



IMU
**International
Mathematical
Union**



Symposium Report

**Mathematics in Emerging Nations:
Achievements and Opportunities
(MENA O)**

**August 12, 2014
Seoul, Korea**

Support for Mathematics in Emerging Nations: The Power of MENAO



During the last decade, the International Mathematical Union (IMU) has increased its attention to mathematics in the developing world. It is the opinion of the IMU that the developing world is home to significant, but largely untapped, mathematical talent and that this talent, if properly harnessed has the potential to transform both local and international mathematical communities. The IMU Commission for Developing Countries (CDC) partners with developing nations to develop the talent of young mathematicians and emphasizes their contributions to economic and societal development.

MENAO Symposium at the ICM

In August 2014, the IMU held a day-long symposium prior to the opening of the International Congress of Mathematicians (ICM), entitled Mathematics in Emerging Nations: Achievements and Opportunities (MENAO). More than 250 participants from around the world, including representatives of embassies, scientific institutions, private business and foundations attended the symposium. Attendees heard inspiring stories from individual mathematicians and from several developing nations that have progressed substantially in mathematics over the last half-century. The program and all lectures can be found on the MENAO website at: www.mathunion.org/cdc/menao.



Successful start of MENAO: more than 250 participants from around the world met in Seoul, Korea.

A vision of mathematics' power

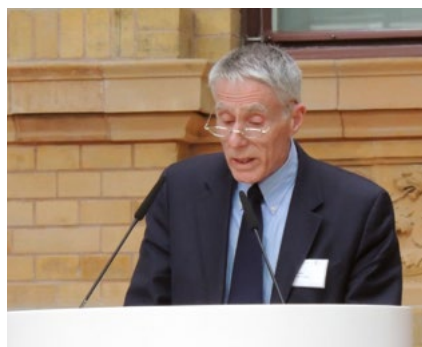
The symposium showed that a mathematically-educated population is a powerful force to spur economic development in all nations. Major challenges such as: disease, hunger, climate change, environmental degradation and energy development require strong mathematical, computational, statistical and other quantitative skills.

Given such challenges, more support is needed for those who wish to become educators and researchers in mathematics. Raising international mathematical literacy has been a goal of the IMU since its founding, but the resources to achieve such a goal have been – for the majority of the history of the IMU – insufficient. IMU has recently initiated a drive for public and private sector funding to allow it to take a more active role in supporting mathematics in developing countries. In that context, the goals of the MENAO symposium were not only to hear the stories from the developing world but also to build partnerships and networks between mathematical communities, their governments, international agencies, private business and foundations.

The status of mathematics development efforts has been described in three “regional reports” covering Mathematics in Africa, Southeast Asia and Latin America and the Caribbean and its challenges and opportunities. These reports were presented at the MENAO symposium and can be found at: <http://www.mathunion.org/cdc/research-and-useful-links/>. The reports also include initiatives and projects which are in need of financial support.

The symposium demonstrated the importance of mathematics to economic and social development in several countries and concluded that supporting mathematics and mathematics education in the developing world requires concerted efforts of mathematicians and the public and private sectors.

The introductory session of MENAO featured remarks by several IMU leaders including Cheryl Praeger, Vice President of the International Commission for Mathematical Instruction and Marcelo Viana, IMU Vice President and Hyungju Park, chair of the International Congress of Mathematicians (ICM) 2014.



Herb Clemens

Herb Clemens, Secretary for Policy of the CDC, described the motivating theme of the CDC – that ability and interest in mathematics is not confined by national or regional borders – but the opportunity to pursue that interest is, to a large extent, confined to such borders.

IMU President Ingrid Daubechies officially announced that the five inaugural laureates of the Breakthrough Prize in Mathematics would each give \$100,000 for a new IMU fellowship and mentorship program for tal-

ented young mathematicians from some of the least developed countries.

