

# REFLECTIONS ON ARAB RENAISSANCE

A Call for Education Reform

*By Ahmed Zewail*

I recently read an important study that left me in awe of the knowledge demographics of our planet. In *Educating All Children: A Global Agenda*, Joel Cohen and David Bloom argue that while the aim of achieving primary and secondary schooling for all children is urgent and feasible, more than three hundred million children will not be in school in the year 2015. Empowering future generations with contemporary liberal arts education represents a significant challenge, even for highly developed nations. A year ago, President Barack Obama announced a major expansion of Educate to Innovate, a program to raise, in the coming decade, the level of American students in science, technology, engineering, and mathematics, or STEM, as the disciplines are collectively known. One of the new initiatives of the project is to spend more than \$250 million of public and private funds to prepare ten thousand new teachers and retrain more than one hundred thousand others in the fields of math and science. As a presidential advisor, I know that the Obama administration has made all levels of education, an enterprise of nearly a trillion dollar budget, one of its top priorities.

For the Arab world, good education is critical for making our future. The failure of Arab education is one of the underlying causes of the youth discontent we are witnessing throughout the region. The serious cultural, economic, and political consequences have become obvious. The children of Facebook have ignited an intifada to plant democracy in Egypt, Tunisia, Bahrain, Yemen, Libya and other Arab countries. Only when we diagnose the symptoms can we cure the disease, and it is education that is at the core of any recovery—an Arab renaissance. It is imperative and a matter of urgency

that education be elevated to a much higher national priority throughout the Middle East. Anyone who examines the progress achieved in Europe, the United States, or in more recently developed nations

▷ Physics class at the German University in Cairo, March 1, 2006. Gary Knight/VII/Corbis



in Asia or Latin America, can understand the direct correlation between good education and the development of societies. Indeed, Egypt is a living testimony to the link between the power of knowledge and the impact of its ancient civilization—and that later one established on the shores of the Mediterranean some two thousand years ago, in Alexandria, whose library and museum constituted a beacon of knowledge.

The concept of civilization itself is based upon knowledge. On the banks of the river Nile, the ancient Egyptians introduced new concepts in fields such as architecture, medicine, astronomy, and chemistry that influenced the Pharaonic as well as later civilizations. In my own field, some six thousand years ago, they were the first to ingeniously measure time and create the solar calendar. Recently, French scientists reported yet another astounding achievement, namely that the eye cosmetics used in the time of Nefertiti contained a man-made lead compound that helped treat or prevent eye disease. The modern West continues to explore the progress attained by this ancient civilization.

Arab civilization, a millennium ago, recorded outstanding achievements as well. Last year, I published with Sir John Thomas of the University of Cambridge a book about four-dimensional microscopy imaging. In this book and elsewhere I point out that major contributions to the science of imaging and vision were made by the Muslim thinker Ibn al-Haytham (known in the West as Alhazen) who lived ca. 965–1040 in Iraq and Egypt. He developed concepts in optics, later used by Descartes, Newton, Da Vinci, and our modern photographers, that explain how the retina works to receive an image from reflected light. His experiment, called *al-hugra al-muzlimi*, “the dark room,” later known as camera obscura, demonstrated how external light passing through a pinhole in a box forms an upside-down image on an interior surface. The making of useful knowledge by Ibn al-Haytham, Ibn Rushd (the polymath philosopher known in the West as Averroës), Ibn Sina (the foremost physician of his time, known as Avicenna), al-Khawarizmi (whose Latinized name, Algoritmi, inspired the terms algorism and algorithm), and other renaissance men, forged centers of enlightenment in capitals such as Baghdad, Cairo, and Cordoba.

Modern Egypt, too, was recognized for a renaissance in educational, cultural, and industrial fields, in part due to the progress made possible by the visionary leadership of Mohammed Ali. He transformed Egypt into a regional industrial and military power through reorganization and reforms in the society and by means of educational and cultural missions from Egypt to Europe. Rifa‘a al-Tahtawi and his followers were among the pioneers in bringing about a renaissance in education with the aid of knowledge translated from French into Arabic. In the years to follow, Egypt became a powerhouse in literature, arts, science, and culture. Personalities in all fields emerged and influenced Arab society at large. We still live on the echoes of their contributions,

from the writings of Taha Hussein, Naguib Mahfouz, and Ali Moustafa Mosharafa, to the songs and films of Umm Kulthum, Abdel Wahab, and Faten Hamama. In the Middle East, only a century ago, Egypt pioneered democratic governance and established institutions in different sectors of higher education and scientific research (Cairo University), banking (Bank al-Ahly), mass media (Al-Ahram), and industries such as textile and the motion picture. With this advanced status, Egypt attracted and educated future generations of Arabs, including, among many others, the renowned Palestinian Edward W. Said, Michael Atiyah of Lebanon, King Hussein of Jordan, and my own father-in-law Chaker El-Faham of Syria. As recently as the 1960s, after the 1952 revolution, my generation benefited from a fine education system amid a rich cultural life and national dreams of colossal projects, such as the High Dam, space aviation, and nuclear energy.

