Building Mathematical and Scientific Talent in the BMENA Region

Zohra Ben Lakhdar

University Tunis el Manar-Tunisian Society of optics- Ecole Espri -prépa

Abstract:

The subject “Building Mathematical and Scientific Talent in the BMENA Region” will be connected to the question “Is there an effective way to support meaningful research in a developing country?” Among the subsidiary questions is “How to establish research, to uplift its quality, to mobilize students, to engage a network in research activity in the country and throughout the region? From our experience in research development (reality imposes limitations), and from our observation and analysis, we will offer our opinion and suggestions: imperative synergies, opportunities and requirements to assist in designing and implementing solutions for Building Mathematical and Scientific Talent in the BMENA Region.

BUILDING MATHEMATICAL AND SCIENTIFIC TALENT IN THE BMENA REGION

Royal Scientific Society of Jordan
AAAS
John Templeton Foundation
27–29 September 2010

Presentation by
DR. ZOHRA BEN LAKHDAR

My thanks to Her Majesty Queen Rania Al Abdullah of the Hashemite Kingdom of Jordan, to the American Association for the Advancement of Science, and to the Royal Scientific Society (RSS) in Amman. The question I will address is "Are we nurturing talent in the BMENA region?"

The title of our conference, "Building Mathematical and Science Talent in the BMENA Region" (fig. 1), is connected to the questions "How do we establish research, uplift its quality, mobilize students, mobilize teachers, and engage a network in research activities in the country and in the region?" "How do we engage society?" "Which are the imperative synergies? "Which opportunities?" Which requirements?" and, finally, "Is there an effective way to support Building Mathematical and Scientific Talent in the BMENA region?"

Figure1: Middle East and North African countries

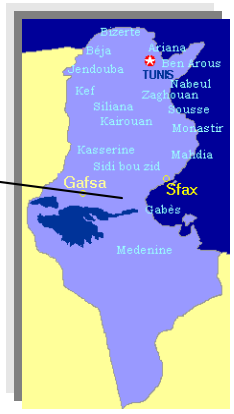

Figure 2

I will try to answer these questions, taking my example from Tunisia (fig. 2) and my own experience in building a research laboratory.

Tunisia gained its independence from the French in 1956. Almost all other MENA countries obtained their independence in the 1960s. So, none of these have known the Industrial Revolution. In the 1960s, the video recording machine used magnetic tapes. The maser was patented in 1959, the compact disk in 1965. Fiber optics was proposed for long distance in 1966. In the 1960s, with a population of about 5 million, there was only one faculty of science in Tunisia with fewer than 500 students, 3 percent of which were women. Only two Tunisians had a Ph.D. in science. There was one faculty of medicine, with about100 students, and there was just one engineering school, for agriculture. There was no science research laboratory.

The government had yet to develop and enhance education and to build schools, hospitals, and houses. When it did, the new services and construction led to an increase in the numbers of students in general, and females in particular, at the university (fig. 3). Unfortunately, what ensued was a decrease in the quality of education because there were not enough qualified teachers.

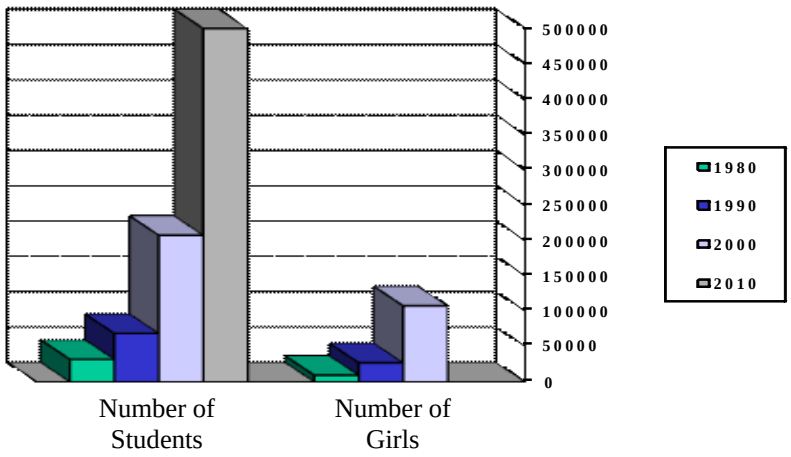

Figure 3

In the 1980s, two pilot secondary schools were created for the best 10- to 12-year-old students from all over the country. The schools recruited the best teachers in the country. Over a period of six years at the schools, the students got very good preparation for access to the university. The best of them went to study medicine in Tunis or got fellowships to go to France or Germany to study at the best engineering schools in those countries. As a result, we in Tunisia have very good physicians but we lost those who went abroad.

Excellence needs excellence! It is an imperative synergy. There was a need for a pilot university, a center of excellence! We did not yet have this facility!

I got my bachelor's degree in physics in Tunisia in 1967, and I was awarded a fellowship to Pierre Marie Curie University in Paris, to prepare for a master's degree and a thesis in the spectroscopy of atoms and molecules! But what is a master? How does one write a thesis in atomic physics? Nobody can help you answer those questions. I had no idea of how to carry out research activities. Each scientific word seemed new.

I prepared my thesis (*Doctorat 3ème cycle*) and came back to the Faculty of Sciences in Tunis. I worked as an assistant for three years, contributing to the development of a master's degree in quantum physics, but there were no supervisors and no laboratories, and I did no research. I went back to France to prepare my State Doctorate (*Doctorat d'Etat*) in the same lab at Pierre Marie Curie University, and I got on with my research in spectroscopy.