During the day a poster session featured the work of sixteen international centres, projects, commissions, foundations and initiatives supporting mathematicians and mathematics educators. The well-staffed booths and descriptive materials introduced the participants to the creative efforts from around the world to support mathematics in developing countries.

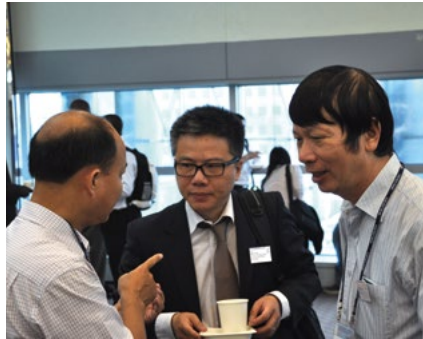


IMU President Ingrid Daubechies

Formulas for success: Vietnam and Korea

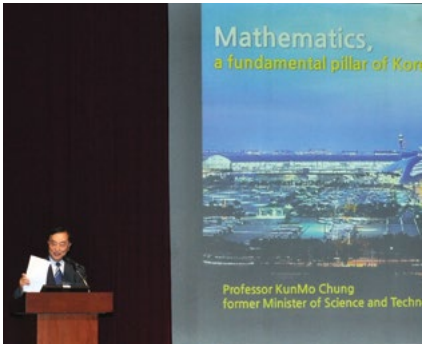
As an example of how quickly a nation's mathematical community can develop with the support of the international community, Ngô Bao Châu summarized the swift ascent of Vietnam after decades of turmoil. As recently as 1967, the country had only one mathematician holding a PhD but by 1975 (after the cessation of the hostilities in the Vietnam War) it was already participating in the International Mathematics Olympiad (IMO), and according to Prof Châu its team's performance was "beyond expectations".

After the Asian economic collapse of 1990, the more fortunate scholars were able to find positions and support abroad. By 2007, the government launched a report on how to revive research and education in mathematics. This report in the community of mathematicians eventually led to the National Priority Program, approved in 2010. In the same year, Prof Châu became the sixth Asian mathematician to receive the Fields Medal. In the following year, the Vietnam Institute for advanced study in Mathematics was founded and promotes research and education in mathematics and emphasizes continuous engagement with applied math and society.



Prof Châu in a discussion


Another model of rapid development is Korea, whose mathematical development proceeded alongside economic development. KunMo Chung, who twice served as Minister of Science and Technology, offered MENO participants a vivid picture of transformation from an agrarian economy to the high-tech "Asian tiger" of today. In 1953, he said, during the Korean War his country "lost whatever we had" and its per capita income dwindled



Prof. KunMo Chung gave a speech "The Republic of Korea: Mathematics, a fundamental pillar of Korean economic development"

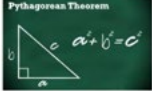
The first phase. 1950-1960's

1-3. Math, measure of one's educational success



There was nothing stronger than the conviction of making their children successful through education. Again, mathematics has been at the center of education.

Pythagorean Theorem



Mathematics, a fundamental pillar of Korean economic development



A makeshift school in Seoul, 1961

to less than US\$75. After the War the government decided to place education at the top of its priority list. Poor farmers sold even their land and cattle to pay for their children's schooling. "And Korea always viewed mathematics as a pillar of educational development" he said. By 2012 the Republic of Korea had become the seventh member of the "20-50 club" – nations with a GDP per capita above \$20,000 and a population over 50 million – while maintaining a democratic system of government and a fierce dedication to achievement.

Prof Chung acknowledged that the rapid integration of Korean institutions of higher learning into the global network of scholars would not have been possible without the openness of the international mathematical community.

Achievements in other countries

Rubí E. Rodríguez, Professor of Mathematics at the Universidad de La Frontera, described elements that have influenced mathematics development in Chile since the first Chilean doctorate-holder returned after earning his PhD abroad in the 1960s. Such elements include a strong mathematical society, international collaborations and the decision of the government to support advanced mathematics degree programs, beginning in 1970. Chile joined the IMU in 1984 and today is the leading mathematics country in South America as gauged by the number of



research mathematicians (350) and the number of research papers per inhabitant. It is also one of the most stable and prosperous in the region, thanks in part to the math-based science and technology that support its educational system, mining, agriculture, bioinformatics, astronomy, and health sectors.

