in being involved.

The University of Michigan efforts to integrate research and undergraduate education started in the late nineties in all subjects, as an attempt to foster institution-wide reform of undergraduate curriculum [24]. In the medical field,
the opportunity was given only to "eligible" students to work with medical school faculty. So far, we are not aware of indexed publications documenting this experience. At about the same time, a research link has been established by the Council on Undergraduate Research to introduce experimental research to the undergraduate biology curriculum [25]. Awareness, it seems, is a rising tide all over the world.

It is important to realize that a successful research career requires not only an aptitude for science, but also the mastering of other skills including communication, management, and proposal and grant writing [26]. A growing number of institutes aim at teaching these crucial skills to graduate students, postdoctoral fellows and junior faculty. It may be wiser to start these earlier in the undergraduate curriculum.

A first-year course in George Washington University School of Medicine, on methods of reading medical literature, reinforced later by preclinical course in study design and statistics have affected students' knowledge and perception of research [27]. This started as early as 1986, and followed by many other colleges of medicine and paramedical sciences. Studies on instruction on research at the Albert Einstein College of Medicine showed that 80-90% of students responded that the projects increased their ability to write research papers, all were satisfied with the supervision of their mentors [21]. However, 50% of students thought that projects should not be a mandatory requirement for graduation. In other colleges, worldwide, elective participation in workshops on research enjoyed high acceptance by students, and improved their research skills [28].

In response to the decline in the number of physicians applying for and receiving grants from the NIH, Mount Sinai School of Medicine, created its Office of Student Research Opportunities (OSRO) directed by a senior faculty member. The number of publications by students almost doubled in two years [29]. Similar programs were equally successful in other institutions [30].

5 SUGGESTED STRATEGY

5.1 General

It is unfortunate that most well established universities in the Muslim world, are satisfied with their traditions and reputation, and refrain from doing major changes in their curricula to accommodate new adventures, even if evidence-based. Our universities have created their own rules of conservatism and continued "worshiping" or "adoring" them. If they can look out for change, this is one small suggested move in the direction of the theme of this paper. IAS may help higher education institutions [HEIs].

5.2 Research infrastructure

The medical schools which have chosen innovative methods of curriculum design and evaluation can continue planning academic departments of education and research that may serve all other health professionals with the preparation of basic infrastructure - analytical labs, field-work inventories, camping sets,
data forms and questionnaire preparation, photography and illustration unit, media studio, and a college journal. These should be all rendered to a "students' research forum." We have seen many equipments and supplies expiring in locked laboratories, unused, underused or outdated.

5.3 Mandatory credited courses

The areas covered in colleges' objectives should extend to include training each student in credited courses to prepare at least one review and one original investigation, before graduation. In traditional curricula, a similar setup is needed to involve other major department in the college. Projects supervised by faculty from rather marginalized department of community medicine, until awareness for community orientation is brought to the optimum. This compulsory course can replace any of many courses regularly given, as an inherited habit, and nobody knows why they are taught.

5.4 Elective courses

Starting from summer holiday 1 (between year 1 and 2), each student should have the responsibility of choosing one elective course in the research sciences - literature review, study design, data collection, sampling, statistics, and illustrations, communication skills, management, grant and proposal writing etc. In the third or fourth summer, selection of the best 10% of those with special interests and effort in research, may give a safe harvest of future researchers.

5.5 Selective approach to students

The 10% of students selected are given the opportunity of being members of grant-supported faculty projects, and may be allowed to compensate for any other electives publication.

5.6 Advocacy for funding

Introducing staff and students to research-oriented industry is the responsibility of the department of research. The grant can be grown from seed money allotted by the university from school fees, invested and added to contracts with industry, preferably in a revolving fund. The long hands of the administration should not extent to this fund.

5.7 Role of mentoring and support

Academic supervision for students and mentoring relationships between students, and junior and senior faculty have a role in increasing research productivity and career growth [31]. As a means of assuring that staff takes this seriously, any application for a research grant students should be included in the list of investigators, and that academic supervision and mentoring should be among the criteria for ranking universities.
REFERENCES

12. Merrill RM, Lindsay CA, Shields EC, Stoddard J. Have the focus and sophistication of research in health education changed? Health Educ Behav 2006; Epub ahead of print).

* As listed by the author.


PART FOUR
HIGHER EDUCATION: GAUGING EXCELLENCE
Ranking and Evaluation of Universities Worldwide and the Implications for Universities in OIC-Member Countries: Some Methodological Considerations

MOHD HAZIM SHAH  
*Department of Science and Technology Studies*  
*University of Malaya*  
*Kuala Lumpur, Malaysia*  
and  
ASIYAH KASSIM  
*Universiti Teknologi MARA*  
*Malaysia*

1 GLOBALISATION AND THE CONCEPT OF WORLD-CLASS UNIVERSITIES

The world is changing ever more quickly and there is an urgent need for universities to be able to compete on the world stage, and to fulfil national requirements for world-class universities. The rationale for this phenomenon lies in the necessity to maintain and to enhance national comparative advantage in an increasingly economically-competitive world, especially given that knowledge and science and technology capabilities are acting steadily as major drivers of economic growth. In addition, most visibly, universities are the key to this comparative advantage. Their research and teaching performance in particular are the basis either for success or failure in the knowledge-based economies that mark the contemporary era.

Perhaps we could describe this kind of ‘force’ as the language of globalisation. The Malaysian government is not alone in responding to it; administrations everywhere are also responding. The governments of Australia, China, Korea and Singapore reveal also their respective anxiety about global competitiveness and the need for more world-class institutions in their higher education sectors. For OIC countries, the picture is more complex given that the OIC is made up of 57 member states with different levels of economic development and standards of education. But when did this kind of ‘language’ start to emerge and what triggered it? And what do we mean by globalisation anyway, and what are its implications for higher education?

These days the term globalisation appears everywhere. All can see that there hardly passes a day without some reference to it, either in newspapers or in
academic books and journals. Yet in fact, it is a term invoked to explain a myriad of phenomena. While some writers use globalisation to explain what is happening to the modern world, such as greater global economic-connectedness and the emergence of a new world economy, others regard globalisation as a process that needs explaining by, say, theories of capitalism or models of the constant creation of new forms of technology. It is important to note that many see globalisation as a purely economic phenomenon - as worldwide economic integration, powered by neo-liberal politics, electronics, instantaneous communications, and the multinational corporations - while others see it more as a form of Western cultural imperialism or as having a political dimension and agenda.

But what does this 'language' or 'influence' have to do with universities? It is significant to note that historically, universities are international or 'originally global' in their academic and intellectual orientations, as it is a fact that the pursuit of knowledge is a universal phenomenon. Perhaps we should remind those who might forget the essential nature of the academic himself: the wandering scholar may be less fancy-free and footloose than in medieval times, but inter-country academic exchange and mobility are critical aspects of university enquiry and teaching.

On the other hand, we clearly understand that universities are the instruments of the State, as well as being regulated and funded by those States. Although research is becoming increasingly globally and socially-networked and distributed as Michael Gibbons has observed, the teaching and community relations functions of universities are still rooted largely within national boundaries, despite the Internet and the commercial growth of global higher education. This means that although the influence of globalisation is becoming pervasive, there are certain areas where local influences still predominate.

These tensions between State and global forces, and between governments and universities, can be found at a number of levels. One is in the different interpretations of the international agreements forged by governments. To take one example, for some countries the European Bologna process, which seeks greater harmonisation between members' university systems, is a means for making European universities more competitive in the face of American, Australian and Asian challenges for international fee-paying students and commercial research opportunities. For others however, Bologna is regarded as a form of protection from globalisation for public service higher education in Europe, with its domestic monopolies, government grants and public good ethic, and its commitment to social objectives such as equity, national cultures, emancipation, and access.¹

It reminds us that even in the age of globalisation, varieties of national economy and comparative institutional advantage persist, and these are reflected in different policy stances by governments to global higher education. However, whatever the stances of governments, naturally many individual universities lack the resources or capabilities to become global commercial players.

¹ Case taken from the article of "Globalization and Higher Education" by Professor Roger King, 2003
Despite persistent differences in national educational policies, there is evidence that globalisation tends to increase international and supranational convergence on higher education policies by governments, and on forms of regulation. The forces affecting higher education around the world are often strikingly similar - such as expanding enrolments, less public funding (per student), lifetime learning, and new disciplines - and may be regarded as constituting global phenomena. This implies that eventually similar standards will be adopted by universities worldwide in evaluating their performance.

Furthermore, a major question looms large. Will globalisation make universities even more the instruments of the nation State, i.e. the instruments of governments’ objectives to generate comparative economic advantage in an integrated, knowledge-based world economy?. Will globalisation make universities more autonomous and free to pursue their own academic vision, or will it and the attendant commercialisation and corporatisation of universities lead them (or at least a sizeable segment) to drift away from the social objectives and grip of the nation State to pursue their own corporate, national and multinational interests? And what will happen to those universities that remain behind from this process? Must governments ‘bow’ to the forces of globalisation, or may they ignore the influence of globalisation and pretend it never existed?

Notably, globalisation is not only creating stiffer competition in various areas, but also reshaping the functions of universities by giving birth to a new form of competition in higher education, and academic and intellectual appraisal. While it is certainly true that globalisation plays a leading role in creating world-class universities and bringing new trends and phenomena, but the concept and practice of ‘ranking’ universities is much more ‘alarming’. It amounts to a form of ‘battle’ to be the best and to be at the top, and also a form of ‘warning’ to universities that a comfort zone no longer exists.

This paper discusses this currently topical issue, and analyses and enhances understanding of the real concept of world-class universities. This discussion will then be extended to the question of higher education and university ranking in OIC-member countries, and what approach they should take in facing this new situation. In this paper, the characteristics of world-class universities and world university ranking will be explored. The problems and challenges facing the effort to achieve world-class status will be discussed elsewhere.

Many of us will have heard that most Vice-Chancellors around the globe, including in Malaysia, have a vision of building their universities into truly world-class universities where learning and teaching is valued as much as research, and have aspirations to achieve the highest standards. Yet what does that mean exactly, and how should they get there? Perhaps the best answer will be obtained by identifying what most experts believe are the characteristics shared by world-class universities.
2 THE HALLMARKS OF WORLD-CLASS UNIVERSITIES

It is essential to note that world-class universities appear in many sizes, configurations and locations. They can be large, for instance the University of Michigan at Ann Arbor with approximately 38,000 students, or they can be small like Princeton University with only around 6,000 students. World-class universities can be public or private, such as the University of California at Berkeley and Stanford University. In addition, they can be found in all parts of the world, such as Harvard University in North America, Cambridge University in Europe and the National University of Singapore in Asia.

Although the following characteristics have by no means been agreed upon by teams of experts, the histories and record of leading world-class universities has shown that to achieve a pre-eminent status a university must have them.

(i) Excellence in Research

The first vital criterion of world-class universities is excellence in research, which underpins the idea of world-class itself. This means research that is recognized by peers and that pushes back the frontiers of knowledge. Such research can be measured and communicated. Note that if research is the central element, other features are required in order to make outstanding research possible. Top-quality professors are, of course, essential. In turn, in order to attract and retain the best academic staff favourable working conditions must be available. The best professors see their work as a "calling" and this is something to which they are committed by intellectual interest, rather than it being just a job.

(ii) Good Governance

The governance of the institution is important. World-class universities have a significant measure of internal self-governance and an entrenched tradition, often buttressed by statutes, ensuring that the academic community has control over the central elements of academic life - the admission of students, the curriculum, criteria for the award of degrees, the selection of new members of the professoriate, and the basic direction of the academic work of the institution.

This also means that world-class universities practise the art of good management. It goes without saying that a truly eminent university will excel in teaching and research (criterion (i)), but paralleling and supporting those core activities will be an excellence in management driving first-rate administrative systems.

With continuing and increasing pressures on resources, every dollar reasonably saved is a dollar to be strategically spent. Beyond the need for such basic efficiency, there is the imperative to invest funds to maximise returns, to manage financial and student data in order to provide timely and accurate information to teachers and researchers, to market imaginatively, to build and renovate campus facilities - particularly when pressures are strong for
expenditure of a more recurrent kind, and to do well all those prosaic things which teachers and researchers could take for granted in simpler, better-funded and less-competitive times.

Good management should not be a pejorative term, but often it is when caught up in the tension now quite widespread in universities in a number of countries over the perceived divide between collegiality and managerialism (Welch et al 2003). Part of the questioning so important in university life must be embraced by academics themselves about the nature of the modern university, along with a realisation that if we wish to build and pass on to subsequent generations universities of world-class stature in the Asian region, we will need to be quite strategic in how we go about our business.

(iii) Academic Freedom

Academic freedom, scholar autonomy and an atmosphere of intellectual excitement are also central to a world-class university. This means that professors and students must be free to pursue knowledge wherever it leads and to publish their work freely without fear of sanction by the administration, government, or academic or external authorities. Some countries permit unfettered academic freedom in the non-political hard sciences but place restrictions on it in the more sensitive social sciences and humanities. Yet in most countries, academic freedom extends to expression of opinions by members of the academic community on social and political issues as well as within the narrow confines of professional expertise.

(iv) Adequate Facilities / Infrastructure

Adequate facilities and infrastructure for academic work are essential. It is significant to realise that the most advanced and creative research and the most innovative teaching rely on access to appropriate libraries, laboratories and knowledge centres, as well as to the Internet and other electronic resources. The increasing complexity and expansion of science and scholarship make the cost of providing full access high. Although the Internet has given rise to some cost savings and has eased access to many kinds of knowledge, it is by no means a 'panacea.'

The facilities and infrastructure needed go beyond laboratories and libraries; staff and professors must have adequate offices, in addition (and most importantly) to enabling working conditions and an environment to increase productivity and the quality of their research and teaching and the other tasks they undertake. In the case of students, an encouraging atmosphere is crucial for them to boost their spirits and enthusiasm for acquiring knowledge.

(v) Adequate Funding

In addition, adequate funding is critical and must be available to support the university's research and teaching as well as its other functions. In addition, the support must be consistent and long term, as the cost of maintaining a research
university continues to grow due to the increasing complexity and expense of scientific research.

With the emergence of ICT, many people say that most institutions and organisations will be able to reduce costs but at the same time maintain or increase their productivity levels by becoming a ‘virtual university’. Universities, however, cannot benefit from many of the productivity increases other enterprises have achieved through automation, because teaching and learning in general still require professors and students to be in direct contact. One thing is certain: the title of ‘world-class’ won’t come at a discount price, and without world-class funding the goal of reaching and maintaining that high standard will be rhetoric alone.

(vi) Quality of the Faculty

A world-class university will be recognised widely as an eminent institution and as a place where top scholars will wish to congregate. That is, given the chance, staff from other universities will migrate to the world-class university. In turn, a top faculty will attract top students. The process is autocatalytic. In addition, such a university will almost certainly be a research-intensive university. It would also teach well. But first and foremost it will be a place people will want to experience and gain the fame and respect that goes with this. Absolutely fundamental to building such a climate is having qualified staff, particularly academic faculty members.

(vii) Talented Undergraduate Body

As in the past and so into the future, universities accorded the top spots will enrol the best of the brightest into their undergraduate programs. Life will have its second chances, and people will make several (perhaps more than several) journeys in their lifetime through universities of their choice. But the universities most sought after for that first degree, particularly in a world where choice is national and even international, will have a very big edge indeed in pushing their reputation capital (Nilland, 1995). There is a unique uplift effect through having thousands of very talented undergraduates on one campus sparking off each other and keeping the rest of the students, including the postgraduates, on their toes.

(viii) International Presence

World-class universities must have an international presence. It should be noted that universities have long reached beyond their national borders to recruit staff, acquire knowledge and even to enrol students. Now, for universities, the world is shrinking even further through an array of developments: the globalisation of economies, the revolution in international travel - both real and virtual - and most importantly, the opening of minds to a sense of an international engagement through networks that interlace study, work, consumption and leisure activity.
This clearly means that world-class universities hold their international presence by actively participating in academic and intellectual activities and endeavours ranging from international collaborations in research activities, and sending staff and students to seminars and conferences. It is interesting to consider some experts assert that universities must strive to develop world citizens, such as Martha Nussbaums: "We increasingly find that we need the comparative knowledge of many cultures to answer the questions we ask."\(^2\)

*(ix)* World-Class Universities Embrace Many Disciplines

The last but certainly not the least feature of a world-class university is the need to embrace a variety of disciplines and programmes. A world-class university will accommodate a large number of disciplines and areas of study to ensure the cross-fertilisation of ideas and the stimulation that comes from gathering together bright, high-energy people from a variety of backgrounds and traditions. Some universities with a specific disciplinary focus, such as engineering, pharmacy, accountancy or even technology in a wider sense, will draw international acclaim.

Will possessing all the above characteristics be able to guarantee the university a good world ranking? Why must there be some kind of contest among universities around the world? Is it well-intended, and does it set some kind of benchmark to improve the quality of higher education around the globe? Or have we once again been fed with a new kind of propaganda; this time of a more sophisticated kind, i.e. academic propaganda and a kind of intellectual imperialism?

Although we should admit there’s always a bona fide objective - competition will help us to improve ourselves from learning good things from other universities - still there are a lot more things to argue about the idea of ranking before we conform to it. To coin a common phrase: birds do not need a race to fly higher. However, like it or not, the trend of university ranking which comes from the influence of globalisation and global benchmarking will most probably be here to stay. And perhaps as a first step and before making any judgment, we should examine the rankings in order to have a better understanding of them.

### 3 WORLD UNIVERSITY RANKINGS: FRIEND OR FOE?

An important parallel development, which has been stimulated also by the power of globalisation and the growth of the higher education sector, is the strong demand for accountability, evidence of quality, effectiveness and ‘value for money’. This development has given rise to an expanding ‘evaluation culture’. This evaluation culture is based on elements present already for a long time in the scientific world, namely the judgment of research quality through peer review and citations. Note that all these developments have led to an

---

\(^2\) Quote from article “Building World Class Universities”, by Frank Hsia-San Shu, 2000
increasing competition between universities, within nations and globally for financial support and for the best students and researchers.

The current scenario has universities striving to become not only the top in their countries, but also the world’s best. This implies the existence of some kind of a league, whether it is a national or an international one, to which one can only be admitted on the basis of performance. The higher the performance, the better chance a university has of becoming a member of the elite league, and of reaching a high ranking position in this league.

Clearly, the basic question is: How can we identify the best universities in the world? From this basic question, many academics around the world have raised several issues disagreeing with the rankings phenomenon that need to be answered in the context of ranking procedures. First, to which activities are the leagues related? In the case of universities, are they related to teaching, to research, or to both of these main academic tasks? Second, how do we measure performance with respect to a chosen activity in an international context? Third, is it possible to conduct these performance measurements for all universities in the world in a relatively easy but still reliable and valid way? Fourth, is it possible to express this performance in terms of just one numerical value? (Van Raan, 2005).

So the most crucial question is a third one: how much effort will a reliable evaluation of an entire university take, and, as a consequence, will such an evaluation be possible for all universities in the world in a short period of time and against reasonable costs?

Perhaps a clearer picture can be given by the following example. Since the early 1990s universities in the Netherlands have been evaluated by discipline. Each year the focus is on three or four disciplines, for instance chemistry, biology, psychology and civil engineering. In the next year, three or four other disciplines are evaluated, and so on. The whole procedure has a ‘cycle time’ of about five years, so after five years there is new evaluation round for chemistry. In these nation-wide discipline-specific evaluations, all departments and research groups in the specific discipline in all thirteen Dutch universities are subject to an international peer review, and in most natural and life sciences, an extensive bibliometric analysis is involved as well. An international peer committee of between five and ten members meet in the Netherlands, and conduct discussions with heads of departments and site visits (in some cases), compile reports and so on. Staff members of the VSNU (the Association of the Universities in the Netherlands) must prepare these evaluations, organize the peer committee, commission the bibliometric studies etc. It is not difficult to imagine that these evaluations cost in the order of 50,000 Euros per discipline. With about 20 major disciplines, the entire evaluation procedure (peer review, bibliometric analysis) per university within one cycle of five years is in the order of one million Euros (VSNU, 2002).

Clearly, this kind of thorough evaluation as a basis for institutional research management cannot be applied in a relatively short time on a worldwide scale. Therefore, the following questions become even more critical: is this type of evaluation too ‘fine-tuned’ and would it be possible to evaluate universities on a
broader level, with less attention for detail and more focus on their ‘overall quality’? Would a survey of, say, 1000 scientists worldwide provide us a reasonably reliable broad picture of the research performance of a great number of universities all over the world? Would a carefully designed bibliometric analysis be able to do that? Moreover, if both approaches were adopted, would they converge to the same results? Are rankings a reliable means of benchmarking universities against a global standard? In other words, is it possible to establish, on the basis of a survey, bibliometric analysis or a combination of both, one overall mark for each university that takes into account all disciplines, or at least all natural and life sciences (including medicine)? Alternatively, should we try to quantify universities at the level of major science disciplines such as natural sciences, life sciences, engineering, social sciences and humanities? (Graham, 2003). Let us explore a bit more this increasingly-employed ‘tool’ of assessing universities around the globe.

4 RECENT DEVELOPMENTS IN RANKINGS

In the last few years rankings of universities, although controversial, have become increasingly popular. Examples include national rankings such as US News rankings, the UK Sunday Times University Guide and the Guardian’s Guide to Universities, McLean University’s Rankings in Canada, the German CHE University Rankings, and Asia Week’s Best Universities in Asia. Recently, two ranking publications attracted wide attention from policy makers, the scientific world and the public media; these were the rankings published by Shanghai Jiao Tong University in China ('Academic Ranking of World Universities', SJTU 2003; 2004; 2005) and the rankings published by Times Higher Education Supplement (THES) 'World University Rankings' 2004, 2005).

It should be noted that these and other rankings suggest simplicity in the evaluation of scientific performance similar to the case of a football league. The immediate observation that well-known top American universities take the lead reinforces these suggestions. Universities responded enthusiastically, particularly if they felt their position was worth publishing. Although things are not so simple and the various methodologies used in these ranking still have to be discussed thoroughly, the influence of these rankings is striking. Rankings have become unavoidable, and they will remain part of academic life. And as we have mentioned a number of times about the force of globalisation, general ideas about the international reputation and position of universities will be influenced considerably by rankings.

4.1 THES v SHJT Rankings

THES is published by TSL Education Ltd of London, a leading educational publisher in the United Kingdom. The company is a subsidiary of News International Publishers Limited, which prints The Times and The Sunday Times
(www.thes.com). In the THES ‘top-200 universities worldwide’ rankings, the opinions of scientists worldwide play a crucial role. Around 1,300 researchers in 88 countries were asked to mention the best universities in the geographic regions and fields in which they considered themselves sufficiently qualified to judge scientific standing. Table 1 represents the assessment factors in the THES top-200 universities for 2004, Table 2 for 2005, and Table 3 for 2006.

Table 1. THES Top-200 Universities Assessment Indicator for 2004

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicator</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Peer Review Assessment</td>
<td>50%</td>
</tr>
<tr>
<td>2.</td>
<td>Citations per Faculty</td>
<td>20%</td>
</tr>
<tr>
<td>3.</td>
<td>Staff Student Ratios</td>
<td>20%</td>
</tr>
<tr>
<td>4.</td>
<td>International Student</td>
<td>5%</td>
</tr>
<tr>
<td>5.</td>
<td>International Staff</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 2. THES Top-200 Universities Assessment Indicator for 2005

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicator</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Peer Review Assessment</td>
<td>40%</td>
</tr>
<tr>
<td>2.</td>
<td>Citations per Faculty</td>
<td>20%</td>
</tr>
<tr>
<td>3.</td>
<td>Staff Student Ratios</td>
<td>20%</td>
</tr>
<tr>
<td>4.</td>
<td>International Student</td>
<td>5%</td>
</tr>
<tr>
<td>5.</td>
<td>International Staff</td>
<td>5%</td>
</tr>
<tr>
<td>6.</td>
<td>International Employers Survey</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Table 3. THES Top-200 Universities Assessment Indicator for 2006

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicator</th>
<th>Brief Description</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Quality</td>
<td>Peer Review</td>
<td>Composite score drawn from peer review (which is divided into five subject areas consisting of science, medicine, technology, social sciences, and the arts and humanities) - this involved gathering data from 3,703 responses from academics around the world</td>
<td>40%</td>
</tr>
<tr>
<td></td>
<td>Citations per Faculty</td>
<td>Score based on research performance factored against the size of the research body</td>
<td>20%</td>
</tr>
<tr>
<td>Graduate Employability</td>
<td>Recruiter Review</td>
<td>Score based on responses to recruiter survey. These involved 736 responses (recruiters) comprising people from companies in the manufacturing, services, finance and transport sectors, as well as from the public sector</td>
<td>10%</td>
</tr>
<tr>
<td>International Outlook</td>
<td>International Faculty</td>
<td>Score based on the proportion of international faculty members</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>International Students</td>
<td>Score based on the proportion of international students</td>
<td>5%</td>
</tr>
<tr>
<td>Teaching Quality</td>
<td>Student Faculty</td>
<td>Score based on student/faculty ratio</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
</tbody>
</table>

‘Peer review’ assessments accounted for fifty per cent of the total score for a university in 2004, but this was reduced to 40% in 2005 and 2006. Four further criteria were used: research impact in terms of citations per faculty member and staff student ratios, each of which accounted for twenty per cent of the score; and the percentage of students and staff recruited internationally, which were each five per cent of the total\(^3\). Thus in the THES rankings the bibliometric element counts for 20 per cent. These bibliometric data are derived from a commercial product - the Essential Science Indicators database produced by Thomson Scientific (the former Institute for Scientific Information, ISI). Finally, the scores used in the ranking were normalised against a score of 1,000 for top-ranked Harvard University (refer to Appendix 1 for further detail). The crucial difference between the THES rankings and the rankings produced by the SHJT is that the latter do not include ‘peers review.’ The Shanghai rankings are based on four criteria; Table 4 details these indicators.

---

\(^3\) All the data are extracted from THES 2004
### Table 4. SHJT Ranking Indicators

<table>
<thead>
<tr>
<th>No.</th>
<th>Criteria</th>
<th>Indicator</th>
<th>Code</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Quality of Education</td>
<td>Alumni of an institution winning Nobel Prizes and Fields Medals</td>
<td>Alumni</td>
<td>10%</td>
</tr>
<tr>
<td>2.</td>
<td>Quality of Faculty</td>
<td>Staff of an institution winning Nobel Prizes and Fields Medals</td>
<td>Award</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Highly cited researchers in 21 broad subject categories</td>
<td>HiCi</td>
<td>20%</td>
</tr>
<tr>
<td>3.</td>
<td>Research Output</td>
<td>Articles published in the natural science journals <em>Nature</em> and <em>Science</em></td>
<td>N&amp;S</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Articles in Science Citation Index-expanded and Social Science Citation Index</td>
<td>SCI</td>
<td>20%</td>
</tr>
<tr>
<td>4.</td>
<td>Size of Institution</td>
<td>Academic performance with respect to the size of an institution</td>
<td>Size</td>
<td>10%</td>
</tr>
</tbody>
</table>

|       | Total                     | 100%                        |

First, ‘quality of education’ over a long period, in terms of the number of alumni of an institution winning Nobel Prizes and Fields Medals, accounts for 10 per cent in the ranking. Next, there are two ‘quality of faculty’ measures, one non-bibliometric (the numbers of staff winning Nobel Prizes and Fields Medals) accounting for 20 per cent, and a bibliometric measure (the number of highly-cited researchers in 21 broad subject categories), also accounts for 20 per cent.4

The next two criteria concern research output and thus are also bibliometric measures. Finally, the Shanghai group uses a kind of normalisation criterion: ‘academic performance’ with respect to the size of an institution (accounting for 10 per cent). Thus 60 per cent of the total score is based on bibliometric data. For each indicator, the highest scoring institution is assigned a score of 100 and all other institutions are calculated as a percentage of the top score. Scores for each indicator are weighted to obtain overall scores for each institution.5

---

4 Data extracted from official website SJHT Ranking

226
From the above we can make some preliminary observations. Both the Shanghai and the THES ranking do not cover measures of performance-related ‘input indicators’ such as amount of research funding secured (such as grants from national research councils or governmental programs or funding from industry). Smaller universities, and particularly those with an emphasis on social sciences and humanities, will obtain a better score given the weighting of the peer review element in the THES ranking than they will in the Shanghai study. Since excellence in research is a critical characteristic present in world-class universities, it should carry more weight.

Moreover, in general studies based on bibliometric data will have difficulties in giving proper coverage to the social sciences and humanities given the inherent limitations of the bibliometric methodology with respect to these disciplines. It is more difficult to reach consensus on what counts as quality publications in the social sciences and humanities given the range of subjects and differences in approach and orientations related to various competing ‘schools of thought’ which could amount to and reflect ‘ideological differences.’ In addition, in peer-based analyses the problem is to find an adequate coverage of scientists in relevant social science and humanities fields because of the many different ‘schools of thought’ in these fields. Furthermore, the quality of teaching, particularly at the M.Sc. and Ph.D. levels, and with that the international attractiveness for young people, is not included in both ranking approaches. Perhaps only the THES criterion concerning the percentage of students and staff recruited from overseas relates to this ‘quality of teaching’ element; even so, this shows a weakness. But why is this weakness overlooked when the key principle is to measure quality in all segments, particularly given that quality of faculty is an essential characteristic of world-class universities?

In Germany, the Centre for the Development of Universities (Centrum für Hochschulentwicklung, CHE) applies a broader range of criteria to judge the standing of German universities with a focus on specific disciplines. These criteria include research income, number of publications, number of patents, number of Ph.D. examinations, and a peer-based ‘reputation survey’ (probably this is one of the reasons why some outstanding German universities which are well known for their first-rate quality and strength did not conform to the THES and SHJT rankings). Thus, CHE does not provide an ‘overall ranking’ to determine which university is the best; rather it applies a more differentiated approach, i.e. which universities are at the top for chemistry, for engineering, and so on. This seems more practical and acceptable given that most universities have their own strengths and specialties.

Furthermore, like it or not, rankings have strong ‘de-equalizing’ effects. In bibliometrics it relates to number of publications, citations and so on. These numbers are skewed and often of a ‘power-law’ type. This is a fundamental principle and it is well-described and documented. Rankings confront directly scientists, university board members, policy-makers, politicians, journalists, and even the interested man-in-the-street with this inequality. It is significant to realise that rankings strengthen the idea of the academic elite, and institutions
use the outcomes of rankings, no matter how large are their methodological problems, in their rivalry with other higher education institutions.

We are already alerted and concerned that the recent ranking publications reinforce the ‘evaluation culture.’ Evaluations are necessary to account for financial support received from society or industry. In addition, academic researchers cannot withdraw anymore from these responsibilities as in earlier times, simply because nowadays the academic enterprise has grown to such an extent that it consumes a considerable part of the public means (Brown, Robert 2005). Moreover, governments and national research councils are inclined increasingly to use the outcomes of evaluations for the distribution of finances between institutions, and university boards are willing to use the same outcomes for re-distribution of money within their institutions, and even for salary increases for individual academics involved in research.

Position rankings already have their effects. Recently, Deutsche Telekom wanted to finance two professorial chairs in German universities, and almost all of the university vice-chancellors selected as candidates for the chairs put forward their ranking positions as evidence of their research performance (www.dfg.de/en/html). Whether these rankings are based on sound methodology or not, universities that consider themselves ‘winners’ have already begun to cash in on them.

We have been introduced to the nature of rankings, which are neither friend nor enemy for universities. The fact is that although the majority of universities are eagerly and excitedly adopting rankings and standards, we cannot simply extol these systems of university evaluation without recognising the major pitfalls that surround them. The following are some of the problems analysed by groups of academics and researchers who believe that there should be other alternatives to evaluating and ranking universities. It is not to condemn the systems but rather to learn from them, understand them and make our own judgment.

5 A COMPARISON BETWEEN THES AND SHJT WORLD UNIVERSITY RANKINGS AND SESRTCIC’S OIC UNIVERSITY RANKINGS

5.1 The THES World University Rankings

THES has been an acknowledged player in producing world university rankings since 2004. THES’ initial objective was to develop a holistic evaluation of universities that enabled comparison of institutions across borders. In order to achieve this, THES identified four principal criteria, namely:

1. Research Quality;
2. Graduate Employability;
3. International Outlook; and
4. Teaching Quality.
Basically, THES ranks universities via several indicators of academic or research performance including academic peer review, recruiter review, student faculty ratio, citations per faculty member, the proportion of international faculty and the proportion of international students.

For each indicator, the highest scoring institution is assigned a score of 100, and other institutions are calculated as a percentage of the top score. The distribution of data for each indicator is examined for any significant distorting effect, and standard statistical techniques are used to adjust the indicator if necessary.

5.1.1 THES Methodology

The ranking methodology used by THES consists of the following:

(i) Peer Review

Over 190,000 academics were emailed a request to complete a THES online survey each year and 1600 responded. Previous respondents are given the opportunity to update their response. Respondents are asked to identify both their subject area of expertise and their regional knowledge. They are then asked to select up to 30 institutions from their region(s) that they consider the best in their area(s) of expertise. There are at present approximately 540 institutions in the initial list. Responses are weighted by region to generate a peer review score for each of the following principal subject areas:

1. Arts & Humanities;
2. Engineering & IT;
3. Life Sciences & Biomedicine;
4. Natural Sciences; and
5. Social Sciences.

The five scores by subject area are compiled into a single overall peer review score with an equal emphasis placed on each of the five areas.

(ii) Recruiter Review

Over 375 recruiters responded in 2006. The recruiter review operates on the same three-year latest response model utilised by the peer review. Recruiter names are sourced through Quacquarelli Symonds (QS) databases, media partners and partner schools & universities. Responses are weighted by region to reach a final score.

(iii) International Students

Score calculated simply on the proportion of total students coming from other countries.
(iv) **International Faculty**

This score is calculated on the proportion of Full Time Equivalent (FTE) faculty members from other countries.

(v) **Student Faculty**

This score is based simply on the student/faculty members ratio - the higher the number of faculty members per student, the higher the score. THES claims that this is intended as a measure of ‘commitment to teaching’.

(vi) **Citations per Faculty Member**

Thomson’s Essential Science Indicators (ESI) database collates the numbers of papers published and the citations received by research staff at most institutions throughout the world. THES multiplies the ESI number by number of faculty members in order to scale the score according to the size of the institution. Citation data is taken for the last five years.

### 5.2 The Shanghai Jiao Tong (SHJT) University Rankings

One of the most widely-cited rankings, the Academic Ranking of World Universities, is compiled by researchers from Shanghai Jiao Tong University. It comprises major institutes of higher education ranked according to a formula that takes into account alumni winning Nobel Prizes and Field Medals, staff winning Nobel Prizes and Fields Medals, ‘highly-cited researchers in 21 broad subject categories’, articles published in *Nature* and *Science*, the Science Citation Index, the Social Sciences Citation Index and the Arts and Humanities Citation Index, and the size of the institution.

For institutions specialising in the Humanities and Social Sciences (such as the London School of Economics), the number of articles published in *Nature* and *Science* is not considered and the weighting is redistributed to other indicators (*Source:* http://ed.sjtu.edu.cn/ranking.htm).

#### 5.2.1 SHJT Indicators

The indicators used in the SHJT ranking exercise consist of the following:

(i) **Alumni**

This refers to the total number of alumni of an institution who have won Nobel Prizes and Field Medals. The term ‘alumni’ is defined as those who obtain Bachelors, Masters or Doctoral degrees from the institution. A different weighting is set according to the period in which the degree was obtained: the weight is 100% for alumni of 1991-2000, 90% for alumni of 1981-1990, 80% for alumni of 1971-1980, and so on. If a person obtained more than one degree from an institution, the institution is considered once only.
(ii) **Awards**

This indicator refers to the total number of staff of an institution who have won Nobel prizes in physics, chemistry, medicine and economics, and the Fields Medal in Mathematics. The term ‘staff’ is defined as those who work at an institution at the time of winning the prize. As for alumni, there is a different weighting according to the period in which the prize is won: the weight is 100% for winners since 2001, 90% for winners in 1991-2000, 80% for winners in 1981-1990, 70% for winners in 1971-1980, and so on. If a winner is affiliated with more than one institution, each institution takes an equal share of the score (e.g. if the person works at three institutions, each institution gains one-third of the score for that person). For Nobel prizes, if a prize is shared by more than one person there is a different weighting for winners according to their proportion of the prize.

(iii) **HiCi**

This refers to the number of highly-cited researchers in 21 broad subject categories in life sciences, medicine, physical sciences, engineering and social sciences. The total number of HiCi is about 5000, about 4000 of which are university staff.

(iv) **Nature & Science (N&S)**

N&S indicates the annual average number of articles published in *Nature* and *Science* in the past five years. As to distinguish the order of author affiliation, a weight of 100% is assigned for corresponding author, 50% for first author (second author if the first author is the same as corresponding author), 25% for the next author, and 10% for other authors. Only publications of article type are considered.

(v) **SCI**

This refers to the total number of articles indexed in the Science Citation Index-expanded (SCIE) and the Social Science Citation Index (SSCI) in the past year. A weight of 2 is assigned to articles indexed in SSCI to compensate for the bias against humanities and social sciences. Again, only publications of article-type are considered.

(vi) **Size**

This refers to the sub-total scores of the above five indicators divided by the number of full-time equivalent academic staff. If the number of academic staff for institutions of a country cannot be obtained, the total scores of the above five indicators are used.
5.3 SESRTCIC – Academic Ranking of Universities in the OIC

This is a pro-active attempt by the OIC to develop a new ranking specifically for OIC-member countries, with the objective of encouraging universities in OIC countries to be on par with universities from more developed nations.

What is the methodology used by SESRTCIC in the ranking? The ranking by the OIC centre was developed by analysing accessible internationally-comparable data according to verification and objective quantitative criteria. The number of articles published by all universities during 2001-2006 and the number of citations received are used also as indicators. The ranking covers only universities in OIC-member countries, and specifically those articles published in the period 2001-2006 in journals covered by the Institute for Scientific Information (ISI) i.e. the Science Citations Index (SCI), the Science Citations Index Expanded (SCI-EXPANDED), and the Social Science Citation Index (SSCI). Currently 49 of 57 member countries are covered by this ranking, in which 323 of 1799 universities are included in single-factor rankings, and 85 of those 323 are ranked by the composite index (see below).

5.3.1. OIC Ranking Methodology

The data used in this system can be divided into two:

1. ISI Web of Knowledge
   a) Number of articles by universities / countries; and
   b) Number of citations by universities / countries.

2. SESRTCIC
   a) Web Search;
   b) List of universities by country;
   c) Number of faculty members; and
   d) Any other data has been taken from the database of the Centre or is presented according to our own calculations.

There are two types of rankings used by SESRTCIC: (i) Single-factor rankings; and (ii) Composite index rankings.

(i) Single-Factor Rankings

The single factor considered here is publication, and its corollary: citation. This system is based on a ranking by number of articles published and the average number of citations per article. Under this system, universities are ranked with respect to the number of citations per article (published in 2004-2006), using the formula:

\[
CpA = \frac{\text{Number of citations received in 2004 - 2006}}{\text{by articles published in 2004 - 2006}} \]

\[
\text{Number of articles published in 2004 - 2006}
\]

232
(ii) Rankings by Composite Index (CI)

Using this methodology, several indicators are used:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicator</th>
<th>Code</th>
<th>Weight*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Quality</td>
<td>Measures the quality of the research performed</td>
<td>A1</td>
<td>35%</td>
</tr>
<tr>
<td>Research Performance</td>
<td>Measures the research performance of faculty members</td>
<td>A2</td>
<td>35%</td>
</tr>
<tr>
<td>Research Volume</td>
<td>Measures the volume of research produced by faculty members.</td>
<td>A3</td>
<td>18%</td>
</tr>
<tr>
<td>Rate of Growth for Research Quality</td>
<td>Measures progress shown relative to the entire OIC in a 3-year period with respect to the quality of the research performed (see A1).</td>
<td>A4</td>
<td>12%</td>
</tr>
</tbody>
</table>

**Total** 100%

The formula for the Composite Index is given as follows:

\[
\text{Value of the indicator A4} = \left( \frac{\text{Value of A1 for the university for the year 2007}}{\text{Value of A1 for the entire OIC for the year 2007}} \right) \left( \frac{\text{Number of articles published by the university in 2004}}{\text{Number of articles published by all universities in 2004}} \right) \left( \frac{\text{Number of articles published by the university in 2004}}{\text{Number of articles published by all universities in 2004}} \right) - 1
\]

\[
\text{Score of the indicator} = 100 \times \frac{\text{Value of the indicator}}{\text{Highest value of the indicator}}
\]

\[
\text{CI} = \sum \text{Indicators (Weight of the indicator) x (Score of the indicator)}
\]

233
Statistical analysis via the Correlation Coefficient provides useful information about the relationship between variables of interest. The Correlation Coefficient (r) is:

- A statistic that gives a measure of how closely two variables are related;
- A statistical measure of the extent to which variations in one variable are related to variations in another.

A value of +1 indicates a perfectly positive relationship, −1 indicates a perfectly inverse relationship, and 0 indicates no relationship between the variables.

6 CRITICISMS OF THE CURRENT METHODOLOGIES OF WORLD UNIVERSITY RANKING

Criticisms have been made of both the THES and SHJT methods of ranking.

6.1 Problems with the THES Method

(i) The use of Peer Review as the first indicator in the THES method gives rise to immediate grounds for concern. The THES method calculates a university’s overall ranking score by giving a huge 40% weighting to peer review assessment based on the reputations of university departments in the eyes of a cross-section of university researchers. This has led to some problems: it is important to bear in mind always that peer review is a subjective criterion. Assessors’ opinions about the best departments in their fields are likely to vary according to their own scholarly and theoretical leanings (assessors are likely to prefer departments that are strong in their own research areas). Another problem is that although they are experts in their fields, assessors are unlikely to be immune to the influence of reputation. As Simon Marginson has said (Marginson 2006, p. 90), “there is the ‘halo’ effect: perceptions are shaped by existing prestige”.

(ii) Secondly, regarding international employers, a key difficulty is that assessments by employers of their employees are not based primarily on the quality of the employees’ university education. Prominent universities tend to attract well-connected students whose employability is enhanced further at university by influential alumni networks. Because of these advantages, graduates from these universities are likely to perform well in the eyes of their employers for reasons often having little to do with the quality of their university education.

(iii) In relation to citations, the THES method determines a university’s score by the number of academic papers its researchers publish per capita. Focusing on research (citations), this gives proper attention to a core criterion of university achievement and offers a reasonably objective
measure of that achievement. But the issue is that this indicator is the only THES criterion that measures directly research output, and it accounts for only 20% of a university’s score. Furthermore, the THES description is vague about what counts as a relevant publication, and it seems clear that the criterion measures quantity without attempting to distinguish and give special credit for high-quality research.

(iv) Another issue important in considering THES rankings is measuring teaching quality. Often people assume that staff members who are involved in research, and good at it, will on the whole be good at teaching as well or at least they will be sufficiently knowledgeable about the subject taught.) Thus, the THES method determines a score for a university’s teaching according to the average research output of its teachers. However, studies have been unable to demonstrate convincingly that there is a positive correlation between teaching ability and research productivity, so this approach is based only on speculation (Marsh et al 2002).

6.2 Problems with the SHJT Method

A glance at the SHJT ranking criteria shows that the system is based very largely on research performance.

Alumni are graded so that that the more recently a prize was won, the more credit the university receives. The criterion accounts for only 10% of the total score and it is meant to determine the quality of the education a university provides, and this is the only recognition the SHJT system accords to teaching excellence. What makes this an issue is that many universities have no Nobel or Fields laureates among their alumni, and the criterion has nothing to say about the wide variations in teaching standards that are surely to be found among those universities.

The Award, HiCi, N&S and SCI criteria of THES measure research output, and each count 20% towards an institution’s score. This amounts to a massive 80% emphasis on research. The ‘Award’ criterion focuses on Nobel Prizes and Fields Medals, but concerns itself with prizes won by a university’s sitting faculty members as an indication of research excellence. Although Nobel prizes are not awarded on the basis of transparent academic criteria, we should accept that the prizes are obviously respected and consistently are won by leaders in their fields, so there can be no serious complaint about the status of the awards as indicators of achievement in research. In using a criterion focusing on particularly outstanding research, the SHJT ranking system rewards quality as distinct from the mere quantity of an institution’s research output. However, the ‘Award’ criterion excludes Nobel Prizes for Literature and counts only those won for physics, chemistry, medicine and economics, which is indicative of an emphasis on science that is a general feature of the SHJT system.

The N&S criterion takes account only of publications in the prestigious journals Science and Nature, thus it is similar to the ‘Award’ criterion that focuses exclusively on very high quality science. SCI however, by contrast,
measures research quantity and accommodates not only scientific research but also the full range of academic research. This builds into the SHJT system an important indicator of the volume of general research output.

7 ON HOW TO IMPROVE THE CURRENT METHODOLOGY OF OIC RANKINGS (LESSONS LEARNT FROM THE TWO MOST POPULAR UNIVERSITY RANKING METHODS)

By examining the strength and weaknesses of the THES and SHJT rankings, OIC countries will be able to improve current ranking method and take into serious consideration several issues aimed at enhancing further university excellence in OIC-member countries.

7.1 The SHJT method gives appropriate attention to research (similar to the OIC’s approach), and its methods for assessing research performance are admirable both in their objectivity and in the way they attend to both quantity and quality. Regarding the quantity of research output, an ideal ranking system would give significant credit - as the SHJT system does - for the number of academic articles a university’s departments place in peer-reviewed academic journals. However, unlike the SHJT system, it would not have a bias towards science or any other academic field. For the system to be fair it would also have to find a way of evaluating the varying weight of articles - for instance in terms of length and substance - and the varying contributions individuals make to a publication (recognizing, for example, the difference between individual authorship and multi-authorship).

7.2 It would also need to find a way of crediting the authorship of academic monographs, which are another form of academic output that falls through the cracks of the SHJT and THES methods. Regarding the quality of research output, an ideal ranking system would follow the SHJT system in giving credit for high quality research, though perhaps giving less emphasis to rare forms of achievement like the winning of Nobel and Fields Prizes, while expanding its list of prestige journals to accommodate more than just two (i.e. Science and Nature) since there are other highly-prestigious science journals and there are analogues of these journals in non-science fields which should also be acknowledged. An ideal system would follow also the SHJT in crediting institutions for their highly-cited researchers, since the presence of research leaders is obviously a distinctive feature of excellent universities.

7.3 It should be noted that the SHJT ranking system has been widely criticised for giving too little attention to teaching excellence. An ideal ranking system would address this. The managers of the SHJT system point out that it is difficult to obtain objective measures of good teaching (Liu et al 2005, p. 133). However an objective criterion that can be used
to measure teaching quality, as used by the THES system, is staff-student ratios which, as has been suggested previously, are at least a significant indicator of teaching quality.

7.4 The ranking for OIC countries also has to be clear as to whether it is interested only in fields pertaining to science and technology or to include the humanities and social sciences as well.

8 AN ALTERNATIVE APPROACH TO THE SELECTION OF OIC UNIVERSITIES TO DETERMINE ELIGIBILITY FOR OIC SUPPORT

University ranking is one method which has been suggested to identify which OIC universities should be given support in order to improve their position in international rankings and standing. At present there are two internationally known rankings, namely THES and SHJT. A third ranking system has been proposed by SESRTCIC. In this paper, in addition to these three, a fourth alternative is proposed which is based on a combination of information obtained from the international data on Science and Technology Indicators and the information on university rankings above.

In this approach, instead of ranking the universities according to given criteria such as the multiple composite index or the single factor index, we begin by identifying the countries which have contributed significantly according to international science and technology indicators, namely input indicators (GERD, no. of RSEs), and the output indicators (patents, publications). Since these have a close relationship and correlation with science and technology in universities, they can function as quite reliable measures of the performance of universities in various OIC countries. This is because universities are the major contributors of the science and technology performed in various countries.

Using this approach, the steps involved are:

(i) Based on the figures for world S&T indicators obtained from organisations such as the United Nations, figures for performance of OIC countries in science and technology based on those indicators are obtained;

(ii) For all four S&T indicators, for example the number of publications, a ranking is made for all OIC countries for which data is available;

(iii) For each country, an ‘overall score’ is obtained by summing up the rank number for each country. For example, country X, which is ranked no. 1 in indicator 1, no. 2 for indicator 2, no. 3 for indicator 3 and no. 4 for indicator 4, will obtain a total score of 1+2+3+4= 10. Country Y, which is ranked no. 2 for indicator 1, no. 3 for indicator 2, no. 4 for indicator 3, and no. 5 for indicator 4, will obtain a total score of 2+3+4+5= 14. The country with the ‘least score’ will be the ‘highest ranked’. Thus, overall country X with a score of 10 is ranked higher than country Y with a score of 14;
(iv) From the ranking obtained in (ii) we select the top five countries;
(v) For each of these five countries we select the top three universities in each
country. This information is to be provided by the educational
representatives of those countries;
(vii) We will then obtain a list of 15 (5 x 3 = 15) universities from five
different countries.