### **A Bleak Situation**

With these past achievements in mind, and knowing that human resources are still available, one has to ask what happened to education and scientific research in the modern Arab world? Today, the contribution of the Arab world to international scientific research is negligible. In both research investment (R&D spend compared to GDP) and capacity (researcher numbers compared to population), as reflected in research publication output between 2000 and 2009, the predominance of Turkey and Iran is evident; in 2009 Turkey produced twenty-two thousand publications as compared to five thousand in 2000, and Iran produced fifteen thousand papers in 2009, in vast contrast to thirteen hundred in 2000. During the same period Egypt and Saudi Arabia had a flat trajectory at nearly two thousand, according to a very recent global research report by Thomson Reuters. No Arab university regularly ranks among the world's five hundred best institutions, though Alexandria University made it in one ranking in 2010. Ibrahim El-Moallem, vice president of the International Publishers Association, estimates that book sales in the Arab world are 1 percent of the world market (Egypt accounts for 0.4 percent), and that books of basic sciences and arts are only 3 to 5 percent of total sales. Egypt's national income from research and development is minor. The GDP depends on revenues from traffic in the Suez Canal, tourism, and natural resources such as gas and oil, all a "gift of the Nile," as Herodotus called the land of Egypt. By contrast, Israel, with less than a tenth of Egypt's eighty-million population, acquires more than 90 percent of its GDP primarily from industry and services, with technology being the back bone of the economy.

Current conditions do not encourage optimism if we consider government expenditures. On basic education, according to a report by the renowned medical doctor Mohamed Ghoneim, based on United Nations Development Programme data, the



Egyptian government spends annually twenty-four billion Egyptian pounds (less than \$5 billion and around 2.4 percent of the national income) which amounts to about \$250 per student per year. Israel, to make another comparison, spends at least \$1,500 per student per year. At university level, the Egyptian government spends less than \$500 per year on each of its 2.2 million students. In contrast, Egyptians are paying \$15,000 and \$10,000, respectively, for private education at the American University in Cairo or the Nile University, for example. Such is the bleak situation in public education that causes Egyptian families to pay between ten and fifteen billion Egyptian pounds per year for private tutoring in the hopes of giving their children a greater chance to learn and succeed.

The infrastructure of most of the Egyptian schools is far behind a country like Finland or South Korea. The number of students in public-school classes reaches sixty and more, making it impossible for a teacher to interact well with pupils. University lecture halls are packed with hundreds of students. Teaching also relies heavily on indoctrination, failing to take advantage of pedagogical methodologies that have advanced throughout the modern world. Many of the topics in the curriculum are not suitable, especially when we consider that these students have to compete in the information and space age.

In Egypt, teachers have an unfavorable financial position and a lower-than-ever social status. Even with a recent salary increase, many find themselves forced to offer private lessons on the side as a way of supplementing their incomes. What is needed are teachers, or *mu'allims*, who can cognitively attract students to new ideas and knowledge, not simply tutors who prepare them for rote memorization and passing exams.

### **Society and Media**

Conditions in Arab society at large have not been very conducive to advancement in education. More than 35 percent of the Arab population is under the age of fifteen. This represents a potential boom in human resources, yet it is not effectively utilized. The unemployment rate in the region ranges from 10 to 20 percent. Egyptian families face a greater burden in raising children today compared to fifty years ago. In an estimated 30 percent of the families, women are the breadwinners due to issues like divorce.

The Arab media are not equipped to perform their responsibility to illuminate educational and scientific matters, despite the increasing number of newspapers, magazines, and over five hundred television satellite channels (most of them concerned with music video clips and soap operas). A few years ago I happened to arrive in Egypt right after the landing of the NASA rover, Opportunity, on Mars. The world seemed transfixed by this remarkable event, but in Egypt I could only find a small story about it in one of the newspapers. It is generally acknowledged that the search

for truth and in-depth analysis are uncommon features in the programming of the influential broadcast media, which consume about one-third of the day in the life of the average Egyptian. In a recent TV program watched by millions, the anchorman said we must find out “who changed the weather” (*min illi ghayyar al-gaww*) to make it so bad, adding in all seriousness “We must deal immediately with the culprit or the country involved!”

The culture is under pressure. One of my concerns is that we are creating sub-cultures within the Arab culture. In private schools, which are now becoming a major force in Arab education, the language used and culture practiced are often those of other nations. Of course it is proper to teach foreign languages, yet without proper education in the Arabic language and traditions, the country risks class/language fragmentation in society. I also see blind imitation as another threat to the culture of the Arab world. If MTV in America (which incidentally does not reflect the rich American culture) airs certain programming, it does not mean that Arab society is not modern unless its channels offer the same thing. The quest for modernization must respect cultural identity.