The contributions of UNESCO

Magalie Lebreton-Traoré, a representative of UNESCO (Paris), spoke on Capacity Building and Innovation in Mathematics in the Developing World. She offered a summary of the current barriers to wider participation in mathematics, including a lack of mathematical literacy in the general public, a general lack of interest in youths for the subject, a shortage of effective learning tools and trained teachers, a scarcity of role models, especially for young girls and a lack

of well-functioning South-South or North-South networks. In response to these challenges, she gave an overview of initiatives and activities implemented or supported by UNESCO worldwide, especially in the framework of the International Basic Sciences Program.



MENAO union panel

MENAO featured a group of mathematicians from countries that are currently developing their mathematics community, and for which Korea, Chile and Vietnam may serve as models. These countries have adopted the strategy of regional networking to help one another by means of conferences, workshops, exchanges, and scholarships. O. Daniel Makinde (Nigeria/South Africa) Secretary General of the African Mathematical Union, Edy Tri Baskoro (Indonesia), President of the South East Asian Mathematical Society, and José Antonio Seade (Mexico) of the Unión Matemática de América Latina y el Caribe (UMALCA) all described the progress of their groups.

In the question and comments session that concluded the panel, several issues were addressed. Among these were what is being done towards mathematics teachers. The panelists explained the various measures taken in their regions, and commented on further actions. The panel was moderated by Ragni Piene of the University of Oslo (Norway).



Union Panel

The power of an individual mathematician

The MENAO symposium audience also heard how much a single mathematician can do for a country and region. Edward Lungu of the University of Botswana was born in Northern Rhodesia (now Zambia), where black schoolchildren were not encouraged to study mathematics. While Edward was serving as a class monitor, the textbook they were using called “fundamentals of Arithmetic” was withdrawn and replaced with a textbook called “Native Mathematics”. Edward was curious enough to steal a copy of the original textbook. “I read it, and it was indeed a very good book. That’s how I learned the math that got me going.”

His skill at mathematics kept him out of the copper mines for which his classmates were destined, and he managed to earn a PhD in 1981. When searching for colleagues however, he only managed to find three other mathematics PhD holders in all of southern Africa. These three subsequently established the Southern African Mathematical Sciences Association (or SAMSA), which continues to function today.



Meeting of SAMSA in Malawi 2012

Professionally, he began his work in the field of fluid dynamics, but was deeply affected by the social problems around him. He decided he could do more to alleviate suffering through mathematical modelling and so changed to this field. Focusing on the epidemic of HIV/AIDS, he has been able to convince governments that it is more cost-effective – as well as humane – to change the threshold for treatment; to treat infected infants and to treat HIV sufferers earlier in the course of disease. Using modelling, he was able to prove that “there is strong social benefit in keeping patients alive and functioning.” His work has been rewarded by a grant from the Simons Foundation, which supports nine other PhDs in mathematical modelling.



Edward Lungu with colleagues

The power of regional networks

The experience of Prof Lungu has shown how well-implemented outside support can increase the effectiveness of work in developing regions. In trying to extend the reach of his modelling, Prof Lungu had the good fortune to meet Prof Bernt Øksendal of the University of Oslo (Norway) and began a north-south partnership with the Norwegian Development Program (NUFU).

Prof Øksendal gave a speech regarding the role of Norway's programs (including NUFU) in the development of mathematics in Southern Africa. The program based in Zimbabwe ran from 1996 to 2007, and was designed and implemented with the intention of discouraging students from moving out of the region, thus reducing the risk of "brain-drain". The program supported approx. 160 masters' graduates and roughly 10 PhD graduates. With few exceptions, graduates have remained in the region as teachers, researchers, and other professionals.