8.1 Pros and Cons of the Alternative Method

This method, like most other methods of determining rankings, has its own
advantages and disadvantages. One advantage of this method is that it relies on
an internationally-accepted standard of measure for national performance in
science and technology, namely the S&T indicators. For example, it cannot be
disputed that among OIC countries Turkey has the highest number of
publications in S&T, Jordan has the highest number of R&D researchers in per
million of population, and Malaysia has registered the highest number of
patents. These figures also tally with the rankings of these countries in industrial
and technological competitiveness indexes. Since universities are the major
contributors to these scores, the indicators also function as indirect measures of
the performance of universities in these countries, and this is especially true in
the case of publications. A second advantage of this method is that by
commencing with the use of national rankings, already it ensures that the
selection of universities will be made on the basis of country representation.
Thus, the result will not be skewed towards any particular country. By starting
from the ‘bottom up’ in the SESRTCIC methodology and using its criteria, the
resulting distribution of selected universities will not be equally distributed
toward universities in deserving countries. That is, using the composite index
methodology for instance, the country distribution for the top 50 universities is
as follows:

<table>
<thead>
<tr>
<th>Country</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey</td>
<td>26</td>
</tr>
<tr>
<td>Iran</td>
<td>9</td>
</tr>
<tr>
<td>Malaysia</td>
<td>3</td>
</tr>
<tr>
<td>Egypt</td>
<td>3</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2</td>
</tr>
<tr>
<td>Uganda</td>
<td>1</td>
</tr>
<tr>
<td>UAE</td>
<td>1</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>1</td>
</tr>
<tr>
<td>Lebanon</td>
<td>1</td>
</tr>
<tr>
<td>Kuwait</td>
<td>1</td>
</tr>
<tr>
<td>Jordan</td>
<td>1</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>1</td>
</tr>
</tbody>
</table>

We can see that through this method, countries like Jordan are not fairly
represented, at least not in terms of what those countries have contributed and
achieved in science and technology. Similarly, Malaysia with two universities
(University of Malaya and Universiti Kebangsaan Malaysia) included in the THES ranking of the world’s top 200 universities falls way below Turkey that does not have any university in the top 200 of the THES ranking.

The disadvantage of this method is that it leaves the decision of the top three universities from each country to the country representatives themselves, in which case a consensual result might not be achieved unless we specify a further set of criteria. It also has the disadvantage of leaving out potentially fine universities because their host countries do not fare well according to the S&T indicators. Another possible weakness of this method is that after shortlisting to 15 universities, clear guidelines for selection need to be given should the final number to be chosen be less than 15 (for example five).

9 GENERAL PROBLEMS IN RANKING PROCEDURES

There are various problems in the methodology used in university rankings. We will discuss some of these problems below.

9.1 The Scenario between Expert Survey and Peer Review

‘The greatest influence has been exerted by those in the position to judge: the academics’, says John O’Leary, editor of the Times Higher Education Supplement (THES 2004). Indeed, judgement by knowledgeable colleague-scientists - known as peer review - is the principal procedure of assessing research performance, notwithstanding its shortcomings and disadvantages.

In most cases, peer review is applied on a relatively small scale, ranging from the review of a submitted paper or a research proposal by two or three referees, the review of the record of candidates for a professorship by, say, five experts in the field, to the assessment of research groups and research programs within a specific discipline by between five and ten peers. The above examples illustrate cases we consider to be typical peer review in science. In these cases the ‘cognitive distance’ between the individual peers and the object to be evaluated (paper, proposal, person, group, program) is small. This implies two important things: first, the peer can be regarded as an expert with respect to the quality of the object; and second, the object to be evaluated has a ‘size’ that is comparable with the normal direct working environment of the peer, namely a research group or a research program, thus making it surveyable for individual peer judgement.

In THES rankings, experts are required to assess the quality of entire disciplines, for instance all natural sciences or all biomedical and life sciences. Martin Ince (THES 2004) proclaims peer review as ‘...the most trusted method for university comparison...’ It is however questionable whether all the individual academics involved in such large-scale surveys can be regarded as knowledgeable experts in all those parts of the evaluated entities that really matter. As indicated above, the ‘cognitive distance’ between evaluating person and evaluated object is becoming too large. In such cases, the ‘experts’ will
more and more tend to judge on the more general basis of established reputation instead of their own actual knowledge of recent past performance.

However, this awareness is precisely what a peer must have. It is also this recognition of recent past performance that forms the strength of bibliometric analysis. Indeed, bibliometric indicators can be seen as the aggregate of typical peer review. Well-informed colleague-scientists play their role as a member of an ‘invisible peer review college’ by giving citations in their own work to the earlier work of other scientists. As this happens for all university publications in many disciplines, the outcomes of a bibliometric analysis on the level of a university will be statistically very significant.

Furthermore, dependence of the outcomes on the choice of experts is another major problem. This dependence may cause biases in fields of expertise. After publication of the first THES ranking, The Sydney Morning Herald gloried the presence of no less than six Australian universities in the top 50, while the German news agency DPA bemoaned the absence of the country in any top positions (THES 2004). Six universities in the top-50 amounts to 12%, while Australia contributes only about 2.5% to the worldwide scientific impact (on the other hand, Germany contributes around 8% to worldwide scientific impact). Further, most of these Australian ‘top’ universities score low to very low on the number of citations.

The strange discrepancies which occurred especially in terms of the results of an expert survey versus bibliometric findings suggest that most probably there are strong geographical biases (particularly an Asian one) in the THES expert survey (note that the THES expert survey was produced by a London-based company specialising in MBA and graduate recruitment). This may very well cause a positive bias for universities with large institutes of economics and schools of management and a negative bias for universities without a strong emphasis on these disciplines. As the following THES comment on the very low ranking in citation positions of the Australian ‘top’ universities indicates: ‘But the Australian universities are popular in our peer review and do especially well in our rankings of international success. They are among the world’s most enthusiastic recruiters of international staff and students, with years of recruiting in Asia and beyond now visibly paying off’ (THES 2004).

Furthermore, the experts were probably not asked to compare all universities in the ranking. How many universities could they nominate? Did they receive a worldwide list of universities to make their selection, or did they have to nominate universities ‘by heart’? The experts know only a limited part of all universities involved. All this imposes severe limitations on the statistical reliability of expert scores for the entire ensemble of universities. For instance, do all reviewers use the same judgement scales for the same number of universities, and how large is this number? How can it be validated that the differences in scores between peers with their very many different field-specific backgrounds have a reliable meaning?

Moreover, for external validation of the experts there is significant need to control variables such as own institution, geographic distribution, fields of
expertise and own scientific status. So far all these methodological questions remain, to the best of our knowledge, unanswered.

9.2 The Drawbacks of Bibliometric Analysis

9.2.1 Basic assumptions

Bibliometric assessment of research performance is based on one central assumption: scientists, who have something important to say, publish their findings vigorously in the open international journal (serial) literature. This assumption introduces unavoidably a ‘bibliometrically limited view of a complex reality.' For instance, journal articles are not in all fields the main carrier of scientific knowledge. They are not equivalent elements in the scientific process. They differ widely in importance. And they are challenged as the ‘gold standard’ by new types of publication behaviour, particularly electronic publishing. However, the daily practice of scientific research shows that inspired scientists in most cases, and particularly in the natural sciences and medical research fields, aim for publication in the better and - if possible - the best journals. A similar situation is developing in the social and behavioural sciences, engineering and, to a lesser extent, the humanities.

A first and good indication whether bibliometric analysis is applicable to a specific field is provided by the publication characteristics of the field, in particular the role of international refereed journals. If international journals are the dominating or at least a major means of communication in a field, then in most cases bibliometric analysis is applicable. Therefore it is important to study first the ‘publication practices' of a research group, department or institute in order to establish whether bibliometric analysis can be applied. A practical measure here is the share of CI (citation index)-covered publications in the total research output. Work of at least some importance provokes reactions of colleague-scientists. Often, these colleague-scientists play their role as a member of the invisible peer review college by giving citations in their own work to the earlier work of other scientists.

Thus, citation analysis is based on the reference practices of scientists. The motives for giving or not giving a reference to a particular article may vary considerably. So undoubtedly, the process of citation is a complex one, and it certainly does not provide an ideal monitor of scientific performance. This is particularly the case at a statistically low aggregation level e.g. the individual researcher. There is, however, sufficient evidence that motives for referencing are not so different or random that the phenomenon of citation loses its role as a reliable measure of impact. The application of citation analysis to the entire

---

6 Van Raan, 2004, Problems in Rankings
7 More reference Education Social Science Library / Ranking Cautions & Controversy /2005/ htm
8 Garfield, Dorof, 2004, Citation and its Impact
9 Ibid

241
work, i.e. the work of a group of researchers as a whole over a longer period of time, does yield in many situations a reliable indicator of scientific performance.

9.2.2 Methodological problems

Methodology relates directly to the aims of a study. The objective of both the SHJT as well as THES is to obtain a worldwide ranking of universities in terms of their ‘scientific strength’. The crucial point is thus with which indicator or weighted combination of indicators such rankings have to be constructed.

An important bibliometric-ranking element in the SHJT study is the number of highly-cited researchers in a university in relation to the life sciences, medicine, physical sciences, engineering, and social sciences. The SHJT group used the Thomson Scientific Highly-Cited Scientists database; these individuals are the 250 most highly-cited researchers within each of 21 broad fields of science for the period 1981-1999\(^{10}\). The SHJT group depends here completely on how the database producer identifies the highly cited scientists and calculates citation rates. Methodologically, this means the use of a ‘black box’.

Moreover, publication and citation characteristics vary substantially between fields of science within these broad fields. Because of these differences, proper field-specific normalisation is necessary, which is not done in the highly-cited scientists database. Field-normalisation must also take into account the size of the field. The Thomson Scientific broad fields differ considerably in size, for instance immunology covers around 70 journals, while molecular biology and genetics cover around 150 journals.

Furthermore, the period 1981-1999 does not reflect the state-of-the-art of the research front at present. These highly-cited scientists are determined by ‘life time citation counts’, which enhances the ‘old boys effect’ and does not focus on the impact at the research front of today, particularly by younger researchers. In the identification of highly-cited papers, it is important to distinguish between the various article types that include normal articles, letters, notes, and reviews. There are large differences between reviews and normal articles both on the ‘citing side’, which involves the number of references (for reviews this number is usually high to very high), and on the ‘cited side’ which comprises the number of citations received (for reviews in many cases it is again high). Therefore, review papers may constitute a considerable part in the collection of highly-cited scientists.

However, reviews are in most cases not original scientific work, as their authors present state-of-the-art overviews of developments in their field. Therefore, it is necessary to take article type into account in all normalisation procedures, for example, the comparison of reviews with reviews and so on in the calculation of impact-indicators used in rankings. Definition of fields on the basis of international journals and the application of citation data depends on the role of journal articles in the different fields and the coverage of these journals by the

---

citation index system. Coverage merely by citation index has become a problem for engineering and the social and behavioural sciences, and certainly for the humanities. Thus, the strength of a university in engineering, in the social and the behavioural sciences or in the humanities may contribute little - or even hardly - to the position of that university in a ranking based on bibliometric data.  

A further point concerns the time dimension in the indicator framework. Perhaps one will say that this factor is trivial in determining the quality of universities, however this aspect is in fact related to reputation and contemporaneous performance. It might not be applicable to most universities today, but it might be significant in determining the quality of certain universities in 15 to 20 years time should these rankings become mandatory for universities around the globe. In the SHJT 2005 study different time horizons are used for the various indicators: back to 1910 for Nobel Prizes, the period 1981-2003 for highly-cited scientists, the period 2000-2004 for the number of Nature and Science papers, and the year 2004 for articles covered in the SCI-expanded index. It still needs to be explained how these very different time horizons contributes to the notion of ‘who belongs now at the top’, which is undoubtedly the question that drives the users of such rankings.

A further important methodological problem is the influence of biases in the citation index system. In rankings based on bibliometric indicators, American universities and research institutions tend to dominate the top positions of the ranking. There is no doubt that the American top universities are institutions of undisputed world-class. There is, however, also an American dominance in the overall publication and citation traffic. It is not easy to determine to what extent this phenomenon affects impact assessments and to correct accurately for it. More methodological work is necessary to come to grips with this problem.

Furthermore, a more concrete bias is related to publication language. Recent work (Grupp et al 2001; van Leeuwen et al 2001) shows that the utmost care must be taken in interpreting bibliometric data in a comparative evaluation of national research systems. The measured value of impact indicators of research activities at the level of an institution and even of a country strongly depends upon whether one includes or excludes publications in CI-covered journals written in languages other than English, particularly French and German. Generally the impact of publications of these French and German-language journals is very low. Thus, in the calculation of impact indicators, these publications count on the output side but they contribute very little, if any, on the impact side. Therefore, such non-English language publications do not contribute much to the measured impact of a university or a department, even though their research output might be significant.

---


12 Van Raan, Problems in Ranking, 2004

13 Reference taken from Grading Curve, 2004

243
9.2.3 Technical problems

The final type of problem with the regards to the ranking system is the technical aspect. The most central technical process on which citation analysis is based is the matching of citing publications with cited publications (Graham, 2004). In a publication (the ‘citing publication’), a reference is given to another publication (the ‘cited publication’) and this reference has to be identified as an earlier ‘source publication’ in the citation indexes. A wide variety of errors may occur in this citing-cited matching process leading to a ‘loss’ of citations to a specific publication. On average, the number of non-matching references -although they are citation index-covered source papers - is about 7% of the citations matched. Frequently occurring non-matching problems relate to publications written by large groups of authors or consortia, to variations and errors in author names particularly - but not only – those of authors from non-English speaking countries, errors in journal volume numbers, errors in initial page numbers, discrepancies due to journals using dual volume-numbering systems or combined volumes, or to journals applying different article numbering systems. Thus these non-matching citations are highly unevenly distributed in specific situations, which may cause an increase of the percentage of lost citations up to 30\%\textsuperscript{14}. So if the citation indexes are used for evaluation purposes, all these possible errors must be corrected as much as possible, otherwise the credibility of the ranking will continually be jeopardized.

The next major technical problem relates to the attribution of publications\textsuperscript{15} and the citations to these publications to specific organisations such as institutes, university departments. This occurs when attributing even on a high aggregation level to the main organisation (for instance universities). Often it is believed that the citation indexes can simply be scanned in order to find ‘all’ publications of certain universities. This assumption is based on the argument that all these publications mention clearly somewhere in the address data of the publication 'University X' as the main affiliation of the authors. However, this assumption is wrong.

Next to variations in the name and abbreviations of the same university, departments and institutes (in many variations) are not to a negligible extent mentioned without proper indication of the university\textsuperscript{16}. To illustrate clearer, for example in the commercial database of highly-cited scientists, five variants can be found for (parts of) Leiden University: Leiden University, Universiteit Leiden, Leiden Observatory, Leiden University Medical Centre, and Leids Universitair Medisch Centrum.

Moreover, there are major differences in research systems between countries affecting the definition of a university\textsuperscript{17}. For instance, the University of London is not a university in the usual sense; it is an ‘umbrella organisation’ covering

\textsuperscript{14} Data of percentage taken from Van Raan, 2004Problems in Ranking
\textsuperscript{15} Ibid
\textsuperscript{16} Graham, Amy. 2004, Broken Rank
\textsuperscript{17} Ibid

244
several different virtually autonomous universities. A similar problem occurs with multi-campus university systems in the United States, for instance the University of California\textsuperscript{18}. In France, there are autonomous universities in the same city that were part of originally one ‘mother-university’, and as a consequence it is very cumbersome to distinguish between departments of these different universities within one and the same city. In some cases these problems are so large (e.g. Vrije Universiteit Brussel and the Université Libre de Bruxelles, both are indexed as ‘Free University (of) Brussels’) that it is impossible to distinguish both universities on CI-based address data only\textsuperscript{19}.

Very problematic is capturing the medical research of universities, as often only the medical school and/or the name of the hospital (without mentioning the university) is indicated. One needs to know the names of the hospitals in a specific city - and also in the suburbs of a city - that are in fact university hospitals. So if a hospital clearly has the role of a university hospital (because it is known as such and such is indicated in, for instance, the website of the university’s medical faculty), but an article mentions only the hospital name (for instance Radcliffe Hospital) this article must be added to the ‘broad definition’ of the university (in this example Oxford)\textsuperscript{20}. Otherwise, a university would miss a major part of its basic and clinical medical research when compared to universities where the hospital has the word ‘university’ clearly as part of its name. It is clear that this is not always a simple procedure as university-related hospitals are often autonomous organisations that may have relations with other research institutes or other institutes of higher education. This problem might sound a bit funny, but even a little thing can cause a lot of discontentment and frustration to those who require ‘fair judgement’ in the league. It is significant to bear in mind that technical errors may look small and not-so-critical but the impact of them may be very significant in validating the accuracy and credibility of the ranking itself.

\textbf{10 CHARACTERISTICS OF WORLD-CLASS UNIVERSITIES AND WORLD UNIVERSITY RANKINGS: DO THEY REFLECT EACH OTHER?}

Despite all the shortcomings uncovered in university ranking procedures, the world university rankings produced by the \textit{Times Higher Education Supplement} and \textit{Shanghai Jiao Tong University} are increasingly popular and have received astonishing feedback. However, with all the controversies that have haunted the rankings system another question looms large, and this time it concerns whether there are disparities between the concept and characteristics of world-class universities and university rankings. If there are, then everyone should conclude

\textsuperscript{18} Data taken from Curve in Grading, 2004
\textsuperscript{19} Examples given by the researcher, extracted from Problems in Rankings
\textsuperscript{20} Ibid
that rankings are gratuitous and superfluous as they are unable to portray the world-class concept itself.

Conversely, although there are numerous criticisms of rankings, we should accept the fact that both the concept and characteristics of world-class universities and world university rankings are 'twin-siblings' which complement and reflect each other. The pitfalls that surround ranking systems and procedures could be corrected and the evaluation could be improved either over a short or a long timeframe. The concept and standard of world-class universities symbolise high standards of excellence in various aspects while the world university rankings will reflect (or at least attempt to reflect) the superior quality and excellence of universities through the rankings themselves.

Furthermore however, even if they both are 'twin-siblings', there will always be pros and cons surrounding them. On the positive side the rankings will bestow a first-class reputation to the universities, and the rankings help automatically to 'advertise' those universities in the top rank. Since students and academics/researchers from all over the world refer now to the rankings as a guide to which universities are of first-rate quality, they will be able to attract the best students and academics. Other than that, through their ranking and the publicity that results from that the universities promote their host-country and thereby allow its economy better prospects of growth. Moreover, by looking at the indicator as an evaluation of the criteria for world-class standing, our universities may gain a better understanding in order to plan for which areas should receive attention and which problems should be tackled.

But then again, back to the 'dark side' of it, most people who rely on the rankings do not know what lies behind them: they rely simply on the numbers; i.e. universities in the low rank are not good compared to universities in the high rank. And what happens to those universities that do not even make to the top 200 (THES) or top 500 (SHJT)? Was it because they did not have all the qualities required, and thus are bad institutions? Were all universities at the top rank better than other universities below them? Tellingly, even Harvard University was not no.1 in all disciplines. Further, what about those outstanding universities around the world that refuse to comply with this standard and evaluation? Are they worse? There are some great universities which repudiate the concept of evaluating world-class standard through world university rankings, e.g. the University of Gottingen, as well as most technical and technological universities in Europe (particularly Germany) and Japan. How are they so brave to ignore this seemingly all-powerful system? The decisions of these institutions are not without risk, especially in relation to admission. To date however, their action has received widespread enthusiastic support from parents, students, faculty members, and other higher education institutions and, interestingly, university presidents, several of whom have even confided that they wish they could refuse to participate. Colin Diver of Reeds College University in the United States cautions prospective students and parents against relying on rankings. Rankings, he says, are grounded in a 'one-size-fits-all' mentality. "They are primarily measures of institutional wealth, reputation, influence, and pedigree. They do not attempt, nor claim, to measure the extent
to which knowledge is valued and cultivated” on each campus. Reeds does not rank its students, so "Why should we participate in a survey that ranks educational institutions?"21

Notably all these so-called ‘ignorant’ universities continue to stand apart from current trends, resisting pressures to abandon their core principles and clear focus on academics. Studies continue to show their graduates earning doctorates or winning postgraduate fellowships and scholarships at rates higher than all but a handful of other institutions. By looking at their audacity, all of them are paradigmatic examples of a higher education institutional commitment solely to the cultivation of a thirst for knowledge. And they illustrate a relatively small but robust segment of higher education whose virtues may not always be celebrated by the popular press but can still be found by those who truly seek them.

11 OUR OWN PERSPECTIVES AND HOPES FOR WORLD-CLASS UNIVERSITIES

The great universities of the 19th century were shaped by nationalism but it seems that the great universities of today are being shaped by globalisation; the world’s higher-education system is dominated increasingly by a super-league of world-class universities competing with each other for talent and prestige. Whenever we talk about globalisation which influences flows in higher education, the term ‘world-class universities’ comes into the picture as it is born from the force of unavoidable competition inherent in globalisation itself. No matter how hard we try to argue about the status and standard, we must admit that it is a powerful force which somehow, sooner or later, we must be part of. However, to be part of it does not mean to comply with it without further justification and insight. Perhaps as a preliminary move toward acceptance of the concept we should put forward a general description of its characteristics.

Firstly, world-class universities will conduct their learning and teaching in a research-led environment, yet they will not necessarily be pure research universities. They will be committed to taking students to the boundaries of knowledge and encouraging them to contribute to that knowledge base. This provides students with the attributes and confidence that enable them to become leaders in their chosen field or application. Most importantly, world-class universities generate leaders of the future.

Secondly, world-class universities generate knowledge that makes a difference, i.e. new knowledge that influences the way that society works and/or the way governments make decisions, or that influences major public sector organisations, industry, and national corporations. It would be a bonus if they influence international corporations.

Thirdly, world-class universities will have clearly-identifiable peaks of excellence, i.e. features that are regional or world-renowned and of which they

---

21 Quote from article on www.collegeranking.org/reed/html

247
will be proud. They will have a breadth of excellence across everything they do. This aside, world-class universities are not ivory towers; they imbue themselves in their city and their region as well as contribute to national and international agendas. They are able to look beyond their own immediate needs and beyond themselves, and help others and contribute to society in general.

Lastly, world-class universities have a moral responsibility to take seriously the widening of participation, particularly in terms of making the university accessible to individuals from under-privileged, low socio-economic and low-income backgrounds.

12 SHALL WE ISOLATE OURSELVES FROM THE CURRENT TREND OF WORLD-CLASS UNIVERSITIES?

It is significant to note that universities operate in both national and global contexts. The world-class idea falls into the global sphere by which it assumes that universities are competing with the best academic institutions in the world and are aspiring to the peak of excellence and recognition. However, we must accept the fact that national and even regional realities may differ. The constraints are unique for each country, for example political realities, the financial situation, national policy and so forth. Most significantly, they relate to the needs of the immediate society and economy and imply responsiveness to local communities. In these contexts, the nature of academic performance and roles of a university may differ from what is expected at (other) institutions competing in the global realm. To label one sphere world-class while relegating the others to the nether regions of the academic hierarchy is perhaps inevitable but nonetheless unfortunate (Altbach, 2003).

Yet a sense of realism and sensitivity to the public good must also factor into the equation. Ambiguity in the concept of world-class universities combined with the impossibility, so far at least, of measuring academic quality and accomplishment, makes the struggle even more difficult. Indeed, it might well be that the innovative energies and resources of higher education should be focused on more realistic and useful goals.

We have been looking at the overall concept of world-class universities and the development of global university rankings, and perhaps most of the time, we have condemned them probably because they disrupt our routines and comfort zones in OIC countries, and also probably because of the latest national embarrassment arising from the slide down and disappearance of most of our universities in these rankings. However, it is futile to dwell too much on ranking or standard issues without seeing them in perspective: they are symptoms of major existing problems plaguing higher education in our countries. To be 'world-class' - whether this is based on our own orientation or a global standard - and achieve all the excellencies that we admire most, the significant problems and dilemmas plaguing our higher education need to be diagnosed and treated.
13 UNIVERSITIES IN OIC COUNTRIES AND THE RANKINGS SYSTEM

After having discussed some of the characteristics, shortcomings and methodological issues relating to world university rankings, which policy should OIC countries adopt towards the matter? In the 2006 THES rankings, only two Malaysian universities (namely the National University of Malaysia and the University of Malaya) appeared in the top 200, and these were the only universities represented from OIC countries. The question is how did this happen? Should we be critical of the rankings themselves and thus refuse to participate in them? The OIC represents 57 countries, and Muslims comprise around a quarter of the world’s population, yet the OIC’s performance in world university rankings is dismal. This is not surprising if we consider the science and technology indicators in which OIC countries fared poorly, e.g. the number of scientific publications and patents, and the number of researchers per million people, which bear a relationship to university rankings. In terms of scientific publications, the data for 1981-2002 showed that OIC countries together contributed only 0.7%, i.e. less than one percent of the world’s scientific output. In relation to researchers in R&D per million population (1990-2003), the OIC average (186) is one-sixth of the world average (1,146). In other words, OIC countries lag far behind when compared to Asia, Europe and America in terms of science and technology as well as educational achievement. Therefore, if we were to adopt a policy of participation in world university rankings, it would not do to apply cosmetic changes by leveraging the criteria used in the ranking procedure; what is needed instead is nothing short of a ‘paradigm shift’ in university management. This is however something that OIC countries might not be prepared to do since it involves a holistic change which might well clash with other national priorities set up by their respective governments.

To take an example, let us look at one of the THES criteria i.e. international staff and students, which contributes 10% of the total score. Not many OIC countries can afford to offer places to foreign students in their universities in view of the shortage of places for their own citizens. Nor can they afford to reduce the staff-student ratio - which contributes 20% of the total score - since this would imply extra expenditure for recruiting more academic staff or depriving some students from entering universities in order to keep the ratio low. The fact of the matter is that in a competitive world, the disadvantaged are not equipped to compete with those in the top league and may do so only at their own expense and detriment. In fact, it would make more sense for OIC countries to set their own standards and priorities that are realistic given the constraints and limited resources at their disposal. These standards and priorities would be aimed at improving the standard of the universities themselves and providing better quality education to their citizens instead of pursuing the chimerical aim of joining those in the top league. In addition, those in the top league (such as Harvard, Cambridge and Oxford) have a long tradition of academic excellence backed by sound finance, management and resources,
something which OIC countries, which are in the main newly-independent post-colonial states still dependent on their former colonial metropolis, do not have.

OIC universities would have to be clear as to what their objectives are, and how Islam features in those objectives. They should not be swayed by the so-called forces of ‘globalisation’ and ‘international standards’ in planning the development and management of their own universities. Although this paper does not advocate total disengagement from the trend found in world university education, it does recommend a cautious approach in matters of evaluation that bear on university management.

Perhaps one approach that the OIC could adopt towards the currently popular practice of world university rankings, is to adopt a two or three-tier approach in which universities in OIC countries are classified ‘High’, ‘Medium’ or ‘Low’. Only those in the ‘High’ category should be encouraged to compete in these rankings and considered potential candidates for the top 200, and thus given the necessary financial and infrastructural support by the OIC as a collective body. These universities should in turn serve as models, and provide support and consultancy services to other OIC universities so as to improve conditions in OIC universities as a whole. In this way, the dilemma of ‘elitism’ vs ‘egalitarianism’ in university education can perhaps be resolved. The types of support that could be given to these ‘High’ universities include for example: (i) engaging consultants to help the universities conduct their strategic planning and devise plans of action aimed at improving university management and the quality of education and research; (ii) adopting an aggressive recruitment policy by hiring qualified staff and researchers from around the world in order to improve the quality of research and education, as well as help boost the number of publications and patents; (iii) providing necessary infrastructure such as ICT facilities and up-to-date laboratories to facilitate education and research; and (iv) helping to establish publishing houses or buying established publishing houses to facilitate the publication and marketing of books and journals in the global academic and educational market. With regard to the methodology to be applied in selecting OIC universities under this category, the two methods available are those that have been discussed in sections 5 and 8 of this paper.

For universities in the ‘Medium’ and ‘Low’ categories, a different approach should be adopted towards their development in which world university ranking need not be of paramount concern. Instead, they should aim toward optimising the use of resources for the delivery of quality education that would contribute toward the national development of those countries. For this purpose, some sort of guidelines or criteria can be formulated and adopted, which are different to those set up by the more advanced countries which are unsuitable for universities from less developed countries. Instead of adopting a criterion such as publication in ISI-indexed journals, other more relevant criteria such as ‘relevance of publication to national needs and problems’ can serve as a criterion in their local journals. Although this might sound as if it is encouraging a ‘closed system’ that denies merit at the international level, some sort of standard could be instituted in the peer review or ‘refereeing’ process by including reputable scientists from more advanced countries in the editorial or
review board to ensure academic quality within the context of national relevance. The world of information, like the global mass-media, comes under the hegemony of advanced nations which use the process of globalisation to impose standards on the rest of the world. Developing countries should not fall into this trap and demoralise themselves in acquiescing to such norms and standards. Without turning a blind eye to standards, instead they should focus on their own strategy of self-improvement, and not let themselves be discouraged before even reaching the starting line.

14 CONCLUSION

Universities can do harm to themselves if they uncritically accept rankings system criteria and aim simply for a higher ranking as an end in itself. In this way, a system designed to measure performance dictates what that performance should be; thus for instance a university trying to improve its performance according to the SHJT system might channel funds into science at the expense of the humanities (even if it does not have the resources to become competitive in science research), while if traditionally it was strong in the humanities it may have threatened one of its important assets. Thus ranking systems should not dictate university policy either at a national or institutional level, but should be used as sources of information for guiding policies that are made according to the needs of the university’s own community, traditions, market niche, national role, and so on.
REFERENCES


2. Challenges in Ranking of Universities (Invited paper for the First International Conference on World Class Universities), Shanghai Jiao Tong University, Shanghai, June 16-18, 2005, Anthony F.J. van Raan Centre for Science and Technology Studies, Leiden University


Assessment in Higher Education: The U.S. National Research Council Approach to Assessing Research Doctorate Programs

CHARLOTTE KUH
National Research Council
Washington, USA

1 ABSTRACT

The National Research Council, the operating arm of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine in the United States, has embarked on an assessment of research doctorate programs in over 200 U.S. universities. This paper will describe that effort, which is far more detailed than the "league table" approach taken by many magazines and also the detailed peer review used by the Research Assessment Exercise (RAE) in the U.K. It will also describe two current efforts at global university ranking and encourage discussion of how universities in the Islamic world might become more visible in the world university rankings. The American historical context is important because the growing importance of ratings has coincided with the change in the American education system from an elite system dominated by private institutions to a system in which many more students are educated in public institutions.

2 WHY CONDUCT ASSESSMENTS?

Assessment should play a key role in improving practice in higher education. The ability to compare similar types of educational units with standardized measurements provides the tools to set goals and pursue measurable improvements. Assessment using quantitative characteristics of educational units, by itself, will be incomplete. Qualitative measures must be considered as well, but both quantitative and qualitative measures should be related to one another. Improvement along quantitative lines, such as increased research funding, will result in improvement in both qualitative measures, such as the

---

1 Dr Kuh is Deputy Executive Director of the Policy and Global Affairs Division of the National Research Council/National Academy of Sciences. The views expressed herein are her own and have not been reviewed by the National Research Council.
quality of research, and the quantitative measures, such as publications and citations, that are the measurable evidence of qualitative improvement.

Currently, the world is awash in various assessments. There are standardized assessments, such as the International Mathematics and Science Study, designed to assess pre-university student learning in an international context. There are “league tables,” such as those constructed within countries, for example by Der Spiegel in Germany, McLean’s in Canada, or US News and World Report, which rank universities within the countries. Globally, there are the university rankings conducted by Shanghai Jiao Tung University and the Times Higher Education Supplement. The news for universities in the Islamic world in these assessments is not good. At best, only a handful of institutions appear in the Top 500. But that alone does not provide information that is helpful for improvement. For this purpose, it is necessary to find out how such assessments are constructed. It is necessary to ask whether the elements in these assessments are appropriate to the goal of improving higher education performance in the Islamic world. Finally, it is necessary to construct measures appropriate to the objective of improving higher education in the context of higher education systems in the Islamic world.

In this paper, I shall discuss briefly the questions to ask about an assessment in order to ascertain whether it is appropriate to the educational objectives that you are trying to achieve. Then, I will discuss the two global assessments mentioned above and explain why they are inappropriate to assessing most universities in the Islamic world. Finally, I will describe how the National Research Council is assessing doctoral programs in United States universities and mention why this approach, with modifications, might be more appropriate to assessment of higher education in the Islamic world.

3 OBJECTIVES OF AN EDUCATIONAL ASSESSMENT

Let us consider three objectives of an educational assessment:

1. Benchmarking: To construct a comparison of institutions, programs or individual students;
2. To identify areas for improvement; and
3. To quantify the dimensions along which improvement may take place.

These objectives are closely linked. The comparisons involved in benchmarking will result in the identification of areas where the unit measured falls short or excels. This identification, in turn, will permit quantification of goals related to improvement.

These broad objectives can be made more specific according to the unit to be assessed. The unit may range from a single class, for which standardized tests or expert observation may identify those areas where student learning may be improved, to an entire university or a higher education system, for which rates of graduation or publications per faculty member or patents produced will be
among the possible measures. Appropriate measures will vary with the type of unit. What may be appropriate for similar units may cease to be comparable if measurements are made across units that educate with different “technologies,” such as the sciences and the humanities. As we will see later, the measures used in the global rankings are appropriate to the sciences and engineering, but generally less applicable to the humanities and social sciences.

4 WHO SHOULD CARRY OUT AN ASSESSMENT?

Who shall judge is a critical question in any assessment. Judges need to be knowledgeable about what is being assessed. They need to be unbiased, and they need to agree on standards so that they can be applied consistently. Although high level university administrators may be highly esteemed, they may not have the specific knowledge to make judgments of the quality of work outside their own field of expertise. When asked to make such judgments, they may be overly influenced by the presence of well known faculty members or the eminence of the university (a “halo” effect), rather than by documented information about the general level or overall quality of a program or faculty or university. A possibly apocryphal example of this effect is the story of a rating study in which the law school at Princeton University was ranked ninth. The only problem was that Princeton didn’t have a law school!

The design of an assessment study has to consist of a number of steps:

1. Agreement on what is to be assessed;
2. Choice of judges; and

The first step is the most important. Unless there is agreement about what is important to measure and how it should be measured, an assessment is doomed from the start to irrelevance or, worse, misguidance. Too often, users of the rankings that come out of assessments look only at the ranking, rather than the basis of that ranking. For example, 30% of the Shanghai Jiao Tung (SJT) ratings of universities are determined by the number of staff or alumni who have won Nobel prizes and Fields medals. Such distinction is certainly commendable, but only a very small number of universities in the world can boast of such graduates or staff. Thus, the overall index loses almost one-third of its measurement ability to a variable that can, at best, distinguish among only a handful of universities. Further, none of the components of the SJT measure such things that might be of importance to universities in the Islamic world, such as contribution of the university to research in a country as measured by citations, or budget, or proportion of the university-attending age cohort educated there.

Determination of what should be assessed is best accomplished through an advisory process, where the advisory group consists of experts in measurement (statistics) and in higher education outcomes. Their recommendations should
consist of a list of items to be measured and weights to be apportioned to each of these measures, if an index is desired.

In addition to the expert groups described above, at this stage, the judges should be experienced administrators who are used to making comparisons across disciplines. Their task is to find a common set of measures that are applicable to a number of fields and to agree on the principles of comparability.

When it comes to the actual assessment, the judging should be done separately for each discipline. Raters should be asked about familiarity with the programs they are rating and then asked to judge the quality of each program. An important decision in the design of the assessment is how much information each rater should have about each program. One extreme is the British Research Assessment Exercise, where faculty are asked to read representative papers chosen by each program and rate the program on the basis of judgments about the quality of the papers. The National Research Council model is less specific to research alone. It assumes that peer judgments of quality of research are reflected in quantitative measures of grants and publications. It also asks faculty raters to consider program information beyond research alone, presenting raters with information about education outcomes, such as completion rates, and other program characteristics.

5 TWO GLOBAL RANKINGS: TIMES HIGHER EDUCATION SUPPLEMENT INTERNATIONAL RANKINGS AND THE SHANGHAI JIAO TUNG UNIVERSITY INTERNATIONAL RANKINGS

The Times Higher Education Supplement International Rankings and the Shanghai Jiao Tung University International Rankings are both widely used to compare programs worldwide. Details about their methodologies may be found on their websites (http://ed.sjtu.edu.cn/ranking.htm and http://www.thes.co.uk/worldrankings/), respectively. I will discuss and contrast them briefly.

The Shanghai ratings are based entirely on measurable factors. These are:

1. Nobel prizes and Fields medals awarded to staff with most recent winners weighted more heavily (20%);
2. Highly cited researchers in 21 broad subjects (20%);
3. Articles appearing in the Science or Social Science Citation Index in the previous year (20%);
4. Articles published in Nature and Science in the previous five years year (20%);
5. Number of alumni winning Nobel prizes or field medals, with most recent winners weighted more heavily (10%); and
6. Size—the above five measures divided by faculty size. (10%).
These measures have the advantage in that they are each quantifiable. However, they apply almost exclusively to the sciences and social sciences. The arts and humanities are entirely ignored. Further, it is not clear where the weights come from. For most universities in the world, only the third and sixth items will have a value that is not zero.

The Times Higher Education Supplement rankings take an approach that combines peer assessment and quantitative measures. Their ratings are a combination of six elements:

1. Peer review by research-active academics (40%);
2. Citations per faculty member (20%);
3. Staff to student ratio (20%);
4. Employer recruiter reviews (10%);
5. International students (5%); and
6. International staff (5%).

The heavy reliance on peer judgment distinguishes these rankings from the Shanghai rankings, but peers may be knowledgeable about a smaller range of institutions. On the other hand, as mentioned above, quantitative measures need to be broad in scope to yield measures that are applicable globally.

It can be argued that neither the THES nor the Shanghai rankings have great relevance to most universities in the Islamic World. The measures that they use are outcomes of a well developed research infrastructure and reflect the involvement of faculty in networks of scientists and journal editors. They are good indicators in the developed world. Although they use measures to which universities in the Islamic World should aspire, at present, they are not measures of great applicability. Something better needs to be found, and some of the papers at this conference are helpful toward that end.

6 THE NATIONAL RESEARCH COUNCIL (NRC) ASSESSMENT OR RESEARCH DOCTORATE PROGRAMS

It should first be noted that the NRC is attempting to assess doctorate programs in the United States. It is based on programs, not universities, and at this time it is limited to one country. Within the United States, it has a history that goes back to 1925, although its current form was established in studies in 1982 and 1995.

6.1 Principles

While recognizing the strengths of earlier studies as being authoritative, comprehensive, and presenting a clearly stated methodology, in 2002, the methodology committee that I described above recommended a number of changes:
• An increase in the number of fields covered to include the agricultural sciences, biomedical fields in medical schools, and a few fields that had grown rapidly;
• A different approach to rankings should be taken—“rankings should be presented as ranges of ratings;”
• Less emphasis should be placed on rankings altogether—the study should be gather data on more quantitative measures to make it useful as a benchmarking study;
• It should be more useful to students;
• To this end, the analytic uses of the study data should be stressed;

More specifically, a new approach should be taken to assessing doctoral programs. The study should provide a unique resource for information about doctoral programs that should be easily accessible. In addition to providing peer ratings similar to those provided in the past, it should provide:

• Comparative data about doctoral education outcomes, such as time to degree and completion rates;
• Information about doctoral education practices, such as patterns of student funding, student workloads, and services provided to students; and
• Data on student characteristics (diversity, gender, international mix).

These data should be linked to research characteristics of the program, such as funding, research resources, and citations and publications.

Finally, the methodology committee recommended that the new report not contain rankings based on peer assessment alone. There were two primary reasons for this:

First, fields of knowledge have become both more interdisciplinary and more specialized. This makes it unlikely that any peer rater will be broadly enough informed about a particular program that he or she will be able to provide an informed rating. Second, there is a tendency to use rankings naively, without an understanding of how they have been constructed. In place of pure peer rankings, the methodology committee wanted to construct weighted averages of quantitative measures, where the weights were determined through a statistical relationship between peer ratings and a number of quantitative measures.

6.2 Operational aspects of the NRC Assessment

The assessment collects data from institutions, doctoral programs, faculty, and students. Comparable definitions of data elements should permit comparisons across universities that may be organized differently from one another. For example, one university may have its biochemistry program in the faculty of arts and sciences, while another may house it in the faculty of medicine.

Examples of the data collected include the following:

• Data about students: demographic characteristics, completion rates, time to degree;
• Data about faculty: interdisciplinary involvement, postdoctoral and previous employment, citations and publications; and
• Data about programs: student funding policies, enrolments, numbers of teaching faculty and their characteristics, and research funding of faculty.

We will also ask faculty what they value in doctoral programs. From the answers to these questions, we can construct weights for explicit measures. These weights can be combined with the values of these measures for each program and the sum of these weighted values can be used to calculate rankings based on explicit measures. These rankings will change over time as the underlying measures change.

The committee will also conduct an “implicit” rating study. In this part of the study, raters will be given data about fifteen programs within their field. These data will include a list of faculty and selected quantitative information about the program (for example, the completion rate). They will then be asked their familiarity with each program and then will be asked to rate the quality of the program along a six point scale, where 1 is the lowest rating and 6 is the highest. The quantitative measures will then be regressed on these ratings to determine what we call the “implicit weights.” A ranking can then be constructed by applying these weights to the values of the quantitative measures for each program. These rankings will have a range across raters and measures of that range will be included when the ranking data are presented to the public.

6.3 Uses of the study

Previous NRC assessments of doctoral programs have been widely used. High level administrators use them to understand variations across programs. It provides them with the ability to analyze multiple dimensions of doctoral program quality and invest in those programs where resources are likely to result in improvement. They also use the NRC data and ratings to compare their own institution with other peer institutions. Program administrators and department chairs also use them for comparisons with those programs with which they compete for students and faculty. The additional data that the new study will provide about educational practices will encourage more healthy competition.

Prospective students will be able to use the study to identify those factors that are important to them and to create their own rankings. The NRC plans to update much of the data on which the ratings are based more frequently in the past. This will permit recalculation of ratings that will be current. The committee expects that if students have more information about program characteristics, and act on it, lower rates of attrition may result. Attrition is costly to both students and institutions and so such an outcome would be a definite benefit.

6.4 Next steps

It is planned to publish the data collected by the study in December, 2007. So far, the data collection appears promising. We have data from 5400 programs at 214 American universities. All the questionnaires have been web-based and this
appears to be good for response rates to the faculty questionnaire. We have response rates of over 70% of 120,000 faculty members who received questionnaires. During 2008, we expect that researchers and institutional planners will use the data. A conference will be held in September 2008 that will provide an opportunity to display the various analytic studies that have been carried out.

7 CONCLUSION: APPLICABILITY TO HIGHER EDUCATION PROGRAMS IN THE ISLAMIC WORLD

I have presented information about the NRC Assessment of Research Doctorate Programs as an example of an approach to higher education assessment that is far more useful than league tables or global rankings. Either within countries or among countries, the NRC methodology can be used to present a quantitatively based assessment of higher education programs which can be used for benchmarking and comparison. Comparisons can be made with exemplary programs and efforts directed to improvement. As improvements occur, it may well be that more universities in the Islamic World may find themselves appearing in the global rankings. What is needed first is a system that points to where improvements should be made.

The National Research Council’s methodology of assessing research doctorate programs arose as the number of PhDs increased by a factor of 30 from the 1920s to the 1980s. As the U.S. higher education system expanded from serving an elite to being widely available, and the need for teachers to facilitate this expansion and then for highly trained researchers to move innovation forward grew, it became important to describe and distinguish among increasingly diverse doctoral programs. It is quite likely that universities in the Islamic World are also at the point of taking off, and would find a similar assessment scheme to be useful.

The National Academies thanks the Islamic World Academy of Sciences for this opportunity and hope that you will follow our progress as the study continues. That progress and more detail about the study may be found on the web at Research Doctorate Programs: Study on Methodology and Assessment.

262
Prospect of Excellent Centres and Universities in Arab Countries: The Iraqi Experience

NAJIH EL RAWI
Emeritus Professor
University of Baghdad
Iraq

1 ABSTRACT

This paper cites the excellent universities during the Arab-Islamic civilization’s heyday. Today, Arab universities are weak by the international standards of excellence. This is due to economical, academic factors as well as the increasing number of students seeking higher education. This paper cites excellent universities throughout the world. It examines the Iraqi experience and concludes that there is a need in Arab countries to concentrate on some research centres and universities in an attempt to approach excellence and prepare leaders who will develop their countries. This will leave the regular universities and institutes to absorb most of the students seeking higher education.

2 INTRODUCTION

It is clear that good education and scientific research are the means of achieving progress and development of countries. The Arab-Islamic civilization witnessed great centres of excellence like "Bait al-Hikma" in Baghdad for the translation of Greek science and philosophy; to the well known academic centre of Al-Nizamiyyah School - regarded as 400 years older than the first academy in Europe the ‘Accademia dei Lincei’ [1]. It is true that the word academy belongs to a place near Athens where Plato and his followers met to discuss science and philosophy [2]. The Arab-Islamic civilization however witnessed excellent universities like Al-Mustansiriyyah, Al-Azhar, Al-Zaitona Institute, and the Andalus centres; which played a great role in the advancement of science and technology at that time [3]. The West had benefited from such centres in their transfer of science and technology in the fields of medicine, astronomy, chemistry, algebra, engineering, and social sciences.

* Professor of Civil Engineering and Fellow of the Islamic World Academy of Sciences. Formerly, President of the Iraq Academy of Sciences.
Today, although there is a great demand for higher education in the Arab countries with more than 200 universities, however none could be regarded as excellent centre yet.

Excellent research centres and excellent universities today play a great role in the development and advancement of countries. They are badly needed in the Arab countries.

3 THE PHILOSOPHY OF EDUCATION IN THE ARAB COUNTRIES

During the last quarter of the twentieth century, education spread in most of the Arab countries. Most of these countries have imposed compulsory primary education and carried out campaigns to reduce illiteracy.

As a result, there were increased numbers of students at the secondary schools and more awareness of the important role of science and technology and thus greater demand for higher education took place.

The philosophy of university education in most Arab countries was unstable and divided between the following two options:

1. Higher education should be limited to the elite to prepare leaderships and high standard government staff.
2. Higher education is the right for every citizen capable and willing to acquire it. The government is to provide general education but is not obliged to appoint the university graduates.

The goals of the universities may be summarised under the following headings [4]:

- Transfer of knowledge – by teaching;
- Generating knowledge – by scientific research; and
- Application of knowledge – to serve the public through extension centres.

Unfortunately the teaching goal is prominent at the Arab universities. Their contribution to generating knowledge through scientific research is very limited. What Arab countries spend on R&D is the least among nations as shown in Table (1).

This is partly due to the education system that teaches students how to memorize rather than how to think and analyze. The education is concerned about the quantity rather than the quality of the graduates.
Table 1. R&D expenditure as a share of GDP, 2000 [5]

<table>
<thead>
<tr>
<th>Country</th>
<th>% of GDP</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>S. Korea</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>U.S.A</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>U.K</td>
<td>1.9</td>
<td>World Av. 1.7</td>
</tr>
<tr>
<td>Canada</td>
<td>1.7</td>
<td>Industrial Countries 2.4</td>
</tr>
<tr>
<td>China</td>
<td>1.0</td>
<td>Developing Countries 0.8</td>
</tr>
<tr>
<td>Russia</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>¹Brazil</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>S. Africa</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Arabs</td>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

Jeraw [6] reported that the teaching staff to student ratio at the Arab universities is 1:25, and about 40% of teaching staff do not possess PhD degrees. Jordan is an exception with a ratio of 1:11.

It is encouraging to note that the use of internet and computers is becoming familiar tools gradually in many Arab universities.

4 THE STANDARDS AND ASPECT FEATURES OF EXCELLENCE AMONG UNIVERSITIES

Excellent universities are usually well known for their scientific reputation, traditions, and their impact on society and public. These universities usually generate new ideas, patents, books, and original research papers. From these universities outstanding students graduate, some of them receive distinguished prizes including Nobel prizes. At these universities, there is a balance between graduate and undergraduate students. The number of students is limited to the planned capacity. The teaching staff is selected carefully for their outstanding reputations, scientific research, and their educational experience. Therefore the different organizations, industrial companies and firms, as well as government agencies support these universities morally and financially, and offer them contracted research projects.