Since about 1970, I have been in the company of atoms and molecules. So, how do atoms and molecules behave?

Here are some of the interactions among atoms: There's a love and hate dynamic in atoms society. And about the behavior of atoms and molecules? They're like humans, but with a nanometer as waist! The medium of communication of this population is light; the identity of each one is its spectrum; their language is math. The only way to find out how they behave is to watch them in their society, at rest or in motion; to get their message; to understand their language; to listen to their story: and then to do what you like with them! Doing all that led to the nanotechnology of today.

It was a game, and I liked to share my newfound knowledge with my students in Tunisia. To bring that research to Tunisia, I wanted to build a laboratory there! In Paris, researchers in our lab were known as "agrégés, from ULM École normale supérieure. I was a researcher and an associate assistant, my husband the same. Nobody understood our choosing to come back to Tunisia. My supervisor had difficulty expressing his feelings: "Zohra! To build a research laboratory will ask 20 years of your life!" I responded, "No problem! I will do it; our students in Tunisia need research laboratories." *I was unaware!!*

Imperative synergy

You have to follow the international way for development. Research is sharing knowledge; it is cooperation, but you cannot achieve much by networking if you bring no strengths of your own. Research is also competition! You cannot contribute to development if you have no intellectual stamina! Advanced research is a luxury for me in Tunisia, where there is no environment, no training, no trainers, and total isolation from the scientific world. There are also no facilities for work, no politics for research, and no involvement of the government. Each step seemed as big as a mountain. Reality was very harsh.

Opportunities

In the 1980s, handheld calculators were developed and computers were being produced at a rate of about 300 million per year. We thus are assisting in a new industrial revolution! Modeling and simulation became an effective way to support meaningful research in the developing countries in the BMENA region. Researchers could now interact through the Internet. They were no longer isolated. It was a chance for developing countries not to be left out from the second revolution. In the 1990s, we assisted in the miniaturization of equipment; by 2000, Intel had begun volume production of ships with sub-100-nm-length transistors. It became possible to develop experimental research without sophisticated equipment.

Requirements

The requirements for success in research include vision, optimism, confidence, perseverance, cooperation, the ability to work on projects without waiting for assistance from the government, the foresight to take opportunities, and the ability to establish a network connection with the country's interests at heart.

In our particular research, it became possible to study the interactions among atoms and molecules with the computer (through ab initio semiempirical calculation) and to connect with researchers over the world to discuss our experimental research (on fluorescence, tunable diode laser absorption spectroscopy, and laser-induced breakdown spectroscopy), with applications to the environment, agriculture, biology, and medicine. We tried to develop research groups in computational molecular physics in different African countries. With the financial support of the International Centre for Theoretical Physics (ICTP) in Trieste, Italy, we began this experience with the Centre de Physique Atomique Moleculaire et Optique Quantique (Center of Atomic Molecular Physics and Quantum Optics, CEPAMOQ) in Cameroon. Researchers came to prepare a thesis or hold a postdoc. At that time, theses were prepared in a "sandwich" between 6 months training and research in France and conducting the same experiment in our lab. This experience was repeated in seven other African countries. We are now coordinating a computing molecular physics researcher's network of eight countries, thanks to the ICTP.

The first research laboratories in physics in Tunisia began in 1999. Our laboratory is the Laboratory of Spectroscopy of Atoms, Molecules, and Applications (LSAMA). In 2006, LSAMA became the Laboratoire International Associé (LIA), an international laboratory associated with the Centre National de la Recherche Scientifique (National Center for Scientific Research, CNRS) in France.

Training of trainers

In the lab, our researchers are teachers. Training for education is very important; indeed, it is the key ingredient in building mathematical talent. If you seek talent, you need the best students. If you seek quality engineers, you need the best teachers.

So, we organized activities around how to train trainers in optics and photonics through an active-learning approach. We began these activities in 2005 within the framework of a UNESCO project for developing countries. Called Active Learning in Optics and Photonics (ALOP), the project is supported by a host of international optics societies: the Optics Society of America (OSA), The International Society for Optical Engineering (SPIE), the International Commission for Optics (ICO), the Abdus Salam International Centre for Theoretical Physics (ICTP), the Institute of Electrical and Electronic Engineers (IEEE), and, most recently, the Arab League Educational, Cultural and Scientific Organization (ALECSO). Participants learn how to teach with simple equipment and in a manner such that the concept is acquired through activity. The teachers have the role of facilitator and do not "spoon-feed" the concept to the students. Instead, the students learn the concept through prediction and subsequent activities comparing observed results with their predictions.

The next workshop will take place in Tunisia in July 2011. If you would like to submit an application, please do so. With the aid of UNESCO, you may be able to help people from developing countries organize these workshops in their countries. I got this training at the beginning and then I prepared our trainers in Tunisia. Some of the trainers I have taught are now considered experts by UNESCO.

Development of talent needs rational thinking

Together with the Association Jeunes Science de Tunisie (Tunisian Youth and Science Association), we decided to hold a conference called "Science and Society" every two to three years. The conference would be organized around a scientist who changed the way of thinking of humanity. The first conference (2005) was about Ibn al-Haytham (known as Al Hazen in the Occident), the father of the camera (camera obscura), and the second conference (2009) was on Galileo. In parallel with the conference, children ages 8 to 12 are trained to carry out some activities connected with the subject of the conference; for example, in 2005 they built their own cameras. These students become involved in science either alone or together with their father or mother. And this is something we think is interesting—because it leads to discussion at home!

.


21 11 2006


22 11 2006