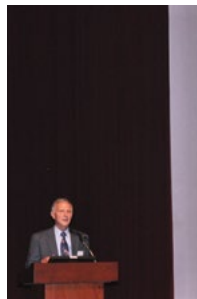
Mathematics teacher and teacher educator workshop CANP in Tanzania 2014

The program has now been adopted and continued by a new host, the University of Dar es Salaam in Tanzania, and most of its graduates continue to work in southern Africa and many have taken important positions in academia and other sectors.

Mathematics and economic development

Mathematics and mathematical applications have become in the last few decades one of the most important pillars of modern societies. The power of mathematics has been shown to reach beyond regional borders and dramatically influence the economic development of countries. This has been a career-long interest of economist Eric Hanushek, of the Hoover Institution of Stanford University, who said at MENAO symposium: "Math is more important than even this audience actually thinks". "The only thing that matters is the rate of growth of an economy and in determining the rate of growth, the only thing that matters is the skills of the population" he added.

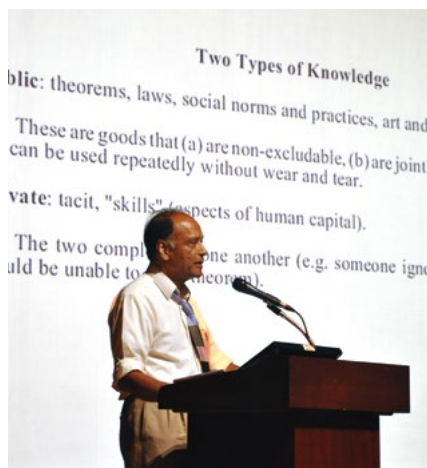
With mathematics as one of the most powerful of those skills, he said, the central focus for developing countries should be on increasing those skills.



Eric Hanushek



As an example, he said that if Brazil were to raise its PISA math scores by 25 points its average GDP would rise 6 percent per year for the next 80 years; this would correlate with every worker receiving a paycheck 12 percent larger. Raising scores, he continued, is determined by teacher quality “and that is essentially all that counts.” He generalized that the long-term economic future of countries is linked to the skills of its population, and to enhance these skills, schools must focus on achievements and outcomes.



Sir Partha Dasgupta

Sir Partha Dasgupta of Cambridge University (Great Britain) extended Prof Hanushek’s presentation with a discussion of the power of Science, Technology, Engineering and Mathematics (STEM) knowledge for modern nations. Perhaps the most relevant and powerful attribute of STEM knowledge, he said, is its very high return on investment. In the United States, he said, in the late 1900s, the social rate of return on R&D expenditures was about 30 percent. A conclusion he drew from the power of educational investment is that “we are under-investing in knowledge.” This is especially true in poorer countries, he said, where the knowledge base is narrowest.

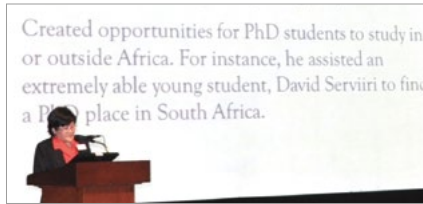
A role for the private sector

A growing effort by the IMU is to interest the private sector in supporting mathematics research and education, especially in the developing world where mathematics students often lack opportunities to apply their skills in technology-based companies. Rune Olav Pedersen, representing the Norwegian company Petroleum Geo-Services (PGS), described his firm’s desire to sponsor valuable activities. PGS decided on a project that supports mathematics research and education in Ghana, demonstrates to students that “mathematics is at the heart” of his company’s activities and designs a program with incentives for students to work and remain in their home countries.

Opportunities

Polly Sy, a mathematician at the University of the Philippines and member-at-large of the CDC, gave a talk entitled “Opportunities for Mathematicians from Developing Countries”. She did this partly in the form of her own personal story, which reflected the perspectives of a female mathematician in a developing country. An essential part of her journey had been the support and mentoring she received from others, and hoped this would be “representative of the larger reality of mathematics in developing countries.” The CDC currently has a four-part vision to foster mathematical development: supporting graduate students, inter-

national mentoring programs, short term volunteer lecturer courses and government, business and industry internships as well as research collaborations.