Excellent universities usually have the following features:

* The ratio of teaching faculty to students for Jordan is actually more like 1:20 according to the 2007 figures (Editors).
1. The university is independent body despite the support of the government and society. It runs its affairs through its board of trustees and the university council;

2. The university president, the college deans, and the department head are chosen from among the outstanding academicians, scientists, and educators;

3. The university arranges scientific conferences and meetings and encourages their staff members and students to attend national and international conferences freely. The staff members are usually well paid to attend these conferences;

4. The university limits the students accepted to those of higher standards. The teaching staff to students’ ratio is comparatively high;

5. The university should have excellent facilities including libraries, laboratories, student union facilities, and athletic and social facilities that should be open freely for long hours.

5 INTERNATIONAL EXCELLENT CENTERS AND UNIVERSITIES

The organizations that compare international universities for excellence might have different criteria and weights for the items mentioned above.

A study at Shanghai University, China in 2004 [7], indicates that the industrial countries of the West have most of the outstanding excellent universities at present. The 2004 study puts the top ten outstanding universities in the order shown in Table 2.

**Table 2. Top Ten Universities**

<table>
<thead>
<tr>
<th></th>
<th>University</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Harvard Univ.</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Stanford Univ.</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>Cambridge Univ.</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>Univ. of California –Berkley–</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>Massachusetts Inst. Of Tech. M.I.T.</td>
<td>10</td>
</tr>
</tbody>
</table>

The revised Shanghai study in 2005 shows a rank change, with Cambridge University elevated to second place while Oxford University ranked at the tenth place [8].

The Shanghai study presents the best 500 outstanding universities and institutes in the world. Table 3 shows the distribution of these institutes among the countries. If the population is taken into account, then Table 3 shows that Switzerland and the Scandinavian countries come in the lead. At present none of the Arab universities are listed as one of the outstanding 500 institutes in the world. It is clear that the evaluation is a general one. A university could be outstanding and excellent only in a particular field or department. For a particular year the criteria used by the Shanghai study in the evaluation is shown in Table 4.
<table>
<thead>
<tr>
<th>Item</th>
<th>Country</th>
<th>Number of Excellent Universities</th>
<th>Population [8]</th>
<th>Excellent Universities per Million</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USA</td>
<td>168</td>
<td>291,000,000</td>
<td>0.577</td>
</tr>
<tr>
<td>2</td>
<td>Germany</td>
<td>43</td>
<td>82,531,671</td>
<td>0.521</td>
</tr>
<tr>
<td>3</td>
<td>UK</td>
<td>42</td>
<td>58,789,194</td>
<td>0.714</td>
</tr>
<tr>
<td>4</td>
<td>Japan</td>
<td>34</td>
<td>127,619,000</td>
<td>0.266</td>
</tr>
<tr>
<td>5</td>
<td>Canada</td>
<td>23</td>
<td>31,920,000</td>
<td>0.726</td>
</tr>
<tr>
<td>6</td>
<td>Italy</td>
<td>23</td>
<td>57,888,245</td>
<td>0.397</td>
</tr>
<tr>
<td>7</td>
<td>France</td>
<td>21</td>
<td>60,200,000</td>
<td>0.349</td>
</tr>
<tr>
<td>8</td>
<td>Australia</td>
<td>14</td>
<td>18,972,350</td>
<td>0.738</td>
</tr>
<tr>
<td>9</td>
<td>Holland</td>
<td>12</td>
<td>16,292,354</td>
<td>0.737</td>
</tr>
<tr>
<td>10</td>
<td>Sweden</td>
<td>10</td>
<td>9,011,392</td>
<td>1.110</td>
</tr>
<tr>
<td>11</td>
<td>Spain</td>
<td>9</td>
<td>42,717,064</td>
<td>0.211</td>
</tr>
<tr>
<td>12</td>
<td>China</td>
<td>9</td>
<td>1,242,612,226</td>
<td>0.007</td>
</tr>
<tr>
<td>13</td>
<td>S. Korea</td>
<td>8</td>
<td>48,517,871</td>
<td>0.165</td>
</tr>
<tr>
<td>14</td>
<td>Switzerland</td>
<td>8</td>
<td>7,317,873</td>
<td>1.093</td>
</tr>
<tr>
<td>15</td>
<td>Israel</td>
<td>7</td>
<td>4,725,000</td>
<td>1.481</td>
</tr>
<tr>
<td>16</td>
<td>Belgium</td>
<td>7</td>
<td>10,336,421</td>
<td>0.677</td>
</tr>
<tr>
<td>17</td>
<td>Austria</td>
<td>5</td>
<td>8,140,122</td>
<td>0.614</td>
</tr>
<tr>
<td>18</td>
<td>China -Hong Kong</td>
<td>5</td>
<td>6,708,389</td>
<td>0.745</td>
</tr>
<tr>
<td>19</td>
<td>Denmark</td>
<td>5</td>
<td>5,411,450</td>
<td>0.924</td>
</tr>
<tr>
<td>20</td>
<td>Finland</td>
<td>4</td>
<td>5,236,611</td>
<td>0.764</td>
</tr>
<tr>
<td>21</td>
<td>Norway</td>
<td>4</td>
<td>4,577,457</td>
<td>0.874</td>
</tr>
<tr>
<td>22</td>
<td>Brazil</td>
<td>4</td>
<td>184,184,264</td>
<td>0.022</td>
</tr>
<tr>
<td>23</td>
<td>S. Africa</td>
<td>4</td>
<td>46,888,200</td>
<td>0.085</td>
</tr>
<tr>
<td>24</td>
<td>Ireland</td>
<td>3</td>
<td>3,917,203</td>
<td>0.766</td>
</tr>
<tr>
<td>25</td>
<td>New Zealand</td>
<td>3</td>
<td>4,009,200</td>
<td>0.748</td>
</tr>
<tr>
<td>26</td>
<td>Hungary</td>
<td>3</td>
<td>10,142,362</td>
<td>0.296</td>
</tr>
<tr>
<td>27</td>
<td>China- Taiwan</td>
<td>3</td>
<td>22,689,122</td>
<td>0.132</td>
</tr>
<tr>
<td>28</td>
<td>India</td>
<td>3</td>
<td>1,027,015,247</td>
<td>0.003</td>
</tr>
<tr>
<td>29</td>
<td>Greece</td>
<td>2</td>
<td>10,939,771</td>
<td>0.183</td>
</tr>
<tr>
<td>30</td>
<td>Singapore</td>
<td>2</td>
<td>4,163,700</td>
<td>0.480</td>
</tr>
<tr>
<td>31</td>
<td>Poland</td>
<td>2</td>
<td>38,173,835</td>
<td>0.052</td>
</tr>
<tr>
<td>32</td>
<td>Russia</td>
<td>2</td>
<td>145,166,731</td>
<td>0.014</td>
</tr>
<tr>
<td>33</td>
<td>Chile</td>
<td>1</td>
<td>15,116,435</td>
<td>0.066</td>
</tr>
<tr>
<td>34</td>
<td>Portugal</td>
<td>1</td>
<td>10,474,685</td>
<td>0.095</td>
</tr>
<tr>
<td>35</td>
<td>Czech</td>
<td>1</td>
<td>10,211,455</td>
<td>0.098</td>
</tr>
<tr>
<td>36</td>
<td>Argentina</td>
<td>1</td>
<td>36,260,130</td>
<td>0.028</td>
</tr>
<tr>
<td>37</td>
<td>Mexico</td>
<td>1</td>
<td>97,483,000</td>
<td>0.010</td>
</tr>
</tbody>
</table>
Table 4. Criteria and Weights [8]

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicator</th>
<th>Code</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of Education</td>
<td>Alumni of an institution winning Nobel Prizes and Medals</td>
<td>Alumni</td>
<td>10%</td>
</tr>
<tr>
<td>Quality of Facility</td>
<td>Staff of an institution winning Nobel Prizes and Medals</td>
<td>Award</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Highly cited researchers in 21 broad subject categories</td>
<td>HiCi</td>
<td>20%</td>
</tr>
<tr>
<td>Research Output</td>
<td>Articles published in Nature and Science</td>
<td>N&amp;S</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Article Indexed in Science Citation Index- Expanded and Social Science</td>
<td>SCI</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Citation Index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size of Institution</td>
<td>Academic performance with respect to the size of an institution</td>
<td>Size</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>100%</td>
</tr>
</tbody>
</table>

6 THE IMPORTANCE OF EXCELLENT UNIVERSITIES IN THE ARAB COUNTRIES

Most of the universities in the Arab countries have a greater student enrolment than they can normally accommodate. This is due to the demand for higher education. The facilities are limited, the qualified teaching staff to student ratio is low, the scientific and academic atmosphere is lacking, hence most universities seem like large secondary schools.

Most of the Arab states - with the exemption of the Arab Gulf States - cannot spend lavishly on education and scientific research because of their limited resources. Hence it seems logical to concentrate on some research centres and universities and to try to make them centres of excellence. These universities should have limited numbers of carefully selected students. The government and the society should encourage these centres morally and financially. The staff should be selected from the best available, with higher salaries. Every possible means of creating free academic and scientific atmosphere should be given. This will create centres of excellence that will provide graduates who play a leading role in developing the country. This will leave the majority of the universities to accept the masses of students who seek higher education.
The Iraqi experience with excellent centres may be grouped under three levels:

7.1 Secondary schools

(1) Baghdad College

As early as 1936, the American missionaries had established the "Baghdad College" as a secondary school intended to be excellent school. It teaches most of the subjects in English. The school was oriented towards Christian students and some upper class Moslems. It was socially and politically oriented towards Western ideas. In 1970, the Iraqi government nationalized all private schools and put them under the supervision of the Ministry of Education. Baghdad College continued to teach in English except higher grade students who continue at the school after passing special entry exams.

(2) King Faisal College

A secondary school was opened by the Ministry of Education in 1946 to accept the outstanding Iraqi students. It was closed in 1948 when the students took part in anti-government riot.

(3) Present excellent secondary schools

During the eighties of the last century, the Ministry of Education established certain excellent schools for boys and girls. They accepted students who obtain grade average above 95% at the primary school exams, and those who pass entry exams. The teachers are selected, the subjects are taught in Arabic. Since the year 1998, students of such schools had to take the same final exams as students form other regular schools. Hence they lost some of the merits of their earlier schooling.

7.2 Scientific Research

Two organizations were created in Iraq with the intension to be excellent research centers:

(1) The Organization of Nuclear Energy

The organization was established in 1956. After 1975, it was given special support to become a leading scientific research centre for the peaceful use of nuclear energy. Israel with the support of the USA attacked the Iraqi nuclear reactor in 1981 and assassinated a number of scientists in an effort to stop any Islamic country who tries to enter this field of research. The Organization of Nuclear Energy was bombed many times during the
American aggression on Iraq. Finally all of its research came to an end after the American occupation of Iraq in 2003.

(2) The Scientific Research Council

The Scientific Research Council was established in 1963. The government gave the council special support in 1980, when its law No. 172 was issued, giving the council the authority of a ministry and an acceptable budget. The salaries of the scientists improved and an academic atmosphere was created and scientists could freely attend international conferences. The council was responsible for the applied scientific research and to coordinating pure research carried out at the universities with the R&D work carried at different centres of the ministries. The council attracted young scientists [9] between the years 1980 – 1989 and the staff increased from 52 PhDs to 259 and from 48 MSc-degree holders to 350. The number of BSc-degree holders increased from 210 to 510. The productivity of researchers in terms of published scientific research papers and registered patents increased from 0.3 per year for the PhD and MSc holders in 1980 to 1.5 in the year 1989. The papers were of higher quality (23% were published outside Iraq – mainly in the USA and UK) [9]. The council with its 9 centres began to solve many problems, and it was on its way to become a centre of excellence when it was closed in 1989.

7.3 University education

Recognizing the importance of excellent universities, Saddam University for Engineering and Science was founded in 1988. It was intended to be a special university for the academic elite.

In 1993, and in accordance with Law No. 17, Saddam University was created to include Saddam College of Medicine, Law, and Political Science which were established in 1987. The university was planned to have a limited number of students, selected teaching staff with high qualifications. At a certain time triple salaries were given to the staff compared with regular Iraqi universities. The lecture hours per week were reduced, so that the professors can have more time for scientific research.

The university adapted the unit system rather than the annual system. The students were offered financial assistance and the government gave the university moral and the financial assistance.

However the university went through the following setbacks:

(1) After 1990 and due to the sanctions imposed on the country, it was not possible to support the university as planned, particularly due to the shortage in the hard currency;

(2) A board of trustees for the university was not formed. The university was connected to the "Dewan" or the President’s office, which limited its flexibility and academic manoeuvrability;
(3) The university utilized the summer session, reduced the study time to three years for BSc and five years for MSc degrees despite the differences in students' abilities. The College of Medicine was the exception.

(4) The university did not have a unified campus where the staff and the students could meet and interact with each other.

(5) Because of the unstable government after the American occupation of Iraq in 2003, the university was connected to the Ministry of Higher Education and Scientific Research under the name Al-Nahrain University and became a regular university losing all the privileges it previously had.

8 CONCLUSIONS

Arab countries need to improve their education systems. They need political stability and strong democratic leadership that believes in the role of science and technology in the development of their countries. At present, there is a need and demand for higher education. Arab universities at present are unable to produce excellent graduates because of the lack of financial resources as well as the lack of capable teaching staff. Therefore, it seems logical to concentrate on a few universities and research centres, and offer them all the moral, financial, political, and educational support possible to turn them into new excellent centres.
REFERENCES

2. Webster's New Collegiate Dictionary.
9. www.citypopulation.de
Excellence of Higher Education Institutions: 
Some Requirements

MOHAMMAD A. HAMDAN* 
Senior Adviser 
Arab Open University 
Amman, Jordan

1 INTRODUCTION

It has become quite evident, in national strategic planning, that human resource development should occupy one of the highest priorities, especially in the current prevalence of “Knowledge Economy.” Acceleration in innovation and application of knowledge made knowledge the most important factor in production. Besides, advances in information and communication technology resulted in acceleration of knowledge transfer with much lower costs. Hence, it became imperative for every developing country to reform education in general and higher education (HE) in particular, which requires national institutions of HE and research to achieve excellence and upgrade their performance to the standards of reputable international universities. Excellence of universities in developing countries will result in the production of highly qualified graduates and researchers of international status who would be able, on one hand, to contribute effectively to national development projects, and would be able, on the other hand, to compete with graduates of other institutions regionally and internationally.

In this paper, we present some ideas and thoughts on the requirements of excellence in higher education institutions (HEI). These ideas and thoughts are based mainly on the author’s experience as a university professor and administrator, the author’s readings and writings on higher education strategy, and the author’s participation and presentations in numerous committees for higher education reform and numerous national regional and international conferences on higher education ([1], [2],........[12]).

The paper starts by expressing how a university seeking excellence foresees itself, that is, the vision of an excellent university. Next, the paper presents some basic features of an excellent university. These features include quality, creativity, outreach, learning environment, leadership, academic freedom, accountability, global outlook and ethics and social responsibility.

*Professor of Mathematical Statistics, former Minister of Higher Education and Fellow of the Islamic World Academy of Sciences (Jordan).
The paper then considers some requirements for an excellent university. These requirements are classified into a number of HE components, namely, programs of study, instruction, research, community service, faculty, students, governance, infrastructure, information technology, and quality assurance.

Finally, some concluding remarks are presented.

2 VISION OF AN EXCELLENT UNIVERSITY

Each university should have a vision expressed in a set of principles that embody its aspirations for continued development, achievements, and progress. An excellent university foresees itself as:

(a) A University for the future, not in the future;
(b) A University of learning, not teaching;
(c) A site for preparing a new generation of leaders, professionals, entrepreneurs, well-rounded persons who are in a position to master the skills needed to thrive and excel in their careers, not degree holders;
(d) A quality-oriented university of academic excellence, competence and distinction that serves national and international needs, not a lucrative institution offering mediocre courses;
(e) An institution that is highly acclaimed, internationally renowned, outward-looking and well in tune with contemporary life and the features and characteristics of an ever-changing era, not traditional and conservative in vision and perspectives; and
(f) A depository centre for a wealth of valuable and updated information which public institutions can consult for important documented sources that help them to make judicial decisions in consultation with concerned citizens, not a mere institution of learning and instruction.

3 FEATURES OF AN EXCELLENT UNIVERSITY

Before we introduce some detailed excellence requirements in the next section, it may be worthwhile to present some aspects that directly attract the attention of an independent observer during a first encounter with the "university." Such aspects are indeed prominent features of a university. The following are some of the features of an excellent university:

(a) Supportive Learning Environment

Catering to a student-centred and supportive modern learning environment that promotes critical thinking, independence of thought and the mastery of advanced technologies;
1. **Quality**
Commitment to high standards and continuous improvement in teaching, scholarship and service;

2. **Creativity**
Promotion and reward of creativity and innovation in the pursuit of academic excellence;

3. **Outreach**
Dedication to nurturing responsive links with the community, emphasizing service, transferring know-how, cultural enrichment and positive contribution for the welfare of the people;

4. **Global Outlook**
Having an international outlook and respect for other individuals and cultures;

5. **Academic Freedom**
Fostering an environment of openness, diversity, fairness and intellectual freedom;

6. **Leadership and Collegiality**
Encouraging teamwork, tolerance, and leadership by example;

7. **Accountability**
Personal and institutional responsibility and accountability are necessary for the accomplishment of an excellent university's mission and goals.

8. **Ethics and Social Responsibility**
Commitment to high social, moral, and ethical values in accordance with Islamic teachings and universal humanistic needs.

### 4 REQUIREMENTS OF AN EXCELLENT UNIVERSITY

The following are some requirements which must be fulfilled by a university seeking excellence and distinction:

**4.1 Programs of Study**
Distinguished universities present first-class programs of study. They make sure that their curricula are to be updated and revised constantly in keeping up with new developments worldwide by means of phasing out obsolete programs and
introducing relevant ones, in order to ensure modernity, relevance and practical skills, in addition to basic skills of communication (languages and computer), problem-solving and critical thinking. The following are some requirements for the programs of study:

(a) Offering rigorous programs in selected areas of specialisations that fully develop individual potential and produce nationally and globally competitive graduates for the workforce;

(b) Establishing graduate and undergraduate programs that pay increased attention to learning outcomes. These outcomes encompass the ability to apply learning in creative thinking and problem solving rather than memorization, support for diversity in mission and approach, and support for improvement rather than simply meeting minimum standards. This also includes the evaluation of graduate progression from all courses and the variation in the job success rates of different degree disciplines;

(c) Introducing new programs, whenever needed, to fill in shortages in qualified human resources in specific areas and specializations;

(d) Providing students with high-quality education that enables them to compete in new and emerging technologies and markets by teaching them to think critically, plan strategically, communicate effectively, and be adaptable to societal changes and life-long learning;

(e) Organizing a series of courses that students should attend to enhance their communication skills in their own national language and one or more foreign languages, as well as computer and Internet literacy courses. These skills would enable students to compete in the marketplace and to be effective and successful in their future careers;

(f) Ensuring that the university does not duplicate traditional course offerings; rather, it emphasizes modern emerging interdisciplinary, multidisciplinary areas of knowledge and research, with due attention being given to continuing education;

(g) Integrating hands-on training as a major component of the teaching/learning process with the aim of endowing students with knowledge and skills which prepare them for the life to come and to provide to the business community with knowledgeable leaders rather than mere graduates with insufficient expertise; and

(h) Attracting, preparing and turning to society an increasingly diverse, academically talented, and achievement-oriented talented researchers, leaders and entrepreneurs.

4.2 Instruction

Teaching and learning represent the core-function of a university. A university seeking excellence uses diversified and innovative teaching and learning processes in a manner that will optimize students' achievements and will
enhance curricular and instructional reforms. The following are some requirements for instruction:

1. Designing a clear structure to the classes, explicit intended learning outcomes and enthusiastic delivery. Role-play, group work, student presentations and references to placement and employment should all be emphasized;
2. Making sure that teaching is not restricted to formal lectures and seminars, but emphasis is placed, as well, on students' interaction and involvement;
3. Providing high quality teaching and learning innovative approaches that draw upon the research and consultancy of staff;
4. Producing student databases that enable the tracking of students' progress throughout the years of study at university;
5. Providing self-learning opportunities for students;
6. Devising innovative assessment methods of students whereby the process is not entirely dependent on examinations;
7. Emphasizing the concept of peer tutoring in certain courses;
8. Making optimum use of ICT in instruction and course delivery for both face-to-face and distance learning methodologies;
9. Resorting to interactive use of technology to improve instruction;
10. Providing a virtual learning environment when possible;
11. Providing adequate learning resources, databases, and learning packages and tools to be used as instruction guides and to pave the way for further readings, research and illustration; and
12. Making sure that theoretical instruction goes hand-in-hand with hands-on training and practical research.

4.3 Research

Research is the most important component that contributes significantly to university excellence. Publications in reputable international journals, patents, prizes, honours, etc. are valued highly by both the academic and production sectors in their assessment of achieving excellence. The following are some requirements for research excellence:

(a) Formulating a general research policy;
(b) Conducting basic and applied research with the ultimate goal of betterment of mankind;
(c) Supporting research projects and patents produced by faculty and students and encouraging researchers to undertake research projects that involve team-work and joint efforts;
(d) Coordinating academic research projects and output; and publishing in specialized international refereed research journals;
(e) Providing adequate research facilities and resources for faculty and students, coupled with effective management of these resources;
(f) Allocating sufficient funds within the budget for quality research and publications;
(g) Laying down an award incentive program for quality high-calibre research;
(h) Stressing quality research for promotion of faculty and re-examining laws pertaining to the promotion of faculty;
(i) Exchanging information, know-how and research outputs with institutions of academic research worldwide;
(j) Building a national database with regard to academic research output and activities;
(k) Streamlining and directing applied research to serve development plans and solve national problems; and
(l) Evaluating applied research output in terms of its actual contribution to developing industry and service sectors.

4.4 Community Service

Community service is the third function of a university. Proper interaction between a university and its surrounding community is demonstrated by the mutual services exchanged. The University's excellence in providing services becomes evident in all aspects of community-life, whether economic or social or cultural or artistic or political. The following are some requirements for excellence in community service:

1. Providing exemplary service to the community at large, in general, and to the marketplace, in particular;
2. Responding to educational, social, cultural, and economic-development needs through increased outreach, applied scholarship, service, and innovative opportunities for lifelong learning;
3. Facilitating the transfer of technological know-how and research for economic and social development;
4. Encouraging the business, industrial and economic sectors to stay abreast of changing technology by providing opportunities for life-long learning;
5. Reaching effective and active partnership with the public, private and service sectors, with a view to realizing economic and social development;
6. Providing up-to-date solutions to overcome relevant problems encountering the society and obstacles related to economic competitiveness and compatibility;
7. Establishing an outreach consultation service centre for research, studies, design and innovation in order to support the work, activities and future of national investment companies.

278
4.5 Faculty

Recruitment of highly qualified faculty is considered one of the most important pillars of university excellence. Distinguished faculty seek the best opportunities for illustrious and productive careers by joining reputable universities that have achieved high esteem, particularly in their disciplines. A university seeking excellence should adopt a proper "process" for faculty recruitment. A good process is characterized by quality, objectivity, equal opportunity, transparency, and accountability. A good number of desired faculty characteristics appear under the sections dealing with instruction, research, and community service. However, the following are some additional requirements for recruiting and maintaining high-calibre faculty:

(a) When recruiting faculty members, due attention should be given to such factors as:

1. The university that the prospective faculty member has graduated from, years spent at the university, reputation of the university, and social and academic considerations;
2. Background of the University and its environment;
3. Outstanding career in teaching at the university level;
4. Excellence of research record and publications relevant to the field of his specialization; and
5. Communication skills in national and one or more foreign languages.

(b) In addition to the qualifications and factors requested for the recruitment of high-calibre faculty members, the university prospective leader should possess the following characteristics:

1. Diversified public relations skills at the national, regional and international level;
2. Vision and charisma;
3. Long-standing history of administrative services and responsibilities at different levels;
4. Good conduct and behaviour;
5. Awareness of the basic principles of management; and

(c) Adopting a stringent policy of appointment according to merit and making sure that transparency is applied;

(d) Making sure that faculty promotion will be linked to performance, research and academic activities;

(e) Implementing internationally-adopted standards with regard to student: faculty ratio, student: administrative staff ratio, and faculty:administrative staff ratio;
(f) Ensuring the participation of faculty members in academic activities and conferences nationally, regionally and internationally;

(g) Encouraging faculty members to attend generic workshops that aim at improving their academic performance and keeps them abreast with new trends and innovations in education and instruction;

(h) Providing a system of life-long education and the acquisition of knowledge and know-how within the context of a lifelong perspective;

(i) Exchanging faculty members to undertake teaching, research, and/or to serve as external examiners for students' graduation projects and final exams;

(j) Enhancing faculty's skills and literacy in IT and computer-related research and instruction;

(k) Establishing centres for improving the skills and performance of faculty members;

(l) Seconding faculty members to industry to undertake research and consultancy work as part of their on-the-job training and to update their experiences in line with modern business practices.

4.6 Students

Like faculty, students represent a second important pillar of a university seeking excellence. Students with high standard entry qualifications contribute significantly to university excellence. Hence, proper attention should be paid to student quality starting from recruitment and going through the whole educational process up to graduation, career advice, counselling and alumni services. Again, a good number of student-related requirements appear under the sections dealing with instruction, research and community service. However, the following are some additional requirements:

1. Making sure that students undergo careful screening, whereby only those with intellectual ability and academic achievement can be eligible to gain admission to university;

2. Attaching importance to personal qualities that allow students to enrich the life of their communities. In that, students sit for an interview prior to making the final decision for their admission to the university. Likewise, language abilities and other skills are to be given their due weight;

3. Implementing effective student support and guidance policies;

4. Organizing an orientation program for newly admitted students, on yearly basis, to make sure that they have ample information about the university and its programs prior to their commencement of formal instruction and class attendance;

5. Providing social and extra-curricular services to students to help them experience university life that is academically beneficial and socially entertaining;
6. Paving the way for students to take part in councils and to share in the decision-making process with direct bearing on their academic life and welfare;

7. Establishing offices for career advice and counselling to keep track of graduates and to help their placement in jobs that best suit their academic qualifications and potential;

8. Creating scholarship programs to sponsor excelling students whereby students are offered scholarships to obtain doctoral degrees at reputable universities worldwide and serve on their alma mater faculty upon their graduation;

9. Publishing brochures and updated versions of the student guide and similar material that help students keep informed and updated about any changes or developments in the university's academic, administrative and social life;

10. Exchanging students whereby they can spend one academic semester, or so, in a foreign university to gain varied expertise and to enrich their academic, educational and cultural background;

11. Catering to the needs of students with disabilities. Disabled students are an integral part of the student body. Thus, accessible and appropriate provision is not 'additional,' but a core element of the overall service which an institution makes available. As such, the quality of the learning opportunities on offer to disabled students in higher education institutions needs to be assured in the same way as any other provision. In that, good physical access to buildings should be made easy. Likewise, facilities beyond the classroom should be accessible;

4.7 Governance

Excellence in academic and human resources should be supported by high quality institutional governance including administration, finances, and legislations. Rigid and obsolete governance approaches represent serious obstacles for a university seeking excellence. The following are some governance requirements:

(a) Independence of academic decisions from institutional ownerships;

(b) Emphasizing the leadership qualities of its top management at the level of the president, vice-president, deans, etc;

(c) Building channels of open dialogue, mutual respect and confidence between the university administration, on the one hand, and the university community, on the other;

(d) Adopting a transparent, accountable and objective policy in administering the various academic, administrative and financial affairs of the university;

(e) Establishing strong cooperation with regional and international universities, and academic and research institutions with the ultimate
objective of enriching the educational, scientific, and research objectives and achievements;

(f) Evaluating, on periodic basis, the feasibility of agreements of cultural and scientific cooperation reached with counterpart universities and academic institutions worldwide;

(g) Formulating well-designed and carefully-examined by-laws and regulations;

(h) Updating by-laws and regulations in accordance with emerging needs and changes;

(i) Resorting to decentralization in administration and in decision-making and delegating responsibilities, if and when possible;

(j) Preparing and publishing universities' annual reports.

(k) Enhancing the financial status of the university;

(l) Increasing self-generating revenues;

(m) Continue to attract students with potential;

(n) Establish needy and excelling students funds;

(o) Establishing fund-raising campaigns.

4.8 Infrastructure

It is imperative for a university to establish a campus which will provide an environment conducive to academic excellence as well as the cultural and social well-being of the university community. The following are basic infrastructure requirements:

1. Having in place a university-wide infrastructure for the provision of modern resources which take into account a planned investment policy coupled by an annual resources review;

2. Providing spacious and comfortable accommodation for students, in addition to some needed extra-curricular activities (sports, cultural, artistic, etc.) and social services like car parks, restaurants, a supermarket, a clinic, etc;

3. Making available to students modern, adequately stocked libraries with good accessibility and available computer rooms;

4. Making sure that an effective support infrastructure is in place for students with special needs.

4.9 Information Technology

A university seeking excellence should bear in mind that technology (applied to education) is employed as a way to ensure that education prepares students for life in the information age, so that they can compete successfully in the marketplaces. Hence, it is of prime importance to employ information technology that enables students to be full participants in the information
revolution, by means of facilitating their access to knowledge, and helping them to communicate effectively with each other and with the world. The following are some IT requirements:

(a) Using Information and Communication Technologies (ICT) in teaching, research and administrative operations;
(b) Providing adequate infrastructure for computer and Internet networks;
(c) Providing needed infrastructure, PCs, software, labs and equipment to enable faculty and students to employ ICT in teaching, learning and research and to facilitate their access to knowledge;
(d) Providing needed PCs and hardware for available computer labs and establishing new labs according to emerging needs;
(e) Providing easy access to Internet for learning and research purposes;
(f) Updating computer and IT-related curricula and introducing & designing new relevant on-line programs in IT, ICT;
(g) Transforming, on constant basis, the teaching and learning process in a manner that will optimize student achievements and will enhance curricular and instructional reforms that are needed to ensure the successful use of technology;
(h) Adapting quickly in the face of new technologies and emerging fields that are expanding faster and faster everyday, and makes optimum employment of IT and educational technologies;
(i) Adopting Learning Management System (LMS) and University Management System (UMS) running systems along with an entire electronic teaching aid and an optical fibre network to ensure a totally wired campus;
(j) Introducing and integrating ICT and educational technologies in the various administrative functions and operations;
(k) Networking with counterpart universities to facilitate the interchange and sharing of information.

4.10 Quality Assurance

In the late nineties, the main issues addressed when speaking of higher education reform were "Access," "Quality," "Relevance," and "Funding". Since the beginning of the twenty-first century, these issues have been replaced by "Life-long Learning," "Information Technology," "Partnership" (among all stakeholders), and "Quality Assurance." Although all these issues have been addressed in the previous sections of this paper, it is worthwhile to devote this section to articulate some further quality assurance requirements, listed below, for a university seeking excellence:

1. Having a formal internal quality assurance process which includes periodic curriculum review, staff appraisal process, good quality
management development programs, staff development program promoting core values and competencies, and an adequate funding and investment program;

2. Providing the best possible environment for graduate, undergraduate education and applied research that fulfill current and anticipated societal needs, with emphasis on emerging technologies, global change, and development;

3. Offering curricula and hands-on training that nurture creative thinking and prepare students for productive careers that enable them to spearhead national development and to ensure the maintenance of national prosperity;

4. Contributing, on continuous basis, to comprehensive sustainable development based on economics of information in education;

5. Excelling in terms of teaching, practical training, basic and applied research, and community service;

6. Devising an on-line, IT-assisted mechanism for accreditation, validation, and self-evaluation;

7. Adopting a system for continuous quality assurance and quality control for the institution and the programs it offers;

8. Demonstrating a strong belief in the importance of quality management and enhancement. This includes the participation of faculty in the quality assurance process and the provision of a structure where interconnecting committees for course review, program review, student feedback, assessment process and peer review of staff performance. Additionally, this also means that faculty members monitor the quality of staff and student recruitment, the quality of teaching and research and the sufficiency of resources to finance improvement and enhancements;

9. Making optimum benefit of student questionnaires and staff appraisal forms to improve weaknesses and build on strong points and practices;

10. Assessing and monitoring academic quality and standards in terms of education output;

11. Making sure that external associations, including external examiners, are linked to continuous improvement in quality and standards;

12. Adhering to strong, active and international accreditation and validation criteria in its various functions, operations, and course delivery and content;

13. Achieving recognition nationally, regionally, and internationally;

14. Providing evidence that the University recruits strong leadership;

15. Aligning the implementation of the University activities with its mission and core values;

16. Providing continuing educational opportunities for all employees;

17. Relying on a number of varied sources for funding and sustainability; and

18. Establishing an independent Unit to take care of quality assurance audit and self assessment.
5 CONCLUDING REMARKS

In the previous sections of this paper, we have covered some excellence requirements for the basic components of a higher education institution. If we look at higher education as a system, then university excellence implies prevalence of excellence, efficiency, competence, and innovation in all three components of the system, namely, input, operations and output.

It may turn out, owing to limited resources, that a university is unable to achieve excellence in all its disciplines or programs. In this case, a university may choose to excel in one (or more) fields of specialization, through the establishment of a centre of excellence for this field, thus, satisfying all excellence requirements. Such centre of excellence will achieve its objectives through:

(a) Serving as a leading provider of theoretical, technical and further education in a particular field of specialization/concentration;

(b) Undertaking research and collecting national statistics about theoretical, technical and vocational education and training in this particular field of specialization;

(c) Serving as a primary source of information on learning and job skills and possessing a research database on this field of specialization; and

(d) Applying information technology in its various operations.

Finally, it is hoped, as a minimum, that each university in OIC countries will achieve excellence in at least one field of specialization through a reputable centre of excellence with international recognition.
REFERENCES*


* As listed by the author.
PART FIVE

HIGHER EDUCATION: CASE STUDIES
صفحة بيضاء
Towards Research and Education Excellence: Experience from a European University of Technology

KEMAL HANJALIĆ

Emeritus Professor, Delft University of Technology

1 ABSTRACT

Under the premise that the industrial and economic development of a nation is closely correlated with the achievements in science and investment in research, and in order to bridge the science gap, some developing countries are trying to imitate the industrial nations and are allocating substantial portions of their income for research. The paper discusses the minimum threshold, the available man-power and the ability of industry in those countries to absorb scientific and innovative achievements and convert them into commercial products. The choice of appropriate science and technology policy is also discussed with a particular reference to the role of university education and basic research within a framework of a simplified model of technological development loop. Needs for strengthening science and engineering education and research are discussed, with a view of mutual impacts of new technologies and the university education and possible paths of its transformation. Some recent developments in an ambitious and dynamic technological university in the Western Europe are presented, not to serve as an exemplar or model, but rather to convey some ideas that could be projected elsewhere and to illustrate the fact that adapting to the ever changing world and meeting societal goals has been and still is a challenge all over the world.

2 THE UNIVERSITY AND THE TECHNOLOGICAL DEVELOPMENT

It has become part of folklore that the industrial and economic prosperity of a nation is closely correlated with the achievements in basic science. Indeed the most developed countries in the West claim that, among a few other crucial factors, it is science and the investment in science and research that have been and still are a major driving force for progress. The broadly accepted linear model "Research+ Development→Production→.Marketing" usually implied

---

1 International Fellow of the Royal Academy of Engineering, UK; and Fellow of the Islamic World Academy of Sciences.
that science is the most important element and that "a good science policy" and a large ingredient of basic science in engineering curricula is a guarantee of technological progress. The same notion is present nowadays among authorities and science policy makers in the developing countries, which are seeking the best routes to catch up with the leading industrial countries of the world.

As Abdus Salam wrote [1]: "The Third World as a whole is slowly waking up to the realization that science and technology are what distinguishes the South from the North. On science and technology depend the standards of living of a nation. The widening gap in economics and in influence between the nations of the South and the North is basically the Science gap."

Indeed nobody can disavow the fact that only few nation in the world, which are leading in science, are drawing enormous amount of capital gain through selling the high-tech goods to the rest of the world - computers and electronics, arms, chemicals and pharmaceutical products, airplanes, automobiles, machinery etc.

However, does it really mean that catching up with the top science is the only way to reduce the development gap? How do we explain the admirable development gradient of Japan, Malaysia, South Korea and many other not so conspicuous examples? Even if there is a unique correlation between the investment in science and the economic development, to match the research investment of leading industrial nations would mean for the not-so-developed countries a sacrifice of a substantial portion of their national income for that purpose, which they simply can not afford. What is the minimum threshold? How about the man-power? And finally, would the industry of those countries at its present level of development and with the present personnel be able to absorb all scientific and innovative achievements and convert them into commercial products competitive at the world market?

The choice of appropriate science and technology policy for a particular country - appropriate in the sense that it will utilize in the best way the comparative advantages and produce best outcome for least investments - is the crucial one. Smaller and less developed countries tend to imitate the leading industrial nations, to follow the same path and to have similar goals. That often means the most modern technology, founded on the country's own high quality research and know-how. It is often forgotten that many market breaking goods, particularly in the past, did not come out as a product of scientific research but rather from innovative initiatives on the workshop floor.

Engineers, by nature of their vocation, tend to advocate technologically most advanced, preferably completely new, not sufficiently tested options (solutions). Unfortunately, many economists, contrary to the common expectation that they will bring in a dose of economic realism into such undertakings, often go along with such ambitions. The reasons lie primarily in the absence of economic responsibility for managing the public money allocated for science and development, i.e. in the absence of an adequate feedback, but also in the fact that advocating most progressive and most modern technological solutions is often regarded as a proof (gives an impression - creates an image) of high professional competence and brings to the supporters of the idea political scores [2].

290
However, it has been frequently proven that technological progress in the economic sense coincides with technological progress in the technical sense only in some situations and under certain conditions. Even smaller communities can concentrate man-power and resources and achieve technological breakthroughs and full independence from the import of certain high-tech goods, but this would inevitably hold the development of other industrial sectors due to the extensive drain of skilled personnel and funds.

In an illuminating comparative study of the innovative styles in Japan and the United States, S.J. Kline wrote [3]: "There is a category of information which can be called Technological Knowledge. Despite the fact that technological knowledge is often considered inferior to scientific knowledge (and sometimes not considered at all), on balance, technological knowledge has been more important for the success in commercial markets than scientific knowledge, throughout the entire period of the industrial era." Kline wrote further that "after World War II in the USA the engineering educators rationalized a large fraction of engineering analysis ... " and "the computer revolution has provided still further enlargement of the range of applications ... providing the engineering students with the access to a remarkable tool kit of analytical methods."

However, Kline maintains that science usually does not finish the task of innovation and stresses the importance of manufacturing skills and operative knowledge, which basically led countries like Japan to become one of the leading economic powers in spite of a surprising shortage of Nobel laureates.

This of course does not mean that science and basic research should be left only to the rich and that the universities should teach only technological skills. It means only that a careful selection of priorities and a balanced attention and commitment should be focused on both, the country's own basic research and the acquisition of knowledge "from any source and with all means at our disposal" (first Emperor of the Japanese Meiji Dynasty back in 1870). However, seeking, acquiring and transferring knowledge is a complex technology of its own, "the knowledge technology," and it is probably the top priority and major responsibility of the education system of a country in which university education plays probably the most important role.

Another major dilemma that smaller and not-so-developed countries face is how to use best the modest scientific potential, concentrated mainly at universities, sometimes already established and recognized internationally, but isolated, i.e. connected more with the international scientific community than with their home environment. How to motivate those "pin heads on a pin cushion" (J.V. Garland) to employ their knowledge and skill to the benefits of the general development goals of the society? One of the first and major tasks of the establishment must be to recognize that such a valuable potential exists at home, regardless of how small, to secure at least a minimum of research infrastructure and to stimulate and direct such a potential to the carefully selected priority goals. But equally important is that local industry should recognize and accept such a potential as an opportunity for its own innovative undertakings and delegate a portion of its research and development tasks to this segment of research potential
in spite of the fact that it may have already established research and development institutions on its own. In fact most of the leading industrial corporations in the world, which have their own research institutes, as a rule, finance a substantial portion of university research, sometimes of a very basic nature. By that they achieve at least two important goals: acquire knowledge that they do not possess within and create a competitive climate in their research institutes.

However, without underestimating the importance of applied and development research as a sublimation of knowledge and innovation, and their transformation into a new value, product or a new quality, it is a fact that only basic research generates new knowledge and new skills which can then be employed in the solution of practical problems. Universities have always been *sui generis* the generators and disseminators of new knowledge and they should maintain this role in spite of the fact that basic research is nowadays carried out extensively in many independent large institutions and even in the industrial research centres. It is also true that only those scientists that contribute steadily to the world science treasure are capable of drawing out the top knowledge, the understanding and use of which requires an accumulation of not so easily acquired pre-knowledge and experience.

In spite of a flood of commercial offerings of various new and sophisticated laboratory instruments, new experimental techniques, software packages for computation, simulation and predictions of various phenomena, by which allegedly many problems of practical nature can be solved, every active researcher and developer knows that only committed, continuous and creative engagement into those research techniques and methods can secure their successful application to problem solving and development.

A simplified functional flow model of the process of technological development of a community can be represented by a kind of "technological pyramid" (Figure 1).

![Diagram](image)

**Figure 1. A simplified sketch of the technological development loop.**
In the foundation is the basic stone - the productive segment of the society which feeds a portion of its income into the next tier, representing the cornerstones of technological progress: the educational system, the science complex and the innovation complex. Material resources, scientific achievements, manpower and innovative ideas (market push / industrial research and development pull) produce new knowledge which is then materialized into a new product or technology. The outcomes of this tier are the scientific achievements and new knowledge which in turn interact with the innovative initiatives and eventually produce new products or, at least, new quality of the existing products. As a final outcome, there should be a general benefit to the community in an increase in the national income, a part of which is automatically being fed back into the production segment and the loop is closed.

The major outside factor is the market, which nowadays seeks continuous innovations. At the sufficiently high level of economic development, this scheme is self-maintaining: prospects of high profit from innovative goods are a sufficient incentive for industry to allocate a part of income to the research and other segments of the chain. But if, at any level of the pyramid, the critical threshold is not achieved, the loop is broken and cannot function without outside intervention. This is a common situation in less developed countries where the science - and innovative complex are not sufficiently established and cannot return even the modest investment from industrial enterprises.

However, it is well known that even in highly developed countries state support, not only for basic science (not counting education), but for most major advanced technological projects is an essential and unavoidable prerequisite for any success.

For two of the major foundation columns of the technological pyramid the science and education systems - the major responsibility lies on universities and their role in technological and overall development of a society - is mostly exercised through these two sectors. Major weaknesses in the technological development loop are often located within these two sectors and they should be identified before any steps are taken to reform the university education system and the scientific activities at the universities, in order to meet the current and future challenge of technological development.

In order to evaluate the technology policy of a country one should recall the basic indicators of its scientific potential. Let us first recall that the science and research complex represents a scientific potential of a community and consists of research personnel, infrastructure (institutions, equipment and laboratories) and science policy and organization. It has two major tasks: to contribute to the creation of new knowledge valued through the participation in global scientific progress - and to contribute to the overall (social, economic, political and technological) development of the society.

Although there are no reliable criteria on what the critical threshold of each segment or tier of the technological pyramid should be, the experience and some comparative survey of the practice in leading industrial countries seem to suggest certain figures that may be used as useful indicators. So, e.g., it is
commonly regarded that the lower threshold of the scientific potential of a community could be defined as 1 scientist per 1,000 inhabitants and expenditure on research and development of at least 1% of GNP.

Below these thresholds notable scientific achievements are possible, but they are isolated, while any contribution to the technological development is very insecure, uncertain and only casual.

In all highly industrialized countries these parameters are at least twice higher, while most other countries fall far beyond these figures. However, the scientific productivity (a number of scientific publications in international journals, and moreover the citation impact) does not usually match this correlation since only in some selected areas of science the output can be correlated with the input. These indicators seem to confirm a thesis that the correlations between the expenditure and both, the scientific and technological productivity have similar nonlinear characters ("S" curves) which indicate that initially even small investments can yield some results, but a systematic and reliable contribution requires a substantial allocation of national income. This is in particular true for science, in which modest expenditure on research can result in notable (though sporadic, isolated) scientific achievements (theoretical sciences, some lucid small scale laboratory investigations etc.), but a systematic and continuous contribution requires steady input well above the critical threshold and over a longer period of time.

Technological progress is correlated with the expenditure in a similar manner but requires even larger input ("S" curve shifted along the expenditure axis) for any achievements that could be regarded as the country's own development.

It has been said that curing any weaknesses in the technological loop cannot and should not be done without the influence and support of society as a whole through its state institutions. However, the major target should be those functions which the state can normally do better than industry or other sectors of the society. That means above all the educational system and scientific research, in particular fundamental science on a sufficient scale, but in selected areas. The sufficient scale means here that the fundamental research produces knowledge and educated scientists capable of communicating with - and contributing to world science (hence only international criteria should hold!), but also scientists must be able to select, verify and critically examine any technology - and know-how.

State funds should also support those segments of applied research in which the end user of the research results cannot be recognized in advance. This implies also the research aimed at acquiring, developing and improving new research and development techniques, instrumentation, skills and general knowledge, i.e. experimental techniques, analytical methods, or nowadays very powerful and prospective methods of mathematical modelling and computer simulation, so that all that accumulated knowledge can readily be employed at the appropriate market signal. The latter technique, "a third wing of science" (J.W. Garland), "mathematization of technological development" (A. Samarski), has already been marked as one of the major achievements of computer technology in bringing the opportunity to even small research and development communities, which do not have access to modern laboratories nor can afford expensive experimental
installations, to undertake major projects in developing new equipment and technologies, since all they need is powerful, but inexpensive desktop computers.

One of the major reasons for a slow technological development of many developing countries lies in the inadequacy of their education system. However, highly developed countries share similar concerns, but for different reasons. Some analysts in the USA fear that it may be losing the economic competition with EU as a whole and with some of its most developed states, as well as with Japan, but the same concern is present also on the other side of the “fence.” Strengthening engineering education is seen in many countries as one of the key issues, next to the strengthening of engineering research, support for facilities and equipment, industry connection and institutional framework. The responsibility is primarily seen with the governments, but also with industry, which are both expected to enable universities to turn out high-quality undergraduate and graduate engineers. Otherwise, it is feared that the system may fail to produce the calibre of the engineering graduates required to maintain industrial leadership.

The problem is much more acute in developing countries where most science and engineering students are not receiving adequate practical training because of inadequate laboratory equipment, laboratory facilities and computer systems. Partly as a result of inadequate infusion of equipment funds, and partly due to the rapid obsolescence of laboratory equipment as a consequence of rapid development of technology, many students are not receiving adequate hands-on experience and graduate without having the background appropriate for engineering practice.

Another important factor is the impact of technology upon engineering education and the need to recognize that engineering pedagogy is undergoing far reaching changes. Most of these changes have come as a result of the technology developed at universities, or at least, universities have had a major role in developing. Engineering design without access to computers no longer makes sense. Simulation of operations and processes on computers has become a tool essential to the instruction process. Experimental facilities with modern equipment are indispensable and unavoidable for hands-on training. Videotaped lectures and visual demonstrations of phenomena or processes have become a new powerful tool for individual and even distant study.

A long established practice at MIT - in the course on Engineering Design - includes an activity whereby every student is given a box with bits and pieces of various handy materials (every student gets the same components) to design an object or to solve a technological problem (e. g. to design a model of an insulated house in the Architecture Department or to solve a problem on the transport and manipulation of in the Mechanical Engineering Department). The subsequent valorisation of the project by testing the outcome in a laboratory or on the computer seems to have contributed to the development of creativity and self-initiative more than many classical university courses.

But to form a modern engineering curriculum and to implement it in practice is a difficult task. It has been known for some time that education technology requires a lot or effort and a substantial financial investment. Many authorities do
not recognize these facts and the engineering schools in many countries lag behind the general technological development. Some international activities along these lines may be of help to universities and teaching institutions, especially in developing countries, which have difficulties in creating, running and assessing advanced level courses in engineering. A carefully selected team of experts from engineering schools of world renown can provide the modern course curriculum by making use of the latest teaching techniques that will include in addition to written texts audio-visual material, supervised laboratory work and interactive self-assessment software. This can allow a much larger number of students to benefit from the assembled high level expertise than would be possible at the traditional institutions With a practical bias, while maintaining a strong intellectual standard, the course can be aimed at producing engineers capable of making major professional contributions after joining the workforce.

Last, but not least, the importance of university/industry links plays an important role, not only in shaping the teaching curricula and setting research priorities, but also in implementation and exploitation of university-bred ideas in industry. The famous concentration of advanced technology industry in and around the Boston area as a "spin-off" of MIT, or Silicon Valley between Stanford and US Berkeley, the Triangle Research Park in North Carolina, the Knowledge City (Kennisstadt) on Delft and many others, should serve as good examples of fruitful links of universities and industry.

3 AIMING AT THE TOP: SOME EXPERIENCE FROM TU DELFT

The ambition to belong to the world top league has motivated many universities worldwide to undergo radical transformations and reforms and to undertake various measures unseen in the past. These changes are especially noticeable in technological and natural-science-oriented universities. The main reason for searching for a new identity, concept, role and a niche in the society, is the increasing importance of the role of science and technology for knowledge-based economy and societal development of a nation. Paradoxically, the technological and science universities have generally been confronted with a continuous decline in the students’ enrolment over the past decades, which in some countries has indicated an alarming loss of interest among the young people to pursue science and engineering career. Re-establishing the respect and the social status of the science and engineering profession and attracting the interest of students has been another motivation for introducing changes not only in the university educational menus and curricula, but have even lead to changes in the academic vocabulary with (sometimes bizarre) terms replacing the traditional nomenclature. New departments are now called “Multiscale Physics”, “Mechatronics,” “Mediamatica,” “Haptics” etc.². I will illustrate this by giving a brief overview of

² The Second Chamber of the Dutch Parliament requested recently from the Minister of Education to take up steps against the “wild” and ”fashionable” trends in the university education.
some major changes that occurred at the Delft University of Technology (TechnischeUniversitätDelft, TUD) in the Netherlands.

3.1 TU Delft Profile, Structure and Ambition

TU Delft is the oldest, largest and most comprehensive technical university in the Netherlands (there were two other technical universities in the country, Eindhoven and Twente – surprisingly a small number for a nation of 16.5 million inhabitants and a long and successful technological and science tradition). The foundation of TU Delft goes back to 1842 when King William III chartered the “Royal Academy for Education of Civil Engineers.” Twenty two years later, the school was transformed into Polytechnische Hogeschool (Polytechnic High School). Its full university rank was granted only in 1905, when the name changed again to Technische Hogeschool (Technical High School), probably under the influence of German nomenclature. The present name, Technische Universiteit was acquired only in 1986, without significant changes in its structure and curriculum. Over the years, TU Delft has emerged as the leading national technical university and has acquired a significant international standing. The current enrolment counts about 2400 students, about one fifth of the total student population of about 13,500. The total work force counts about 4600 staff of which about 850 are academics (~200 full professors). There are currently over 700 PhD students and the yearly output of PhD dissertations revolves around 180. The number of scientific publications has been increasing steadily over the years to reach at present about 6000 per year.

In order to adjust to recent global trends and “to prepare for the social and academic demands of the 21st century,” in the new, internationally oriented world of education and research, in 1997 TU Delft was radically reorganized. Thirteen faculties, some operating for over 70 years, where clustered into only seven new faculties, under new and in some cases controversial names, some of which had to be changed soon afterwards, being judged as too vague and unrecognizable. The name game still goes on and a compromise is sought to reflect the profiles and curriculum of the studies, but also to offer students a sound-bait and flavour of something new and more prospective than the traditional professions. For example, the former faculties of Applied Physics, Chemical Technology and Material Science were merged into the Faculty of Applied Sciences, Electrical Engineering and Electronics, Technical Informatics and Engineering Mathematics into Faculty of Information Technology and Systems (now called Electrical Engineering, Mathematics and Computer Science!), Mechanical Engineering, Naval Architecture and Industrial Design formed the new Faculty of Design, Construction and Production(?!)) (now called again Faculty of Mechanical, Maritime and Materials Engineering or 3M, with Industrial Design Engineering being again a separate faculty), etc.

Clustering the faculties was just a first step in the reorganization. Traditional sections and divisions (chairs, “Lerhstuhls”), were groped to form new departments supposedly reflecting the new trends in the technology developments. For example,
the traditional Physics disciplines, Acoustics, Optics, Particle Optics, Solid-state Physics, Theoretical Physics, etc., earlier each practiced as separate groups, have been merged into departments under names of Nanoscience and Nanotechnology, Imaging Science and Technology, Multi-scale Physics, and so on.

Figure 2. Present organizational structure of TU Delft. BTA stands for the Committee for the Allocation Model (state subsidy distribution) and AKA for Advisory Council for Quality and Accreditation.

Initially met with reserve among some TU Delft academics, this reorganization and name-game, together with several other changes and measures such as a major renovation of the curriculum, introduction of the Anglo-Saxon Bachelor-Master system in 2002, seem to have produced some immediate benefits: already in 2003 the student enrolment increased by a remarkable 14% (with also a significant increase in the number of foreign students), breaking a lengthy downward trend. More offensive popularisation of the university in media, as well as organized and regular campaigns to incite and attract high-school pupils to study science and engineering, are also believed to have contributed to reversing the past negative trends. And the major boost came in October 2003, from the second successive winning of the World 10 Solar Challenge – the 3010 km solar-powered car race across Australia by the TU Delft student team with their Nuna II project (Figure 3).
The success demonstrated that engineering can be fun and apparently doubled the enrolment into Mechanical Engineering as compared with previous years.

Figure 3. The solar-powered car Nuna II in action during the World Solar Challenge, 2003. The average speed was close to 100 km/hr. The second-placed car crossed the finishing line one hour later.

3.2 Delft Research Centres and Research Portfolios

But the major endeavour was focused on restructuring and intensifying the research. The clustering and reorganization of the faculties and departments provided more fertile environment for interaction among the research groups, synergy and interdisciplinary research, as well as for creating critical mass in areas which were fragmented in the past. To this purpose, under the motto: “If demands of the past have brought us this far, where will the demands of the future take us...?” and “Curiosity is our guide, knowledge is our core business and society our partner,” the Executive Board identified thirteen multidisciplinary primary research themes, which are located in the Delft Research Centres (DRCs) (Figure 2). The priorities have been chosen based on the ever more complex technological demands arising from the challenges facing society as a whole, and which need to be studied from a multidisciplinary perspective if we are to find robust and sustainable solutions.

The thirteen Delft Research Centres provide integrated solutions for these multidisciplinary problems by bundling excellent research. In this way, the knowledge and expertise built up over the years on thirteen important research
themes is made available to society, industry and policy. Programmes for the future are:

- Computational science and engineering;
- Earth: observation, utilization, ecology and engineering;
- Information and communication technology;
- Life science and technology;
- Materials science;
- Mechatronics and Microsystems;
- Mobility of persons and transport of goods;
- Nanotechnology;
- Next Generation Infrastructures;
- Sustainable energy: extraction, conversion and use;
- Sustainable industrial processes;
- Sustainable urban areas; and
- Water: environment, cycles, infrastructure and management.

Figure 4. Some examples of current research conducted in Delft Research Centres [4,5] indicating a variety of topics and targets.

3.3 Research Schools

Independent from the above listed Research Centres, TU Delft participates, with other universities in the Netherlands, in a number of research schools, which combine the research and training of researchers (those working for their
doctorates, PhDs) in a particular discipline, with participation of research teams from different universities.

TU Delft hosts the administration and coordination office of eight of these research schools. A research school must be formally recognised as such by the ECOS, the National Research School Accreditation Committee. The Minister of Education, Culture and Science approved all together six top research schools in the first round of the in-depth strategy (1998). TU Delft also participates in the Delft part of the Centre for Technical Geosciences Research School and the Delft part of the Veningh Meinesz fResearch School for Geodynamics in the Centre for Integrated Solid Earth Sciences (ISES). The schools in which TU Delft actively participates are:

- BSDL – Inter-university Research School for Biological Sciences Delft-Leiden;
- Integral Design of Structures;
- CGT – Centre for Technical Geosciences;
- DIMES – Delft Institute for Micro-electronics and Submicron-technologies;
- DISC – Delft Institute for Systems and Control;
- J.M. Burgers Centre/Research School for Fluid Dynamics;
- TRAIL – Research School for Transport, Infrastructure and Logistics; and
- Affiliate Research Schools.

Delft University of Technology participates also in research activities with a number of affiliate research schools, managed by other universities, such as BETA, Institute for Business Engineering and Technology Application (Eindhoven University of Technology), BIOMAC, Structures, Functions, and Working Mechanisms of Biomacromolecules (Leiden University), EIDMA, Euler Institute for Discrete Mathematics and its Applications (Eindhoven), Engineering Mechanics (Eindhoven), IPV, Research School for Integrated Manufacturing and Development (Twente), NETHUR, Netherlands Graduate School for Housing and Urban Research (Utrecht), NIOK, Netherlands Institute for Research on Catalysis (Utrecht), NRSPA, Netherlands Research School for Public Administration (Twente), OSPT Process Technology (Twente), PTN Polymers (Eindhoven), SIKS, School for Information and Knowledge Systems (VU Amsterdam), SIMATH, Thomas Stieltjes Institute for Mathematics (Leiden), Vening Meinesz Research School for Geodynamics (Utrecht), WTMC, Netherlands Graduate School of Science, Technology and Modern Culture (Twente).

3.4 Research Institutes

Research institutes are research organisations that vary enormously in terms of accreditation, size and the participation of disciplines. TU Delft has three officially recognised research institutes: the Interfaculty Reactor Institute IRI, the Research Institute for Housing, Urban and Mobility Studies OTB and the International Research Centre for Telecommunications-transmission and Radar
IRCTR. The latter comes under the Electrical Engineering, Mathematics and Computer Science faculty EWI.

TU Delft also takes part in three of the four top institutes recognised by the Minister: Nutrition, Metals, Telematics and Polymers. Scientific management of the top institute, Metals (NIMR), takes place in Delft. There are numerous smaller research institutes.

4 QUALITY ASSESSMENT

Assessments have become a part of the destiny of academics: no scientist can escape from it for a long time. It seems that everybody is involved in this process, on both sides, sometimes as reviewer, sometimes as the one to be reviewed. However, reviews are important and follow a political obligation: an honest assessment of research by experts is in the interest of everybody.

The quality assessment of research in the Netherlands started in 1993 under the aegis of the Association of Universities in the Netherlands, VSNU. In the period of 1993-1997, all university research, per discipline or scientific area, was assessed by means of peer review, conducted by panels of international experts. The guiding principles were stipulated in 1994 Protocol for the Quality Assessment of Research. A series of Quality Assessment of Research was published by VSNU for different areas ranging from Theology, Pedagogical, Educational, Political … to Natural Science and various fields of Engineering (VSNU, Utrecht, NL). In 1998, at the initiative of the VSNU, Dutch Royal Academy of Sciences (KNAW) and the Dutch National Science Foundation (NOW), the 1994 Assessment Protocol was subjected to review and subsequent enhancements, which resulted in a new evaluation system The Standard Evaluation Protocol for Public Research Organizations, 2003-2009. The main novelty of the new system is the emphasis on the improvement and public accountability of research, the latter seen as both a requirement for publicly funded research and an inherent element in the improvement cycle. The primary objectives of the system of quality assessment of research are:

- Improvement of the quality of research through an assessment carried out according to international quality and relevance;
- Improvement of research management and leadership; and
- Accountability to higher levels of the research organizations and funding agencies, government and society at large.

In addition, for each area of science, specific "Discipline Protocols" were provided with additional requests and questions relevant to each discipline.

The evaluation system is a combination of retrospective and prospective analysis, with the emphasis on the latter one. The results of the evaluation are reported to the higher institutions (including the Minister of Education) and boards that make policy decisions, but are also intended to help the research
organizations, the management of research/programme leaders and the individual researchers to make better decisions about future research, research management and policy. The units of evaluation are “research programmes” defined as “a group of researchers with an articulated shared mission, operating under the same management.” The basis for evaluation is the set of documents that in most cases includes:

- Programme descriptions, research portfolio and publication lists, which include, besides publications, designs and software, patents, invited lectures, contacts with industry and other products;
- Self-evaluation reports containing a SWOT analysis (Strengths - Weaknesses - Opportunities - Threats);
- Bibliographic (citation) analysis provided by an independent professional organization (the Centre for Science and Technology Studies of the Leiden University);
- A set of key publications per programme;
- Analysis of age distribution per programme;
- Additional information given verbally or in writing by representatives of the Faculty or the research group concerned.

4.1 Criteria and Assessment Scales

This basic information is then used to generate two final products: a written assessment on the programme/research group involved, and four numbers, on a five point scale, for the quality, productivity, relevance and prospects respectively.

The 1994 Protocol allowed the review committee considerable freedom to interpret the four aspects and the assessment scale in such a way that the assessments reflect what they see as important, taking into account the variety in the nature of the research programmes under scrutiny, which varies from pure fundamental scientific research to applied technology. The new 1998–2002 Protocol retained the essential matrix of criteria and evaluation scale, though with some minor modifications.

The main criteria are defined in relation to the mission of the institute or group. For instance, if the mission of the institute or group is restricted to national scientific tasks or pretends (and succeeds) in being a player at the international scene. For the assessment of physics research in 2002, the criteria were interpreted in the following way:

Quality is to be seen as a measure of excellence. It refers to the eminence of a group’s research activities, its abilities to perform at the highest level and its achievements in the international scientific community. It rests on the proficiency and rigour of research concepts and conduct; it shows in the success of the group at the forefront of scientific development. When an institute provides high quality state of the art facilities to the research community this can be considered as a measure of excellence.
**Productivity** refers to the total output of the group; that is, the variegated ways in which results of research and knowledge development are publicised. The output needs to be reviewed in relation to the input in terms of human resources.

**Relevance** is a criterion that covers the scientific, the technical and the socioeconomic impact of the work. Here in particular research choices are assessed in relation to developments in the international scientific community or, in the case of technical and socio-economic impact, in relation to important developments or questions in society at large.

**Vitality and feasibility:** This dual criterion refers to the internal and external dynamics of the group in relation to the choices made and the success rate of projects. On the one hand, this criterion measures the flexibility of a group, which appears in its ability to close research lines that have no future and to initiate new venture projects. On the other hand, it measures the capacity of the management to run projects in a professional way. Assessment of policy decisions is at stake, as well as assessment of project management, including cost-benefit analysis.

The rating for each criterion was done on the five point scale:

**Excellent (5)**

Work that is at the forefront internationally, and which most likely will have an important and substantial impact in the field. The institute is considered an international leader.

**Very good (4)**

Work that is internationally competitive and is expected to make a significant contribution nationally. The institute is considered an international player and a national leader.

**Good (3)**

Work that is competitive at the national level and will probably make a valuable contribution in the international field. The institute is considered internationally visible and a national player.

**Satisfactory (2)**

Work that is solid but not exciting, will add to our understanding and is in principle worthy of support. It is considered of less priority than work in the above categories. The institute is nationally visible.

**Unsatisfactory (1)**

Work that is neither solid nor exciting, flawed in the scientific and or technical approach, repetitions of other work, etc. Work not worthy of pursuing.

A summary of specific aspect within each of the criteria is illustrated in Table 1.
### Table 1. A list of evaluation sub-criteria

<table>
<thead>
<tr>
<th>Quality</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do you evaluate quality with respect to:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Originality of the approach and ideas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Significance of the contribution to the field</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Coherence of the programme</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Publication strategy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Prominence of the programme director</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Prominence of the other members of the research group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Quality of scientific publications (scientific impact)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Quality of other results</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall assessment of quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Productivity</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considering the number of staff, how do you evaluate the Productivity with respect to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Number of PhD theses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Number of scientific publications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Number of professional publications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Other results (if applicable)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Distribution of published output within the group</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall assessment of productivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relevance</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considering the stated mission of this programme how do you evaluate the relevance of the research with respect to</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. The advancement of knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The dissemination of knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The implementation of knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall assessment of relevance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vitality and feasibility</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Considering the present status and future developments (if known) of staff and facilities, how do you evaluate the long-term programme viability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. In view of the past scientific performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. In view of future plans and ideas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. In view of staff age and mobility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall assessment of vitality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As an example, we will discuss briefly the research assessments of Physics in the Netherlands, which included research groups both in the general and technological universities. In the first assessment carried out in 1993, the Review Committee for Physics has evaluated physics research in 101 research groups in the nine universities in the Netherlands that have faculties or departments for physics or technical physics: the Universities of Leiden, Utrecht, Groningen, and Amsterdam, Vrije Universiteit Amsterdam, University of Nijmegen, Delft University of Technology, Eindhoven University of Technology, and the University of Twente. Also included was the Faculty of Human Movement Science of the Vrije Universiteit Amsterdam.

It is illustrative to quote some of the conclusions of that assessment. First, the committee found as its main conclusion that the quality of physics research in the Dutch universities is very good. More than 10% of the research programmes presented to this committee were outright excellent (5), which means that they compete with the international elite in their field. More than 50% was judged to be working significantly above the still very acceptable level of 'satisfactory' (3), which in itself means meeting international standards to an acceptable extent. Only in a very small number of cases did the committee grant less than (3) for one or more of the criteria. In a few cases, the committee had to fill in a question mark, because that specific programme appeared to be in a transitory state or a judgment was not appropriate for other reasons. The committee was very pleased indeed to encounter so many good physics research groups in the Netherlands, a fact which made its work difficult but very interesting and stimulating.

It was emphasized, however, that the committee has based its judgment not on one simple measure or ranking scheme, but on the basis of a large range of indicators. Furthermore, these indicators were selectively applied in accordance with the mission, nature and position of the specific programme involved. This means that several yardsticks were used and that no indicators, such as publication counts or citation/impact scores, were used exclusively as an absolute determinant. The largest differences in nature, mission and position was found between (some of the) programmes of general universities on the one hand and universities of Technology on the other. However these differences may be, it was strongly felt in the committee, the result of research from either type of university that had to be made visible in any form or by any means. Groups that were not demonstrably communicating their results through papers, conferences or patents, could obviously not receive satisfactory scores.

The next quality assessment was to be repeated in 2002 following the same pattern, but applying somewhat modified criteria and rules stipulated in the 1998 Protocol. However, by then the wind of globalization was also permeating the Dutch universities and the slogan was launched that we should not measure ourselves with the domestic (national) yardstick and compete between

---

3 The previous occasion Dutch physics was examined on a national and encompassing scale was in 1984 by the Dutch Foresight Steering Committee for Physics ('VerkenningsCommissie Natuurkundig Onderzoek').

306
ourselves, but to enter the international scene and use the international criteria. As a follow up, TU Delft in collaboration with the University of Leiden decided to commission their own joint international peer review [9,10]. Although the Review Committee consisted of very different members than 6 years earlier, and some of the institutes and groups received quite different evaluation than before, it is worth noting that the assessment was in general very much congruent with the earlier one, justifying thus to a large degree the objectiveness and the purposefulness of the assessment exercise.

4.2 A Note on Bibliometric Analysis

The bibliometric analysis prepared by CWTS serves primarily as a check on the assessments that already had been made in advance. Notwithstanding the ongoing discussions about the value and validity of bibliometric data - and they will probably never come to a final conclusion - the review committees usually feel that this way of using these data, i.e. as a check on the independent (and prior!) judgments and as an additional source of information about the publications and the reception of this work in the world, is well justified. In several earlier assessments of different disciplines it turned out that no major changes in the perception of the research groups were induced within the review committee by these data. The average number of citations per publication CPP, normalized with the average field- and journal-citation rate, i.e. CPP/FCSm and CPP/JCSm ratios (for notation, see Table 2), regarded as crown indicators, are used as a sign of the relevance or visibility of a group, rather than as an absolute measure of their quality.

**Table 2: Overview of Bibliometric Indicators**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>The number of articles (normal articles, letters, notes and reviews) published in journals processed for the CD-ROM versions of ISI's Citation Indexes (CI-journals).</td>
</tr>
<tr>
<td>C</td>
<td>The number of citations recorded in CI-journals to all articles involved. Self citations are included.</td>
</tr>
<tr>
<td>CPP</td>
<td>The average number of citations per publication, or citation per publication ratio. Self citations are included.</td>
</tr>
<tr>
<td>CPPex</td>
<td>The average number of citations per publication. Self-citations are not included.</td>
</tr>
<tr>
<td>%Pnc</td>
<td>The percentage of articles not cited during the time period considered.</td>
</tr>
<tr>
<td>JCSm</td>
<td>The average citation rate of all articles published in the journals in which a group has published.</td>
</tr>
<tr>
<td>FCSm</td>
<td>The average citation rate of all articles in the fields in which the group is active. Also indicated as the world citation average in those fields. Fields are defined by means of ISI journal categories.</td>
</tr>
</tbody>
</table>
Table 2: (Continued)

| CPPIFCSm | The impact of a group's articles, compared to the world citation average in the subfields in which the group is active. A '+' ('-') symbol after the numerical value indicates that the impact of the groups' articles is significantly above (below) world average. |
| CPPIJCSm | The impact of a group's articles, compared to the average citation rate of the group's journals. A '+' ('-') symbol immediately after the numerical value indicates that the impact of the group's articles is significantly above (below) the average citation rate of the journals concerned. |
| JCSmIFCSm | The impact of the journals in which a group has published, compared to the world citation average in the fields covered by these journals. |
| %SELFCTS | The percentage of self-citations, defined as citations in which the citing and the cited paper have at least one author in common (first author or coauthor). |

5 FUTURE TRENDS

Severe competition on the global scale has motivated some universities to seek alliances and join forces in the endeavour to reach the elite league. In some cases, long-term inter-university collaborative programmes have been established aimed at gathering researchers and academic staff on joint missions, but also to promote systematic exchange of research and undergraduate students. An example is the so called IDEA League (Imperial College, Delft University, ETH-Zurich and the University of Aachen). It is recognised that such alliances, gathering institutions of similar profile and international standing can certainly produce some synergy, though the concrete results are still lacking.

A more serious and possibly far-reaching new initiative is the recent move in the Netherlands to bring all three technological universities (Deft, Eindhoven and Twente) under the same general management, tentatively named as Duct Institute of Technology or, 3TU. The idea comes from some large institutions consisting of several campuses all over the country (e.g. the University of California). In a recent proclamation it is said that the new situation in which the Dutch knowledge institutions, and consequently TUD too, now find themselves serves to make us aware that we should no longer compete with each other but join forces. By coordinating our research and teaching we expect in due course excellent results from what is a unique step. The increasingly productive cooperation between TU Delft and the University of Leiden over the past few years has been seen as proof that such efforts can be successful. Joint
courses in several fields (life sciences, mathematics and nanotechnology) have become popular attracting more students, and coordination of research to exploit the synergy between the two types of university has proved to generate both increased research funding and a surge in publications.

The idea of joining forces has recently gone beyond the national borders with a new initiative from the EU to found a European Institute of Technology! While at this stage not much more can be said, these trends can serve as an inspiration to universities in developing and other countries where the funding lacks behind the critical threshold that would ensure top quality of education and research in the existing institutional systems.
REFERENCES


Higher Education in Developing Countries: Inherent Problems and Some Solutions

H.A. KHAN*
Executive Director, COMSATS Headquarters
4th Floor, Shahrah-e-Jamhuriat, G-5/2, Islamabad
Pakistan
and
A. NASIM**
Adviser Science, COMSTECH Secretariat
33-Constitution Avenue, G-5/2, Islamabad
Pakistan

1 ABSTRACT

Education is one of the most crucial factors for economic prosperity of any nation. The pivotal role of education has been well emphasized in a number of published documents. This has now been further stressed by the concept of knowledge based economy. Achieving economic prosperity and overall well-being of the inhabitants of any nation are goals of highest priority. Any efforts to achieve these highly commendable objectives require that education be given the highest national priority.

This paper will present currently available statistics on education including literacy rate, number of universities, student enrolment and available skilled manpower with special emphasis on OIC countries. These data will highlight the sharp contrast between developing countries and developed ones. The present state of education in developing countries will be discussed with special focus on OIC member countries.

Some of the current initiatives taken by the Higher Education Commission in Pakistan will be discussed as possible example of the kinds of steps that need to be taken to improve the quality of higher education. One very important aspect of this discussion is the linkage between early primary education and the higher education. A very strong link providing continuity and integration between these different levels is as yet a question mark that merits special attention. For future strategies and effective mechanisms of implementation, different steps will be discussed that can provide a conceptual framework for a sound educational system in the developing countries.

---

* Fellow of the Islamic World Academy of Sciences.
** Fellow of the Islamic World Academy of Sciences.
2 INTRODUCTION

For a gathering of this kind with scholars and researchers with extensive experience in education and research it is not an easy task to come up with any new ideas. This challenge is further enhanced if one examines the knowledge explosion and the rate at which information is being produced. The educational system and development too is a complex process. Keeping this in view, many initiatives need to be taken in parallel.

The Islamic World Academy of Sciences had organised a conference on "Science and Technology Education for Development in the Islamic World" in 1999 which resulted in the publication of a comprehensive volume of nearly 500 pages. Some of the questions raised in this earlier conference are of relevance to the present discussion. Just one quotation from the preface of this volume will illustrate the point:

"Tomorrow's capabilities for any society can be promoted by today's education and research in the scientific field, for these, evidently, are the most important mechanisms through which a nation can shape its future."

However, at this stage there is an idea that we wish to share with the eminent scholars present here. This refers to an assessment of the ultimate impact of gatherings of this kind. One view is that such exercises primarily end up in void and little improvement is effected. This is a matter that merits special attention and the Islamic World Academy of Sciences (IAS) may, perhaps, wish this aspect to be critically examined.

One can start with a review of the status of the present dismal state of higher education in the Organization of the Islamic Conference (OIC) countries. A conventional way of doing this is to present statistics on the current level of higher education in these countries. The salient indices include: literacy rate, expenditure on education, number of universities, number of PhDs and Human Development Index.

There are a total of 853 universities in 47 OIC countries. Among the top 500 World Universities, there are just two universities from Turkey. Yemen and Brunei Darussalam spend more than 9% of their GDP on Education and others less than 9 percent. There are 10 countries out of 53 OIC member states that have literacy rate less than 50 percent. Five OIC member countries fall in first 50 in HDI rank, and 13 countries are in first 100 countries in this category. It is evident that much more must be done if OIC member states have to make sizeable progress.
3 ISSUES AND CHALLENGES FACING HIGHER EDUCATION IN DEVELOPING COUNTRIES

We are currently facing a situation in education where both teaching methodology and content are becoming incongruent with reality. A lot of restructuring is needed to accommodate the new realities of the information-age.

The current educational models, in most developing countries, promote rote-learning culture. Most of the academic information acquired in this manner, cannot be retained for long. A tremendous gulf exists between educational application and the real-world implementation. The skills acquired in the universities are usually found redundant when a student enters the practical world. Therefore the graduates, who perform well academically, fail to succeed in practical environment. An educational degree with no relevant experience does not guarantee a job as readily as it had in the past.

In our educational system, the uniqueness of an individual is completely ignored. Many great minds are wasted in an educational system that caters for the mediocre. This is the root cause of a terrible waste of time, talent and potential. Our education systems are extremely rigid also. For pursuing higher specialized studies, pre-requisite subjects have to be taken at secondary level. Career counselling is scarcely available in the developing countries. If a student decides to change direction after completing secondary education, it is extremely difficult unless one starts afresh. This severely constrains future career-options.

Higher education is being commoditized in the present era. The major change to befall the universities, over the last two decades, has been the identification as a significant site of capital accumulation, a change in social perception which has resulted in the systematic conversion of intellectual activity into intellectual capital and, hence, intellectual property.

4 THE TRANSFORMATION OF EDUCATIONAL SYSTEM: ENABLING TECHNOLOGIES AND TRENDS

Globalization and the emerging technologies are going to be the major factors, set to transform the present-day educational system. Broadband Internet is now a reality to offer unprecedented Internet speed. Words like fibre-optic, cable, modem, digital subscriber line (DSL), broadcast and satellite are here to stay. The satellites will make connection and communication much easier and will deliver data at much higher speeds.

The 21st century will see significant changes in higher education, and many of these changes will be caused by advancement in technology and emerging scientific trends.

The delivery platform of educational content is drastically shifting away from the physical classroom to distance-learning and multimedia environments. We have entered a new era in higher education, one which is rapidly drawing
the halls of academia into the age of automation. Automation, the distribution of digitized course-material online, is often justified as an inevitable part of the new "knowledge-based" society. It is assumed to improve learning and increase wider access. With technological breakthroughs, one could have one's pick of whom to learn from. Digital education will not replace the traditional classroom, but the digitization of educational content will provide the learner with a wider choice. The process of customization of education will continue in the future, adapting to individual learning-styles, something that the classroom in the traditional sense cannot provide.

New knowledge in science and technology has made it necessary to upgrade the curricula. The new curricula will force the educators to update their knowledge and learn a lot of new skills.

Certifications will most likely be done directly by the industry, bypassing traditional educational systems. Both industry and consumers will tend to give preference to certification, as it will ensure quality trained workforce, with specialized industry-relevant skills. Certification had its inception in the IT industry and is expanding in other fields.

The decentralization of the educational mandate into the hands of private and social sectors is becoming imminent for survival and to be globally competitive. The decentralization will become possible by increasing globalization and elimination of state regulations.

Libraries continue to house printed materials, but most of this material is now available in digital form via the Internet. This material is accessible 24 hours a day, seven days a week, from anywhere in the world. Students can access required material online.

In the developed world, the present-day higher education is dominated by research and specialization. Students at the master's level participate in research work and specialize in a certain area. In the educational institutions of most of the developing world, emphasis is not on fundamental quality research work, but on the research done somewhere else in the past. Infrastructure to carry out meaningful research is simply not available. Private and public sectors, in developed countries, provide financial aid to the students undertaking research activities at higher level. The same needs to be done in the developing countries, to promote research in the educational institutions.

5 HIGHER EDUCATION IN PAKISTAN

5.1 Present Scenario and Some Statistics

At the time of creation of Pakistan in 1947, only one university existed. In the subsequent 50 years, expanding tertiary education enrolments has outpaced the construction of new colleges and universities. Today, Pakistan has 103 public and private universities and over 1,000 "affiliated" or "constituent" colleges, technical training institutes, teacher training schools, and other specialized institutions. This is illustrated in Table 1:
Table 1. Educational Statistics (2001-02)

<table>
<thead>
<tr>
<th>Level</th>
<th>Institutions</th>
<th>Enrolment</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>169,084</td>
<td>19,921,232</td>
<td>345,457</td>
</tr>
<tr>
<td>Middle</td>
<td>19,180</td>
<td>4,278,392</td>
<td>99,098</td>
</tr>
<tr>
<td>Secondary</td>
<td>13,108</td>
<td>1,795,444</td>
<td>66,522</td>
</tr>
<tr>
<td>Higher Secondary</td>
<td>682</td>
<td>86,674</td>
<td>16,731</td>
</tr>
<tr>
<td>Sec. Vocational</td>
<td>498</td>
<td>88,000</td>
<td>6,582</td>
</tr>
<tr>
<td>Colleges</td>
<td>789</td>
<td>956,468</td>
<td>35,325</td>
</tr>
<tr>
<td>Universities</td>
<td>103</td>
<td>1,100,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Information Technology</td>
<td>27</td>
<td>22,058</td>
<td>337</td>
</tr>
</tbody>
</table>

*Source: Ministry of Education, Govt. of Pakistan.*

It is no surprise that Pakistan faces immense difficulties in strengthening its higher-education sector in the current economic climate. Pakistan’s health, education, and poverty status-indicators are lower in comparison with other countries in the region. Population growth is rapid and there are escalating challenges for the government to spend on social welfare schemes including higher education.

5.2 Problems and Issues

The most disconcerting element in Pakistan’s higher-education system is the substandard quality of the course-content. The outdated syllabus is not geared towards equipping the youth of today with the requisite tools of success needed to thrive in the practical world. Courses are seldom formulated with the current and future market-demand in mind, as the concerned authorities themselves are unaware of the same. Furthermore, student career-counselling is not a regular feature in our educational system, which allows for mismanagement and suppression of genuine talent. At the end of the day, all these factors amalgamate to produce educated students who do not have any direction as regards their future career and are usually a misfit in the challenging and changing job-market of our country.

The environment of Pakistan’s education system is such that it does not encourage students as well as teachers to consult libraries or latest scientific literature regarding their respective fields. Seminars and workshops are avoided, primarily due to incapacity and lack of command over their subject. Moreover, quality research-work is hampered mostly because of time constraint. Semesters are designed in such a way that teachers as well as students find it extremely difficult to cover all aspects of their course in an effective manner, which results in substandard research work. Generally, the research topics assigned to students are a repetition of the research work already carried out by their supervisors. This practice undermines original thinking and also diminishes the chances of effective researches that may serve as potential solutions for the society’s real-life problems. More importantly, the research carried out is in
complete isolation to the industrial demands of the country. No mutually beneficial research is carried out in this regard and the motive of conducting research has become that of fulfilling a routine rather than anything else.

Management is yet another weak area in our education system. The administrative staff is usually not familiar with the contemporary means and methods of managerial excellence. The result is a bottlenecked management-system, paving the way for mismanagement and injustice.

In the higher education system of Pakistan, there is a keen sense of resistance to change, as virtually all the elements of this system want to adhere to their orthodox ways of working. Students are spoon-fed in their tasks and assignments to such an extent that virtually all matters regarding their endeavours are taken care of, without them having to make any creative effort. Another practice is the handing out of notes to the students for consultation, with the assurance that no queries shall be made outside the scope of that content. All these factors combine to disrupt original and ‘out-of-the-box’ thinking, forcing Pakistani students to remain entangled in the traditional and obsolete knowledge sphere of yesterday.

6 SOLUTIONS AND RECOMMENDATIONS

6.1 Recommendations

Keeping in view the above discussion, the following recommendations may be worth consideration:

- The educational curricula should be updated;
- Distance-learning should be promoted and libraries should be digitized for easy access to knowledge;
- Career-counselling should be provided;
- The developing countries must provide funds for the infrastructure, necessary in universities to carry out research work;
- Public and private sectors should provide funds to the universities, to promote research-based degrees and diplomas;
- Traditional classrooms must not be entirely replaced by distance-learning because in an ideal educational environment, the educator transfers not only information, but morals, ethics and social skills. Some people always prefer being taught by another human being;
- Specialization and interdisciplinary collaboration among specialized fields should be promoted for development of emerging technologies; and
- The higher education in the new age of automation will be very different from what we have now. We must acquire the relevant skills and expertise, if we wish to survive in the 21st century.
6.2 Some Steps for Improvement

It is heartening to note that the government of Pakistan has recently taken salutary initiatives to improve the quality of higher education. Firstly, a high-level national Higher Education Commission has been established. Secondly, the resource-allocation to public universities will be doubled over a period of three years. Thirdly, efforts are being made to develop R&D culture in the country. The prospective plan (2001-2011) for the education sector has an outlay of about Rs. 200 billion (Table 2).

Table 2. Education Sector: Investment Plan 2001-11

<table>
<thead>
<tr>
<th>Sub-Sector</th>
<th>Allocation (Million Rs.)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary education</td>
<td>12,710</td>
<td>20</td>
</tr>
<tr>
<td>Secondary education</td>
<td>6,742</td>
<td>10</td>
</tr>
<tr>
<td>College education</td>
<td>3,558</td>
<td>6</td>
</tr>
<tr>
<td>Scholarship and Misc.</td>
<td>2,842</td>
<td>5</td>
</tr>
<tr>
<td>Technical education</td>
<td>12,969</td>
<td>21</td>
</tr>
<tr>
<td>Literacy programme</td>
<td>9,040</td>
<td>14</td>
</tr>
<tr>
<td>Universal education</td>
<td>14,835</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>62,426</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Note:** In addition, provinces will provide Rs. 130 billion through their ADPs.

*Source: Ten-Year Prospective Development Plan, Planning Commission, Govt. of Pakistan.*

This action plan, if implemented earnestly, will salvage the wasted and ill-used national human capital, resulting in the transformation of the existing system of higher education to world-class standard in a not too distant future.

For the present discussion, the relatively recent initiatives of Pakistan’s Higher Education Commission (website: http://www.hec.gov.pk) which is a comprehensive programme for the improvement of the quality of education in the universities of Pakistan may be worth mentioning.

These initiatives include:

1. **Human Resource Development Programme**
   a. Scholarships
      i. Undergraduate Programmes
      ii. MS Programmes
      iii. MS Leading to PhD Programmes/ PhD Programmes
   b. Foreign Fellowships
   c. Approved PhD Supervisors
   d. Faculty Hiring Programmes
   e. Foreign Experts

317
2. Research and Development
   a. Research Grants
   b. Scientific Equipment & Libraries Grants
   c. Conferences and Meetings
   d. Industrial Liaison
   e. Others
      i. National Core Group in Life Sciences
      ii. Programmes for Faculty Members and Researchers
      iii. Faculty Exchange Programmes
      iv. Collaborative Programmes
      v. Faculty Development Programme

3. Academic and Curricular Affairs
   a. Curriculum Revision
   b. HEC Recognized Journals
   c. Monograph and Textbook writing
   d. Sports
   e. Others
      i. Digital Libraries
      ii. Pakistan Research Repository (PRR)
      iii. Best Teachers Award
      iv. Students’ Convention

4. Quality Assurance & Learning Innovation
   a. Quality Assurance
      i. QA Agency
      ii. University Accreditation
   b. Learning Innovation
      i. LI Department (Learning Innovation)
      ii. NAHE (National Academy of Higher Education)
      iii. ELTR (English Language Teaching Reforms)
   c. Degree Attestation and Equivalence
      i. Degree Attestation Services
      ii. Equivalence Degree Issuance
   d. Other
      i. Ranking of Universities
      ii. Statistics

5. Finance, Planning & Development
   a. Development Projects
   b. Recurring Grants
6.3 How to Achieve Change?

Contrary to the common belief, a meaningful change in the higher education system is not solely associated with intense infusion of funds, but is equally dependent on the subtle, yet consistent, attitudinal modification of all stakeholders directly or indirectly playing a part in the system. There is thus, a need to alter mindsets, and it doesn’t cost much. Some views in this respect are described below:

- The immediate area of concern is the thorough and in-depth review of the usefulness of the present syllabi. Course coordinators and content formulators must keep in view the latest developments in the concerned fields of education and must ascertain, anticipate and integrate the current and future market-demand into this content. They must know where the students can be absorbed after graduating, what other work they may be required to do, what qualification and experience employers require for a particular kind of job, and the number and type of graduates required by a certain employer.

- More importantly, academic excellence cannot be achieved without a committed, empowered and enthusiastic faculty. The need is to provide faculty-members with attractive incentives to discharge their responsibilities. As a first step, their salaries should be de-linked from government pay scales, and performance-based perks should be allowed to them. Moreover, faculty empowerment through greater participation in decision-making and management would also help. Greater emphasis needs to be laid on: the qualification of teaching faculty, student teacher ratios, infrastructure and capacity building investment, diversity of student body, proportion of low-income students and evaluation of teachers done by student.

- A precise mechanism must be evolved in which the teachers and supervisors upgrade their own professional knowledge, keeping in view the latest developments in their pertinent fields, so that they may subsequently impart it to their students.

- Imperative for quality-assurance and funding for higher education in Pakistan, is a supportive and facilitative governing body, which must have a catalytic role, rather than an intrusive one.

- The amount of funds, channelled for research purposes, needs to be reviewed and enhanced alongside the improvement in number and quality of research publications, through proper restructuring of semester duration and less interfering role of research supervisors.

- The inculcation of a mentality promoting the use of libraries and resources, by both teachers and students, for a more healthy and original thinking-process would definitely help in the revitalization of the country’s education system.
• Public and private universities need to follow a financial transparency system, which involves periodic auditor’s statements and adoption of disclosure practices, so as to avoid the possibility of malpractices and corruption regarding university funds.

• Government grants and endowment funds needed for effective faculty-development and student financial assistance must be reviewed, to ensure progressive professional development of university faculty and equitable provision of educational opportunities to all.

• The integration of scientific and technological organizations and research-based institutions with universities must be initiated, so that practical application of the knowledge acquired by the students can be made possible. Moreover, joint projects with the industry of Pakistan may also be initiated, so that meaningful researches can be conducted and their results can be transformed into concrete and measurable improvements in the economy.

• Strict adherence to merit-based procedures for faculty recruitment and promotion, as well as student admission, must be adopted under an explicit and well-defined code of conduct.

• The management and administration of universities needs to orientate itself with the modern methodology of management. In this regard, they must be trained to adapt themselves in areas such as managerial responsibilities, rules and regulations of universities and institutes, conflict resolution and negotiations skills, as well as the proper and timely exercise of discretionary powers.

• There is an agreement on the fact that political activity among students arises due to injustices on the part of universities. Strict adherence to the proposed recommendations is expected to root out such injustices and consequently lessen if not eradicate politics in the education system.

7 CONCLUSION

The future of higher education rests in the hands of such meaningful and result-oriented changes that must be brought about at the earliest. Thorough consensus of all stakeholders of the society must be integrated in any such policy or decision-making, so that the benefits of this reform may reach the grass-root level of Pakistan’s society.

Higher Education must relate to enlightened minds, tolerance, and understanding of the basis of human behaviour. We live in a deeply troubled world characterized by intolerance, aggression and efforts to dominate and deprive others of their justified rights. No one will deny that there is a need to radically change the world that we are living in at present. Realizing all this, one cannot but conclude that such changes can only be achieved through a system of
education that teaches moral and ethical values based on integrity, justice and honesty.

One of the serious limitations of this education in developing countries is the weak link between "the lower education level and the higher education level”. It is indeed vital to acknowledge that the initial primary education forms the foundation of any educational system. "No good higher education without a good basic education". The primary education forms the base of the pyramid on whose apex rests the domain of higher education. If the base is weak, surely the top will not survive. In Pakistan and in many developing countries, the quality and quantity of primary education is neglected in favour of a glamorous higher education. This results in a very fragile higher education of a country. The output of such a fragile system fails to cope with the needs of a country.

It is therefore imperative that the developing world must maintain an appropriate balance between the structures of primary and higher education. One cannot deny the fact that poverty, hunger, disease and vulnerability of a nation can never be eliminated unless the developing world pays a serious attention to the uplift of education, specially the higher education.
REFERENCES


US-Pakistan Program for PhD in Physics at the University at Albany, New York, USA: A Personal Snapshot

MOHAMMAD SAJJAD ALAM
Director, Albany High Energy Physics Lab
Fellow, Islamic Academy of Sciences
USA

1 BACKGROUND

I came to the US on a Pakistani Government Overseas Merit Scholarship in 1970 and completed my Ph.D. in Experimental Particle Physics from Indiana University at Bloomington, Indiana. On completing my degree in 1975, I joined the group of Professor Burton Richter at the Stanford Linear Accelerator Center (SLAC) in California, which was the leading center for Particle Physics in the world at the time. This was right after the 1974 November revolution, when a new series of subatomic particles called \( \psi, \psi', \psi'' \), etc. had been just discovered at masses around 3.0 to 4.0 GeV/c\(^2\). These were soon interpreted as bound states of \( c\bar{c} \), where \( c \) is a new quark possessing a new quantum number called charm (or \( c \)). The \( c\bar{c} \)-quark is the antiparticle of the \( c \)-quark and has negative charm. The discovery of a quark with a new quantum number is a momentous event and heralded a whole family of new subatomic particles containing the new charm quantum number. Professor Burt Richter shared the Nobel Prize in Physics for 1976 with Professor Sam Ting for this discovery. As part of the MARK II collaboration, I reported the first observation of the charmed strange meson \( D^+_s(c\bar{s}b) \), and \( \Lambda^+_u(cud) \) charmed baryon. Soon I became an assistant professor at University at Albany in New York and set up the Albany High Energy Physics Lab in 1985. started recruiting graduate students from Pakistan and other countries to come to my university to complete their Ph.D. in physics. While based at Albany and as part of the CLEO experiment at CESR, I decided to focus on identifying sub-atomic particles containing charm and beauty quantum numbers. I set up a data analysis facility at Albany around a state-of-the-art dedicated computing center. About 20 students have completed their Ph.D. and about 6 have completed their M.S. under this program. The theses report either new decay modes of charmed or beauty particles or report first observations of over 12 new sub-atomic particles containing charm and beauty. More than thirty students have been recruited, which is the result of a personal commitment on my part to help students from any third world country. I now have connections with Quaid-e-Azam University
in Islamabad, Punjab University in Lahore and Peshawar University in Peshawar. As part of a compact the physics department wrote with the university, we have included a program by which students from Pakistan can come to University at Albany with free tuition. Since tuition is half of the $25,000 required annually for going to school, this arrangement allows the Government of Pakistan to send twice as many students to attend the university at the same expense. Instead of one or two students coming annually for their degrees, we could have half a dozen students coming here annually. I will present my experience and discuss how other countries can benefit from my experience.

2 THE PRESENTATION IN SLIDES

![University at Albany](image1)

Figure 1. University at Albany.

![Physics Department](image2)

Figure 2. Physics Department.
Figure 3. Experimental Particle Physics.

Figure 4. Visible Universe.

Figure 5. Mesons.
Figure 6. Baryons.

Figure 7. Carriers of Mass.

Figure 8. Recently discovered as part of BaBar at Albany.
Figure 9. Continuum Production.

Figure 10. PEP-II collider at SLAC.

Figure 11. The BaBar Experiment.
Figure 12. ATLAS Detector, CERN Geneva.

Figure 13. The Beowulf Cluster: Poor Man’s Supercomputer.

Figure 14. The Beowulf Cluster.
Figure 15. Pakistani women make history.

Figure 16. Samya Zain: First Pakistani Female PhD.

Figure 17. Full list of students from Pakistan (1995-2006).
Figure 18. Albany Pakistan Higher Degree (APHD) Scholarship Foundation.

Figure 24. Albany-Pakistan Scholar Exchange Programme.

Figure 25. Conclusion and Summary.
Figure 26. Dream Scenario.

ACKNOWLEDGEMENTS

Thanks to my former students Samya Zain, Akhtar Mahmood, Shamona Ahmed, Frank Wappler, Mike Zoeller and Mahnaz Haseeb & Farida Tahir for providing me with different slides and for the fun of working with them.
Towards Higher Education Excellence

KHALID S. AL-SULTAN
Rector
King Fahd University of Petroleum & Minerals
Dhahran, Saudi Arabia

1 ABSTRACT

Higher education is a vital and indispensable sector within society. It contributes to the personal and professional lives of more than thirteen million students enrolled annually in degree-granting programs, and more generally to the cultural, intellectual, and economic vitality of societies. Higher education is dedicated to the pursuit and dissemination of knowledge, clarification of values, and to the advancement of the society it serves. In recent years higher education has gone through significant changes that the higher education institutions have yet to grapple with the implications of these changes. Higher education institutions are facing pressures of increasing access, demands for accountability, reconsideration of the social and economic role of higher education, meeting workplace requirements, implications of globalization, and the impact of new technologies, among others. Demands by funding sources, workplaces and parents to measure academic productivity, control funding allocations, etc. is increasingly a central part of the debate on higher education.

There is a high correlation, globally, between excellent higher education and overall national achievements in development, growth, competitiveness and welfare. There is an increasing interest in excellence in higher education, reflecting both the rapid growth of higher education and its cost to the public and the private purse. Accordingly, higher education will need to demonstrate that it takes the excellence of its programs and awards seriously and is willing to put into place the means of assuring and demonstrating that excellence. To support today’s goals and to meet the challenges, higher education institution must pursue excellence.

This presentation covers characteristics, measures and instruments of excellence in higher education as well the challenges in pursuing excellence. The experience of King Fahd University of Petroleum & Minerals (KFUPM) in pursuing Excellence will be highlighted.
2 PRESENTATION

Figure 1. Introduction.

Figure 2. Introduction.

Figure 3. Views of Excellence.
Characteristics of Excellence:

Characteristics of Excellence in Higher Education include:

- A mission appropriate to Higher Education
- Well defined and appropriate goals
- Established conditions and procedures under which the mission and goals can be realized

Figure 4. Characteristics of Excellence.

Characteristics of Excellence in Higher Education Continue:

- Assessment of both institutional effectiveness and student learning outcomes and the use of results for improvement
- Substantial accomplishment of mission and goals
- The support needed to continue to accomplish mission and goals
- Meeting the eligibility requirement and standards of accreditation bodies.

Figure 5. Characteristics of Excellence.

Measure of Excellence (quality)

- Several questions associate with the measurement of quality:
  - What evidence or indicators are acceptable as appropriate operational expressions of quality?
  - What evidence should be assembled to reflect the performance and quality of institutions that have diverse mission, history and environment?
  - The evidence of quality (Excellence) at H.E. Institutions requires more than one data point.

Figure 6. Measure of Excellence (quality).
The following indicators could be used as evidence of collegiate quality:

1. Peer reviews as expressed in accreditation and program reviews.
2. Students and alumni opinion and satisfaction indices.
3. Reputation and ranking studies.
4. Students performance profiles on entrance and exit tests.
5. Professional licensure results.
6. Faculty research and publication productivity.

Figure 7. Measure of Excellence (quality) Cont.

Excellence Assurance

Excellence Assurance instruments of excellence (quality) in Higher Education include:

- Accreditation: The test of goal achievement and improvement
- Ranking and ratings: The test of reputation
- Outcomes: The test of results
- Licensure: The test of professional standards
- Program reviews: The test of Peer Review
- Follow-up studies: The test of client satisfaction
- Total quality management: The test of continuous improvement

Figure 8. Excellence Assurance.

Pursuing Excellence

Fundamental Challenges in Pursuing Excellence in Higher Education Include:

- Broadening public appreciation for the work of the academy
- Increasing the understanding of the needs of workplaces
- Becoming more effective learning organizations
- Integrating assessment, planning, and improvement
- Enhancing collaboration and community
- Recognizing that everyone in the institution is a teacher
- Devoting more attention and resources to leadership
- More broadly framing vision of excellence

Figure 9. Pursuing Excellence.
Figure 10. Pursuing Excellence.