Polly Sy

Sharing without expectation

If the MENAO presentations reflected a common theme, it was indeed the nanum, or “sharing without expectation of reward,” as described by the Korean hosts. All participants and countries clearly favoured extending the power of mathematics to the smallest of countries so that they may benefit as strongly as Vietnam, Korea, and others.



Nanum Networking

As Prof KunMo Chung concluded, “We like to share our successful experiences, and also the possibility of making a better life. Brains are all the same. It’s how we use them for the future that’s important.”

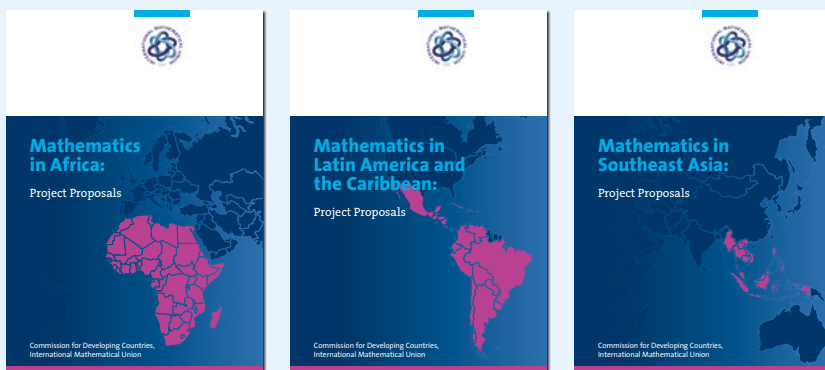


Support IMU

The IMU and the CDC seek partners and donors in support of its “IMU Volunteer Lecturer Program”, the ICMI “Capacity and Network Project” for Mathematics Education, as well as independent initiatives in Latin America, the Caribbean, Southeast Asia and in Africa as described in the three regional reports.

An overview of those initiatives and projects can be found on the CDC website:

www.mathunion.org/cdc



For more information about making a donation, requesting a proposal, or supporting one of the initiatives in support of mathematics and mathematics educational development, please contact:
the IMU Secretariat in Berlin, Germany at

menao@mathunion.org

Program

Mathematics in Emerging Nations (MENA0)

Achievements and Opportunities

August 12, 2014

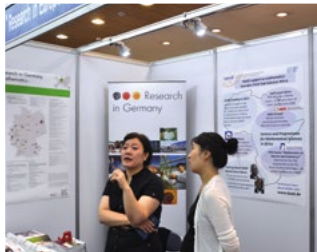
Seoul, Korea

08:00–09:00	Registration
09:00–09:10	Introductions Cheryl Prager , University of Western Australia, (Australia) Marcelo Viana , IMU Vice President, IMPA (Brazil) Hyungju Park , POSTECH, Chair ICM 2014, (Korea) Herb Clemens , University of Utah, CDC Secretary for Policy, (USA)
09:10–10:10	Invited Talks Ngô Bao Châu , University of Chicago (USA) and Vietnam Institute for Advanced Study in Mathematics, (Vietnam): <i>The place of mathematics in a developing country: the case of Vietnam</i> Edward Lungu , University of Botswana, (Botswana): <i>How mathematics shaped my life and career</i>
10:10–10:30	Break and conversation
10:30–11:15	Invited Talk Eric Hanushek , Hoover Institution of Stanford University, (USA): <i>The relationship between mathematical skills and economic development</i>
11:15–12:10	Achievements KunMo Chung , Former Minister of Science & Technology (12th , 15th), The Republic of Korea: <i>Mathematics, a fundamental pillar of Korean economic development</i>
12:15–13:30	Lunch
13:30–14:00	Achievements Rubí E. Rodríguez , Universidad de La Frontera (Chile) and Chilean Mathematical Society: <i>Mathematics in Chile, a half-century of steady development</i>
14:00–14:20	Achievements Bernt Øksendal , University of Oslo (Norway): <i>The role of Norway's programs in the development of mathematics in Southern Africa</i>