Where to Start? Organizational Checklist

- The checklist is a supplement to Excellence in Higher Education.
- Provides an introduction to excellence in Higher Education.
- Provides starting point for discussion and systematic self-assessment using the Excellence in Higher Education model.
- It covers 7 dimensions of organizational functioning that are critical in Higher Education.

Figure 11. Organizational Checklist Cont.

The seven dimensions are:

- Leadership
- Strategic Planning
- External Focus
- Information and Analysis
- Faculty/Staff workplace focus
- Process Effectiveness
- Outcomes and Achievements

Figure 12. Case Study: KFUPM.

KFUPM has established a number of programs and practices towards excellence assurance in its education. These include:

- Preparatory-Year Program
- Program Assessment
  - Accreditation
  - Self-Assessment
- Quality Management and Planning
  - Strategic Planning
  - Performance Measures and Indicators
Figure 13. Case Study: KFUPM Cont.

Figure 14. Accreditation.

Figure 15. Accreditation Cont.
Ranking

Most Higher Education Institutions are concerned with both the perception and the reality of quality.

Hence, they are concerned with the ranking and rating they receive.

Ranking is another instrument for judging the relative quality of Higher Education institutions.

Figure 16. Ranking.

Ranking

A number of independent organizations such as U.S. News carry out rankings of Higher Education institutions.

Question posed regarding the quality rankings include:

1. What indicators are used by rankers to judge quality?
2. What about the stability of ranking?
3. Do rankings make meaningful contributions to program and quality improvement?

Figure 17. Ranking.

Ranking Cont.

Categories of indicators used by 3 different ranking bodies.

<table>
<thead>
<tr>
<th>U.S. News</th>
<th>Shanghai Jiao Tong Univ.</th>
<th>The Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Peer Assessment (25%)</td>
<td>Alumni of an institution winning Nobel Prizes and Fields Medals (10%)</td>
<td>Peer Review (50%)</td>
</tr>
<tr>
<td>2. Retention (20%)</td>
<td>Staff of an institution winning Nobel Prizes and Fields Medals (20%)</td>
<td>Int. Faculty (5%)</td>
</tr>
<tr>
<td>3. Faculty Resources (20%)</td>
<td>Highly cited researchers in 24 broad subject categories (20%)</td>
<td>Int. Student (5%)</td>
</tr>
<tr>
<td>4. Student selectivity (15%)</td>
<td>Articles Published in Nature and Science (20%)</td>
<td>Faculty:Student Ratio (20%)</td>
</tr>
<tr>
<td>5. Financial Resources (18%)</td>
<td>Articles in Science Citation Index-expectanted and Social Science Citation Index (20%)</td>
<td>Citations per Faculty (20%)</td>
</tr>
<tr>
<td>6. Graduation Rate Performance (5%)</td>
<td>Academic performance with respect of the size of an institution (10%)</td>
<td></td>
</tr>
<tr>
<td>7. Alumni giving rate (5%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 18. Ranking Cont.
Follow-up Studies

Follow-up Studies provide a tool for seeking feedback from customers of Higher Education.

Follow-up Studies remain a key element in any effective program of quality assurance.

The primary focus of follow-up Studies is on the perceptions and satisfaction of the student.

---

Figure 19. Follow-up Studies.

Follow-up Studies

There are a number of surveys available for use by Higher Education institutions for seeking student feedback. These include:

- The alumni survey
- The student opinion survey
- The survey of academic advising
- The survey of current activities and plans

---

Figure 20. Follow-up Studies.

Licensure

Licensure is a form of quality assurance that is relatively unnoticed as a means to evaluate program quality.

When students find out their college preparation program has enabled them to attain licensure easily, they may assign their success to the quality of the preparation program.

---

Figure 21. Licensure.
Figure 22. Academic Program Reviews and Audit.

- Academic program review is a comprehensive evaluation of a curriculum leading to a degree.
- The purpose of review/evaluation is to:
  - start or implement a new program
  - assess the quality of an existing program
  - revise or discontinue an existing program
  - ascertain resource needs

Figure 23. Academic Program Reviews.

- The evaluators include:
  - External and/or internal Peer evaluators
  - Currently enrolled students
  - Alumni
  - Advisory panels
  - Deans or other administrators

Figure 24. Academic Audit.

- Academic audit is an instrument of quality assurance
- Academic audit enjoyed extensive application in the United Kingdom, Europe and Asia.
- Academic audit accords the improvement of student learning by examination and evaluation of an institution’s or program’s process of quality assurance.
- Academic audit and unlike accreditation or assessment, make no attempt to comprehensively review program’s resources or activities nor to directly assess the quality of teaching or learning.
Figure 25. Outcomes.

Figure 26. Total Quality Management (TQM).

Figure 27. Total Quality Management (TQM) Cont.
Figure 28. Preparatory Year Program.

Figure 29. Accreditation.

Figure 30. Self Assessment.
Figure 31. Assessment Model.

Figure 32. Strategic Planning Methodology.

Figure 33. Major Directions and Strategic Goals.
Figure 34. Conceptual Approach for Projects Identification.

Figure 35. Faculty Development Program.

Figure 36. Faculty Development Program.
Figure 37. Excellence in e-Learning.

Figure 38. Excellence in e-Learning Cont.

Figure 39. Excellence in e-Learning Cont.
Figure 40. Excellence in e-Learning Cont.

Figure 41. Faculty Development Program.

Figure 42. Student Programs.
Figure 43. Personal Skills Program.

Figure 44. Personal Skills Program Cont.

Figure 45. Personal Skills Program Cont.
Figure 46. Gifted Student Program.

Figure 47. Benchmarking.

Figure 48. Benchmarking.
Figure 49. Benchmarking.

Figure 50. Benchmarking.

Figure 51. Benchmarking.
Figure 52. Benchmarking.

Figure 53. Dhahran Technology-Valley (DTV).

Figure 54. Dhahran Technology-Valley (DTV).
Excellence in Higher Education means that Higher Education Institutions:

- Can not afford to rest on their laurels in their ivory towers
- Should show that they can:
  1. create knowledge and spread it
  2. craft solutions to crucial social challenges
  3. add value in a way that only a higher education institution can.
- Must communicate the value of a university education to their stakeholders.
- Must teach the right things need to be taught:
  1. Problem solving rather than memorization
  2. Critical thinking rather than polemics
  3. Rhetoric and effective communication
  4. Quantitative analysis
  5. Lifetime learning
- Must respond to the question: will universities, as teaching institutions, last?
A Private American University in the Heart of the Arab World: The Experience of the American University in Cairo

EARL (TIM) SULLIVAN
Provost
The American University in Cairo

1 ABSTRACT

The American University in Cairo was established in 1919 as a private, non-denominational, liberal arts university with the purpose of providing an education in English to Egyptians. It is both Egyptian and American, with a strong international flavour. The University remained relatively small for most of its history but began to grow significantly in the mid-1970s.

This paper will briefly discuss the history of AUC, its current structure and enrolment, and its major academic programs. It will go on to discuss some of the factors that make the university distinctive in the contemporary world of global education. Among the factors to be discussed are those that illustrate AUC’s role of outreach and service to the country and region. Topics presented include: the role of AUC’s major research centres and special programs; scholarships and fellowships that enable highly qualified students from low income groups to attend AUC; public lectures and student activities that serve as a public forum for wide-ranging debate of critical and often controversial issues; and the role of AUC as a bridge between Egypt and the world.

2 OUTLINE

1. The American University in Cairo: Overview
2. AUC’s Underlying Philosophy
   (a) Need-based aid to the best and brightest
   (b) AUC as a forum for debate and discussion of major public issues
3. Research Centres and Special Programs:
   (a) The Social Research Centre
   (b) The Desert Development Centre

* The author is deeply grateful for the assistance of Ms Halah Mohsen in the preparation of this paper.
4. AUC as a bridge between Egypt and the world
5. Conclusion

Appendix
   Table 1. AUC Modern History of Growth
   Table 2. Academic Programs at the American University in Cairo

3 THE AMERICAN UNIVERSITY IN CAIRO: OVERVIEW

In 1919, The American University in Cairo (AUC) became the first private university in Egypt. Although the founders were associated with the Presbyterian Church in the United States, AUC was established as a non-denominational institution. The basic mission of the new university was to provide an American-style liberal arts education in English to Egyptians. Although the institution has grown significantly in succeeding years, this objective remains as the core mission of AUC, but has gone beyond that to include students from many other countries. The university contributes to the cultural and intellectual life of Egypt and promotes international understanding, while exemplifying educational principles and practices that recognize the heritage and mores of Egypt and the surrounding Arab World. At the present time, roughly 83% of the students are Egyptian, with about 70 different nationalities making up the remainder of the student body. For most of its early years, AUC was a relatively small institution located on the central square of Cairo, originally named Maydan el-Tawfikiya, but re-named Maydan el-Tahrir after the 1952 revolution. By 1973, it had reached a total enrolment of just under 1500 students, with small but strong undergraduate programs in most basic humanities, social science, and science disciplines as well as Masters level programs in Arabic Studies, Economics, Management, Mass Communications, and a few other fields (see Table 1). AUC also had extensive non-academic outreach programs in the Division of Public Service in which non-credit courses in English, Arabic, as well as many other fields were offered to about 4400 students. Most of AUC's growth has taken place since the mid-1970s and the University now enrols around 5,400 students in academic programs and well over 30,000 in what is now called the Centre for Adult and Continuing Education, formerly the Division of Public Service. AUC offers BA degrees in 17 fields, BSc degrees in 9, and Masters level degrees in 16 areas (see Table 2). Between 1919 and today, over 20,000 people have received academic degrees and well over 6,000 students have learned Arabic at the American University in Cairo.
The AUC approach to education is unique in Egypt. Rather than focusing on learning a traditionally accepted body of facts, AUC students cultivate and refine their thinking through challenging discussions, assignments and interactive deliberations. Student leadership skills are further developed through regional and international co-curricular activities, and by active participation in a number of service activities. They have at their disposal a modern library, which contains roughly a third of a million volumes and subscribes to nearly 2000 electronic journals and databases.

During Fall 2006, Students from over 70 different countries were enrolled at AUC, indicating the geographical and cultural diversity of AUC’s student body. Many of our international students from the US, Canada, Europe and Asia enrol in the School of Humanities and Social Science. They aim to increase their knowledge of the Middle East and/or to learn Arabic. Students from Africa and Asia are spread through the various schools and disciplines, helping to create diversity and challenging classroom dialogues. Students from 57 countries attended AUC’s 2006 summer and 2005 winter sessions. These sessions run every year from mid-June through the end of July for summer and from January 2 to 26 for winter sessions. They include accelerated programs that include cultural activities as well as visits to historical sites.

AUC requires all undergraduate students to complete the core curriculum of courses in Humanities, Social Science, and Science. The core curriculum is a body of courses designed to provide a broad liberal arts base regardless of the discipline of the major field of specialization. Its purpose is to develop basic academic and intellectual traits, familiarize students with certain bodies of knowledge and intellectual traditions, and to show how this diversity can be integrated. The core curriculum covers a wide spectrum of human experience and knowledge, with special emphasis on the Arab World. It assists students in understanding their place in the world - socially, culturally, intellectually, and historically. Whatever students' majors are, they need to understand science, social science, and the humanities in order to be thoughtful human beings and citizens. The core curriculum also aims to enhance students' writing skills and thereby their ability to reason and construct an argument especially in English. Instruction ranges from small seminars to regular classes to large lectures. Students are also required to attend an Information Literacy Clinic, which enables them to efficiently utilize the various resources available to them in the library and to begin the process of becoming independent learners.

As is clear from this brief description, the American University in Cairo is similar to other institutions with a liberal arts approach to education. However, a number of important factors combine to give the University a distinctive profile and to illustrate that AUC does a lot more than produce high quality graduates who are proficient in the various specialties the university offers. In any given year, AUC accounts for less than 1% of the people who graduate with undergraduate degrees in Egypt. (Although the numbers are still small, AUC accounts for much higher percentages of Masters’ level degrees than undergraduate degrees.) In spite of their relatively small numbers, graduates are prominent in virtually all fields of endeavour in Egypt and in many other
countries and the university has alumni chapters all over the world. The high
good quality of the education students receive, plus the fact that they are taught in
English, helps to account for this. A liberal arts education encourages students
to think creatively and independently, small classes enable faculty to give
individual attention to the needs of students, and fluency in English prepares
them for productive employment virtually anywhere. The diversity and scope of
extra-curricular activities on campus also helps in shaping well-rounded
individuals ready to perform exceptionally well in their chosen career paths.
Examples of these activities include, but are not limited to, the following:

- Activities that encourage international understanding and cooperation
  such as the International Day and the International Costume Festival.
- Student groups that foster cultural appreciation such as geographically and
  ethnically based, music, choral, theater and folklore clubs. These groups
  perform both locally and overseas, and have strong ties with other youth
  programs in other universities both locally and overseas.
- Student groups that are part of a larger international student network such
  as SIFE (Student in Free Enterprise) and AIESEC (formerly a French
  acronym for Association Internationale des Etudiants en Sciences
  Economiques et Commerciales), which has over 50,000 members in 83
  countries. Youth exchange and internships and international competitions
  are an essential part of their programs.
- Cultural adjustment programs through the counseling and mentoring units,
  which provide assistance to students to be able to integrate in the diverse
  culture of the university.
- Students travel overseas to various parts of the world to participate in
  athletic tournaments, cultural festivals, university competitions,
  international conferences, etc. Some partial financial support is provided
  to students traveling individually or in groups to participate in
  international student conventions. Cultural sightseeing overseas is also
  provided through the Student Union activities.
- Numerous internship opportunities both local and overseas through the
  Career Advising and Placement Services (CAPS) that help give students
  from various majors the chance to be exposed to work environments.
- Student-organized conferences, which discuss global issues and have
  international participation such as the Model United Nations and the
  Model Arab League (both discussed below), the International Student
  Leadership Conference, and the International Conference on Global
  Economy.
- Diversity awareness through special sessions, which are conducted by the
  offices of Student Development and the Equal Opportunity and
  Affirmative Action Office.
- Study abroad and exchange programs in Japan, the USA, Canada, and
  Europe. This is done through protocols with other academic institutions.
4 AUC’S UNDERLYING PHILOSOPHY

The American University in Cairo has undertaken a leading role in higher education in Egypt and the region. AUC graduates have historically worked for the progress of Egypt and have participated in building a modern economy and society. The university is justifiably proud of its regional reputation as a leading institution and firmly believes that its commitment to educational excellence, leadership and service requires that its student body includes underprivileged students from all over Egypt who feature qualities of leadership and service. As part of its underlying philosophy, the university also proudly provides a platform for exchanging ideas in an atmosphere of academic freedom (discussed in detail below). AUC does not operate in isolation and the university strives to create connections with its surrounding environment through providing assistance to students in need as well as laying the ground for debating and discussing public issues. These approaches strengthen AUC’s ties with the community it is so proudly part of.

4.1 Need-based aid to the best and the brightest

As a private university, the American University in Cairo charges tuition and has a selective admissions program. Historically this has meant that most of those who have attended AUC came from a relatively privileged background. In order to create a more balanced and diverse student body, AUC is committed to reaching out to the brightest, less fortunate students through scholarships that enable them to study at the university. Without scholarships and need-based financial aid, many students would be unable to study at AUC.

A number of full tuition scholarships are awarded each semester to brilliant, but needy students. AUC’s Public School Scholarship Fund (PSSF) introduced in the academic year 1990-91, supports outstanding Egyptian students graduating from Egyptian public schools on the basis of academic merit and financial need. Around 20 students are awarded this full tuition scholarship every year and maintain it until graduation, as long as they make satisfactory progress towards their degree. In fact, around three-quarters of them graduate with honours. The program is very successful and the former Minister of Education, Dr. Hussein Kamel Bahaa El Din, has commended AUC on its efforts saying that “… all these efforts come within the outstanding role that AUC plays in education in Egypt.”

Encouraged by the success of the PSSF, AUC recently partnered with the United States Agency for International Development (USAID) to establish a Leaders for Education and Development (LEAD) Scholarship Initiative directed towards Egyptian public school graduates. What distinguishes this new program is that the main factor in selecting awardees is their proven track record of involvement in student activities and community service. The program awards full tuition to 54 students representing the 27 governorates of Egypt. One male

1 From a letter sent to the University President on June 11, 2000.
and one female are selected from each governorate with a full waiver of tuition, provided that they are able to fulfill the requirements of their chosen programs. In addition to tuition, LEAD students receive free room and board, a stipend, and about one-third of them will have an opportunity to study abroad. Plans are underway to establish a similar scholarship initiative for graduate studies.

The university also provides financial aid and opportunities for student work as a form of financial assistance to Egyptian students who need it to attend AUC. The financial aid or work covers only partial tuition of the university. Approximately 55% of Egyptian undergraduate students and 25% of Egyptian graduate students have received financial assistance in recent years.

In addition, AUC has several graduate fellowship programs specifically intended for international students. These include the African Graduate Fellowship Program, Ryoichi Sasakawa Young Leaders Fellowship, and the International Graduate Fellowship. A brief description of each follows:

- **The African Graduate Fellowship Program** is intended to support talented and dedicated students from Africa who wish to obtain a graduate education at AUC. As a member of the Association of African Universities, AUC began offering these fellowships in 1987 in order to help prepare a cadre of highly qualified African professionals. At present, the university offers a total of 17 African Fellowships (up to 10 new fellowships each year). The majority of beneficiaries come from the Sudan, Nigeria, Ghana, Cameroon and Uganda. However we have had students from many other countries in Africa including Tanzania, South Africa, Tunisia, Libya, and Eritrea. They come from a variety of institutions of higher education including Makerere University (Uganda) Buea University (Cameroon), University of Ghana (Ghana), University of Port Elizabeth (South Africa), Ahfad University (Sudan), and the University of Ilorin (Nigeria).

- **The Ryoichi Sasakawa Young Leaders Fellowship Fund (SYLFF)** was established in 1987. Since 1993, AUC has been one of several universities worldwide to provide these fellowships to promising graduate students in social sciences and humanities as SYLFF Fellows at AUC. The pool of fellows has included students from many countries, including Egypt, the United States, Germany, Italy, Poland, and Kazakhstan.

- **International graduate fellowships** are offered for two academic years and the intervening summer session to international students who wish to pursue full-time study in the Master's program in Arabic Studies, Middle East Studies or Sociology-Anthropology at AUC. International fellows receive a tuition waiver, a monthly stipend paid in local currency, accommodation in the university dormitory or a monthly housing allowance. As part of their fellowship and in support of their professional training, fellows are assigned 18 hours per week of related academic or administrative work.
The university is actively seeking external funding to endow additional scholarships and fellowships for international students. In addition to scholarships and financial aid provided by the university, many individuals and corporations have demonstrated their commitment to higher education in Egypt by establishing scholarships and fellowships at AUC. Annual scholarships and fellowships are made possible through donors who contribute support each year to partially cover the tuition of one or more undergraduate and/or graduate student(s). Examples of this are the Nashwa A. H. Taher Scholarship established in 2002 to support the education of five undergraduate female students from Palestine and other Arab Countries (excluding Egypt) who have met AUC's academic requirements, enrolled in the university and demonstrated financial need. In addition, the university has a Palestinian Scholarship Fund, also established in 2002, which awards scholarships to Palestinian students from the occupied territories based on financial need.

4.2 AUC is a forum for debate and discussion of major public issues

The university is distinguished as a forum for debate and discussion of major public issues, especially introducing topics that are controversial and that present alternative points of view, not necessarily in line with those of the general public at large or the governments of either Egypt or the United States. The University provides a platform for the exchange of ideas in an atmosphere of academic freedom. Under the umbrella of liberal education, this approach has consistently expanded its horizons to include topics that are relevant to world affairs, while focusing on the concerns and sensitivities of the region, and creating opportunities for meaningful dialogue. Recent guest speakers included: Sheikh Hamad Bin Jassim Bin Jabr Al-Thani, Qatar's deputy Prime Minister and Minister of Foreign Affairs, who addressed Arab reform, the situation in Iraq and Palestine, and democracy and human rights in the Arab world; Grand Sheikh Mohamed Sayed Tantawi, head of Al-Azhar, who addressed issues related to tolerance and understanding, fixed interest rates, and veiling for women; Karen Armstrong, world-renowned expert and author of more than a dozen books on religion, spoke about Islam in the West and Christian fundamentalism; and Mohamed Hasanain Haikal, distinguished thinker and political writer, who used the university's stage as a platform for rejecting what has become known as republican monarchies. These controversial speakers and topics are intended to be informative while presenting different opinions in an environment that fosters freedom of expression.

To augment its educational and cultural offerings, the university also established a Distinguished Visiting Professor (DVP) program, which brings to the AUC campus a number of eminent scholars, writers, and artists for short-term lectureships or workshops. Some of these professorships are supported by named endowments or annual grants. Current DVP endowments include the Christopher Thoron DVP, the Bayard Dodge DVP in Arabic Studies, the General Dynamics DVP in Engineering, the Charles J. Hedlund DVP in
Computer Science and Business, and the Endowed DVP in English and Comparative Literature.

Another form of debate and dialogue is represented by the Model United Nations (MUN) program at the American University in Cairo, which was established in 1990. It is a student run organization linked to the University’s Political Science department. AUC’s MUN hosts an international Model United Nations Conference each year in the spring semester that involves several hundred students. It also sends a delegation to an international MUN abroad each year. The conference most often selected has been the National Model United Nations (NMUN) held in New York City every April.

Similarly, the Cairo International Model Arab League (CIMAL) takes place every fall and is currently the largest student-run conference at AUC. It was held for the first time in 1990, during the period leading up to the Gulf war. The program aims to familiarize students with the activities of the League of Arab States and helps them develop an understanding of the regional and international factors that affect the determination of Arab foreign policy. CIMAL is a valuable venue for intercultural exchange among youth interested in Arab affairs. In both the Model United Nations and the Model Arab League, the students select their own agenda so that the conferences become models for what the world should be, not just a simulation of what the world is. The Model Arab League is conducted in Arabic and English, while the Model United Nations is done exclusively in English.

Another example of international interaction is the African Moot Court in Human Rights and Democracy. Each year, the Pretoria University Centre for Human Rights sponsors a Moot Court held in an African state to which participating universities send a team consisting of one male and one female participant, plus a faculty advisor. AUC has been participating in this activity for almost seven years and hosted the event four years ago.

5 RESEARCH CENTERS AND SPECIAL PROGRAMS

The university does not operate in isolation and its various research centers, think tanks, and programs work towards maximizing their outreach and interaction with the rest of the region and the world. The following section briefly outlines the activities of some of AUC’s powerhouses:

5.1 The Social Research Centre

The Social Research Centre (SRC) was established in 1953 and it has functioned continuously ever since, carrying out multidisciplinary research on a broad range of subjects. It is the premier social science research centre in the Arab World. Its mission is to conduct and encourage multidisciplinary social science research in Egypt and the Arab region, to train researchers, and to guide and assist graduate students, scholars, and organizations engaged in social science research in the region. The Centre strives to inform policy formulation
and implementation while contributing to knowledge in the social sciences. It aims to contribute to developing skills and building institutional capacity in the region as well as to advance public awareness about important issues.

Recent research activities of the SRC encompass a broad range of topics including studies of population and fertility, poverty, political participation of women, the effects of economic liberalization, demography, urbanization, social epidemiology, maternal and child health, and the environment. Research at the Centre is conducted in collaboration with national and international agencies, and the Egyptian government. It is directed toward providing and analyzing data relevant for policy making, and initiating an informed dialogue on issues of public policy. The research conducted by the SRC is often used as the intellectual backdrop for high profile reports such as the United Nations Egypt Human Development Report and the United Nations Arab Human Development Report.

Other activities of the Centre include training, research seminars, and support for graduate students and scholars from Egypt and the Arab region. These activities are designed to strengthen social research and scholarly collaboration.

5.2 The Desert Development Centre

The AUC Desert Development Centre (DDC) was established in 1979 as a centre of excellence in applied research and training. As an integral part of AUC, the DDC shares the university's educational mission and, in particular, the goal of carrying out applied research to address development challenges facing Egypt and the Middle East and North Africa Region. In addition, the DDC serves as a bridge linking scientists and researchers in the Egyptian national institutions and civil society with their colleagues at AUC, in the region, and in the global community. The focus of the DDC is on the environmental, social, and economic sustainability of desert communities through increased productivity and economic benefits, enhanced diversity of outputs, and improved conservation of natural resources. The DDC maintains an extensive program of research, training, and informational activities to meet its objectives. It operates two field research stations in Egypt. One of the major roles of the DDC has been to provide training on how to run a farm to recent university graduates to whom a grant of land has been awarded. The DDC has trained thousands of farmers over the years. AUC’s Desert Development Centre also takes pride in having created new citrus seedlings that have significantly improved the citrus crop throughout Egypt.

5.3 The Cynthia Nelson Institute for Gender and Women’s Studies

The Cynthia Nelson Institute for Gender and Women’s Studies (IGWS), established in 2000, is a multi-purpose and interdisciplinary centre that serves scholars, activists, and policy makers interested in gender and women's studies in the Arab world, the Southern Mediterranean, Turkey, the Caucasus, Iran, and
Africa. The primary function of the Institute is to serve as a resource nexus within and through which research projects, educational programs, conferences, workshops, seminars, and policy debates on gender and women’s issues are engaged. The institute is well positioned to benefit from the large number of faculty members representing a variety of disciplines across the university, who teach courses, conduct research, and publish on a wide-range of gender-related issues.

The Institute has so far initiated three workshop series on local, regional, trans-national research on gender and women, gender discourse in Egypt and the Arab world, and gender and conflict. These workshops are well attended and attract scholars and activists from around the globe. Recent workshops include, but are not limited to the following:

- **Middle East Gender and Women’s Studies: A Critical Dialogue:** Two workshops were organized with the National Resource Center on the Middle East at Georgetown University. The first workshop held in Washington DC focused on an assessment of the present strengths and weaknesses of gender and women’s studies across sub-regions and disciplines. The purpose of the second workshop held in Cairo was to facilitate a discussion on research between scholars in different regional academies.

- **Theorizing Trans-nationality and Gender:** A workshop organized with the Institute for Women’s Studies and Gender Studies at the University of Toronto.

- **Gender, War, and Development Workshop:** A regional dialogue on Gender, War and Development in Khartoum, and co-sponsored with Ahfad University. The focus of the event was to bring together gender studies scholars and activists working on and/or in Sudan, and Palestine.

IGWS recently launched an MA and a Graduate Diploma Program in Gender and Women’s Studies. The graduate program provides students with an interdisciplinary and trans-national perspective in gender and women’s studies with a special emphasis on the Middle East and North African region.

### 5.4 The John D. Gerhart Centre for Philanthropy and Civic Engagement

In the spring of 2006, AUC inaugurated the John D. Gerhart Center for Philanthropy and Civic Engagement. The Center has a dual focus: to consolidate university activities aimed at encouraging engaged citizenship and service, and to promote enhanced philanthropic giving in the Arab region. At AUC, academic service learning courses will be expanded and faculty/student skills in program assessment and critical analysis will be made available to civil society groups. Exceptional community activists will be invited to spend short-term residencies on campus. Students will be encouraged to explore ways of making life-long commitments to public service, and faculty and students will have opportunities to engage in research activities that analyze challenges in the
field of civic engagement as well as document best practices within the field. The activities of this Centre are intended to include international as well as Egyptian students. Service activities outside Egypt as well as in the country are already underway.

To promote enhanced philanthropic giving in the Arab region, AUC is committed to assisting in efforts to institutionalize and professionalize what are still largely gestures of individual generosity. It is now a promising time to be joining forces with the growing number of modern philanthropists who are rebuilding the region after decades of neglect.

Charitable giving, which has a rich history in the region, is laudable and provides support to many among the disadvantaged in Arab societies. AUC will also encourage those in the new generation of committed philanthropists to address the root causes of social problems and to utilize rights and social justice as guiding values for their work.

5.5 The Science and Technology Research Centre

The Science and Technology Research Centre deals with a revolutionary cutting edge research field. It supports a variety of nano-science and technology-oriented projects. Research activities are centered around generic imaging, analysis and fabrication equipment focusing on nano-materials characterization, and design and fabrication of micro-opto-electromechanical systems. The centre is inter disciplinary and draws on the expertise of the university's engineering and science departments. The centre makes use of its state-of-the-art equipment housed in its new facilities in the New Falaki Building. People are the centre's key assets and, therefore, the centre aims to attract high-calibre researchers from around the world who, together with the current members, contribute to its research themes and help steer its future research activities.

5.6 The Forced Migration and Refugee Studies Program

AUC's graduate diploma program in Forced Migration and Refugee Studies (FMRS) meets the professional training needs of people working with refugees and fosters research on forced migration and refugee issues. This internationally recognized program initiated by the renowned Dr Barbara Harrell-Bond, founder of the FMRS program at Oxford, attracts students from all over the world. To diversify the student body, the FMRS has recently awarded external fellowships to students from several countries, including Romania, Slovakia, and Azerbaijan.

In addition to its outreach program to serve the refugee community in Cairo, the program offers summer short courses, which are open to attendees from all over the world and are advertised internationally. This program has successfully involved its students in both curricular and extra-curricular activities. Two models worth mentioning here are the following:

- Student Action for Refugees (STAR) was established in 2001 to raise awareness about refugee issues and offer students the opportunity to work
with refugees in practical ways through volunteering and education. Following the model of the international STAR network, AUC students are working to establish their own network of students and refugees here in Cairo. STAR has been active in providing a variety of activities for raising awareness about refugee issues at AUC and beyond, and providing services for the refugee community.

- Cairo to Camps is a six-year-old student initiative aimed at creating channels of direct communication and interactive education with Palestinian refugees in Lebanon, one of the oldest refugee populations worldwide. In 2005, a group of twelve undergraduate and graduate students from AUC and other Egyptian universities spent the year studying and preparing for their month-long sojourn in Lebanon. The trip was undertaken in August 2005, where the students worked with Palestinian refugee children in the Shatila refugee camp, conducting workshops on literature, music, art, theatre, and filmmaking in coordination with Association Najdeh in Beirut. This innovative program was not able to operate in the summer of 2006 due to the catastrophe caused by the Israeli attack on Lebanon.

5.7 The AUC Press

The American University in Cairo Press (AUC Press) is recognized as the leading English-language publisher in the region, and publishes annually more than 70 wide-ranging scholarly monographs, reference works and general interest books on ancient and modern Egypt and the Middle East, as well as Arabic literature in English translation, most notably the works of Egypt’s Nobel laureate Naguib Mahfouz. In addition, it produces books in the fields of history, archaeology, Egyptology, religion, gender and women’s studies, language and literature, travel and guidebooks, politics and economics. Arabic literature in translation is in the forefront of all these internationally acclaimed publishing programs. Most recently, the novel “The Yacoubian Building” was translated from Arabic to English and contributed to expanding the international readership of this Egyptian bestseller. Founded in 1960, the AUC Press now has over 600 titles in print for continuously expanding educational and general book markets throughout Egypt and the Middle East, as well as Europe and North America.

In 1985, the AUC Press signed an exclusive international publishing and licensing agreement with the late Naguib Mahfouz, thus becoming his principal English-language publisher and his worldwide agent for translations and other publishing rights. When Naguib Mahfouz won the Nobel Prize in 1988 for Literature, in that year, eight of his novels had already been published in English and he stated that it was through the translation of these novels into English that other publishers became aware of them and requested their translation into other foreign languages. He believed that the translations were among the foremost reasons for him being awarded the Nobel Prize. Today, nearly 20 years after signing Mahfouz, the AUC Press has published over 100
English translations of works by Egyptian and Arab literary greats including Taha Hussein, Tawfiq El-Hakim, Sonallah Ibrahim and Ibrahim Aslan.

6 AUC AS A BRIDGE BETWEEN EGYPT AND THE WORLD

As part of a larger, global commitment, AUC conceives of itself as a bridge and is dedicated to serving as a link between Egypt and the United States, Middle East, and even more broadly between the Arab world and the rest of the world. Since its founding in 1919, The American University in Cairo has been a global leader in the area of international education. AUC’s commitment to international education is reflected in its mission, its Board of Trustees, its senior administration, its faculty and staff, and its student body. AUC degrees are recognized in Egypt and are licensed and accredited in the United States. The student body and faculty are recruited globally. There has not been a time in the university’s history that it has not been involved in educating across international boundaries and the university is convinced that the presence of international students on campus is a significant contribution to this process.

Today, the University remains committed to international education and has identified it as one of its highest priorities. This is being realized through a number of program initiatives aimed at increasing international scholarships and fellowships, increasing collaboration with universities outside of Egypt, increasing efforts for study abroad and international students in degree programs, and internationalizing the university’s curriculum.

The university has several programs that enhance AUC’s reputation as an international centre for education and dialogue. Among the more prominent is the Centre for Arabic Study Abroad (CASA), which is hosted by AUC on behalf of a number of leading American universities. Virtually all CASA students are on fully funded Fellowships. This program is the global leader for educating students, scholars and others interested in the Middle East. In addition to CASA, the university operates its own intensive Arabic program for well over 100 students from around the world.

Moreover, students from dozens of colleges and universities across North America and around the world enrol at AUC for one or more semesters each year, usually during the third or junior year. Applicants for the Study Abroad Program must be enrolled in a program of study at another college or university and be recommended by their home institutions. Study Abroad students may attend AUC for no more than two semesters and a summer session. AUC has agreements with universities from various institutions around the world including the US, France, Italy, Canada, Norway, Denmark, England, and Scotland. One of the most recent agreements is with the University of Bergen, Oslo. At the present time, roughly 325 non-degree study abroad students attend AUC each semester.

The university also has a Dialogue Project, which encourages interaction between AUC as a liberal arts institution in the Arab World and universities in the US. The goal is to promote mutual understanding and establish relationships that can be capitalized upon in the future. The project is designed to use Internet
videoconference technology and other forms of long distance communication to promote dialogues between students at AUC and students in university classes in the United States and several other countries including Argentina and Nepal. In addition to dialogues conducted as part of academic courses, the Dialogue Project also sponsors extra-curricular dialogues. These come in two forms: single-session videoconference dialogues with university classes in the United States; and face-to-face dialogues with either student groups visiting AUC or groups of students involved in study-abroad programs at AUC.

AUC is also a member of several networks and associations. One of these is the Association of American International Colleges and Universities. As the name indicates, this organization brings together a select group of American universities whose home is outside the United States and most members have locations in Europe or the Middle East. In addition, AUC is a member of the network created by the Tokyo Foundation that award Sasakawa Young Leaders Fellowships.

7 CONCLUSION

Since 1919, the American University in Cairo has been headquartered at what was intended to be its temporary home on Maydan el Tahrir. Over the years additional property was purchased in the neighbourhood and a modern dorm was constructed in Zamalek, but AUC’s ability to grow and offer its clientele the services they require in up-to-date and appropriate facilities has been limited by the crowded conditions of central Cairo. In order to better serve its students and Egypt, the University is currently constructing a campus in New Cairo, roughly 35 kilometres from its present location. Designed by an international team of award-winning architects, the new AUC campus will look and feel like it belongs in the heart of the Arab World. Scheduled to open in 2008, it will provide a superb setting for undergraduate and graduate education as well as continue to serve as a forum for significant interaction between Egypt and the world. Research will be conducted in cutting-edge facilities and a small number of new programs will be added to the curriculum. The Tahrir Campus will be retained as a centre for adult and continuing education, executive training and cultural events as well as for our growing post-graduate programs in Law. While enrolment is only planned to increase by 10-15% on the new campus, the quality of education will be enhanced considerably by the opportunities afforded by the new location and expanded facilities, and AUC’s ability to serve Egypt and the region will be augmented in all areas in which it offers programs of instruction, training, research, and service. In the years to come, the university will work to strengthen its ties with the community and the region as a whole and will extend its bridges to the world at large. In addition to education and training, AUC regards research, service, and internationalization as activities that express the core values of the institution. Together, these activities and functions constitute the distinguishing characteristics of AUC as an American University in the heart of the Arab World.
REFERENCES

1. The American University in Cairo
   http://www.aucegypt.edu/Pages/default.aspx
The Story of a University “Par Excellence” in a 3rd World Country: Al-Nahrain or “Saddam University” in Baghdad, Iraq

MUTHANA SHANSHAL*
College of Science
University of Baghdad
Jadirriya, Baghdad
Iraq

1 ABSTRACT

The ‘Saddam University for Engineering and Sciences (SUES)’ was established in Baghdad, at the end of 1988, in accordance with a legislative decree of the President of the Republic [1].

The university was intended to be a “private scientific university with an independent juristic, financial and administrative character.” It was intended to strive “towards establishing a highly qualified scientific bases on which the creative and innovative abilities would flourish.” It aimed “towards possessing the tribune of science and keys of modern knowledge in order to build up scientists and specialists in the fields of science and engineering who should contribute in the future cultural development of Iraq.” “The University strove towards strong scientific relations with other developed universities and centres of research in the different regions of the world for the sake of mutual benefits.”

SUES was lead by a university senate and an appointed president. The educational bureau of the President of the Republic’s office supervised it.

To be the “University of the Elite,” it was necessary to adopt modern methods in teaching (topics and programs) and administration. Originally the university included two colleges; (a) The engineering college; and (b) The college of science.

In 1993, two other colleges were added to it, the college of medicine and the college of law. Both were formerly established independently in 1988/1989.

2 FACILITIES OF THE NEW UNIVERSITY

Initially, SUES was located at the University of Baghdad campus. These premises were designed as student dormitories and included dining rooms,

---

* Fellow, Islamic World Academy of Sciences.
seminar halls and modern student housing. The college of medicine was located at al-Kadhimiya teaching hospital while the college of law occupied new buildings in al-Kadhimiya district too. Both colleges were added to the university in 1993.

The starting budget for the two college university was 5.35 Million Iraqi Dinar (ID), for the years 1988/89. For 1989/90 the budget was raised to 10.92 Million ID (the market value for the ID at that time was equivalent to 1$). This budget did not include the salaries of the teaching staff nor administration officials. The university was granted open payment eligibility as compared with other universities that are governed by the Ministry for Higher Education and Scientific Research (MHESR). An extra 4.9M ID was promised for importing equipments, scientific instruments and laboratory materials. Initially the import procedure was to be done according to the operational financial instructions and within special accounting regulations developed for SUES. All import orders had to be approved by the “President’s Office.”

![Image of SUES entrance and administration building](image)

**Figure 1. Entrance and administration building of SUES, in Jadirriya, Baghdad.**

### 3 SOME SPECIAL ADMINISTRATIVE FEATURES AT SUES

- Possible open payments for the founding requirements, within the general regulations of the “Central Financial Supervision Office” of the country;

- Import allowances that are beyond the official import regulations followed by other governmental institutes;

- Possible employment of distinguished teaching staff members chosen from other Iraqi universities with moderately attractive salaries;
• Signing teaching contracts with selected scientists and university professors from other countries;

• Adopting modern and progressive theoretical and practical teaching programs for all disciplines, and following special examination and student behaviour rules for both colleges;

• Choosing an appropriate administrative and organizational structure for the colleges within the university in a manner dissimilar to that applied in other universities of Iraq (see the organizational structure in figure 2), and editing a practical job description for the university;

• SUES was allowed to delegate members of teaching staff as well as administrative employees to participate in conferences and seminars;

• It was ordered by the central ruling authorities of Iraq to limit the political activities among students so that students would enjoy undisturbed higher academic and educational milieu; and

• For admission to the university, passing marks of 85-90% were required besides passing a competitive examination in the disciplines desired by the student.

![University Organization Structure Diagram](image-url)

_SUES Organization Structure_

**Figure 2. SUES organizational structure.**
4 ACADEMIC ACTIVITIES

- In the first year, the university began the construction of teaching laboratories, lecture rooms, workshops as well as redesigning the student housing premises into rooms suitable for seminars and teaching purposes. The project included the construction of a workshop of 2900 squared meters designed for services and practical training of the students. SUES followed the concept of contract agreements with the private sector companies and persons to maintain the central air-conditioning plants, gardens, sports fields as well as the maintenance and cleaning of the buildings.

- The number of admitted students for the first year of study for each discipline was limited to 25 students in both colleges, Table 1.

Table 1. Number of students admitted to study in both colleges, of engineering and of science in the years 1989-1991 [2].

<table>
<thead>
<tr>
<th>Academic year</th>
<th>Engineering College (4 depts.)</th>
<th>College of Science (3 depts.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988-1989</td>
<td>74</td>
<td>46</td>
</tr>
<tr>
<td>1989-1990</td>
<td>101</td>
<td>47</td>
</tr>
<tr>
<td>1990-1991</td>
<td>97</td>
<td>98 (4 depts.)</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th></th>
<th>MSc.</th>
<th>PhD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>----</td>
<td>2</td>
</tr>
</tbody>
</table>

- Considering the fact that the number of permanent teaching staff for the academic years 1989 – 1990 was 34 PhD holders, one may calculate a ratio of 1: 16.6 (staff : student ratio).

- Modern text books of international standard were chosen for teaching. Such textbooks were not available in other Iraqi universities. The university had on its schedule the importing of most important scientific literature works such as Gmelin, Beilstein, Landolt-Bernstein, Chemical Abstracts,…etc.

- The university emphasized on the best possible methods of practical training in its laboratories and workshops. The number of laboratory hours was increased compared to that of other Iraqi colleges and modern training programs were adopted. Laboratory tutorials were practiced, with an aim of 10 students for each tutor.

- Modern scientific literature was looked for.
• The total number of curriculum units for all disciplines of study ranged from 140 – 150 units.

• The university aimed at a ratio of 1:10 (staff members: students).

• Teaching contracts were signed with 24 scientists and academic professors from different European and regional universities in different disciplines with emphasis on basic sciences. Advertisements in international journals and newspapers preceded the recruitment drive. All foreign staff members started teaching at the university at the beginning of the academic year 1989-1990.

• Beginning at the first year of its foundation (1988-1989) the university admitted a number of graduate students (MSc and PhD) who started their studies in the 2nd half of 1989.

• The university promoted cultural and sporting activities for the students and served through its central dining hall meals for students and staff members at subsidized prices.

• The university spent a lot of effort to establish scientific and cultural relations with internationally leading universities in Europe, Asia, America and in the Arabic countries as well as with internationally prominent scientific centres such as the Third World Academy of Science (TWAS) in Trieste.

5 EVALUATION AND GENERAL LEVEL OF THE ACADEMIC BUILDUP

All second year students from all disciplines in both colleges of the university as well as the college of medicine were subjected to comparative evaluation examinations together with their counterpart students of all Iraqi universities as well as those of Bradford College (London). Unified exam papers were applied [3]. The examination results showed the following facts;

• Students of the College of Medicine showed higher level of knowledge than those of other Iraqi universities;

• Similarly, students of the College of Science were distinct as compared with those of other Iraqi universities. Particularly, the students of chemistry department showed similar grading as those of Bradford College (London);

• Students of the College of Engineering showed similar degrees of examination as those of the Engineering College, University of Baghdad that was founded 1942;

• In the years 1992 and 1993, the first two graduate classes obtained their BSc degrees, together with a number of MSc and PhD students; and
• The university delegated a number of teaching staff members as well as administrators to international conferences and seminars of scientific and technical importance. In the academic year 1989-1990, 17 professors (50% of the teaching staff) participated in international conferences within their fields of specialization.

6 PROBLEMS AND OBSTACLES

Many obstacles were faced in the founding of SUES. They can be summarized as follows:

1. It was not possible to fulfill the import program for the university. Only 10% ($490,000) from the originally foreseen import budget could be realized. The import process was transferred soon to a committee in the Ministry of Higher Education and Scientific Research, which proved to be a "bottle-neck" that terribly slowed down the whole process;

2. Teaching contracts with foreign professors were cancelled after the international economic sanctions on Iraq started at the end of 1990;

3. Heavy obstacles were put on the way high quality teaching staff members was transferred from other Iraqi universities to the new university. Not only that, but SUES faced some difficulties in employing the scientists that became unemployed after the Scientific Research Council (SRC) was dismantled in 1989. Neither scientific instruments nor literature were allowed to be transferred from the former Scientific Research Council (SRC) to the university either.

4. Delegating young graduates for further studies in prominent international universities had to proceed through the bureaucracy of the Ministry of Higher Education and Scientific Research (MHESR);

5. Political authorities became involved in the administrative and even the scientific affairs of the university. Heads of departments and deans were replaced without considering the order of administrative responsibilities in the university. The "strictness" of administration and of the educational behaviour required at the university became attractive topics for certain local newspapers;

6. The service contracts with the private workshops and personnel were cancelled and the duties were transferred to the still not completely established workshops of the university;

7. The relatively strict and serious methods of teaching and administration as well as the continuous follow up of all activities at the university, as compared with other universities of the country, inspired a feeling of
uneasiness among some of the teaching staff and employees, although they were paid better on the average;

8. Even some of the students began to feel that they were subjected to “unjustifiable stress” caused by the new style of teaching and academic behaviour as well as the uninterruptible attendance of lectures and lab works. Compared with the students of other universities, they felt “overloaded;”

9. In the year 1993, the university was expanded to include the colleges of medicine and law. Years later a college of political science, college of electronic technology and a department of biotechnology were added. This rapid expansion formed heavy financial and administrative burdens on the university. Thus, many of the former elite professors and heads of departments left the university to seek jobs in foreign countries. Obviously, the rapid *horizontal expansion* was at the expense of *vertical elevation* of the scientific level of science and engineering disciplines. It did deprive the university of its scientific distinction;

10. By then a new legislation was put in action and the new name of the university became “Saddam University.” According to the new legislation it was annexed to the Supreme Presidential Office and consequently all its staff members and employees became officials of the same office.

**7 THE DEMISE OF SUES**

SUES had to cancel the teaching contracts with foreign professors and scientists in 1990/91, and could not engage distinguished staff members from other Iraqi universities, nor from the dissolved SRC. The obstacles set by some highly influential political authorities were too big to be overcome by the university. One had to rely on temporary rather than permanent lecturers in many disciplines without considering the quality of the lecturer. It became highly essential to fill the vacancies in the teaching staff. The university was never able to reach the 1: 10 ratio of permanent teaching staff: students.

The leadership of the university was changed in the year 1994 and transferred to the hands of less experienced persons. As a consequence, a decline started to appear in the quality of administration, teaching and training. Things returned more and more towards the local and average methods of academic activities mixed with some illusive concepts of the American teaching system. The newly applied trimester system allowed some students to finish their BSc study in three years. Two years later, the MSc degree was obtainable. The leading position of the university was changed three times since 1998. With these changes the teaching programs and administrative methods were changed too.
Since 2003, after the occupation of the country, the university was called "al-Nahrain" university. And lately the special status of the university was cancelled in 2005, by abolishing its special legislative status. It was changed to a conventional Iraqi university in the sense of the "Law of the Ministry for Higher Education and Scientific Research" [6].

8 CONCLUSION

- "Saddam University" was established to be an excellent academic institution. The aims listed in its legislation law reveal an attempt towards excellent academic and administrative accomplishments. Some of these could be realized quickly. Among these are the graduation of high quality BSc holders (1992-1993) and the first MSc and PhD students as well as the construction of new and comfortable lecture rooms, new workshops, laboratories, a modest library with modern literature, sporting fields and a student "MENSA" (the IQ Society);
- The teaching programs were modern and superior to those of other Iraqi universities. It could attract Arabic and foreign scientists to teach in its departments (but only for one year). However, it faced various unavoidable obstacles and difficulties that caused its deviation from its original "track."
- SUES suffered from the absence of a high, authentic and flexible authority such as a "board of trustees." Its direct association to a supreme powerful centre of decision making, such as the presidential office, allowed the intervention of various politically influential personalities in its administrative and scientific work. A collection of such influences gathered with the time, such as the presidential educational bureau, the political party organization, the students union, the MHESR and even the presidents of other Iraqi universities;
- The reduction of the import program down to 10% of its original budget and even its subsequent stop caused the shortcuts in many of the required instruments, scientific journals and publications and chemicals necessary for teaching and research;
- Due to obstacles set by the MHESR it was not possible to recruit prominent scientists for teaching at the university. The departure of foreign professors obliged the university to be contented with average levelled teaching staff;
- Since 1993 the university has been expanded to include six different colleges in spite of the financial and administrative shortages and before the original colleges of science and engineering reached the international standard of excellent universities. Efforts were spent in the establishing
new, average grade departments rather than the scientific upgrading of the existing ones;

- The commitment of the political decision makers faded with time. Less attention was paid to the university’s quest to towards accomplish its scientific and educational goals;

- The abolishment of the legislation for “Saddam University” and replacing it by the al-Nahrain University under the umbrella of the MHESR deprived it from its status as being “par excellence university.” Although one has to confess that it remained even under such circumstances a relatively higher graded academic institute when compared with other Iraqi universities under the occupation power.

- A Final Axiom: A university “par excellence” needs to be treated as a strategic objective of the country, just as the food supply, defence, agricultural policy, health care ... etc. It does not work when treated in a similar manner as that of a luxury “Ballet School.”
REFERENCES

Improving Science Teaching at
Tehran University of Medical Sciences (TUMS):
A Researcher’s Viewpoint

MOHAMMAD ABDOLLAHI*
Department of Toxicology & Pharmacology
Faculty of Pharmacy and Pharmaceutical Sciences: Research Centre
Tehran University of Medical Sciences
Tehran, Iran.

1 ABSTRACT

Iran's Scientists cautiously reach out to the world. Scientists in Iran are trying to
revive the golden time of Persian science. Many individual Iranian scientists are
involved in this revival. Iran has increased its publication output nearly ten fold
since 1996 and has been ranked first in terms of output growth rate in the world.
Faculties of Tehran University of Medical Sciences (TUMS) are a good
example for such scientists. During the past decade, TUMS has made
considerable advances through focusing on education, training, and research.
During the past decade, publication rate of TUMS in international journals has
been incredibly increased. Records of SCI/ISI shows that publication rate of
TUMS increased from 24 (2% of total) in the year 1995 to 232 (21% of total) in
the mid 2006. It is considerable to note that real amount of publications of
TUMS is very greater than this extent because all journals are not included by
SCI/ISI record system. Although it is still low compared with the developed
Universities, this puts TUMS in the first rank of Iranian Medical Universities
and maybe among Medical Universities of the Islamic countries.

According to SCI/ISI recording system, TUMS scientists have been very
productive in several experimental fields as Pharmacology & Pharmacy,
Immunology, Neurosciences, Toxicology, Surgery, Oncology, Chemistry,
Medicinal Clinical Neurology, Gastroenterology & Hepatology, Medicine,
Research & Experimental. According to SCI/ISI recording system, TUMS
scientists have cooperated with researchers of other countries mostly USA,
ENGLAND, CANADA, SWEDEN, FRANCE, GERMANY, JAPAN,
SCOTLAND, and ITALY.

In TUMS campus, there is access to high speed online INTERNET. There is
dial up access from home too. Digital library of TUMS is very complete and
there is access to about 5000 electronic journals and many electronic books.
Digital library of TUMS is subscribed to sources of almost all databases

including Index Medicos, Medline, Excerpta Medica, Biological Abstract, Scopus, Chemical Abstract, and many others. In addition, TUMS supports publication of 12 Scientific Open Access Journals that all have unique submission system. More than 100 research centers have been established in the past decade that more than 20 of them belongs to TUMS. The research budget has significantly increased in the last 5 years. All researchers in TUMS has at least one grant but average is more than 2. Almost all materials for scientific researches are available and purchasable through local distributors. High technology tools and apparatuses for researches are available too. All TUMS members are allowed to participate in at least one foreign congress/symposium/workshop with support of University every year. In addition, TUMS holds at least 5 international congresses in various areas of medicine by cooperation of foreign Universities.

In the end, I would like to confirm that I am so proud of becoming IAS Laureate in 2005 and I believe it is the best appreciation and encouragement to my works. I hope God bless us and keep all scientists of Islamic countries proficient to continue their academic studies. We should not forget that science started from Islamic countries and the books or handwritten of Islamic scientists have been taught in the world Universities for many years. I hope to reach that situation again and all Islamic countries be superior in the world.

2 THE PRESENTATION

Status of Iran

1) Iran's Scientists cautiously reach out to the world.
2) Many individual Iranian scientists are involved in this revival.
3) Iran has increased its publication output nearly ten fold since 1996 and has been ranked first in terms of output growth rate in the world.
4) Faculties of TUMS are a good example for such scientists.

Figure 1. Status of Iran.
TUMS has:

8 Schools
16 Hospitals
29 Research Center
1260 Academic Member
9000 Students

Figure 2. TUMS.

Publication rate in TUMS

1) During the past decade, publication rate of TUMS in international journals has been incredibly increased.
2) Records of SCI/ISI shows that publications of TUMS reached from 24 (2% of total) in the year 1995 to 232 (21% of total) in the mid 2006.
3) It is considerable to note that real amount of publications of TUMS is very greater than this extent because all journals are not included by SCI/ISI record system.
4) Although it is still low compared with the developed Universities, this puts TUMS in the first rank of Iranian Medical Universities.

Figure 3. Publication rate in TUMS.

Figure 4. Ranking of TUMS publication from 1994 to mid 2006 according to Publication year (SCI/ISI Records).
Figure 5. Top ten Authors of TUMS from 1994 to mid 2006 (SCI/ISI Records).

Top 10 experimental fields of TUMS

- According to SCI/ISI recording system, TUMS scientists have been very productive in several experimental fields as Pharmacology & Pharmacy, Immunology, Neurosciences, Toxicology, Surgery, Oncology, Chemistry, Medicinal Clinical Neurology, Gastroenterology & Hepatology, Medicine, Research & Experimental.

Figure 6. Top 10 experimental fields of TUMS.

Figure 7. Ranking of TUMS publication from 1994 to mid 2006 according to Subject Category (SCI/ISI Records).
Figure 8. Ranking of TUMS publication from 1994 to mid 2006 according to Source Title (SCI/ISI Records).

Foreign Country Collaborations of TUMS

• According to SCI/ISI recording system, TUMS scientists have cooperated with researchers of other countries mostly USA, ENGLAND, CANADA, SWEDEN, FRANCE, GERMANY, JAPAN, SCOTLAND, and ITALY.

Figure 9. Foreign Country Collaborations of TUMS.

Figure 10. Top ten Country Coworkers of TUMS from 1994 to mid 2006 (SCI/ISI Records).
Digital Library in TUMS

- Digital library of TUMS is very complete and there is access to about 5000 electronic journals and many electronic books.
- Digital library of TUMS is subscribed to sources of almost all databases including Index Medicus, Medline, Excerpta Medica, Biological Abstract, Scopus, Chemical Abstract, and many others.

Figure 11. Digital Library in TUMS.

Research facilities

- More than 100 research centers have been established in the past decade that more than 20 of them belongs to TUMS. The research budget has significantly increased in the last 5 years.
- All researchers in TUMS has at least one grant but average is more than 2.
- Almost all materials for scientific researches are available and purchasable through local distributors.
- High technology tools and apparatuses for researches are available too.
- All TUMS members are allowed to participate in at least one foreign congress/symposium/workshop with support of University every year.
- TUMS holds at least 5 international congresses in various areas of medicine by cooperation of foreign Universities.

Figure 13. Research Facilities.
Higher Education Excellence in Korea

SUNG-CHUL SHIN

Professor, Korea Advanced Institute of Science and Technology (KAIST)
Director, The Korea Academy of Science and Technology (KAST), Korea
(e-mail: scshin@kaist.ac.kr; Tel: +82-42-869-2002; Fax: +82-42-869-4800)

1 ABSTRACT

Today’s world is turning fast into a knowledge-based society. Human resources brought up with excellent education and the knowledge they generate are, in themselves, a nation’s mental and physical asset and the source of the nation’s competitiveness. The university is a unique organization that undertakes all of key activities in a knowledge-based society; creation, utilization, propagation, and dissemination of knowledge. In this sense, it is not an overstatement to say that the university leads the knowledge-based society as the stronghold of intellectual activities.

Many developing nations are trying to develop a modern higher education system, particularly in science and technology, to enhance their developmental processes and meet the forthcoming challenges of the knowledge-based society. Korea’s university education has achieved remarkable growth unprecedented in any other parts of the world for the last thirty years just as its economy has grown tremendously in the past. University organization has grown in numbers by 2.7 fold from 142 in 1970 to 384 in 2005, while the number of enrolled students grew by 18 fold from about 0.2 million to 3.6 million. Encouraged by the quantitative growth, the university education has become accessible to the general public. The ratio of students continuing on to pursue higher education has also increased from 33.2 percent in 1990 to 82.1 percent in 2005 having most of the targeted age group receiving higher education.

However, such growth centering on quantity has brought about qualitative issues in university education posing problems in raising creative, interdisciplinary, integrated, and knowledge-creating human resources that is required in the knowledge-based society of the 21st Century. Consequently, a mismatch has been made between the supply of human resources the university provides and the demand from the field of industry and research. Particularly, the drop in the percentage of students applying to study in the field of science and engineering, which plunged from 42 percent in 1998 to 27 percent in 2002 after the national financial crisis at the end of 1997, has become a big issue of the nation.
In this presentation, I will discuss the current situation and the challenges of Korea’s university education, focusing on the education in science and engineering, and explain the national programs such as the Centers of Excellence program and the Brain Korea program in order to enhance the quality of university education and research. Furthermore, I will introduce various programs prepared as a measure to raise global leaders of the 21st century by KAIST being the university devoted to providing education to the science-gifted students in Korea.

![Figure 1.](image1)

**Figure 1.**

![Figure 2.](image2)

**Figure 2.** Global Standing of Korea in the World.
Figure 3. Future of Korea.

Status: Remarkable Quantitative Growth

- No. of Higher Education Institutes: 142(’70) → 384(’05)
  (Universities: 224, Colleges: 160)
- No. of Enrolled Students: 0.2 M(’70) → 3.6 M(’04)
- Ratio of Students Pursuing Higher Education:
  33.2%(’70) → 82.1%(’05)
  (Finland: 85%, Sweden: 76%, USA: 63%, Japan: 49%)
- Ratio of Undergraduate Students/Population:
  4.07% [World Top]
- Ratio of Graduate Students/Population:
  0.61% [World Top, 39%, Japan: 0.17%]
- Ratio of Population Received University Education:
  41% [World 4th]

Figure 4. Status: Remarkable Quantitative Growth.

Challenges: Low Quality

- Mismatch between the Supply and Demand of Human Resources:
  - Demand from the Industry: 26% (FKI, ’02)
  - Seriousness of University Education: 77.6% (FKI, ’04)
  - Re-training Expenses: US$ 2.8B per year (FKI, ’02)
- World Competitiveness of Higher Education:
  (IMD, World Competitiveness Yearbook(’05))
  - Competitiveness of the University Education: 52nd/60
  - Knowledge-Based Competitiveness: 42nd/60
- Low Research Performance:
  - Citation/Paper: 34th(’03)
  - No. SCI Publication: 13th

Figure 5. Challenges: Low Quality.
Figure 6. Challenges: Surplus of Quota.

Figure 7. Challenges: Low Public-Education Support.

Figure 8. Challenges: Huge Expenditure in Private Education.
Figure 9. Challenges: Avoidance of S&E.

Figure 10. National University-Reform Plan.

Figure 11. National Reformation Plan.
Figure 12. National Reformation Plan.

Figure 13. National Reformation Plan.

Figure 14. National Reformation Plan.
Figure 15. Background of Foundation.

Figure 16. Unique Selection & Pre-Training.

Figure 17. Statistics of KAIST Status.
Figure 18. KAIST Vision for the Knowledge-Based society.

Figure 19. Cross-Disciplinary College.

Figure 20. Department of BioSystems.

392
The Graduate School of Culture Technology

Background
The Culture Industry has emerged as one of the core post-industrial sectors.
(8% of GDP in Korea, 15% of GDP in the USA)

Objective
- To provide the high quality experts to the culture industry
- To pursue a new educational model for the culture-rich society. (Creating values by merging engineering, art & culture and management)

Finance
- Fully supported by the Ministry of Culture & Tourism
- US$ 1M in 2005
- US$ 5M per year, over 10 years.

Figure 21. The Graduate School of Culture Technology.

Entrepreneurship Education

KAIST Graduate School of Management ('96)
- Launch a separate management school in 1996 with particular emphasis on technology, information, environment, and knowledge in a global society.
- To train business leaders and policy specialists in both technology issues and global perspectives.
  Programs: Management Engineering, Venture Management, eBusiness, Financial Engineering, Telecommunications, Management and Policy, etc

Business Economics Minor Program ('05)
- To enable KAIST undergraduate students to add basic business skills to their powerful science and engineering knowledge.
- With the donation of US$ 2 M from Chong-Moon Lee, Chairman of Silicon Valley Venture Fund and a US$ 4 M matching fund from Korean Government.

Figure 22. Entrepreneurship Education.

Leadership Education

- Leadership Training
  (7 Habits of Highly Effective People)
- Bilingual Communication Training
- Physical Training in the Military Academy
- Cultural Experience
- Community Service
- Overseas Training Program

Educate the students who best serve the nation and the world in the 21C.

Figure 23. Leadership Education.
3 CONCLUSION

Higher education in Korea has experienced remarkable growth in the numbers of universities and students; however, such quantitative-oriented growth has brought about qualitative issues in university education, posing problems in raising HRs required in the knowledge-based society. National reform for enhancing university competitiveness is underway now with the principles of qualitative upgrade, differentiation and specialization, and university-industry ties.

KAIST, a mission-oriented university for educating science-talented students, is implementing a vision to produce knowledge-creative global leaders with the educational philosophy of cross-discipline, entrepreneurship, and leadership.
Higher Education Reform in Qatar:
Qatar University and Education City

IBRAHIM SALEH ALNAIMI*
Chemistry and Earth Science Dept.
College of Arts and Sciences
Qatar University
P.O. Box: 2713 – Doha – Qatar
E-mail: i.s.alnaimi@qu.edu.qa

1 ABSTRACT

For any visitor to Qatar, he will step into a one gigantic workshop. Renovations at the Doha International Airport with a new airport is under construction, building of bridges, highways, and high rising buildings, construction of industrial areas, erection of petrochemicals, gas and oil plants. With this infrastructure activities comes a booming economy with one of the highest income globally. In parallel, Qatar is investing as well in the human resources through reconstruction of its education matrix. With the assistant of the international community, the Qataris are thriving to place their country on the map of superb education system that include the primary and secondary education. To that end, Qatar has launched a campaign to reform the primary and secondary education in the country.

In this presentation, I will focus on the reform of the higher education in Qatar, and will touch on two successful projects. The establishment of the Education City and the reform at my university, Qatar University.

The Education City is the flagship project of Qatar Foundation. It is a cluster of learning and research facilities including branch campuses of five world-renowned universities, a science and technology park and a state of the art specialty teaching hospital. The vision of Qatar Foundation is to equip the new generation of engaged and innovative leaders to face the challenges of an increasingly global society.

Qatar University reform has focused on learning and teaching excellence. Its vision is set to seek to be a model national university that offers high quality, learning - centered education to its students. The university became an autonomous institution with a Board of Regents on 2004. Its reform scheme is in progress and major achievements had already reached with many ambition goals are laying ahead.

*Professor of Chemistry and Fellow of the Islamic World Academy of Sciences.
2 THE PRESENTATION

Figure 1. The University Vision.

The University Vision

To promote and extend its Arab and Islamic heritage by enriching cultural and scientific endeavors within Qatari society. The University's dissemination of knowledge is intended to contribute to the development and advancement of human thought and values.

Figure 2. The University Mission.

The University Mission

The University of Qatar will and should remain the primary option for Qatari students who seek and are qualified for academically oriented postsecondary education. A QU education will be broad, laying a foundation of successful professional life and good citizenship and preparing students to accept individual responsibility, to take initiative, and to work effectively in teams.
Figure 3. Brief History of Qatar University.

Brief History of Qatar University

- Established as a university on 1977.
- It started with four colleges (Education, Humanities, Science and Islamic Studies).
- In 1980, College of Engineering was added.
- In 1984, College of Business Administration was the sixth college.
- It hosts more than 500 academic staff.
- It caters for more than 8000 students.

Figure 4. Why Reform Qatar University?

Why Reform QU?

A study revealed the need for broad reforms in university governance, administration, and structure if the university is to serve the nation adequately in the coming decades. It must have autonomy, provide a more rigorous education for its students, and enhance the quality of faculty instruction and scholarly endeavors. Once these goals are accomplished, the university graduates will be equipped with advanced knowledge, research techniques, skills, and expertise that respond to the needs of the Qatari society.

Figure 5. Principles of the Reform

Principles of the Reform

Three principles:

1. Autonomy; It aimed to make QU an autonomous institution with a Board of Regents that directly report to the Emir. The University is now authorized to govern itself in all respects, e.g., manage all finances, hire all personnel, approve the mission and vision statements.

2. Decentralization; Programs, departments, and colleges administration will have the ability to make a number of decision that effect their units. They will have control over an appropriate budget, be able to recommend personnel decisions that affect their units, and propose changes in curriculum, including assessment policies.

3. Accountability; with decentralization comes the necessity to develop new accountability mechanisms that provide a system of checks and balances. These policies and procedures are based on assumption that with the freedom to make decisions, comes the need for assessment and evaluation of the level of performance achieved.
The Leaders of the Reform

The Board of Regents, Chaired by the Heir Apparent, the University President, and the newly established Office of Institutional Research and Planning. A Senior Reform Committee, made up of QU and international experts on university management and operations led by RAND-Qatar policy institute has been formed to give consultation to the leading team.

Figure 6. The Leaders of the Reform.

How The Reform Affect Students

1. Revised Admission Standards; A minimum standard of admission is adopted for every degree-granted program.

2. Core Curriculum; A flexible core curriculum provides a broad foundation of knowledge and skills that prepare students for multiple professional careers and social roles. The college of Arts and Science is the institutional home for these courses.

Figure 7. How the Reform Affect Students.

How The Reform... con’d

3. Improved Student Services; In addition to improving the conditions for the teaching and learning at the University, the reform aims to generate a stronger University Community. It provides students with better systems of advising and registration. It also introduce the Office of Career Services. The office advises students on career opportunities, and works as a link between them and potential employees.

Figure 8. How the Reform ... con’d.
The Effect of Reform on Faculty

1. Increase “Scholarly Endeavors”; This phrase signifies activities that are broader than traditional academic research. It encompasses participating in rigorous and objective inquiry, formulating and investigating new hypotheses, and engaging in creative efforts to improve teaching.

Figure 9. The Effect of Reform on Faculty.

The Effect of … con’d

2. Enhance Faculty Performance; Faculty teaching and advising should foster active and creative learning on the part of students. An Office of Faculty and Instructional Development has been established in order to assist academic units in devising and administrating programs to support the professional and pedagogical development of faculty.

Figure 10. The Effect of …. con’d.

The Effect of … con’d

3. Improve Compensation System. A new hiring and retention policies has been adopted. The faculty members are justly compensated and they operate under a consistent and transparent employment policy. A system of longer term and rolling contracts has been introduced. This policy is linked with the performance appraisal system. A more stable and reliable working environment for faculty is created.

Figure 11. The Effect of… con’d.
"The sharing of knowledge, ideas and values is the noblest way to transcend barriers..."

Her Highness Sheikha Moza bint Nasser Al-Missned, Chair of Qatar Foundation

**MISSION AND VISION**

Qatar Foundation is guided by the principle that a nation's true wealth is its people. QF goal is to develop that human potential:

- by creating a network of centers committed to delivering first-rate education, supporting science and research and promoting community development
- by partnering with world-class educational and research institutions
- by building a unique Education City, featuring state-of-the-art technology and facilities, that is a hub for the creating, sharing and finding practical uses of knowledge

**Figure 13. Mission and Vision.**

**Figure 14. The State of Qatar.**
Figure 15. Qatar Foundation.

Figure 16. Mission.

Figure 17. Partnership Models.
Figure 18. Qatar Foundation Requirements.

Figure 19. Qatar Foundation Requirements (continued).

Figure 20. Qatar Foundation Requirements (continued).
**Figure 21. The Challenge.**

**Figure 22. Research Enterprise in Education City.**

**Figure 23. Education City.**
Figure 24. Weil Cornell Medical College in Qatar 2002.

Figure 25. Virginia Commonwealth University.

Figure 26. Texas A & M University in Qatar 2003.
Figure 27. Carnegie Mellon University in Qatar 2004.

Figure 28. Georgetown University in Qatar 2005.

Figure 29. Specialty Teaching Hospital.
3. Science & Technology Park

Objectives

- Promote applied research, technology development and commercialization in Qatar
- Grow and diversify Qatar’s economy through application of technology
- Encourage formation and growth of start-up technology companies
- Create high-value employment opportunities, in particular for Qatar’s university graduates

Target Themes

- Aircraft operations
- Environmental technology
- Gas & petrochemicals
- Healthcare
- Information & Communication technology
- Water Technology

Research Funding

- Well of Knowledge
- Support of Industry and Business
- Qatar National Research Fund

Figure 30. Science & Technology Park.

Figure 31. Target Themes.

Figure 32. Research Funding.
Figure 33. Objectives.

Figure 34. Funding Activities.
PART SIX

HIGHER EDUCATION:
SOME OIC-SPECIFIC ASPECTS
The World Educational Crisis: 
An Islamic Perspective with Reference to Higher Education

Z. R. EL-NAGGAR*

Supreme Council of Islamic Affairs
Cairo, Egypt

1 ABSTRACT

Amid a virtual explosion of knowledge and a world-wide expansion in education, man is living an educational crisis. This has been viewed in terms of the continued increase in the aggregate numbers of adult illiterates in the world due to economic difficulties that have hindered the expansion in education from keeping pace with the population growth especially in the under-developed countries. However, the crisis shows itself more graphically in the general degeneration of the educated individuals, their general tendency to violence, the corruption of the human society and the vacuity of the present-day culture, which point to the failure of contemporary education.

The roots of the crisis have been viewed to be basically economic, social, professional, administrative and organizational, psychological, ideological, moral, religious, or a combination of all such factors. Nevertheless, suggested reformations on such bases have proved to be partial and futile.

The crisis is believed to have stemmed from the fact that education has limited itself to the passing on of a body of knowledge and the training for a few skills, hence has confined its main role to mere certification. Here, education has deviated its message, the teacher-student relationship has lost its proper framework, and examination has become something that supersedes actual learning. The products of such schooling come out fundamentally uneducated, unsuited for servicing their own good or the good of their societies and unfit for playing their role in life. This is simply because they do not understand their own selves, their relationship to the universe in which they live and the message of their life. Such fundamentals cannot be gained through human senses, reason and intellect alone, but need the divine guidance which was revealed to Adam and Eve on the moment of their creation and has since been the same message of whoever was destined for the guidance of man. It is a

* Prof. Z. R. El-Naggar is a professor of Earth Sciences; Chairman, Committee on Scientific Signs in the Glorious Qur'an, Cairo, Egypt; and Fellow of the Islamic World Academy of Sciences.
complete way of life towards which our Creator has guided man through a long chain of his Prophets and Messengers and was integrated in the message of Prophet Mohammad (peace be upon him).

Improvised systems mixing the divine message with various elements of human ideas, philosophies and allegations has produced a number of beliefs that have failed when put to practice or tested by human reason, and hence have either been rejected or replaced by man-made ideologies. This has resulted in a general divorce between society and religion, or in a blind belief in any ideology without enough reasoning to justify the resulting fanaticism and many injustices. Consequently, contemporary education has become mainly secular, if not nihilistic and disbelieving and this is the core of the crisis.

The only way out of this crisis is the re-institution of the Islamic system of education where the purpose of human existence is clearly outlined; seeking knowledge is a must for every one's education is an integer, humane activity that embraces all the faculties of the human being; caters for man and his society; respects individual differences. Making allowances for it and is by nature a continued process that concentrates more on character-building than on mere transference of information. The Islamic education relies on the leading characters of the educator and the good will of those to be educated; combines knowledge with wisdom and gives a coherent picture of the universe, a proper concept of life and its true objectives and an integrated way of how to live it. Such a system produces a good human being not on a good citizen with a profound belief in the divine guidance, a thorough commitment to high moral values and standards, as well as a living inner conscious. Such educational system binds the student to live up to what he learns and teaches him that everything he does, every word he utters and every penny he earns or spends is recorded and that he will be judged for it. Not only this, but he will be asked about his life and how did he pass, and his knowledge how did he benefit or harm humanity by.

Only such a system of education can produce a good human-being that knowingly seeks the goodness in this life and expects the reward here and/or in the life hereafter. An educational system as such is not only the solution to the contemporary educational crisis, but to all the crises our world is currently facing. It has proved its success in the past and its revival in our time will not prove difficult. This entails the proper education, that encompasses all the faculties of the educated, the Islamization of human knowledge, the revival of Muslims' contributions to the human civilization and the scientific notions in both the Glorious Qur'an and the sayings of Prophet Mohammad (peace be upon him).

2 INTRODUCTION

Despite the world-wide expansion in education, the marked advances in its methodology, the continued improvement of its curricula and the piling-up of its literature, the world is living an educational crisis. Quoting Coombs (1968) "This is a world educational crisis – more subtle and less graphic than food crisis or military crisis, but no less weighted with dangerous potentialities. The
crisis varies in form and severity from one country to the next. But its inner lines of force appear in all nations alike, whether they are old or new, rich or poor, whether they have stable institutions or are struggling to build them in defiance of heavy odds”.

The crisis has been mainly viewed in terms of the continued increase in the aggregate number of adult illiterates in the world due to economic difficulties that have hindered the expansion in education from keeping pace with the population growth, especially in the under-developed countries. However, the crisis shows itself more graphically in the general increase in the wickedness of man, corruption of society, propriety of violence, vacuity of culture, delinquency degeneracy and failure which have become general characters of the present age. This crisis has been taking place amid a virtual explosion of the knowledge and an educational expansion without precedent in human history. Indeed, contemporary education has failed to achieve both its purpose and objectives at a time when the material requirements of instructions have reached a very high standard (especially in the developed countries). Nevertheless, student’s unrest, revolt, violence, anarchism, and other uninhibited behaviors have been steadily increasing. This shows itself in numerous negative protest movements that are currently embracing most of the societies, and the unlimited cases of bewilderment, frustration, disillusion, egotism, viciousness, psychological and mental diseases, cold-blood killing and even suicide.

Within the framework of the educational institutions, certification - not education – has become the main role, the teacher-student relationship has lost its noble touch, examination has become something that supersedes actual learning and cheating on examinations has become an international disgrace, the publish or perish race has spoilt the scholarly message of scientific research and the necessary qualities of the educator and of those to be educated have become conditions that are very rarely fulfilled. Consequently, present-day graduates come out fundamentally uneducated and unsuited for carrying out their role as successful individuals, as coherent members of a good society and as proper human beings, who can order whatever is right and forbid whatever is wrong.

Outside schools and colleges, usury has become the basis of modern economics and gambling one of the main fields or statistical research; business has been equated with ruthlessness if not corruption, politics with deviousness, deceit and lust for transgressions and aggressions, justice has been confused with personal interest, human relationship with material benefit, and freedom with laxity, immorality, chaos and encroachment on the rights of others; values have been replaced by adjustment to society; general decadence and debilitating relativism has been pervading life; the words right and wrong have come to be meaningless in our material world and very few intellectuals are now able to act as upright human beings or as informed mediators.

This has been taking place at a time when the number of “educational institutions” and of the “educated individuals” is steadily increasing everywhere. New schools, colleges, universities, technical as well as other institutes and research, vocational training and functional literacy training centres are being built. Simultaneously, extended education in the form of extramural studies,
professional refreshing courses, on-the-job and in-service training is being encouraged. Special youth programs and education through the various media of information (internet, press, radio, television, cinema, theatre, etc) have taken marked strides in their technicalities. Contemporaneously, world, regional and local conferences, seminars and debates on education are regularly being held, and the literature on education is constantly piling up. All such media of instruction and information have only helped man to develop materially (in the limited sense of the word) on the expense of his spiritual and moral needs, and thus have taken him out of his balanced humane nature. This is probably why the educational crisis show itself more lucidly in the so-called developed countries and among the “Supposedly Educated” people. Enough to have a glance at the world’s modern history and review the crimes committed against mankind such as the crimes of the two world wars, the Hiroshima and Nagasaki bomb ardent with atomic weapons, the several decades’ old Palestinian tragedy, the Vietnam and other Southeast Asian wars, the South African drama, the Namibian and Rhodesian agony, the Hungarian as well as the Czechoslovak crush-down, both the Southern Philippines and the Southern Thailand homicide, both the Cyprus and the Myanmar (Burmes) turmoil, the tyrannized in many of the third world countries, the recent human butchering in both Iraq and Afghanistan, following the illegal and unlawful Anglo-American invasions of these two countries that are UN full members, the daily Israeli massacres of the Palestinian people and devastation of their lands, the turmoil in Central Africa, in southern and western Sudan, in Zanzibar, Erytheria, Chad, Somalia as well as repeated invasions of Lebanon and non-stop massacres of the Lebanese civilians and devastation of their own country, the scandals committed in the Anglo-American prisons such as Abou-Ghuraib, Basrah, Guantanamo and their flying prisons around the world; the turmoil in Central Africa, in southern and western Sudan, in Zanzibar, Erytheria, Chad, Somalia; etc. It is sufficient to attend one of the international meetings (such as those of the United Nations' Council or its Security Council or of any of its numerous agencies) and see how the world governments’ representatives behave, or skip through the life history of contemporary leaders (see for example the White House scandals revealed in number of recent publications such as the Kennedy legend entitled “The Dark Side of Camelot” by Nelson Thompson or the Clinton’s – Monica Lewinsky’s scandal). Enough to get a glimpse of what is going on in the underworld of intelligence gangsters, have a tour in any of the numerous countries ruled by tyrants and dictators, or dig into the files of any giant business enterprise. Wherever one goes he can easily see that corruption, dishonour and disgrace, partiality, unfairness, dishonesty, insincerity and falsehood, laxity, duplicity, and suppleness, wickedness, opportunism and treachery, sneakiness, artfulness and fishiness, graft, jobbery, crookedness and deviousness, briability, complicity, improbity and lawbreaking, scoundrelism, racketeering, villainy, knavery, rascality, and every sort of immorality have become the rule. In this, one cannot exclude even clergymen (e.g. the Jimmy Swagart's sexual scandals), monarchs and heads of states (see for example the Kennedy’s and the Clinton scandals, the Johnson’s offensives, Nixon’s Watergate, etc), or the so-called “Nobilities” and prime ministers (e.g. the Prince
Bernard of Holland and the Japanese prime minister Tanaka's involvement in the Lockheed and Northrop bribery cases), members of cabinets (e.g. the Profumo and the John Stonehouse obnoxious crimes in Britain), national representatives (e.g. the recent W. L. Hays' scandal), etc. In the latter scandal, Elizabeth Ray, the mistress of the married, 65 year old, U.S. congressman W. L. Hays (who had kept her on the public payroll for the sole purpose of being one of his sexual playmates) admitted to have had similar contacts with over 13 congressmen and 2 senators. Her recently published autobiography entitled the "Washington Fringe Benefit" is a clear picture of the level to which the educated modern man has sunk, but one cannot exclude a number of exceptions.

These are only individual cases that happened to come to the public notice from amidst a much more inundating ocean of corruption that is engulfing our present world, but they are enough to raise a number of disturbing questions such as:

What is education for? And what is it meant to do to a human being? Are we wasting our time, money and effort in our educational institutions? Is education a means to an end or is it and end in itself? And if so what is the end of education? Have we left the spirit behind and that is why we are suffering in its absence? What are science and technology for? Are they for more exhaustion of the earth's resources, polluting of its environments, the more complication of life and the piling-up of more and more nuclear bombs (atomic, hydrogen and neutron bombs), chemical and biological bombs, and other horrifying weapons of mass-destruction that are waiting for some fool to press the button and destroy man and all his achievements and heritage?

Such questions embody the world educational crisis and enhance the immediate need for facing it.

3 ANALYSIS

The world educational crisis has been clearly recognized by a large number of contemporary scholars (e.g. Moberly, 1950; Fletcher, 1962; Rosenhead and Norden, 1963; Coombs, 1968; Niblett, 1969; Annan, 1971; Bowden, 1971, 1974; Adamson, 1974; Mather, 1974; Wingo, 1974; etc.), but they differ in its diagnosis, in the analysis of its causes and in the suggested remedies for it. Some educationists see that the crisis lies mainly in the continued increase in the aggregate numbers of the adult illiterates in the world due to the fact that the expansion in education cannot keep pace with the population explosion, student flood, acute resource scarcities, rising costs complex technologies and their sociological implications.

Other educationists see the crisis in its social framework as the world is currently involved in a great transition and societies in transition usually suffer a loss of traditional values and this loss abets cultural confusion and social crisis. Quoting Wingo (1974) "The common core of ideals and beliefs that once represented cultural solidarity is dissolving. The turmoil, therefore, that is so evident in American education is reflecting the confusion in American society".  

415
A third group of educationists, relate the crisis to the lack of moral guidance as contemporary educational systems have – in general – become moral-free, and hence seek the remedy in moral education. A fourth group attributes the crisis to the general divorce between society and religion, hence call for religious education. More queries about the current educational crisis are being thrown in every direction as follows:

- Is it due to the inefficiency of the educational systems?
- Is it a psychological problem, and hence the solution lies in the realm of educational psychology?
- Is it due to the wanting coherence in the very idea of the educational institution as a community of persons engaged in learning and discovery, and hence the solution may be found in bettering the social conditions of learning?
- Is it due to the disparity between educational systems and their environments and hence the unsuitability of the educational systems’ output?
- Is it due to the lack of proper leadership? And the fact that contemporary education is not really planned for public responsibility and hence cannot motivate and equip the younger generation to assume the responsibilities of leadership? And that the American thriving for world domination and the imposition of the American way of life on the rest of the world is not and cannot be the solution?
- Is it due to the domination of the purely materialistic outlook of education and hence, the lack of wisdom and the widening gap between knowledge and belief?
- Is it due to the conflict between sciences and humanities, between general and specialized education or between liberal and professional learning, and hence the call for narrowing the gaps between such fields and methods?
- Is it due to the continued fragmentation of human knowledge due to the growing over-specialization, and hence the lack of the much needed integrated outlook?
- Is it due to the absence of continued education or extended education and hence the call for it?
- Is it due to the explicit or implicit command laid upon intellectuals by governments and the fact that our educational life is generally dominated by politicians and businessmen, and hence the call for more independence?
- Is it due to the sense of insecurity among people due to the piling-up of weapons of mass-destruction?
- Is it due to the fact that the knowledge which ought to be unconditionally international, is currently suffering from egoistic nationalism and selfish chauvinism and hence the increasing amount of classified knowledge and the prime alliance of contemporary scholars to flag, country and culture
and only secondarily to the dispassionate pursuit of an international or rather supra-national pattern of truth?

- Is it due to the existing discrepancy between theory and reality in the pursuit of knowledge?
- Is it due to the lack of justice in the society, the emphasis on the material reward only and the absence of a proper understanding of man's role in life?
- Is it due to all the second/or to other unknown factors?

4 THE SOCIO-ECONOMIC BASIS OF THE CRISIS

Some educationists (e.g. Coombs, 1968) diagnose the world educational crisis in terms of the economic disasters which have hindered the educational expansion from keeping pace with the population growth especially in under-developed countries. This has led to a continued increase in the aggregate numbers of adult illiterates in the world and has led to serious sociological consequences. Contemporary education is said to be suffering from shortage of everything except students. Shortage of funds, teachers, classrooms, teaching materials, able administrators, coherent systems, etc., that have almost crippled the process of education in many countries.

The acute scarcity of resources and the rising costs, coupled with the population explosion and the sharp increase in popular aspirations for education, the inherent inertia of the educational systems themselves, the inertia of their respective societies and the unsuitability of the educational systems' output have led to a marked disparity between such systems and their environments world educational crisis. This disparity is one of the alarming symptoms of the scarcity of resources has constrained the educational systems from responding more fully to new demands. The sharp increase in popular aspirations for education has laid siege to existing schools and universities. The inherent inertia of the educational systems caused them to respond too sluggishly in adapting their internal affairs to new external necessities, even when resources have not been the main obstacle to adaptation. The inertia of the societies has blocked the educational systems from making the optimum use of education and of the educated manpower to foster national development. On the one hand, there is an obvious separation between established university principles and what societies want to do and want to go. On the other hand, while many more people want more education, they do not necessarily want the kind of education that under the new circumstances is most likely to serve both their own future best interests and the best interest of national development. This cleavage is apparently one of the roots of the crisis, which obviously needs substantial mutual adjustment and adaptation by both education and society. If such adjustment in not fulfilled, the growing disparity between education and society will inevitably crack the frame of the educational systems and, in some cases the frame of their respective societies.

Coombs (op. cit.) did not overlook the ideological basis of education stating that: contemporary educational systems need, above all, what money alone
cannot buy, ideas and courage, determination and a new will for self-appraisal, reinforced by a will for adventure and change. Nevertheless, he did not mention what ideas, or what parameters for self-appraisal, what changes should be aspired, or how such qualities can be introduced. Can they be caught through the contemporary secular education? Or do they need a particular moral or religious up-bringing? Apparently, he favours the first alternative as he did not mention religious education except when raising the question whether a blind, dogmatic faith guides any particular system, or whether it is a faith enlightened by rational analysis, reflection and imagination. He warned from the danger of clinging to conventional practices merely because they are traditional, lashing to inherited dogmas.

Coombs (op. cit.) carried out a system analysis to display the interactions between an educational system (with both its formal and non-formal sides) and the environment. The resource input from the society included aims and priorities, students, teachers, management, structure and time schedule, content, facilities, learning aids, technology, quality controls, research and costs. He believes that the output will be educated individuals that are better equipped to serve themselves and their society (as individuals and family members, workers in the economy, leaders and innovators, local and world citizens, contributors to culture, etc). This is simply because of his belief that systemized education must have improved their basic knowledge, intellectual and manual skills, powers of reason and criticism, values, attitudes and motivations, powers of creativity and innovation, cultural appreciation, sense of social responsibility and understanding of the modern world.

However, he (op. cit.) came to admit certain difficulties in analyzing the educational process as a system. These include:

- Scarcity of statistical data.
- Swift rise of educational demand for education.
- Rise in enrolments and participation rates.
- Gap between social demands and educational capacity.
- Imbalanced growth rates which deter national development.
- Impact of population “Explosion” in developing countries.
- Alternative strategies for dealing with the educational gap.
- Shortage of qualified teachers.
- Difficulties of measuring educational outputs, as figures on graduates and dropouts, though useful indicators of an educational system's output, do not - in themselves - provide a sufficient basis for evaluating its performance.
- Greater rise in number of unfinished products as a result to failures and dropouts, as well as the consequences of different policies of admission.
- Education's fitness for the manpower requirements of economic growth and the disparity between manpower needs and market demands and the following mounting problem of “Educated Unemployed.”
- Influence of attitudes and social changes on educational and career preference.
- Hard choices involved in establishing priorities and facing the expansion of educational aims.
- The problems of quality and content and its evaluation. Quality of students, teachers, administrators, etc. and curricula contents in the light of the flow of new knowledge and how to bring it into the classroom.
- Clashing views about new educational technologies, teaching processes educational research and innovation.

However, money seems to present the cornerstone of the crisis in Coombs' analysis as he writes "The crucial matters of financial inputs and cost trends has led to a disturbing picture of the future, especially as it applies to developing countries ..... Only with a vast cutback everywhere of present high military expenditures and their redeployment for peaceful uses, a quickening of economic growth, great improvements in the efficiency of educational systems, a sharp rise in external assistance to developing countries .... etc." And adds: "But given the looks of the things at the present time, such happy conjunction seems only a distant dream". Consequently, he sees the key to meeting the crisis in international cooperation. Through a form of education's worldwide common market, mutual benefits of educational commerce among nations can take place. The importance of individuals in fostering this commerce cannot be overlooked and so is the importance of external assistance. Similarly, the role of universities cannot be ignored although older universities may not be designed to present challenges as many of them have failed to stop the two world wars, or minimize national and international conflicts, or to help poorer nations to overcome any of their difficulties. On the contrary western intellectuals were- in their majority in favour of imperialism, military invasions, colonialism and exploitation of all the natural wealth of the poorer nations under many falsified slogans. Nevertheless, there are urgent needs for universities to help both the primary and secondary schools, as well as higher educational organization, in the planning and implementation of educational systems, the development of research capabilities, the strengthening of the dialogue among universities, taking the leadership in educational innovations at all levels, encouraging the cooperation between higher educational organizations, reducing the drainage of needed talents from developing countries, and in encouraging collaborations among scholars in various countries.

In brief, Coombs (op. cit.) outlined the crisis factors in the student flood, acute resource scarcities, rising costs, unsuitability of output inertia and inefficiency. The inherent inertia of the current educational systems was said to have deferred them in adapting their internal affairs with sufficient speed to meet a fast changing set of circumstances. Consequently, he adds that "the old arrangements that had served them well before the systems of administration, the syllabi, curricula and teaching methods, the self-contained classrooms, the means of teacher training and recruitment, these and all those other things that
have characterized traditional education processes – have proved no match for the new situation .... as attested by echoing protests against quality deterioration.”

Coombs (op. cit.) suggested focusing on the relationships of things, stress heavily on innovation, modernization of educational management of teachers and of the learning process, strengthening of educational finance, emphasis on non-formal education, international cooperation and on the consideration of the world educational crisis as everybody’s business.

This masterpiece of professional writing on education has however failed in diagnosing the crisis fully, because it is mainly a human crisis and one of the deepest causes of inhumanity in our time. Coombs' analysis has only rotated in the physical sphere of the problem, which is a true reflection of the purely material outlook of our time. This does not mean that we belittle the material side of the problem, but concentrating on it alone can be equally as dangerous as completely overlooking it, if not more. This is simply because in such materialistic approach to the crisis the focusing is on the devising of the institution and the implementation of its regulations that come to be regarded as more important than the formation of character, the main goal of education. Originally, education should be concerned with the souls of the youth before being concerned with the machines of their bodies. This is simply because it is the personal conviction that determines a youngster's behaviour more than any other single factor. Coombs’ system of analysis does not take such factors into consideration and hence, cannot be complete. Again, it lacks critical attention to assumptions about the nature of the learning process and the purpose of human existence. It works towards changing the educational institution into a community of learning but does not explain the values it advocates. It only concentrates on the physical needs of the educated and overlooks the higher purposes for which such needs are to be used. It puts much emphasis on knowledge, but forgets that knowledge is not separate from either wisdom or goodness and that facts are not isolated from higher values.

5 INEFFICIENCY OF THE EDUCATIONAL SYSTEM AS BASIS OF THE CRISIS: AN EXAMPLE FROM TEACHING EARTH SCIENCES AT THE UNIVERSITY LEVEL

The scientific procedure is generally based on observation and interpretation or on experimentation, observation and interpretation. This is how all the sciences have developed and advanced, but unfortunately, modern science teaching has drifted to merely memorization and examination. This has changed the goal of science education from stimulating thinking to mere memory filling, a problem that needs immediate consideration.

Most universities' curricula are currently based on a number of individual courses that are generally diversified and in many cases incoherent. The natural products of such curricula are students that lack mental integration and self-
discovery. This is beautifully expressed in the publication of the CEGS
“Council on Education in the Geological Science” (1971), p. 1 as follows:

“The flame of youthful interest is crushed and extinguished by over 2,400
hours (1800-3,300) of fragmented courses, poured, shaken-down and
compressed to which the average student, passive and dazed is exposed, (during
four years of university education).... The results of this continuing
disintegration, fragmentation, and compartmentalization of university teaching
extend beyond frustrated students into the adult years... “This is probably due
to the increased amount of cumulative human knowledge during the last two
decades and the sense of responsibility to cherish and preserve such great
human wealth. However, this has gone so far at the undergraduate level; that
there is an immediate need to go back from structured curricula, based on a
large number of review courses, to the normal scientific procedure. Review
courses have proved disastrous in the sense that they only entail more
information, but less comprehension and perception, and as put forward by an
eminent Earth Sciences professor. “It is more useful to the student to be able to
ask good new questions than to answer some old ones.”

Consequently, the main goal of university science education should lie more
in the area of teaching the scientific method, techniques, and implications than
memorizing information. A student should be taught how to explore a selected
subject, topic or area at depth, how to develop needed techniques and evaluate a
particular methodology, or in other words how to think in a scientific manner
and express his thinking freely in his own way. The product of this training is a
sharp, precise mind, trained in logical distinctions and methods of verification.

This is more needed in the field of Earth Sciences than in any other
discipline, because by its nature, Earth Sciences are very comprehensive
subjects, that deal with the origin of our planet, its relationship with the rest of
the cosmos, its composition, structure, morphology, history, processes,
successive changes in both its surface and interior activities, as well as the
causes of such activities, the history of its lithosphere, hydrosphere, atmosphere
and biospheres, and the successive changes of these with time, as well as the use
of such information for exploring its natural wealth and solving its
environmental problems. As thus defined, Earth Sciences include very broad
and diverse subjects, with many subdivisions and several closely allied fields.
These occupy a central position in human knowledge because of the multiplicity
of the contacts with all other sciences, and thus are subdivided into numerous
fields. It is virtually impossible to cover all such fields in a four-year under-
graduate course, and any attempt towards this goal will only crowd the students'\nbrains with loads of information that will hardly be clearly understood.

Instead of indulging into a multiplicity of fragmented courses, Earth
Sciences' students are urged to embark on small projects in their particular
environment (research courses) through which they can both develop the
scientific method, sense and techniques, and can gain an amount of retainable
knowledge. This does not defy that lecturing can remain as a valuable
educational tool and the most economical way of getting a large amount of
information across to a large number of students. Nevertheless, anything the

421
student can investigate personally will be better conceived and retained. This simply means, going back to the early method of gathering scientific knowledge by observation and interpretation or experimentation, observation and interpretation, using all the modern techniques and the accumulated human knowledge instead of mere memorizing that.

Consequently, present-day curricula should be changed to get out of its structured frameworks and give more freedom of movement to both professors and students, instead of remaining stagnant. A professor should be allowed to teach his students whatever he thinks adequate to them, according to each student's ability and liking, and in the way, he thinks best for each of them. This means that no structured curricula should be forced on either the professor or the student, and the whole problem should be left to an able tutor and a student willing to learn. However, this does not prevent the existence of structured curricula for students who cannot indulge into research. Such curricula cannot be transplanted from outside, as it must evolve locally, from within the society, its culture, traditions and heritage as well as from the philosophy of those who teach. The only architects of a curriculum are those who teach it and the best curriculum cannot be of much value, or effect, when the teacher does not know how to use it or understand the philosophy behind it. As mentioned by Gheith (1974) "the strength of the institutions of learning lies in the ability and the skill of each to determine its own goals and to achieve them by its own methods." However, this does not defy studying available curricula critically and taking the best in each, according to local needs.

The same author (op. cit.) mentions that "the Arab world has had long-established heritage and traditions that must not be sacrificed in a hasty trial to adopt systems foreign to such heritage and tradition, always keeping in mind that it is part of the same heritage and tradition to encourage and often demand investigation, and the main lines along which present-day universities should plan their science courses.

In the Islamic past, an eminent scholar could attract students from different parts of the world, then teach them in the way he likes and graduate them according to his own assessment and judgment, on the basis of mutual trust and understanding, without the interference of any other power. Similarly, student evaluation in the present-day universities and institutions should be left entirely to their professors as part of the learning experience. Otherwise, studying to pass a particular type of examination becomes an art and a goal superseding actual learning and evaluation and hence, becomes primarily only a measure of performing skill in exam-taking.

The Islamic educational system to tutorial and individualized education, which does not only use lecturing, but any and every other method which will make the student learn, enjoy learning and wanting to learn more. Consequently, the number of alternatives for learning should be available to the students at any given time. A number of significant decisions by the students should be allowed, and mutual trust between student and professor should always be there.
Earth Sciences (with its different branches) can be taught by two main ways. The first of these relies mainly on the research work, either in the field or in the laboratory, or in both, where the student learns to collect, analyze and present data in a reasonable way. By this training, the student develops the scientific thinking as well as its skills, and gains a reasonable amount of retainable knowledge. This can go on with or without lecturing according to whether the student is capable of independent reading or not. The second method relies mainly on lecturing, with a reasonable amount of both field and laboratory studies. Here, the students receive a huge amount of information which can be differently retained according to their different abilities. Unfortunately, most Earth Science departments today rely mainly on lecturing with little or no field or laboratory work at all; producing graduates with immense amount of information that is clearly neither understand nor is liable for application. It is high time to start teaching Earth Sciences by more fieldwork than lecturing, and by more research than memorizing, as its main laboratory is the field, and one field excursion could teach the student more than a number of lectures.

This means that Earth Science students should be allowed to spend as much time as they can in the field. However, as this branch of acquired knowledge needs a broad background on basic sciences (Astronomy, Physics, Chemistry, Biology and Mathematics), it is here suggested that a student majoring in Geology should spend about two years studying such basic sciences, by both research work and lecturing, then the other two years or so should be mainly devoted to the field and laboratory studies of one or more branches of Earth Sciences, asking good new questions and finding out their answers instead of repeating answers of old ones and memorizing information that cannot be fully perceived or retained.

6 ESSENTIALS, ADVANTAGES AND DISADVANTAGES OF INDIVIDUALIZED EDUCATION

Essentials

- The primary focus of the classroom should be learning, not just lecturing.
- The learning environment should be rich and varied.
- Students should be enabled to engage in learning activities of their own choosing and at their own rate, a traditional structured course being always available as one of the students' option.
- Norm concepts must be removed.
- Non-grading must be encouraged. Grades seldom reflect students' creative abilities.
- Schedules should be totally flexible.
- Student evaluation must be done individually and include his or her active participation – perhaps students should have total freedom to do the entire evaluation themselves.
- Constant teacher retraining is necessary.
- Independent study must be encouraged.
- A teacher's function is that of a facilitator for individualized learning.
- Students' evaluation of their professors' activities should be taken into consideration.