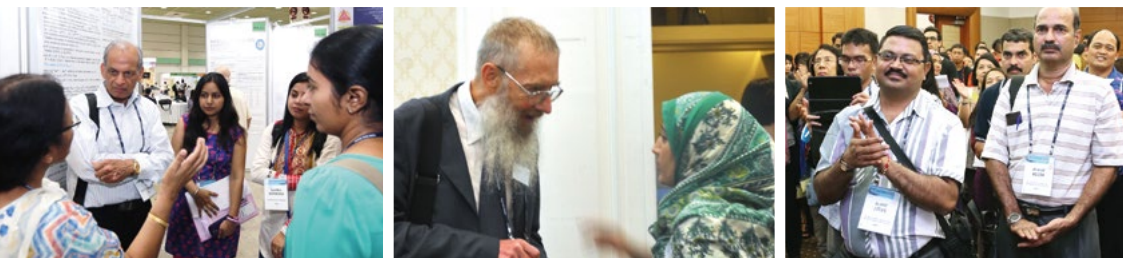
14:20–14:30	Engagement of the Private Sector Rune Olav Pedersen , PGS ASA (Norway)
14:30–14:45	Break and conversation
14:45–15:30	Union Panel O. D. Makinde , African Mathematical Union, (South Africa) Edy Tri Baskoro , South East Asian Mathematical Union, (Indonesia) José Antonio Seade , UMALCA, Unión Matemática de América Latina y el Caribe, (Mexico) Ragni Piene , CDC, University of Oslo, (Norway)
15:30–16:30	Parallel poster and conversation session Contributions of international agencies, institutions and foundations Poster and Conversation Session IMU in Developing Countries Report and Regional Reports: Africa, South East Asia and Latin America
16:30–16:50	Break and conversation
16:50–17:05	Invited Talk Magalie Lebreton-Traoré UNESCO, (France): <i>Capacity building and innovation in mathematics in the developing world</i>
17:05–17:30	Opportunities Polly Sy , University of the Philippines, (Philippines): <i>Short presentation of a four-part vision</i> <i>Graduate Student Support</i> <i>International mentoring</i> <i>Volunteer lecturer program</i> <i>Government, business, industry internships and research collaborations</i>
17:30–18:15	Invited Talk Sir Partha Dasgupta , Cambridge University, (Great Britain): <i>The Place of Knowledge in Economic Development</i>
18:15–18:30	Wrapping up Sir Partha Dasgupta , Cambridge University, (Great Britain)
18:30–18:40	Closing Ingrid Daubechies , Duke University, IMU President (USA)
18:40	Reception (jointly at the ICM Welcome Reception)

The following institutions' and organizations participated in the MENAO poster session:

Abdus Salam International Centre for Theoretical Physics (ICTP)
African Institute for Mathematical Sciences (AIMS)
African Mathematics Millennium Science Initiative (AMMSI)
African Mathematical Union (AMU)
Centre International de Mathématiques Pures et Appliquées (CIMPA)
Commission for Developing Countries (IMU-CDC)
European Mathematical Society- Commission for Developing Countries (EMS-CDC)
Heidelberg Laureate Forum and Klaus Tschira Foundation
ICMI Capacity and Network Project (CANP)
International Centre for Mathematical Sciences (ICMS)
International Science Programme (ISP), Uppsala University
Japan International Cooperation Agency (JICA)
Mentoring African Research in Mathematics (MARM)
National Board for Higher Mathematics (NBHM)
“Research in Europe” (Germany, the Netherlands)
Simons Foundation
Southeast Asian Mathematical Society (SEAMS)
Mathematical Union of Latin America and the Caribbean (UMALCA)



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