Major Advantages

- Built in provisions for enrichment and remedial work if desired.
- Intrinsic motivation becomes the key: self-direction, self-activity, own learning pace, etc.; high student involvement - high student interest; and under proper guidance it reduces student dependency.
- Humanizes teaching and learning.
- Reduces or eliminates student categorizing.
- Self-taught discipline.
- Allows time for in-depth studies.
- Minimizes or can eliminate student failure. This could greatly improve a student's self-concept.
- Students can cultivate their special talents, as both initiative and creativity are encouraged.
- Uniqueness of each student and his or her capabilities is recognized, accepted and encouraged.

Major Criticisms or Disadvantages

- Many teachers will not devote the time and energy necessary to provide a truly personalized program for each student.
- There are students who are too “immature” to participate in planning their programs, to work independently, and to evaluate their own programs.
- Many teachers are not genuinely interested in students as individuals in their society, do not understand them, and do not have special ability in diagnosing difficulties and devising ways of overcoming them.
- It is difficult for the teacher to discover how a student really perceives himself, which is basic to helping him as a unique human being.
- Many learning problems exist that mere individualization cannot alter.
- New approaches such as individualization present new problems, which can upset and frustrate students, teachers, administrators and parents.
7 THE GENERAL DIVORCE BETWEEN SOCIETY AND RELIGION
AS THE BASIS OF THE CRISIS

Europe has divorced religion since the early days of the renaissance and has
imposed its secular way of life on the rest of the world through colonialism. The
secular attitude came as a result of the waged war between the church and the
European scientists as the former tried to impose on the latter’s primitive "Old
Testament" views, refuted by the scientific method. Finally, European scientists
won the battle after endless sufferings, and hence, have rejected religion and
insisted on taking a purely naturalistic attitude. Consequently, contemporary
education has negated religion and has limited its role to the passing on of a
body of material knowledge and a number of technical skills to the ignorant
young. Not only this but this acquired material knowledge has been
continuously suffering from fragmentation and compartmentalization. The net
result is the limitation of the current education to only schooling and
certification, and a flow of graduates that are fundamentally uneducated and
unsuited for servicing their own good or the good of their societies. Contrary to
this, the primary goal of education is the preparation of young men and women
to carry out their roles successfully as good vicegerents on earth, and this cannot
be carried out without a proper understanding of man's role in life as destined
by his creator i.e. understanding one's role on Earth cannot be achieved without
religion. Religion is the divine guidance to operate in areas that cannot be
correctly addressed by man such as the area of faith, acts of worship, the moral
code and the code of transactions with others. Human efforts in these areas have
proved to be absolutely futile, because faith is absolutely in the unseen domain,
acts of worship have to be absolutely divinely decreed, and history testifies to
the complete failure of man to tailor for himself any correct moral code or code
for transactions with others as the two areas are controls over human behaviour.

Stemming from this, religion has to be purely divine, without the slightest
human infiltration. Corrupted beliefs were behind the clash between the clergy
and the scientists. Consequently, the European revolt against the church was not
truly combating religion, but was against the human misinterpretation and
corruption of the divine guidance as both the Old and New Testaments are
products of the human efforts.

The divine guidance was taught to Adam and Eve on the moment of their
creation. They definitely taught it to their descendants and whoever lived with
this system of faith, acts of worship, moral code and the divine code of
transactions with others, lived peacefully and happily, achieving his (or her)
role successfully as a good vicegerent on Earth. However, man is bound to
forget and is subject to deviations, and hence, a long chain of Prophets and
Messengers were sent for the guidance of man. If the divine guidance was kept,
and people had drifted away from it, a Prophet was sent to bring them back to
the divine guidance and guide them to live according to the divine Will. However, if the divine guidance was lost, a Messenger was sent with invariably
the same message, from the same source to guide people to the same target.
This process of the divine guidance to men went on throughout the planet and
the whole history of humanity, encompassing (120,000) Prophets, including (315) Messengers, but it had to come to an end, and the end was the message of Prophet Mohammad (peace be upon Him). This seal of that long chain of Prophets and Messengers was sent by our Creator for the guidance of all human beings of all races, nationalities colours, tongues and ages. His message being the last form of divine guidance to man, the Creator (all glory be to Him) has taken the responsibility to preserve it forever. Indeed, the Glorious Qur'an has been preserved in its entirety, in exactly the same language of revelation (the Arabic language) for more than 14 centuries, while all the previous revelations have been completely lost. Whatever human memory could recollect of revelations prior to the Glorious Qur'an are currently preserved in man-made writings and in languages other than the languages of revelation. These writings are purely human and despite the fact that they have been constantly edited, they are still full of mistakes (linguistic, historic, scientific, religious, etc.) and hence cannot be referred to the divine guidance. Consequently, while the European revolt against the church was justified, its generalization against religion at large is not.

Man needs the divine guidance to know exactly who he is. Who has created him and sent him to this world? What is his message in it? How can he fulfil that message successfully? And what is for him after this life? These basic questions crop up to the memory of everyone, regardless of his age, level of education and social status, and cannot be answered by the human intellect, senses, reason and imagination, but need the divine guidance. And if not properly answered, these questions can always remain a source of unrest, unhappiness, and turmoil in the human mind, as his psychological and spiritual needs are not correctly satisfied. Such needs can only be satisfied by the divine guidance (Al-Deen) which is the system of thought and conduct of the whole life of all human beings of all ages. This system is called Al Islam which means the surrender of one’s self to the guidance of his Creator, in full obedience, worshipping Him alone in the way He has prescribed (without parallels, partners or similarity) and carrying out one’s duty as a good vicegerent on earth by being more constructive on Earth and more helpful to all its inhabitants, by being fair, in ordering whatever is right and forbidding whatever is wrong. Islam is invariably the same message of whoever was ordained for the guidance of man in different periods of time and at different parts of the world. Finally, Prophet Mohammad (peace be upon him) was sent to invite the whole world towards Islam as integrated, completed and preserved in both the Glorious Qur'an and in his teachings. Consequently, the solution to the contemporary educational crisis is its Islamisation, i.e. reconstructing it on the basis of the Islamic guidance. This is the only available divine guidance today that has been preserved for over 14 centuries in its revealed language and in its divine purity. The philosophy of Islamic education is the totality of Islam, with its comprehensive concept of man, the universe, life and the life hereafter. The basics of Islamic education include the deep belief in the Creator, His Angels, revelations, Prophets and Messengers, in the life hereafter with all its realities and in the commitments to both good deeds and excellent morality. This system was laid down for us by our Creator, and who can know man better than his Creator?
The content in the Islamic education includes both the acquired and the revealed knowledge. The former includes all the basic sciences and their applications (i.e. science and technology), and the philosophy of sciences, as well as the humanities and its philosophies or what we call philosophy at large while the revealed knowledge includes faith, acts of worship, the moral code and the code of transactions with others. No man can cover all such knowledge with both its acquired and revealed aspects, but every intellectual has to specialize in a narrow area of the acquired knowledge, but should never deprive himself from a general acquaintance of the revealed knowledge. By this one can see that the Islamic education covers all aspects of man including his physical, mental, psychological, moral, and spiritual faculties, and the way and means of the Islamic education are unlimited.

This include individual as well as collective teaching, tutorials, independent reading, field studies, research work, vocational training, extended education, extramural studies, professional refreshing courses, on the job and in-service training, etc. To achieve this all the available tools, aids, innovations and the various useful media of information can be used.

As to its methodology, Islamic education is most comprehensive, integral and unified because it caters for the physical, mental, psychological, moral and spiritual development of the students and qualify them for carrying out their roles successfully in this life, and for getting the reward in this life and/or in the life to come. It imbues the students with the glory of Islam, trains them for the more commitment to its guidance and decorates them with the spirit and ideals of this religion which is the only acceptable one by our Creator. It also trains them to be good human beings and constructive vicegerents on earth. This can be achieved by enlightenment and commitment, learning and specialization of both the acquired and the revealed knowledge which unites man and the cosmos in complete submission to the will of the Creator, and equates both the material and spiritual aspects of everything, with its moral bindings. Islamic education it equates seeking knowledge with the acts of worship, faith with striving hard for the honest earnings of one's living and for playing his or her role as a successful and a good vicegerent on earth. Islamic education includes this world and the world-to-come in one equation, and hence, Islamic education is not only the solution for the world education crisis but for all the crises of our troubled world.

8 SUMMARY AND CONCLUSIONS

Amid a virtual explosion of knowledge, and a worldwide expansion in education, man is living an educational crisis. The crisis shows itself in many ways, but comes out more graphically in the general degeneration of the educated individuals, the corruption of the human society, the vacuity of culture and the numerous injustices, transgressions and aggressions in the world.

The roots of the crisis have been viewed as basically economic, social, professional, organizational, administrative, psychological, ideological, moral,
religious, etc. or a combination of all such factors, but suggested reformatory
on such bases have proved to be partial and futile. This is simply because on
one hand, western education has taken a secular stand, religion has been
completely negated and the clergy continued to cling to conventional practices,
merely because they are traditional and inherited dogmas, without rational
thinking, reflection or imagination. This has widened the gap between
education and religion, and has resulted in complete failure of the current.

On the other hand, in the Muslim world, secular education was imposed by
the Western colonialists, and the secularists were aided to the seat of power and
dominated the life of Muslims. Consequently, religious education was
completely isolated and dwindled because its graduates became isolated from
the latest contributions of scientific research. This dualism of education in the
Muslim world is an ailment that was transferred by the western colonialism and
has no precedence in the Islamic civilization.

From the above-mentioned summary of the main causes of the current
educational crisis, it becomes obvious that the real solution to the problem is to
go back to the Islamic system of education which combines both the revealed
knowledge and the acquired one to go all the way, hand-in-hand, honouring the
specialization. Islamic education covers all aspects of the educated youth
including his/her physical, mental, psychological, moral, spiritual and religious
faculties. It uses all the acceptable tools, ways and means of bettering the
educational system, without reservation. It is the most comprehensive, integral,
unified system of education known to man, and its negation represents the core
of the world educational crisis. It imbues the students with the truthfulness and
glory of Islam, convince them with the more and more commitment to its divine
guidance and decorates them with the spirit, morals and ideals of the only
religion acceptable by the Creator. Islamic education trains its students to be
good human beings – not just good citizens and constructive vicegerents on
earth – not destructive ones –, ordering whatever is good and forbidding
whatever is bad according to the divine judgment. Islamic education is the only
way out of the current education crisis, and we hope that it will soon be adopted
by every educator.
REFERENCES


429


Integrated S&T Curricula: The Present Need of the Islamic World

M.M. QURASHI and M.D. SHAMI

Pakistan Academy of Sciences
Islamabad, Pakistan

1 ABSTRACT

It is universally recognized that science and technology provide the most effective means for achieving progress and development, as well as self-reliance and independence. Science and Technology do have an impressive record of achievements, but their social impacts are often vitiated by the tacit assumption that science has the right to direct the physical, social and mental life of man. Development, to be truly sustainable, must not only improve the physical quality of life, but also be in harmony with man’s intellectual, moral and spiritual aspirations, which form a part of human culture.

The problem therefore arises of bringing about an appropriate cultural match between our scientific and technological development, on the one hand, and our moral and spiritual development, on the other. This is particularly significant in case of countries of the Islamic World, because our Islamic heritage of faith is deeply ingrained in all Muslims, whether Arab or non-Arab, in the East or in the West. Several world conferences on education for Muslims held in the past ultimately led to the concept of integrated curricula, involving a cross-fertilization of scientific and Islamic concepts and have been tried with success in Malaysia, Indonesia and Nigeria.

Today, the whole Muslim world needs this integrative approach, and accordingly this paper is an extension of what was presented in 1999 at the Teheran I.A.S. Conference, in the shape of a comprehensive 15-year Outline Plan for Integrated Education from 2006 to 2020. The plan has been broken up into 3 five-year periods as well as into 3 levels of education, viz., school, college and university, which needs due consideration by the Muslim countries. Besides, IAS may constitute a high-level committee to examine the proposal and implement the same as far as possible.

1 Secretary, Pakistan Association for History & Philosophy of Science, C/o Pakistan Academy of Sciences, Constitution Avenue, G-5, Islamabad; and Fellow of the Islamic World Academy of Sciences.

2 Treasurer, Pakistan Academy of Sciences, Constitution Avenue, G-5/2, Islamabad, Pakistan; Fellow and Vice-President of the Islamic World Academy of Sciences.
Science and Technology can be of immense continuing benefit to humanity. The teaching as well as the application of science and technology involves a combination of observation, experimentation and theorization. The last of these three occurs within the human mind, and so has close links with human culture and beliefs.

2 THE PRESENT CRISIS BETWEEN SCIENCE AND RELIGION

Today, at the beginning of the 15th century Hijra with a great upsurge and revival of Islamic values, the Muslim ummah nevertheless finds itself in a crisis of thought, this time with the effects of science and technology as a major factor in the shaping of our world-view and therefore, of our thoughts and actions. In almost all Muslim countries, there is, on the one hand, the urge to follow the Islamic tenets to live a life of spiritual good and, on the other hand, the enormous pressure to learn and adopt science and technology so as to harness it for the benefit of the Muslim world. This has created a dichotomy: They can neither wholeheartedly support the “materialistic” science and technology-based view, nor the “spiritual Islamic view of life.”

The Muslim, and indeed all of mankind, is thus caught between the demands of the body, which find satisfaction through the material comforts so amply provided by science and technology, on the one hand, and the inherent urge of the soul of man, on the other, which seeks fulfilment through a spiritual exercise that should elevate man to his proper station as the best of God’s creation. The situation implies overlapping spheres of the physical and the spiritual. In order to keep himself balanced between these often opposed forces of materialism and spiritualism, man stands in need of a model that he can understand and follow; and such a model is provided by the Sunnah of the Prophet (SAW), his precepts and his example in various spheres of activity. Of course, everything in the universe is there for man to make use of, viz. it is said in Surah Luqman:

*See ye not how Allah hath made subservient (serviceable) unto you whatever is in the skies and whatever is in the earth and showered on you His blessings, both manifest and hidden (Al-Qur’an 31:20).*

The proviso is that man should use these in accordance with the guiding rules given by Allah (SWT) and His Prophet Muhammad (SAW). It is stated in Surah ash-Shuara that:

*Whoso desireth the harvest of the Hereafter, we give him increase in its harvest. And whoso desireth the harvest of the world, we give him thereof, and he hath no portion in the Hereafter (Al-Qur’an 42:20).*

An eminent scholar has said “Man is clearly in a precarious state, having much to live with, but little to live for. He is submerged in an abundance of
trifles and meaningless riches. Progress has come to mean just moving on, without care for the consequences of his materialistic technologies. The more technologically powerful he becomes, the more destructive he is, to himself and his planet. There is obviously something fundamentally wrong with our behaviour, or is it simply that we have not recognized that science has reached its limits?"

The emphasis in the Islamic view is primarily on establishment of Salat as a means of developing subservience to Allah (SWT) and the wisdom to use His gifts properly and secondarily there is the inducement to observe and analyse the natural phenomena and utilize these in the service of mankind. There is, thus, a definite need to develop an integrated view of the matter so as to resolve the dichotomy presently faced by the Muslim scientists and technologists.

The truth is that, while the Qur’an sets out to provide guidance to mankind for living a harmoniously productive life, with a view to success in the hereafter, it nevertheless makes repeated references to various natural phenomena as well as historical laws and events, the descriptions of which must be truthful, precise and correct if they emanate from Allah, the Creator of the universe and the Source of all knowledge. So, the interpretation of all such statements and descriptions must, in the nature of things, tally with observed facts. As our observational knowledge grows, the degree of correspondence should therefore increase, rather than decrease; and this is indeed so, as shown by M. Buacille.¹

3 THE CLASSICAL ISLAMIC VIEWPOINT

As against the now well-known axioms of science, we have the classical viewpoint of Islamic philosophical thought, as expounded by men like Al Ghazali and elaborated and declared by various Muslim ulama (theologians) down the centuries, which tends to attribute every phenomenon directly to the power of Allah (SWT). The contrast between this view and the idea of causation is obvious. Thus, for example, in a paper comparing and contrasting Al Ghazzali’s and Ibn Rushd’s views on causality, S. Kocbas², when discussing Al Ghazzali’s claim that, “in the burning of cotton through contact with fire, the agent of the burning is God, through His creating the black in the cotton and the disconnection of its parts,” and the subsequent rebuttal by Ibn Rushd, has written that: “Both had the aim of establishing and assuring the functionality of language (and understanding) among the Muslims...In this section, the central subject is causality and its place in language...Causal implication is different from logical implication, for it rests on a theoretical or hypothetical generalization, not a logico-mathematical one...Ghazali was using the terms “cause” and “effect” in a religious grammar.

“Ibn Rushd’s objection to Ghazali is directed to his understanding of “cause” and “effect” in a totally religious grammar...We know that causality is not a principle, but only a structure we use in theoretical-hypothetical-empirical explanations-----Today we are using some other structures besides the causal
structure in theoretical-hypothetical-empirical statements. These are: the probabilistic structure, the relativistic structure and the indeterministic structure.”

In fact, in Ibn Rushd’s concept of ‘ilm’ (knowledge), besides the truly Islamic sciences (i.e. the Qur’an, Hadith and Tafsir), logic, mathematics, astronomy and other theoretical sciences had an important place; and in his concept of ‘hikma’ (or wisdom), logic and philosophy were indispensable constituents. His stance visa-a-vie scientific knowledge was thus a positive one.

4 MATCHING THE TWO VIEWPOINTS

The Muslim world in the past generally appears to have accepted the philosophical approach expounded by Al Ghazali, while the Europeans, soon after, took up the more rationalistic exposition of nature put forth by his near contemporary, Ibn Rushd. That enabled them to develop science and the scientific attitude in their culture.

Clearly, to bridge the gulf between these two points of view, we need a fresh look. In this context, a recent paper\(^3\) has elaborated the fact that, in any given measurement or observation in the physical or biological sciences (and therefore in the laws derived therefrom), there is a certain measure of variation or uncertainty on either side of the so-called mean value. This uncertainty (i) varies in relative extent, being smallest in physical measurements and largest in biological observations, and (ii) seems to have a certain truly indeterminate component e.g. a medicine may affect a cure in only 60% cases. This indeterminacy not only shows that scientific causality has an essentially probabilistic structure, but opens the door for the existence of a direct interaction of the spiritual/sociological sphere with the spheres of physical and biological sciences.

Thus, in a sense, Allah (SWT) does indeed directly control all phenomena: the laws of the universe are made by Allah Ta’ala, but He also has the power to alter these laws (as, for instance in the early phases of the “Big Bang” process). This constitutes the bridge between the normal rules of Allah and the power of Allah and, therefore, between the views of Ibn Rushd and Ghazali. This difference and inter-mingling has to be understood and then explained at the secondary school level with the purpose:

(i) To make science and Islamic values an integral part of our way of thinking, bringing out the power of Allah (SWT) as well as the laws of the world laid down by Him;

(ii) To introduce and adopt Islamic teachings and values in a rational manner at all educational levels.

As a result of discussions at three world conferences on education from 1981 to 1985, it was essentially agreed that the purpose of basic education to children in the Muslim world should be:
(i) To prepare a sound well-integrated base for providing education and scientific knowledge to Muslims; while that of secondary education would be:

(ii) To provide essential scientific knowledge that can form a coherent foundation for higher S&T education, training, and its utilization in the light of Islamic values.

Beliefs – develop over a lifetime and – are very resistant to change. In our daily life we observe that people express their beliefs through their actions and transmit them across generations. Yero (2002) observes that the beliefs of the people not only cast their effects on their behaviour, but also affect how they perceive (or pay attention to) their environment. He proposes to change the old saying, “seeing is believing” into “believing is seeing.” He said that when people believe something is true, they perceive information supporting that belief. Beliefs alter the expectations, people perceive what they expect to perceive. It seems that a particular view and belief about the nature of science has a considerable influence on the beliefs of our students.

The results of a study by M. Iqbal et al. indicate that Pakistani science teachers hold constructivist views with respect to just three items, that is, (i) Old theories are no use to scientists, (ii) Scientific knowledge is final, not tentative, and (iii) Scientific laws can be proven to be absolutely true, and it is obvious that teachers’ views with respect to these three items are in accordance with religious views. Although traditional beliefs have little scientific basis, it is difficult to ignore them. Consequently, teachers and administrators tend to use them as the basis for educational procedure, even though during their professional training these beliefs have been pointed out to them as untrue. Traditional methods and points of view are attractive because they are psychologically comforting and reassuring, despite their ineffectiveness. The constructivist view about science can help teachers and students, as well, by relieving them from “symbolic violence” resulting from understanding science from the traditional perspective. Developing teachers’ understanding about the constructivist epistemologies may be an essential component of teacher-education programs.

5 THE BEGINNING OF INTEGRATED CURRICULA

Efforts to undertake this exercise were started in several countries soon after the second world conference on Muslim education held at Islamabad in 1980, notably in Indonesia, Pakistan and Malaysia. In Indonesia, a task force was set up in 1978, which actively participated in the subsequent world conferences and came up with draft curricula, involving a combination of perennial and acquired knowledge, which were soon adopted in the country. In Pakistan, a commission for Islamisation of education was set up in 1988, the aims of which included:

(i) Safeguarding the Islamic traditions and ideology of Pakistan;
(ii) Moulding the syllabi and text-books into the Islamic system; and
(iii) Need for the introduction of natural sciences in the syllabi of Deeni Madaris (religious schools).

In Malaysia, the effort towards creation of the integrated curriculum for secondary school (KBSM) started in 1980, in line with some recommendations made by the Report of the Cabinet Committee on the Implementation of Education Policy (1979). This report also became a basis for the reformation of curriculum at primary school level i.e. Curriculum Planning for Primary School (KBSR), which was implemented in all the states of Malaysia by 1983.

In brief:

1. The contents of KBSM include knowledge, skills, attitudes, and relevant values for the development of the potentials of students in a comprehensive and integrated manner, so that they become harmonious and balanced people in intellectual, spiritual, emotional and physical aspects. The development of potentials of the students in intellectual aspects includes the following elements: to receive useful knowledge, to develop thinking ability, to acquire arithmetical skills, problem-solving skills, reasoning as well as communication and interaction.

2. In structuring the learning activities under KBSM, some subjects are considered as the core ... that is obligatory for all students. These subjects are for the fulfilment of the need for overall and integrated individual development. There are also some subjects that are optional or elective. In lower secondary level, the elective subjects are called additional subjects.

6 CURRICULA AT SECONDARY SCHOOL

Sustained efforts should be made to develop the creativity of the students by co-ordinated re-awakening of the latent Islamic moral and social values, emphasizing the balanced and just way of life advocated by the Qur'an and Sunna, which had been the base for the early Muslims' progress in scientific knowledge. The foundation for this would in fact have been laid at the primary level if the curriculum had been properly organized (the efforts made in Indonesia and Malaysia could be used as models for this purpose): viz., the primary curriculum for classes-I-III may be integrated into two books only; one integrating Language, Islamiyat and Science, and the other dealing with Mathematics.

At each appropriate level, books on Islamic studies should be included, presenting the worldview of Islam, in coherent juxtaposition with the scientific and technological worldview, and recognizing that moral reformation has to precede the scientific and technical uplift of the Muslims. A ten-year plan for the secondary level is outlined below:
Figure 1. A ten-year plan for the secondary level.

The effective dialogue between the leaders of Madrasas and Western-type education would have a crucial role in the successful implementation of the above plan. An attempt has been made in Indonesia and Pakistan to follow the mentioned outline in selected modern and traditional schools (Madrasas).

Teaching of science should have three main aims:

a) To develop a rational and critical aptitude for observation of natural phenomena;
b) To inculcate mental skills to develop coherent theories of natural phenomena, based on the observed data that also fit the Qur’anic stance;
c) To enable persons to build on previous knowledge and work collaboratively for unravelling the laws of nature.

During the learning-teaching process, it should be incumbent upon the teacher to present himself as an exemplary person and to explore practical Islam-Science relationship through Qur’anic examples, e.g. biological phenomena and meteorological phenomena (see Figure 2).
Figure 2. Examples of practical Islamic-Science relationship.

It is illuminating to note here that repeatedly in the Qur’an; Allah Ta’ala refers to His power when referring to biological phenomena and agriculture. For example, He brings rain wherever He wishes, He brings forth crops as He wishes (Surah AlWaqiah, V. 68-69; 62-63), and He cures when He so wills (Surah Shuara, V. 80).

7 QUALITATIVE IMPROVEMENTS IN THE UNIVERSITIES

Science education of high quality imparts attributes to students that they retain over a lifetime. These attributes include: an understanding of the methods of scientific inquiry; an appreciation of the structure of mathematics and the processes of mathematical reasoning; the capacity to organize one’s thoughts and to present logical, concise oral and written arguments. A well-educated person can apply his knowledge and skills productively in economic processes. Quality higher education also develops the capacity for learning, so that the professional and technical worker is imaginative, innovative, and self-critical, and able to respond effectively to the changing demands of society.

Quality-improvement, not merely quantitative expansion, should be the overwhelming priority in science-education at the university level in Muslim countries. Expansion should occur only under conditions that guarantee and sustain high quality. The root cause of faltering quality in higher education as well as scientific research is its supply-driven orientation. People are “educated and trained” and “knowledge is produced” with little consideration of the economic requirements of the agricultural, industrial, and services sectors. To improve quality in college and university science- education, fundamental changes will be needed, and should be resolutely implemented in three areas: the institutional framework, uses of resources, and the very nature and content of higher education and scientific research.
Some of the essential ingredients of quality science-education at universities, which need to be taken care of include: sincere, dedicated, highly motivated, faithful faculty members who themselves possess education of high quality, attentive students who are committed to learning itself, not merely to acquiring the paper certifications of learning; libraries with modern facilities; well-equipped laboratories; and technical support staff.

8 UNIVERSITY CURRICULA IN PAKISTAN

In 1973, the Government of Pakistan established the University Grants Commission (UGC) under an act of the parliament. One of its functions was to recommend to the universities measures necessary for the improvement of university education. All the education policies of Pakistan have laid due emphasis on curriculum development. Initially, a National Curriculum Bureau (NCB) was constituted “to review and up-date the curricula for all stages of education, including technical and vocational education, to keep them constantly under review and to revise and modernize them at regular intervals.” Subsequently, the Government of Pakistan under ‘Federal Supervision of Curricula, Textbooks and Maintenance of Standards of Education Act 1976’ appointed the University Grants Commission as the competent authority to look after the curriculum revision work beyond ‘Class XII’ and at Bachelor’s level and onwards and to all degrees. These included certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

In pursuance of the above decisions and directives, the commission had undertaken the task of curriculum revision in collaboration with the universities, R&D institutions, industry and other relevant sectors. National committees in various disciplines were constituted to revise the existing curricula, and to bring them up to the national requirements by introducing innovations so that the quality of education is improved and future needs of the country are met. This also ensures more or less uniform academic standards in different colleges and universities of Pakistan.

The University Grants Commission was authorized under this Act to:

a) Prepare or cause to be prepared schemes of studies, curricula, manuscripts of text-books and schedules of strategy for their introduction in various classes of an institution, in connection with the implementation of the education policy of the federal government;

b) Approve manuscripts of text-books produced by other agencies before they are prescribed in various classes of an institution; and

c) Direct any person or agency in writing to delete, amend or withdraw any portion, or the whole, of the curriculum, text-book or reference material prescribed for any class of an institution within a period specified in such directive.
The UGC has so far revised and updated the curricula of 46 subjects at the BA/BSc and MA/MSc levels, incorporating new global trends and advancements in each discipline. The process of revision and modernization of curricula continues at regular intervals of 2-3 years.

9 FACULTY DEVELOPMENT PROGRAM OF HEC

The Higher Education Commission (HEC) was established on September 11, 2002 under the Presidential Ordinance, replacing the University Grants Commission, which was operating under an Act of the Parliament since 1974. The HEC faced major issues in regard to poor standard of faculty, low enrolment for higher education, minimal relevance for higher education to national needs, low quality of research and poor governance of universities. To improve the situation, the HEC launched the Medium-Term Development Framework (2005-10) with strategic aims of faculty development, improving access to higher education, promoting excellence in learning and research and its relevance to the national needs. Several programs have been launched to enhance faculty-development.

In Pakistan, about 25% of the current faculty members hold PhD degree and less than 25% of the faculty is engaged in research. The major thrust of faculty-development involves scholarship programs for increasing PhD faculty-base, in-service training, attracting talented young graduates towards teaching and research, and provision of enhanced facilities for PhD qualified faculty, to ensure that they have an intellectually stimulating academic career. Some relevant programs for this five-year period are mentioned below:

1. **PhD Fellowship** for 5000 scholars (indigenous), with provision of monthly stipend of Rs 8,000 plus Rs 100,000 per year to the university department for equipment, chemicals, etc., with reference to research work, plus Rs 5,000 per month to the supervisor. The fellowship is of four-years duration.

2. 15,000 to 20,000 persons will be sent abroad for PhD to reputed foreign institutions in fields of national priority over the next five years. Each scholarship is for 4 years with maintenance allowance of $800 per month, plus university tuition-fee, book allowance and air travel. The scholarships are offered for pursuing studies in selected universities in Austria, China, France, Germany, UK, and USA, etc.

3. The **Split-PhD Program** is aimed at increasing international linkages in the priority subject-areas. Two models are followed: (a) first two years at a local university, two years abroad; degree is awarded by the foreign university; and (b) first year in Pakistan, two years in a foreign university and fourth year in Pakistan for thesis-work, and degree is awarded by the local university. All expenses are paid by the HEC.

4. The **Post-Doctoral Fellowship Program** includes 1,200 fellowships: 80% to faculty working in public-sector universities and institutions and 20%
to the faculty engaged in private sector and degree-awarding institutions. Each fellowship is of 9-12 months duration, with monthly stipend of $1200 plus economy air ticket. A bench-fee waiver may be obtained.

These programs have attracted numerous talented students and faculty members to enrol for post-graduate studies in local universities. This is evident from the following figures in the Statistical Yearbook on Higher Education (HEC, 2005):

In 111 universities and degree-awarding institutions, the enrolment at MPhil level has doubled from 3,871 to 7,454 and similarly for PhD level from 3,124 to 6,472 between the years 2001-02 to 2003-04. In contrast, some years back just 12 PhDs and about 150 MPhils were being produced annually by the local universities. Even allowing for normal attrition by students getting good jobs and leaving during the MPhil/PhD program, this is indicative of a substantial increase in high-level S&T manpower during the next five years.

There is a lot of controversy about the use of cumulative productivity factor and citations as tools to measure quality and performance of university teachers and scientists in Pakistan. To consider only this index and publications in international journals for future promotion and allowances to them may ruin the tradition of applied research in Pakistan and lead to migration of talented persons. Dozens of scientists and engineers have done excellent work in agriculture and industrial sectors, but no contribution to international journals and thus no appreciation from the HEC, whereas some university teachers and scientists in basic sciences continue to benefit monetarily and have an edge over others, in terms of national recognition and merit. Evaluation of performance should also be based on development of new varieties, patents and products and quality manpower and not based only on such borrowed formulae, which vary from year to year and from one discipline to another.

HEC has introduced the Tenure-Track System (TTS), whereby the continuity in employment is based on performance and thereby leaves no permanency in the job, whereas in the past, if one entered as lecturer in the public-sector universities, through experience and some publications, he was likely to climb to the position of professor, depending on availability of the post, heavy emoluments are paid to the faculty members under the tenure-track system. Under this system and hiring of foreign faculty, some young PhD holders from foreign universities are receiving four-times higher salary than their old teachers with 25-30 years experience. The Federation of All Pakistan Universities Academic Staff Associations and its component bodies, opposing the TTS, are pressing hard for upping the scales for the faculty one grade higher and introducing special pay-scales in universities, as was the case in other public-sector research organizations like PARC, KRL and NESCOM. It is reported that one grade higher demand of university teachers has been accepted by the government.

Unfortunately, the human resource development program of HEC has not yet proved to be a significantly potent factor in stimulating the formation of a large number of research groups at the universities in Pakistan, which are ultimately the feeders for producing highly qualified manpower.
10 TOWARDS UNDERSTANDING THE COMPLETE REALITY

In order to apply the integrative approach fully we need to combine the information (see Figure 3) from the three types of knowledge, characterized above, namely:

i) Knowledge of the physical universe, as specified by observation and experiment and, of course, extended by scientific theories;

ii) The Qur’anic knowledge, i.e. the commandments of Allah and His statements about the universe and the operation of its constituents;

iii) The Islamic view of social sciences and philosophy, which is made up of the Ahadith* of Rasulullah (SAW) and the Islamic worldly knowledge of economics, sociology, etc.

Figure 3. Combination of information from three sources to define the phenomenon precisely.

The above process may then be represented diagrammatically in the sketch of Figure 3 in which the three composite elements or rays from these to the phenomenon being examined are shown, forming the small shaded triangle of error near the middle of the sketch.

By using all three rays, one is thus able to fix or delineate the precise position (or the complete reality) with a fair degree of certainty or precision. On

* The Ahadith explain and amplify the application of the Qur’an to our lives in this physical universe and give us the Islamic view of social sciences, combining the prophetic commentary with our limited knowledge of the social behaviour of man. This is indicated by showing the amalgam of Hadith and social sciences at one corner in the figure.
the other hand, if as often happens one uses only two out of the three rays (or sources of knowledge), then the intersection of the two would lead to a large margin of uncertainty, even for a small error in the directions of the two rays, each of which may be subject, individually, to large errors.

11 DISCUSSION OF AN INSTRUCTIVE EXAMPLE\textsuperscript{11} FROM SURAH LUQMAN

Ayah 34 of Surah Luqman states: “Lo! Allah! With Him is knowledge of the Hour. He sends down the rain, and knows that which is in the wombs. No soul knows what it will earn tomorrow, and no soul knows in what land it will die. Lo! Allah is knower, Aware,” (See M. Pickthall).

A careful examination of the contents of this Ayah reveals that here there are five elements mentioned by Allah, namely;

i) With Him is knowledge of the Hour (The Day of Judgment);
ii) He sends down the rain;
iii) And knows that which is in the wombs;
iv) No soul knows what it will earn tomorrow;
v) And no soul knows in what land it will die.

The portions (ii)–(v) fall into two categories of two elements each:

a) Those which are stated to be exclusively in the knowledge of Allah, and mankind has not been given knowledge of these, namely elements (iv) & (v), as indicated by the definite word “no”;

b) Those elements where Allah has not withheld (or denied) knowledge thereof from mankind; these latter are elements No: (ii) & (iii), which are essentially scientific phenomena from meteorology and biology.

It will be seen that modern science, with the aid of satellites orbiting the earth, is now in a position to forecast the weather with a fair degree of certainty (upto 80% or more in many cases) and even to make artificial rain. Also, with the aid of ultrasound and other instruments, man is now able to ascertain the sex of the foetus with high degree of precision (may be 90%), as well as some hereditary defects, \textit{before} the birth of the foetus. This accuracy is likely to increase with further advancement of science. So, when considering the Hadith that purports to say that man has not been given knowledge of these five things, one must interpret it (the Hadith) to refer to complete knowledge of items (ii) & (iii) above.

We now proceed to describe the lay-out of a 15-year action plan for S&T education, based on this type of integrative approach for producing a well-balanced and productive Ummah.
12 A LAY-OUT OF THE 15–YEAR ACTION PLAN

This outline has been prepared in the light of the strategy of integrated curricula and the needs for education at the various levels discussed above. Due emphasis has been placed on the scientific and technological components of education at the primary, secondary, vocational as well as tertiary levels\textsuperscript{12}.

The first and second rows in the plan deal with the progressive development and gradual implementation of integrated curricula at (i) Primary Schools and Technical Schools, and (ii) Secondary, Vocational and Technical Schools. An effort has been made to divide the plan, as far as possible, into successive five-year periods, with smaller sub-divisions of two years where needed. The integrated curricula can probably be fully made operational in the third five-year period.

In the third and fourth rows, the corresponding process has been outlined for the case of (i) Degree and Technical Colleges, and (ii) Universities and Institutes of Higher Learning.

The success of this process will largely depend on two major factors: (i) the quality as well as quantity of the inputs from the first two educational levels, and (ii) the extent to which the college and university teachers can be made to accept and adopt the somewhat radical concepts and suggestions given above.

The last row gives a rough picture of the essential interactions required between universities, R&D organizations and industry, which would lead to technology development, cooperation between industry and R&D institutes, ultimately resulting in the establishment of operative R&D groups within selected industries. This interaction would hopefully set the stage for the development of sound industrial policies, with special emphasis on technology development/transfer and regional cooperation in the long-term perspective.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Framing/Development of integrated Curriculum Textbooks</td>
<td>Teacher Training at Primary Level</td>
<td>Integrated Curriculum Teaching at Primary Schools</td>
<td>Dialogue for Coordination between Madrasah &amp; Traditional &amp; Western type Education</td>
<td>Plan for Coordination between Madrasah &amp; Traditional &amp; Western type Education</td>
<td>Integrated Curriculum made operational at Primary Schools and Madrasah &amp; Traditional Schools</td>
<td></td>
</tr>
<tr>
<td>Curriculum and Textbooks Development with emphasis on Practicals in Secondary and Vocational Schools</td>
<td>Introduction of Group Activity in Secondary Schools and Vocational Schools</td>
<td>Training of Teachers for integrated curriculum at Secondary and Technical School Levels.</td>
<td>Integrated Curriculum made operational at Secondary and Technical Schools level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development of Curricula for Degree and Technical Colleges</td>
<td>Plan for Training of Teachers for Scientific Methodology at Degree and Technical College Levels, including a component of Social Sciences and Humanities</td>
<td>Cooperative Research Activity in Degree and Technical Colleges in emerging fields, e.g., Bio-Tech, Electronics, etc</td>
<td>Training of Teachers for integrated Curricula at Degree College Level</td>
<td>Training of Teachers for integrated Curricula at Technical College Level</td>
<td>Integrated Curricula to be made operative and Scientific Methodology at Degree &amp; Technical Colleges</td>
<td></td>
</tr>
<tr>
<td>Plan for Curriculum Updating and Practical Activity at University Level</td>
<td>Plan for Research at University Level</td>
<td>Establish Practical and Group Activity at University level</td>
<td>Establish R&amp;D Groups in Universities and Institutes</td>
<td>R&amp;D Groups operational progressively at various Universities and Institutes of Higher Learning.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Outline Plan for Industrial Policy</td>
<td></td>
<td>Development Bilateral inter-Islamic and international cooperation, Technology Transfer and Development</td>
<td></td>
</tr>
</tbody>
</table>
13 ROLE OF IAS

In order to promote scientific literacy among Muslim students, the Islamic World Academy of Sciences (IAS), in collaboration with COMSTECH and ISESCO, should develop a strategy and draw up 25-year plan for OIC countries. IAS should constitute teams of eminent educationists, scientists and scholars drawn from Muslim countries, particularly involving its own Fellows, for the development of curricula and textbooks at school, college and university levels. Guidance shall be sought from the Holy Qur’an and the Sunnah for basic principles that further this task. This may, in part, help our students to meet the challenges of the 21st century.

It needs hardly any emphasis that we are already late by about two decades in accepting and implementing the idea of integrated curricula. Since it is never too late to mend, the Islamic World Academy of Sciences may give due consideration to the usefulness and dissemination of the proposed Fifteen-Year Action Plan from 2006-2020. The first phase should be developed in consultation with persons who have experience with integrated curricula, e.g. in Indonesia, Malaysia and Pakistan.
REFERENCES


* As listed by the authors.
Higher Education Excellence for Development in the Islamic World: A Viewpoint from ISESCO

ABBAS SADRI
Director of ISESCO Regional Office
Tehran, Iran

1 ABSTRACT

The first and one of the most venerated words in the Quran is "read;" learning is believed to make a person more faithful to God, and more useful to humanity. In Islam, acquiring knowledge is equated with seeking the truth. As the great Arab philosopher Abu Youssef Al-Kindi (805-873) said: "We should not shy away from welcoming and acquiring the truth, regardless of where it comes from, even if it comes from distant races and nations that are different from us. Nothing is more important than seeking the truth except the truth itself." Today, we live in the information age and Islamic countries could be left behind once again if they do not modernize their education system. This has to be taken into account in educational reform both to catch up with the developed world, and to ensure technological development in every field.

The demand for efficient performance of the educational sector, especially in the higher education institutes, is increasing especially due to the shift from the industry based society to the knowledge based society. So, the member states of the Organization of the Islamic Conference (OIC) must be aware of this new paradigm and the needs for socio-economic development in their countries. In this regards, the strategic planners in the Islamic countries should consider the following issues and challenges:

a) Globalization;
b) ICT Revolution;
c) Economic Restructuring; and
d) Emergence of Knowledge-based Society.

2 A PROPOSED PLAN OF ACTION

Key aspects of these efforts should include:

- Improving science education at the primary and secondary levels, upgrading universities and research institutions, and launching and reinvigorating merit-based national science academies. Innovative ways of
teaching science must help children learn and involve them directly in acquiring new knowledge, especially through new Information and Communication Technologies (ICT). Special schools for children gifted in science should be established and scientific information, including access to non-credit ‘distance learning’ courses, which present science in ways that can be easily understood by a non-expert audiences, should be offered to adults both on radio and television. Islamic states should seek to strengthen their universities and research institutes;

- In addition, access to high-level science courses and lecture seminars should be facilitated by providing access to such information on the internet. Again, this is taking place but the pace of reform should be accelerated. As in many other countries around the world, efforts should be made to transform science academies from somber ‘old men’s clubs’ into dynamic ‘boundary’ organizations capable of addressing key social problems and advising governments on scientific issues and critical national and international concern. Scientists working in Islamic countries that do not yet have merit-based science academies should encourage their governments to launch such organizations;

- Harnessing science, technology and innovation for economic development and social benefits. This requires multi-disciplinary teams of experts.

- Enhancing international scientific collaboration.

- Each of these reforms requires specific actions that should also prove instrumental in achieving two broader objectives:

  - **Raising the status of quality-research and education in science, technology and innovation by focusing on human resource development and the development of universities and research institutes of excellence.**

  - **Mobilizing and engaging scientific communities to assist in designing and implementing solutions to real-life problems and challenges facing various Islamic countries.**

These challenges have posed some sort of opportunities and also threats for the member states of OIC. Developed countries with their futurology have paved the grounds to make the best use of such opportunities and have shaped long-term and mid-term strategies and in fact new doctrines for the role of higher education in development and the ways to face these challenges. In order to achieve these goals, international collaboration should be encouraged, especially for the purposes of fostering a new generation of talented scientists throughout the Islamic world. Such collaboration should take place through fellowship programmes for meritorious undergraduate and graduate students to study at universities and centres of excellence, both in the developed and developing world. Competitive institutional grant programmes should be created to upgrade the infrastructure of existing institutions and lay the groundwork for transforming such institutions into regional and perhaps even international centres of excellence.
On the other hand, developing countries consisting most of the OIC member states have not yet been able to define the ways forward and also opportunities and threats of new paradigms and the ways to overcome the conditions of aforementioned challenges. So they have failed to a great extent to equip their human resources to meet those challenges. Reform of education can play a central role in economic development because it develops the minds of the young to be useful citizens. It must include teaching the young how to think for themselves and to have confidence in their knowledge.

One fact that has been ignored is the “specialized workforce training and development of human sources” which are the responses to new challenges. Such deficiencies have caused poverty, low level of education, educational injustice, outbreak of diseases and population growth in these countries. The deficiencies should be attended for to enhancing socioeconomic status, for poverty reduction and elevating the respect of the nations.

It is clear that developing the doctrine for development and responsiveness of higher education systems should be carried out into the agenda of OIC countries although some measures should be taken.

Especially, knowledge as the intellectual capital, which is one of the emerging trends in the twenty first century, and particularly the role and responsibilities of the higher education in the Islamic countries, will be taken into account. The traditional missions of research and teaching is being supplemented or replaced to some extent by treating knowledge as an intellectual property by reducing the gap between pure and applied research and the commercialization of innovations.

3 WHAT OF TRANSFORMATIONAL TECHNOLOGIES?

Emerging technology is another issue that can be considered in this context. Islamic countries’ condition in all aspects of emerging technologies will also be taken into consideration. Some of them are as follows:

- ICT;
- Biotechnology;
- Nanotechnology;
- Energy;
- Environment issues;
- Community and rural technology.

The ways to get access to these technologies have impact on policies, objectives, methods and contents of higher education aspects and we must pay special attention to general skills of higher education, such as:

- Creativity and innovation;
- Critical thinking;
- Communication and presentation;
- Career and long life learning; and
- Cross-cultural understanding.
4 S&T IN THE ISLAMIC WORLD

4.1 Current status of S&T in the Islamic World

- Illiteracy is highest in the Islamic countries;
- S&T infrastructure is weak;
- Research and innovation is absent;
- The total GDP of the Islamic world is small;
- Japan has virtually no resources but over 1000 universities

4.2 Expected status in near future

- The economic activity will not be stabilized without having capability in science and technology;
- Islamic countries will become relatively ignorant nations in the world and will lag significantly behind in the knowledge-based global economy.

4.3 Relationship between economic activity and S&T

- Impetus for growth in the economy comes from increasing the knowledge base of economy, including research and education and skills, and fostering technological innovation.
- Science and technology is an engine of creating and driving knowledge, weakness in S&T may seriously undermines success in knowledge-based economy

4.4 Strategy for promotion of S&T in Islamic countries

- Acquiring knowledge;
- Absorption of knowledge; and
- Communication knowledge in the information age.

4.5 Strengthening National system of innovation (NSI)

- NSI comprises several institutions and competencies interacting in order to assimilate the growing stock of global knowledge and in order to adapt it to local needs and use it to create knowledge and technology
- New scientific knowledge can contribute to economic development only if the NSI works effective.
4.6 What should be done?

Reform at a snail's pace is no longer acceptable. The pace of worldwide progress is exceedingly fast. No one is afforded the luxury of slow motion; being left behind in any endeavour results in marginalisation.

The main obstacle that must be removed is the unfounded fear of "cultural invasion." The goal here is reform, and not Westernization or adopting the cultural nuances of the West. Europeans emerged from the Dark Ages by learning from the Muslim civilisation and importing its knowledge to their lands.

It is never too late to remedy a problem, particularly when it relates to the future of a nation. A factory that goes out of step with the times is retooled. In the same manner, the objectives and mission of education in the Islamic world need to be quickly updated. What is needed is to immediately reform the existing educational system, and improving its infrastructure.

It is important for Islamic intellectuals to speak their minds and lead the way. As the British parliamentarian Edmund Burke said: "The only thing necessary for the triumph of evil is for good men to do nothing."

Conditions are so bleak in some Islamic countries that they require drastic changes, and more of a revolutionary approach is necessary. Some crucial issues and suggestions include:

a) Agreement between universities of OIC countries for exchange of publications, course materials, admission of students and recruitment of faculty members;

b) Development of the quality standard of course materials and syllabuses for mobility of students;

c) More public and private investment in higher education sector in OIC countries. Public spending may be intensified for the deprived section of the society;

d) A committee consisting of personnel from the higher education authorities and the chamber of commerce and industry may be formed and should have active relations with similar cells of other OIC countries;

e) Improve the quality of human capital and reduce the technology-gap between the Islamic community and the developed world by enhancing the level of R&D activities.
5 ISESCO’S ROLE

5.1 The role of the Islamic Educational, Scientific and Cultural Organization (ISESCO)

- ISESCO under the framework of its charter is committed to create societies that value knowledge and build up capacity to utilize knowledge and advances in S&T to enhance the socioeconomic and wellbeing of the Ummah;
- Science strategies:
  - Strategy for development of science and technology for the member states;
  - Strategy for management of water resources;
  - Strategy for development of biotechnology.

5.2 ISESCO centre for promotion of scientific research (ICPSR)

- New knowledge is dependent on research, which is one of the weakest areas in the Islamic countries;
- ISESCO established ICPSR to promote advanced studies and scientific research in all fields of science and technology;
- ICPSR provides a permanent forum for the elite researchers to meet each other, exchange knowledge, address common concerns and develop and supervise realistic programs for achieving excellence in scientific research.

6 CONCLUSION

ISESCO is conducting almost 500 activities during the current year that one third of them is related to S&T, and their object is primarily capacity-building in member states. Some of the notable ones are in the fields of Biotechnology, Information, Communication technology, Nanotechnology, Water-Management and Renewable Energy. Evaluation of these initiatives shows that they are beginning to be successful in most of the countries. We hope that this success will prove to be a stepping-stone for a radical change in the society-science paradigm and help to develop a science culture.

To this end, we would like to see more co-operation between the IAS and the ISESCO.
Contributions of Muslims to Science: The Indian Scenario in Brief

M.SHAMIM JAIRAJPURI*
Professor of Zoology & INSA Senior Scientist
Section of Nematology, Department of Zoology
Aligarh Muslim University
Aligarh 202002, India

Muslims were already in sufficiently large numbers in India before the beginning of the great Mughal Empire. Their numbers gradually increased during the past few centuries and the present-day estimates in the post-independent India are that the population has risen approximately to 12%. But, some other estimates put it to be anywhere between 15-20%. Irrespective of the exact population, their performance at higher levels in science has unfortunately been extremely poor.

In India we have, since the 1930s, three very elite and renowned academies of sciences. They have almost similar mandate and deal with all branches of science e.g., physical and chemical sciences, engineering, mathematics, earth sciences, biological, medical and agricultural sciences, etc. The three academies are, the National Academy of Sciences, India (NASI) located in Allahabad, the Indian Academy of Sciences, Bangalore (IASc) and the Indian National Science Academy, New Delhi (INSA).

The last two mentioned academies elect only some 20-30 fellows each year while the Allahabad Academy elects twice as much, i.e., 50-60 fellows. As a result, NASI has some 1200 fellows while IASc has 860 but INSA only 754.

The election to the fellowships in all the three academies is strictly merit-based on the scientific contributions of the nominee. The impact factor of the journal and the citation index are invariably used as criteria besides several other very strict parameters. The selection process in these academies is very fair and is free from all kinds of biases to the best of my knowledge and belief as I was myself a part of the selection process for number of years.

Besides the above mentioned three academies, the Third World Academy of Sciences (now the Academy of Sciences of the Developing World), Italy; as well as the Royal Society of London were searched for Indian Muslim fellowships. The result of this search has been very disappointing as it revealed a very miserable performance by Indian Muslims.

* Fellow of the Islamic World Academy of Sciences.
Out of a total of about 1200 fellows in Allahabad Academy only 30 are Muslims, while their number is only 14 out of 860 fellows in Bangalore and 15 out of 754 fellows in the Delhi-based Academy. All fellows of the various academies put together are 2814 of which only 59 are Muslim, a paltry 2%. This is almost of the same order as the percentage of Muslims in the Government and other services in India.

The TWAS fellowship has been awarded to only 4 Indian Muslims so far and only one Muslim, namely Professor Obaid Siddiqi, an old boy of Aligarh Muslim University, has been elected to the fellowship of Royal Society of London, UK, in the post-independence India.

Though Muslims have been elected to 63 fellowships (excluding FRS being a rarity), this figure is rather deceptive as the actual number of scientists that are involved are only 35. This is due to the fact that 4 of these scientists have 4 fellowships each and all these are biological scientists and three of these are from the Aligarh Muslim University (AMU), namely Professors Obaid Siddiqi, S.Z. Qasim and M. Shamim Jairajpuri. Four other scientists have three fellowships each and two of these are from AMU. Eight scientists have two fellowships and nineteen have only one fellowship each and that too largely of the Allahabad Academy which elects the maximum number of fellows per year. Of these 19, ten are from AMU.

These data alone speak of the ‘substantial’ contribution of the Aligarh Muslim University which was established in the late 19th century by Sir Syed Ahmad Khan, the great visionary as the Mohammadan Anglo-Oriental College which in 1920 became the present university. This great seat of learning has contributed to the education of Muslims in India, not only in all areas of sciences but in all spheres of education. When we look at the age profile of the Indian Muslims elected to the fellowships it is also very depressing to note that 12 of these scientists out of 35 are above 70 years of age and are not doing much science any longer, with one or two rare exceptions. Nine fellows are above 60 years of age and only a few of these may still be active. Twelve of these scientists are above 50 years of age and it is these who are still active in their research contributions. It is rather very unfortunate that only 2 are above 40 years and none are below 40 years of age.

The last figure of two fellows clearly indicates that younger Muslims are either not interested in science or if they are at all interested may not be doing science at that level which could fetch them the fellowships of the academies of sciences in India and abroad.

In all sciences in general, but more so in the Biological Sciences, the contributions of those who were either educated in the Aligarh Muslim University or may have been educated elsewhere but have worked or are still working in Aligarh has been a big contributing factor. Only in the following areas of science the contributions from Indian Muslim have been significant to some extent viz., Genetics, Cell and Molecular biology, Plant Protection and Nematology in particular, and Fisheries including Oceanography in general.
PART SEVEN
APPENDIXES
APPENDIX A

2006 Conference Committees

Advisory Science Committee

Prof. A S Majali FIAS (Chairman)
Prof. Ahmed Marrakchi FIAS
Prof. Mehmet Ergin FIAS
Prof. Naci Bor FIAS

IAS Organising Committee

Moneef R Zou’bi DG-IAS
Ms Lina Jalal, IAS
Ms Taghreed Saqer, IAS
Moneef R Zou’bi DG-IAS (Rapporteur)

Local Committee

Prof. İhsan Doğramaci

Prof. Sinasi Ozsoylu FIAS
Prof. Mehmet Ozturk
Prof. Bilal Talatar
Ms Reyyan Ayfer
Dr Phyllis Erdogan, and
Mr Kamer Rodoplu.
# Appendix B

## Chairpersons of the 2006 Conference Sessions

<table>
<thead>
<tr>
<th>Session</th>
<th>Chairperson</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prof. Abdel Salam Majali FIAS</td>
<td>Jordan</td>
</tr>
<tr>
<td>2</td>
<td>Prof. Adnan Badran FIAS</td>
<td>Jordan</td>
</tr>
<tr>
<td>3</td>
<td>Prof. Ali Dogramaci</td>
<td>Turkey</td>
</tr>
<tr>
<td>4</td>
<td>Prof. Ignaz Bender</td>
<td>Germany</td>
</tr>
<tr>
<td>5</td>
<td>Prof. Ibrahim Al-Naimi FIAS</td>
<td>Qatar</td>
</tr>
<tr>
<td>6</td>
<td>Prof. Earl (Tim) Sullivan</td>
<td>USA/ Egypt</td>
</tr>
<tr>
<td>7</td>
<td>Prof. Mualla Selecuk</td>
<td>Turkey</td>
</tr>
<tr>
<td>8</td>
<td>Prof. Mohammad Asghar FIAS</td>
<td>Pakistan/ France</td>
</tr>
<tr>
<td>9</td>
<td>Prof. Mehmet Ergin FIAS</td>
<td>Turkey</td>
</tr>
<tr>
<td>10</td>
<td>Prof. Mehdi Golshani FIAS</td>
<td>Iran</td>
</tr>
</tbody>
</table>
APPENDIX C

2006 Conference Participants

1. Mr M. Abdelgadir, Sudan Embassy, Ankara Turkey.

2. Prof. Mohammad Abdollahi, Professor of Pharmacology and Toxicology, Laboratory of Toxicology, Faculty of Pharmacy, Tehran University of Medical Sciences, Tehran 14155-6451, Iran. E-mail: mohammad@tums.ac.ir

3. Prof. Sahel Abduljauawd, Dean of Academic Development & Director of Office of Planning and Quality, King Fahd University of Petroleum and Minerals, PO Box 608, Dhahran 31261, Saudi Arabia. E-mail: sajauwad@kfupm.edu.sa

4. Prof. Naim Afgan (FIAS), UNESCO Chair Holder Bulevar Kralja Aleksandra 205, 11000 Belgrade, Serbia and Montenegro. E-mail: nafgan@ist.utl.pt

5. Prof. Ishfaq Ahmad (FIAS), Advisor to the Prime Minister, Prime Minister’s Secretariat, Government of Pakistan, Shahrah-e-Jamhuriat, Islamabad, Pakistan. E-mail: ishahmad@comsats.net.pk

6. Prof. Mohammad Sajjad Alam (FIAS), Director, Albany High Energy Physics Lab, University of Albany, SUNY, 30 Tarraon Terrace, Clifton Park, NY 12065, USA. E-mail: msa90@albany.edu

7. Prof. M. Shamsher Ali (FIAS), Vice-Chancellor, South East University, House 64/B, Road 18, Block B, Banani, Dhaka 1213, Bangladesh. E-mail: msali@seu.ac.bd

8. Prof. Halis Akat, Ankara University, Faculty of Divinity, Ankara, Turkey.

9. Prof. Qurashi Mohammed Ali (FIAS), Dean, National College for Medical and Technical Studies, PO Box 3783, Khartoum 1111, Sudan. E-mail: dean@nc.edu.sd

10. Dr Savas Alpay, OIC Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRTCIC), Attar Sokak No. 4, 06700, Ankara, Turkey. E-mail: oicankara@sesrtcic.org

11. Prof. Wiranto Arismunandar (FIAS), Professor of Mechanical Engineering, Institute of Technology Bandung (ITB), GANESA 10, Bandung 40132, Indonesia. E-mail: wiranto@lmbsp.ms.itb.ac.id

463
12. Prof. Muhammad Asghar (FIAS), Professor, Institute of Sciences Nucleaires, 53 avenue des Martyrs, 38026 Grenoble Cedex, France. E-mail: masgharfr@yahoo.fr

13. Prof. Attia A. Ashour (FIAS), Professor Emeritus, Mathematics Department, Faculty of Science, Cairo University, Giza, Egypt. E-mail: ashour@mail.eun.eg

14. Prof. Abdullah Atalar, Provost, Bilkent University, Ankara, Turkey. E-mail: atalar@ee.bilkent.edu.tr

15. Prof. Saleh Al-Athel (FIAS), President, King Abdulaziz City for S&T, PO Box 6086, Riyadh 11442, Saudi Arabia. E-mail: sathel@gmail.com

16. Dr Mehmet Aydin, Minister of State, Turkey.

17. Prof. Ahmad Nawawi Ayob (FIAS), Emeritus Professor, University of Malaya, A1-2A, Astana Darnasara, Jalan 17/1, Petaling Jaya 46400, Selangor, Malaysia. E-mail: nawawi@um.edu.my

18. Prof. Ahmed Abdullah Azad (FIAS), Scientific Advisor & Consultant, 04 Chapel Court, Doncaster, Victoria 3108, Australia. E-mail: a_azad05@yahoo.com.au

19. Prof. Adnan Badran (FIAS), Former Prime Minister, President, Petra University, PO Box 961343 Amman 11196 Jordan. E-mail: president@uop.edu.jo

20. Prof. Ibrahim Gamil Badran (FIAS), Former President of the Academy of Sciences and Technology; and Cairo University, 2 Dar El Shefa Street, Garden City, Cairo, Egypt.

21. Prof. Mehmet Baray, Dean, Bilkent University, Faculty of Engineering, Ankara, Turkey. E-mail: baray@bilkent.edu.tr

22. Prof. Ignaz Bender, Chancellor, University of Trier, Novalisstrasse 4, D-54295 Trier, Germany. E-mail: bender@uni-trier.de

23. Prof. Naci Bor (FIAS), Editor-in-Chief, Medical Journal of IAS, Mithatpasa Caddesi, No. 66/5, Ankara, Turkey. E-mail: nacibor@bir.net.tr

24. Prof. Nahide Bozkurt, Ankara University, Faculty of Divinity, Ankara, Turkey.

25. Prof. Noor Mohammad Butt (FIAS), Chairman, Pakistan Science Foundation; and Chairman, National Commission on Nanoscience & Technology (NCNST), House No. 155, Street 15, Sector E-7, Islamabad, Pakistan. E-mail: nmbutt36@yahoo.com

26. Mr Nabil Dabour, OIC Statistical, Economic and Social Research and Training Centre for Islamic Countries, Attar Sokak No. 4, 06700, Ankara, Turkey. E-mail: ndabour@sesrtcic.org
27. Ms Lina Jalal Dadan, Programme Officer, Islamic World Academy of Sciences, PO Box 830036, Amman 11183 Jordan. E-mail: ldedan@yahoo.com

28. Prof. Oussaynou Fall Dia (FIAS), Vice-President, Academie des Sciences et Techniques du Senegal, 61 Bd Djily – Mbaye, P.B. 4344 Dakar RP, Senegal. E-mail: academ.sc@sentoo.sn - adia@sentoo.sn

29. Prof. Ugur Dilmen (FIAS), Chief, Dr Zekai Tahir Burak Maternity Hospital, Talatpasa Bulvari, Hamamonu, Ankara, Turkey. E-mail: uguрудilmen@gmail.com

30. Prof. Ibrahima Mar Diop (FIAS), Fellow, Academie des Sciences et Techniques du Senegal, Clinique Fann Hock, Rue 55 angle 70, Fann, Dakar, Senegal. E-mail: diopmar@sentoo.sn

31. Prof. Recai Dogan, Ankara University, Faculty of Divinity, Ankara, Turkey.

32. Prof. Ali Doğramaci, Rector, Bilkent University, 06800 Ankara, Turkey. E-mail: rector@bilkent.ed.tr

33. Prof. İhsan Doğramaci Hon. FIAS, Chairman and President of Bilkent University, 06800 Ankara, Turkey. E-mail: presid@bilkent.edu.tr

34. Prof. Mustafa Doruk (FIAS), Department of Metallurgical and Materials Engineering, Middle East Technical University, Ankara, Turkey. E-mail: mdoruk@metu.edu.tr

35. Prof. Saban Ali Duzgun, Ankara University, Faculty of Divinity, Ankara, Turkey. E-mail: duzugun@divinity.ankara.edu.tr

36. Dr Engin Erdem, Ankara University, Faculty of Divinity, Ankara, Turkey. E-mail: eerdem@divinity.ankara.edu.tr

37. Dr Phyllis Erdogan, Vice-President, Bilkent University, 06800 Ankara, Turkey. E-mail: phyllis@bilkent.edu.tr vicepres@bilkent.edu.tr

38. Mr Nuran Erdoganu, Ankara University, Faculty of Divinity, Ankara, Turkey. E-mail: erdogaru@divinity.ankara.edu.tr

39. Prof. Mehmet Ergin (FIAS), Secretary General, IAS; Huzur Mahallesi, 2. Cadde No. 164, Daire 22, Dogankent Sitesi, D-Blok, Ankara, Turkey. E-mail: mergin02@superonline.com

40. Prof. Richard R. Ernst Hon. FIAS, Laboratory of Physical Chemistry, ETH Hoenggerberg, HCI, CH-8093 Zurich, Switzerland. E-mail: Richard.Ernst@nmr.phys.chem.ethz.ch

41. Prof. Hasan Erten, Dean, Bilkent University, Faculty of Science, Ankara, Turkey. E-mail: enten@fen.bilkent.edu.tr
42. Prof. Seyfettin Ersahin, Ankara University, Faculty of Divinity, Ankara, Turkey.

43. Prof. Mohamed Baha-Eldin Fayez (FIAS), Emeritus Professor, National Research Centre, 14 Taha Hussein St., Zamalek, Cairo, Egypt. E-mail: fayez.mohd@yahoo.com.

44. Mr. Hosni Goja, Financial Officer, Islamic World Academy of Sciences, PO Box 830036, Amman 11183, Jordan. E-mail: hosnigoja@yahoo.com

45. Prof. Mehdi Golshani (FIAS), Professor of Physics, Sharif University of Technology, Department of Physics, PO. Box 14155-1871, Tehran 14374, Iran. E-mail: golshani@ihcs.ac.ir

46. Prof. Hashim Mohamed El-Hadi (FIAS), PO Box 32, Khartoum North, Sudan. E-mail: hmedlhadi@hotmail.com

47. Prof. Mahmoud Hafez (FIAS), Entomology Department, Faculty of Science, Cairo University, Cairo, Egypt.

48. Mr. Syed Mustansir Haider, Dhaka University, Dhaka, Bangladesh. E-mail: hshabbir@bdmail.net

49. Prof. Syed Zahir Haider (FIAS), Editor, JBAS, Bangladesh Academy of Science, Dhaka, Bangladesh. E-mail: hshabbir@bdmail.net

50. Prof. Talat Halman, Dean, Bilkent University, Faculty of Humanities and Letters, Ankara, Turkey. E-mail: halman@bilkent.edu.tr

51. Prof. Kemal Hanjalic (FIAS), Emeritus Professor, Delft University of Technology, Department of Multi-scale Physics, Lorentzweg 1, 2628 CJ Delft, The Netherlands. E-mail: k.hanjalic@tudelft.nl

52. Prof. Mohamed H A Hassan (FIAS), Executive Director TWAS, The Academy of Sciences for the Developing World, c/o ICTP, Strada Costiera 11, 34100 Trieste, Italy. E-mail: m hassan@twas.org

53. Prof. Ali Ali Hebeish (FIAS), Emeritus Professor, National Research Centre, Textile Research Division, Tahrir Street, Dokki, Cairo, Egypt. E-mail: hebeish@hotmail.com

54. Prof. Abdul Latif Ibrahim (FIAS), Professor, University Industry Selangor, 2 Jalan Bunga Raya 2/8 40,000 Shah Alam, Selangor, Malaysia. E-mail: alatifi@ymail.com

55. Prof. Mohammad Shamim Jairajpuri (FIAS), Professor and INSA Senior Scientist, Aligarh Muslim University, Department of Zoology, Aligarh 202-002, India. E-mail: jairajpurims@lycos.com

56. Mr. Yakup Karaca, OIC Statistical, Economic and Social Research and Training Centre for Islamic Countries, Attar Sokak No. 4, 06700, Ankara, Turkey. E-mail: ykaraca@sesrtcic.org
57. Prof. J. (Younis) Ario Katili (FIAS), Vice-President, IAS, Jalan Ciawi II/11 A, Kebayoran, Jakarta Selatan, Indonesia. E-mail: youniskatili@telkom.net

58. Mr Basel A. Al-Kayed, Deputy Head of Mission, Embassy of Jordan, Ankara, Turkey. E-mail: bkayedjordan@yahoo.com

59. Prof. Hamza El-Kettani (FIAS), Professor, University of Rabat; 41 Avenue Bir Kacem, Souissi, Rabat, Morocco. E-mail: kettani_Hamza@hotmail.com

60. Prof. Salambek Khadjiev (FIAS), Head of Laboratory, A.V. Topchiev Institute of Petrochemical Synthesis of the Russian Academy of Sciences (TIPS RAS), Mutnaya St., 115162 Moscow, Russia. E-mail: khadzhiev@ips.ac.ru

61. Prof. Recep Kilic, Ankara University, Faculty of Divinity, Ankara, Turkey.

62. Dr Charlotte Kuh, Deputy Executive Director, Policy and Global Affairs Division, US National Academy of Sciences, 500 5th St. NW, Rm. 557, Washington DC 20008, USA. E-mail: CKuh@nas.edu

63. Dr Mohammed Ali Mahesar, Assistant Coordinator General, COMSTECH, Constitution Avenue, G-5/2, Islamabad 44000, Pakistan. E-mail: astcogen@comstech.org

64. Prof. Abdel Salam Majali (FIAS), President, Islamic World Academy of Sciences, PO Box 830036, Amman 11183, Jordan. E-mail: jas@go.com.jo

65. Prof. Iftikhar Ahmad Malik (FIAS), Professor Emeritus, Higher Education Commission (HEC); 129-Hali Road, Westridge, Rawalpindi, Pakistan. E-mail: chsaimit@ish.paknet.com.pk

66. Prof. Ahmed Marrakchi (FIAS), Vice-President IAS, Mohammed Bensaleh Street N2, Menzah 6, 2091 Tunis, Tunisia. E-mail: marrakchi@planet.tn

67. Mr Ehsan Masood, 5 Westgate House, Chalk Lane, Epsom, KT18 7AN, United Kingdom. E-mail: em@ehsanmassod.com

68. Prof. Syed Qasim Mehdi (FIAS), Director General, Biomedical and Genetic Engineering Division, KRL General Hospital, PO Box 2891, Islamabad, Pakistan. E-mail: sqmehdi@comsats.net.pk

69. Prof. Amdulla Mehrabov (FIAS), Department of Metallurgical and Materials Engineering, Middle East Technical University, 06531 Ankara, Turkey. E-mail: amekh@metu.edu.tr

70. Prof. Zaghloul Raghib El-Naggar (FIAS), Chairman, Committee on Scientific Facts Revealed in the Glorious Quran, Supreme Council on Islamic Affairs; 14 Road 262-A, New Ma’adi, Cairo, Egypt. E-mail: info@elnaggarzar.com
71. Prof. Ibrahim Saleh Al- Naimi (FIAS), Professor of Chemistry, University of Qatar, Chemistry Department, College of Science, PO Box 36363, Doha, Qatar. E-mail: i.alnaimi@hotmail.com

72. Prof. Isam Naqib, Project Manager, UNDP Higher Education Project, United Nations Development Program, Oxford Centre for Innovation, Mill Street, Oxford, United Kingdom. E-mail: isam.naqib@gmail.com

73. Prof. Jamal Nazrul Islam (FIAS), Emeritus Professor, University of Chittagong, Chittagong 4331, Bangladesh. E-mail: rizvi@spnetctg.com

74. Dr Razely Bin Mohd Nordin, Director General, Department of Science and Technology, OIC General Secretariat, PO Box 178, Jeddah 21411, Kingdom of Saudi Arabia. E-mail: razley171@yahoo.com

75. Mr Abdel Moneim Osman, Director, UNESCO Regional Office for Education in Beirut, Cite Sportive Avenue, Bir Hassan, PO Box 5244, Beirut, Lebanon. E-mail: am.osman@unesco.org

76. Prof. Korkut Ozal (FIAS), Chairman, “AKOZ” Group of Companies and WAKF, Kisikli Caddesi No 18, Blok B, Kat 3, Altunizade-Uskudar, Istanbul, Turkey. E-mail: korkutozal@hotmail.com, korkutozal@yahoo.com

77. Prof. Mehmet Ozdemir, Ankara University, Faculty of Divinity, Ankara, Turkey. E-mail: mozdemir@divinity.ankara.edu.tr

78. Prof. Mehmet Ozturk, Chairman, Bilkent University, Faculty of Molecular Biology and Genetics, Ankara, Turkey. E-mail: munirozturk@gmail.com

79. Prof. Sinasi Ozsoyulu (FIAS), Fatih University, Faculty of Medicine, Department of Paediatrics, Ciftlik Caddesi 57, Emek 06510, Ankara, Turkey. E-mail: sinasiozsoyulu@hotmail.com

80. Prof. Mehmet Pacaci, Ankara University, Faculty of Divinity, Ankara, Turkey. E-mail: pacaci@divinity.ankara.edu.tr

81. Prof. Syed Muhammad Qaim (FIAS), Advisor, Professor, Institute fur Nuklearchemie, Research Centre Julich, D-52425 Julich, Germany. E-mail: s.m.qaim@fz-juelich.de

82. Prof. Yves Quere, Co-Chair, Inter Academy Panel (IAP); Academie des Sciences, 23 Quai de conti 75005 Paris, France. E-mail: y.quere@academie-sciences.fr

83. Prof. Mazhar M Qurashi (FIAS), Secretary, PAIHS, Pakistan Academy of Sciences, Constitution Avenue, G-5, Islamabad, Pakistan. E-mail: pasish@yahoo.com

84. Prof. Atta-Ur-Rahman (FIAS), Coordinator General, COMSTECH, COMSTECH Secretariat, 3 Constitution Avenue, G-5/2, Islamabad 44000, Pakistan. E-mail: chairman@hec.gov.pk
85. Prof. Najih El-Rawi (FIAS), Member, Iraq Academy of Sciences, PO Box 4023, Aadamea, Baghdad, Iraq. E-mail: ahmedelrawi@yahoo.com

86. Ms. Sevgi Rencberoglu, OIC Statistical, Economic and Social Research and Training Centre for Islamic Countries, Attar Sokak No. 4, 06700, Ankara, Turkey. E-mail: grecberoglu@sesrtcic.org

87. Mr. Kamer Rodoplu, Director, Bilkent University, School of Applied Technology and Management, Ankara, Turkey. E-mail: rodoplu@bilkent.ed.tr

88. Dr Abbas Sadri, Director of ISESCO Regional Office/ Tehran, Islamic Educational Scientific and Cultural Organization (ISESCO), Kalantri Avenue No 1/2, Tehran, Iran. E-mail: isesco@isesco-tehran.org

89. Mrs Fahire Saatci, Senior Architect, Medcon Consultants, Gulden Sok. 9/7, Ankara 06960, Turkey. E-mail: fs@teknos.com.tr

90. Prof. Hussein Samir Salama (FIAS), Professor, Plant Protection Department, National Research Centre, El-Tahrir Street, Dokki, Cairo, Egypt. E-mail: hsarsalama@hotmail.com

91. Dr Sameh H. Salama, c/o National Research Centre, El-Tahrir Street, Dokki, Cairo, Egypt E-mail: hsarsalama@hotmail.com

92. Ms Taghreed Saqer, Executive Secretary, Islamic World Academy of Sciences, PO Box 830036, Amman 11183 Jordan. E-mail: tsaqer@hotmail.com

93. Dr Selim Saruhan, Ankara University, Faculty of Divinity, Ankara, Turkey.

94. Prof. Mualla Selcuk, Dean, Ankara University, Faculty of Divinity, 06500 Bepevler, Ankara, Turkey. E-mail: selcuk@divinity.ankara.edu.tr

95. Prof. Ahmet Nedim Serinsu, Vice Dean, Ankara University, Faculty of Divinity, Ankara, Turkey. E-mail: serinsu@divinity.ankara.edu.tr

96. Prof. Dr Mohd Hazim Shah, Head, Department of Science & Technology Studies, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia. E-mail: drhazim@um.edu.my

97. Prof. Misbah-ud-Din Shami (FIAS), Vice-President, IAS, Islamic World Academy of Sciences, Islamabad Office, G-5/2, Constitution Avenue, Islamabad, Pakistan. E-mail: pasib@yahoo.com - shami1930@yahoo.com

98. Prof. Ahmad Shamsul-Islam (FIAS), Research Associate, Molecular Cell and Developmental Biology, University of Texas, Department of Botany, Austin, TX 78713, USA. E-mail: aislam24@yahoo.com

99. Prof. Muthana Shanshal (FIAS), Professor of Chemistry, Department of Chemistry, College of Science, University of Baghdad, Jadirriya, Baghdad, Iraq. E-mail: mshanshal2003@yahoo.com

469
100. Prof. Sung Chul Shin, Professor, KAIST; Chairman of the International Cooperation Committee of the Korean Academy of Sciences and Technology (KAST), 373-1 Guseong-dong, Yuseong-gu, Daejeon 305-701, Korea. E-mail: scshin@kaist.ac.kr

101. Mr Tjoek Aziz Soeprapto, The Indonesian Marine Geological Institute, Jl. Dr Junjunan No. 236, Bandung, Indonesia. E-mail: tjoek@attglobal.net

102. Prof. Ahmedou Moustapha Sow (FIAS), Professor of Internal Medicine, Polyclinique Cheikh El-Hadj Malick, Rue B x Alles Ababacar SY, BP 10156, Dakar, Senegal. E-mail: ahmadoumoustapha@sentoo.sn.

103. Prof. Earl (Tim) Sullivan, Provost, The American University in Cairo (AUC), 113 Kasr El Aini Street, PO Box 2511, 11511 Cairo, Egypt. tims@aucegypt.edu

104. Dr Muzaffer Tan, Ankara University, Faculty of Divinity, Ankara, Turkey. E-mail: tanatar@fen.bilkent.edu.tr

105. Mr Mohamed Ali Toure, Senior S&T Expert, Science and Technology Office, Islamic Development Bank, PO Box 5925, Jeddah 21432, Saudi Arabia. E-mail: MToure@isdb.org

106. Prof. Muhammad Anwar Waqar (FIAS), Professor of Cell Biology, Dr Panjwani Centre for Molecular Medicine and Drug Research, International Centre for Chemical Sciences, University of Karachi, Karachi 75270, Pakistan. E-mail: anwarwaqar@hotmail.com

107. Prof. Ibrahima Wone (FIAS), Villa 156, Cite CSE, Dakar, BP-7197, Senegal. E-mail: ibawone@yahoo.fr

108. Prof. Mikhail Zalikhanov (FIAS), Deputy, Russian State Duma; Chairman of the Supreme Ecological Council of Russia, Russian Federation, Moscow, Russia. E-mail: zalihanov@duma.gov.ru

109. Mr Moneef R. Zou’bi, Director General, Islamic World Academy of Sciences, PO Box 830036, Amman 11183, Jordan. E-mail: ias@go.com.jo - mrzoubi@ias-worldwide.org
APPENDIX D

PATRONS OF THE ISLAMIC WORLD ACADEMY OF SCIENCES

His Excellency the President of the Islamic Republic of Pakistan.
His Royal Highness Prince El-Hassan Ibn Talal of the Hashemite Kingdom of Jordan, Founding Patron.

HONORARY FELLOWS OF THE ISLAMIC WORLD ACADEMY OF SCIENCES

His Excellency Rauf Denktash, President of the Turkish Republic of Northern Cyprus.
Prof. Ihsan Dogramaci, Chairman, and President of Bilkent University, Turkey.
Prof. Richard R. Ernst, 1991 Nobel Laureate (Chemistry), Switzerland.
Mr Fouad Alghanim, President, Alghanim Group, Kuwait.
Sheikh Saleh Kamel, Chairman, Dallah Elbaraka Group, Saudi Arabia.
Datuk Patinggi Tan Sri Haji Dr Abdul Taib Mahmud, Chief Minister, State of Sarawak, Malaysia.

Tun Dr Mahathir Mohamad, Former Prime Minister of Malaysia.
Prof. Ferid Murad, 1998 Nobel Laureate (Medicine), USA.
His Excellency Nursultan Abishevic Nazarbayev, President of the Republic of Kazakhstan.

Dr Enver Oren, President and Chairman, Ihlas Gazetecilik Holding, Turkey.
HE Mr Mintimer Shaimiev, President of the Republic of Tatarstan/Russian Federation.

Sheikh Hamad Al-Zamil, Chairman, Al-Zamil Group, Saudi Arabia.
Prof. Ahmed Zewail, 1999 Nobel Laureate (Chemistry), Egypt/USA.
The late Dr Hakim Mohammed Said, President, Hamdard Foundation, Pakistan.
FELLOWS OF THE ISLAMIC WORLD ACADEMY OF SCIENCES

1. Prof. Mohammad Abdollahi
2. Prof. Omar Abdul Rahman
3. Prof. Naim Afgan
4. Prof. Ishfaq Ahmad
5. Prof. Askar Akayev
6. Prof. Sajjad Alam
7. Prof. M Shamsher Ali
8. Prof. Qurashi Mohammed Ali
9. Prof. Huda Saleh Mehdi Ammash
10. Prof. Wiranto Arismunandar
11. Prof. Muhammad Asghar
12. Prof. Attia A Ashour
13. Prof. Saleh A Al-Athel
14. Prof. Ahmad Nawawi Ayob
15. Prof. Ahmad Abdullah Azad
16. Prof. Agadjian Babaev
17. Prof. Adnan Badran
18. Prof. Ibrahim Gamal Badran
19. Prof. Kamal H. Batanouny
20. Prof. Farouk El-Baz
21. Prof. Kazem Behbehani
22. Prof. Azret Yusupovich Bekkiev
23. Prof. Naci Bor
24. Prof. Rafik Boukhris
25. Prof. Noor Mohammad Butt
26. Prof. Muhammad Iqbal Choudhary
27. Prof. Ali A Dafaa'
28. Prof. Mamadou Daffe
29. Prof. Fakhruddin Daghestani
30. Prof. Ramazan Demir
31. Prof. Oussaynou Fall Dia
32. Prof. Ugur Dilmén
33. Prof. Mustafa Doruk
34. Prof. Mehmet Ergin
35. Prof. Mohamed B E Fayez
36. Prof. Nesreen Ghaddar
37. Prof. Mehdi Golshani
38. Prof. Kadyr G Gulamov
39. Prof. Hashim M El-Hadi
40. Prof. Mahmoud Hafez
41. Prof. Mohammad Hamdan
42. Prof. Adnan Hamoui

Iran
Malaysia
Bosnia-Herzegovina
Pakistan
Kyrgyzstan
Bangladesh/USA
Bangladesh
Sudan
Iraq
Indonesia
France
Egypt
Sudan Arabia
Malaysia
Bangladesh/Australia
Turkmenistan
Jordan
Egypt
USA
Kuwait
Balkar/Russia
Turkey
Tunisia
Pakistan
Pakistan
Saudi Arabia
Mali/France
Jordan
Turkey
Senegal
Turkey
Turkey
Turkey
Turkey
Turkey
Egypt
Lebanon
Iran
Uzbekistan
Sudan
Egypt
Jordan
Syria
<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>Prof. Kemal Hanjalic</td>
<td>Bosnia-Herzegovina</td>
</tr>
<tr>
<td>44</td>
<td>Prof. Mohamed H A Hassan</td>
<td>Sudan</td>
</tr>
<tr>
<td>45</td>
<td>Prof. Ali Ali Hebeish</td>
<td>Egypt</td>
</tr>
<tr>
<td>46</td>
<td>Prof. Bambang Hidayat</td>
<td>Indonesia</td>
</tr>
<tr>
<td>47</td>
<td>Prof. Rabia Hussain</td>
<td>Pakistan</td>
</tr>
<tr>
<td>48</td>
<td>Prof. Abdul Latif Ibrahim</td>
<td>Malaysia</td>
</tr>
<tr>
<td>49</td>
<td>Prof. Mohammad Shamim Jairajpuri</td>
<td>India</td>
</tr>
<tr>
<td>50</td>
<td>Prof. Hamza El-Kettani</td>
<td>Morocco</td>
</tr>
<tr>
<td>51</td>
<td>Prof. Pulat K Khabibullaev</td>
<td>Uzbekistan</td>
</tr>
<tr>
<td>52</td>
<td>Prof. Salambek Khadjiev</td>
<td>Chechnya</td>
</tr>
<tr>
<td>53</td>
<td>Prof. Idriss Khalil</td>
<td>Morocco</td>
</tr>
<tr>
<td>54</td>
<td>Prof. Abdul Qadeer Khan</td>
<td>Pakistan</td>
</tr>
<tr>
<td>55</td>
<td>Prof. Hameed Ahmed Khan</td>
<td>Pakistan</td>
</tr>
<tr>
<td>56</td>
<td>Prof. Naem Ahmad Khan</td>
<td>Pakistan</td>
</tr>
<tr>
<td>57</td>
<td>Prof. Mostefa Khiati</td>
<td>Algeria</td>
</tr>
<tr>
<td>58</td>
<td>Prof. Abdelhafid Lahlaidi</td>
<td>Morocco</td>
</tr>
<tr>
<td>59</td>
<td>Prof. Zohra Ben Lakhir</td>
<td>Tunisia</td>
</tr>
<tr>
<td>60</td>
<td>Prof. Abdel Salam Majali</td>
<td>Jordan</td>
</tr>
<tr>
<td>61</td>
<td>Prof. Ahmed Marrakchi</td>
<td>Tunisia</td>
</tr>
<tr>
<td>62</td>
<td>Prof. Akhmet Mazgarov</td>
<td>Tatarstan/Russia</td>
</tr>
<tr>
<td>63</td>
<td>Prof. Syed Qasim Mehdi</td>
<td>Pakistan</td>
</tr>
<tr>
<td>64</td>
<td>Prof. Amdoulla Mehrabov</td>
<td>Azerbaijan</td>
</tr>
<tr>
<td>65</td>
<td>Prof. Sami Al-Mudaffar</td>
<td>Iraq</td>
</tr>
<tr>
<td>66</td>
<td>Prof. Badri Muhammad</td>
<td>Malaysia</td>
</tr>
<tr>
<td>67</td>
<td>Prof. Zaghloul El-Naggar</td>
<td>Egypt</td>
</tr>
<tr>
<td>68</td>
<td>Prof. Ibrahim Saleh Al-Naimi</td>
<td>Qatar</td>
</tr>
<tr>
<td>69</td>
<td>Prof. Anwar Nasim</td>
<td>Pakistan</td>
</tr>
<tr>
<td>70</td>
<td>Prof. Jamal Nazrul-Islam</td>
<td>Bangladesh/UK</td>
</tr>
<tr>
<td>71</td>
<td>Prof. Souleymane Niang</td>
<td>Senegal</td>
</tr>
<tr>
<td>72</td>
<td>Prof. Gulsen Onur</td>
<td>Turkey</td>
</tr>
<tr>
<td>73</td>
<td>Prof. Ramdane Ouahes</td>
<td>Algeria</td>
</tr>
<tr>
<td>74</td>
<td>Prof. Korkut Ozal</td>
<td>Turkey</td>
</tr>
<tr>
<td>75</td>
<td>Prof. Mehmet Nimet Ozdas</td>
<td>Turkey</td>
</tr>
<tr>
<td>76</td>
<td>Prof. Sinasi Ozsoy</td>
<td>Turkey</td>
</tr>
<tr>
<td>77</td>
<td>Prof. Munir Ozturk</td>
<td>Turkey</td>
</tr>
<tr>
<td>78</td>
<td>Prof. Iqbal Parker</td>
<td>South Africa</td>
</tr>
<tr>
<td>79</td>
<td>Prof. Syed Muhammad Qaim</td>
<td>Germany</td>
</tr>
<tr>
<td>80</td>
<td>Prof. Subhi Qasem</td>
<td>Jordan</td>
</tr>
<tr>
<td>81</td>
<td>Prof. Mazhar M Qureshi</td>
<td>Pakistan</td>
</tr>
<tr>
<td>82</td>
<td>Prof. Atta-ur-Rahman</td>
<td>Pakistan</td>
</tr>
<tr>
<td>83</td>
<td>Prof. Najih Khalil Al-Rawi</td>
<td>Iraq</td>
</tr>
<tr>
<td>84</td>
<td>Prof. Riazuddin</td>
<td>Pakistan</td>
</tr>
<tr>
<td>85</td>
<td>Prof. Makhmud Salakhtdinov</td>
<td>Uzbekistan</td>
</tr>
<tr>
<td>86</td>
<td>Prof. Hussein Samir Salama</td>
<td>Egypt</td>
</tr>
<tr>
<td>87</td>
<td>Prof. Eldar Yunosoglu Salayev</td>
<td>Azerbaijan</td>
</tr>
<tr>
<td>88</td>
<td>Prof. Mohammad Salimullah</td>
<td>Bangladesh</td>
</tr>
<tr>
<td>89</td>
<td>Prof. Lorenzo Savioli</td>
<td>Italy</td>
</tr>
<tr>
<td>90</td>
<td>Prof. Misbah-Ud-Din Shami</td>
<td>Pakistan</td>
</tr>
<tr>
<td>91</td>
<td>Prof. Ali Al-Shamlian</td>
<td>Kuwait</td>
</tr>
<tr>
<td>92</td>
<td>Prof. Ahmad Shamsul-Islam</td>
<td>Bangladesh</td>
</tr>
</tbody>
</table>
93. Prof. Muthana Shanshal  Iraq
94. Prof. Ahmedou M Sow  Senegal
95. Prof. Mahmoud Tebyani  Iran
96. Prof. Ahmet Hikmet Ucisik  Turkey
97. Prof. Mohammed A Waqar  Pakistan
98. Prof. Ibrahima Wone  Senegal
99. Prof. Bekhzad Yuldashev  Uzbekistan
100. Prof. Khatijah Mohd Yusoff  Malaysia
101. Prof. A. Hamid Zakri  Malaysia
102. Prof. Mikhael Zalikhanov  Balkar/Russia
APPENDIX E

LAUREATES OF THE IAS-COMSTECH IBRAHIM MEMORIAL AWARD

<table>
<thead>
<tr>
<th>Name</th>
<th>Year</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof. Ugur Dilmén</td>
<td>1996</td>
<td>Turkey</td>
</tr>
<tr>
<td>Prof. Mohammad Abdollahi</td>
<td>2005</td>
<td>Iran</td>
</tr>
<tr>
<td>Prof. Mohammed Manna Al-Qattan</td>
<td>2007</td>
<td>Saudi Arabia</td>
</tr>
</tbody>
</table>
APPENDIX F

COUNCIL OF THE
ISLAMIC WORLD ACADEMY OF SCIENCES
(2003-2009)

President: Prof. Abdul Salam Majali Jordan.
Vice-President: Prof. Akhmet Mazgarov Tatarstan/Russia.
Vice-President: Prof. Ahmed Marrakchi Tunisia.
Vice-President: Prof. Mibahuddin Shami Pakistan.
Treasurer: Prof. Adnan Badran Jordan.
Secretary General: Prof. Mehmet Ergin Turkey.
Member: Prof. M Shamsher Ali Bangladesh.
Member: Prof. Naci Bor Turkey.
Member: Prof. Mohamed H A Hassan Sudan.
Member: Prof. Anwar Nasim Pakistan.
Member: Prof. Muthana Shanshal Iraq.

IAS EXECUTIVE STAFF

Moneef R. Zou'bi Director General.
Lina Jalal Programme Officer
Taghreed Saqer Executive Secretary.
Abdel Mu’ti Khayyat Finance Officer.
Abdel Hamid Sami Web/IT Officer.
Habes Majali Public Relations Officer.
Saleh As’ad Janitor.
Hamdi Bader Driver.

477
APPENDIX G

DECEASED FELLOWS OF THE
ISLAMIC WORLD ACADEMY OF SCIENCES (IAS)

Prof. Mohammad **Ibrahim** (1911-1988) Bangladesh.
Prof. Djibril **Fall** (1930-1992) Senegal.
Prof. Salimuzzaman **Siddiqui** (1897-1994) Pakistan.
Prof. Abdus Salam **Mia** (1925-1995) Bangladesh/USA.
Prof. Suleiman Gabir **Hamad** (1937-1996) Sudan.
Prof. Mohammad R **Siddiqi** (1908-1998) Pakistan.
Prof. Abdullah M **Sharafuddin** (1930-1998) Bangladesh.
Prof. Ali **Kettani** (1941-2001) Morocco
Prof. Samaun **Samadikun** (1931-2006) Indonesia.
Prof. Iftikhar Ahmad **Malik** (1936-2008) Pakistan.
Prof. Ibrahima Mar **Diop** (1921-2008) Senegal.
Prof. Syed Zahir **Haider** (1927-2008) Bangladesh.
Prof. Muhammad Ilyas **Burney** (1922-2008) Pakistan.
APPENDIX H

PUBLICATIONS OF THE ISLAMIC WORLD ACADEMY OF SCIENCES

CONFERENCE PROCEEDINGS

- *The Islamic Academy of Sciences*. Proceedings of the Founding Conference (1986). Published by the Islamic Academy of Sciences, **Editor: A. Kettani (Morocco)**.


- *Science and Technology Policy for Self-Reliance in the Muslim World*. Proceedings of the second international conference, Islamabad (Pakistan) (1988). Published by the Islamic World Academy of Sciences, **Editors: F. Daghestani (Jordan), H. El-Mulki (Jordan), and M. Al-Halaïqa (Jordan)**.

- *New Technologies and Development of the Muslim World*. Proceedings of the third international conference, (Kuwait) (1989). Published by the Islamic World Academy of Sciences, **Editors: F. Daghestani (Jordan), and S. Qasem (Jordan)**.

- *Technology Transfer for Development in the Muslim World*. Proceedings of the fourth international conference, Antalya (Turkey) (1990). Published by the Islamic World Academy of Sciences, **Editors: F. Daghestani (Jordan), A. Altamemi (Jordan), and M. Ergin (Turkey)**.


- *Environment and Development in the Islamic World*. Proceedings of the sixth international conference, Kuala Lumpur (Malaysia) (1992). Published by the Islamic World Academy of Sciences, **Editors: S. Al-Athel (Saudi Arabia), and F. Daghestani (Jordan)**.

- *Health, Nutrition and Development in the Islamic World*. Proceedings of the seventh international conference, Dakar (Senegal) (1993). Published by the Islamic World Academy of Sciences, **Editors: N. Bor (Turkey), A. Kettani (Morocco), and Moneef R. Zou'bi (Jordan)**.
• Water in the Islamic World: An Imminent Crisis. Proceedings of the eighth international conference, Khartoum (Sudan) (1994). Published by the Islamic World Academy of Sciences, Editors: M. Ergin (Turkey), H. Dogan Altinbilek (Turkey), and Moneef R. Zou’bi (Jordan).


• Materials Science and Technology and Culture of Science. Proceedings of the twelfth international conference, Islamabad (Pakistan), (2002). Published by the Islamic World Academy of Sciences, Editors: M. Ergin (Turkey), and Moneef R. Zou’bi (Jordan) (ISBN 9957-412-06-x).


BOOKS

- *Islamic Thought and Modern Science*. Published by the Islamic World Academy of Sciences (1997) - **Author: Mumtaz A. Kazi**.


PERIODICALS


- *Newsletter of the Islamic World Academy of Sciences* – quarterly. Chief Editor: **Moneef R. Zou’bi**.


OTHER PUBLICATIONS

- An *Overview* of the IAS, Chief Editor: **Moneef R. Zou’bi**.

- IAS Postcards.
APPENDIX I

IAS SUPPORTERS

The Hashemite Kingdom of Jordan
The Islamic Republic of Pakistan
The State of Kuwait
The Republic of Turkey
Malaysia
The Republic of Senegal
The Republic of Sudan
The Islamic Republic of Iran
The State of Qatar
The Republic of Tunisia
The Kingdom of Morocco
The State of Sarawak/Malaysia
The Republic of Indonesia
The Republic of Tatarstan/ Russian Federation
The State of Selangor/Malaysia
The Sultanate of Oman

The OIC Standing Committee on Scientific and Technological Co-operation (COMSTEC), Pakistan.
The Islamic Development Bank (IDB), Saudi Arabia.
The OPEC Fund for International Development, Vienna, Austria.
Arab Potash Company, Jordan.
Islamic Educational Scientific and Cultural Organisation (ISESCO), Morocco.
The World Bank, USA.
The United Nations Environment Programme (UNEP), Kenya.
Kuwait Foundation for the Advancement of Sciences (KFAS).
Turkish Scientific and Technical Research Council (TUBITAK).
The Royal Scientific Society (RSS), Jordan.
Pakistan Ministry of Science and Technology.
Ministry of Science, Technology and the Environment, Malaysia.
University Cheikh Anta Diop, Dakar, Senegal.
Ministry of Higher Education and Scientific Research, Sudan.
National Centre for Research, Sudan.
Ministry of Culture and Higher Education, Iran.
Iranian Research Organisation for Science and Technology (IROST).
The Academy of Sciences, Tehran, Iran.
The Academy of Medical Sciences, Tehran, Iran.
Saudi Arabian Oil Company, Saudi Arabia (ARAMCO).
Ihlas Holding, Turkey.
Arab Bank, Jordan.
Jordan Kuwait Bank, Jordan.
Rafia Industrial Company, Jordan.
Secretariat of State for Scientific Research and Technology, Tunisia.
Academy of the Kingdom of Morocco.
Petra Private University, Jordan.
Higher Council of Science and Technology (HCST), Jordan.
Pakistan Academy of Sciences.
Majlis Islam Sarawak, Malaysia.
Tabung Baitulmal Sarawak, Malaysia.
Sasakawa Peace Foundation, Japan.
Royal Jordanian Airlines, Jordan.
Arab Jordan Investment Bank, Jordan.
National Centre for Human Resources Development, Jordan.
Al Bukhary Foundation, Malaysia.
Bilkent University, Turkey.
US National Academy of Sciences, USA.
International Islamic Charity Organisation, Kuwait.
Perdana Leadership Foundation, Putrajaya, Malaysia.
Fouad Alghanim & Sons Group of Companies, Safat, Kuwait.
Saudi Basic Industries Corporation (SABIC), Riyadh, Saudi Arabia.
World Islamic Call Society, Tripoli, Libya.
University of Industry of Selangor (UNISEL), Shah Alam, Malaysia.
International Islamic Academy of Life Sciences and Biotechnology (IIALSB), Shah Alam, Malaysia.
# APPENDIX J

<table>
<thead>
<tr>
<th>IAS Waqf</th>
<th>IAS Endowment Fund</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Islamic World Academy of Sciences</strong></td>
<td><strong>Islamic World Academy of Sciences</strong></td>
</tr>
<tr>
<td>Jordan Islamic Bank</td>
<td>Arab Bank</td>
</tr>
<tr>
<td>Shemeisani Branch</td>
<td>Fifth Circle Branch</td>
</tr>
<tr>
<td><strong>Account No.: 809/$91</strong></td>
<td><strong>Account No: 0134/034765-5/710</strong></td>
</tr>
<tr>
<td>Telephone : +962 6 5677107</td>
<td>Telephone : +962 6 5526870</td>
</tr>
<tr>
<td>Facsimile: +962 6 5691700</td>
<td>Facsimile: +962 6 5536874</td>
</tr>
<tr>
<td>PO Box 925997</td>
<td>PO Box 141107</td>
</tr>
<tr>
<td>Amman 11110</td>
<td>Amman</td>
</tr>
<tr>
<td>Jordan.</td>
<td>Jordan.</td>
</tr>
</tbody>
</table>

---

**IAS on the Internet**

http://www.ias-worldwide.org

**Medical Journal of the IAS on the Internet**

http://www.medicaljournal-ias.org