In the realm of religious values, the vital role of true religion has been replaced by ideological stubbornness and, I may say, ideological terrorism by some. I believe that the use of politics in religion and religion in politics is creating confusion and conflict in society. The spread of rulings or pronouncements from non-qualified proselytizers has diverted society’s energy into superficial issues and led to calcification of the mind. And evasion of the rule of law has had many consequences. The most threatening of all is ‘societal fragmentation,’ which has led to cracks in national unity through bigotry and violence, as we saw in Nag Hammadi and Alexandria in Egypt. Superficial media rhetoric does not solve problems and people must use reason to reach their goals for national coherence and civil society governance. One essential change is good education.

### **A Paradigm Shift**

It is clear that the education system is in need of major reform. In any nation, schooling can generally be categorized into primary and secondary education, higher education, and research and development, normally involving Master’s and Ph.D. degree studies.

#### *Primary Education*

Basic education is a human right, especially in the knowledge society of today. It must be a priority for governments to embark on a major national project to eliminate illiteracy. I find it hard to believe or understand, in an age seeking ever greater scientific knowl-

edge, that from 25 to 50 percent of the Arab population of some three hundred and fifty million remains illiterate. How can this population at large deal with the modern world of services through the internet, or be effective in the knowledge-based work force? How can illiterate parents prepare the children of tomorrow?

Arabs need to dramatically increase spending on education. In most of the Arab countries, the current low percentage of national wealth spent on education will never improve the schools, curricula, and teachers to produce the kinds of students that are equipped to handle national and international demands. More resources are needed, and they should have priority over less essential projects like mega-resorts for luxury living. The allocation of new resources must be directed with care to enhance quality over quantity.

The status of teachers must change through a merit-based system of evaluation and appreciation. That should eliminate the present parallel education system of private tutors, upon whom Egyptian middle-class families spend a disproportionate amount of their income to enhance an education that is supposedly free. The involvement of the private sector should take on a new structure, one that creates a partnership between schools and families and involves them in the education process; no single person, not even a minister, knows the answers to questions pertinent to the most effective mechanisms in education.

### *Higher Education*

Higher education with hundreds of thousands of university students and low-level resources has proved to be ineffective. It is time to restructure the current organization, which was effective half a century ago, and to create a modern multi-tier system of public and private higher education. For public education, it would be reasonable to establish three or four tiers of universities with the layers being defined according to students' ability and social situation. On the other hand, private universities should not be for business; in fact, they should represent the pinnacle of education, research, and development as nonprofit organizations.

In California, for example, the state supports the University of California and California State University systems, community colleges, and others such as adult education schools. Each of them has its own goals and mission; the aim of educating a student going to Berkeley is different from that at Cal State, Los Angeles, or Pasadena City College. In the end, the students will get educations that serve them and the society. But depending on ability, status, and presence on campus (full/part time), the student and the state are in a position to tailor needs and effectiveness. Parents who can afford their children's university fees should be required to make financial contributions, just as they do when their children are enrolled in private universities at home or abroad,

but those students who do not have the means should acquire appropriate education either through merit-based scholarships or from a loan-granting banking system.

Also in California, again by way of example, there exist some of the best private universities in the world, including Caltech and Stanford. Besides the excellent education they offer, and the enabling of the thinkers behind Intel, Google, and other mega-companies, they represent powerhouses for global research and development. Both Caltech and Stanford are nonprofit private universities. Their support comes from endowment, philanthropy, and relatively high tuition. For research, both public and private institutions receive funding mostly from federal government agencies and the private sector. The National Science Foundation is a key source of funding, and Arab countries should establish similar entities for funding independent and creative research. I also suggest defense ministries develop funding programs, as a percentage of their total budget, for national support of R&D even if the research is only remotely related to the defense issues of today.

In the region, Israel and Turkey have succeeded in establishing advanced private institutions. In Turkey, Bilkent University is a leading research institution, whose endowment is sustained by income from major international projects such as the construction of world-class airports (for example in Cairo and Doha) and the supply of high-tech products to various industries. Such a concept was proposed as a national project in Egypt more than ten years ago; more details can be found in my book, *‘Asr al-‘ilm*. With independent institutions, Israel has become a high-tech superpower over the past two decades. Scaling to its population, it leads the world in number of start-ups and size of venture-capital industry. The Israeli government has now identified new frontiers of focus, including areas of potential growth, in alternative energy, water management, agricultural innovations, and of course in the military industry.

Teaching methodology in higher education is in need of revamping. Understanding of and respect for facts is essential for the scientific method, which is not only important for education itself but also for integrating rational thinking into the fabric of the culture.

In countries with overpopulated universities, students are not provided with “hands on” opportunities for involvement in learning. When I was a student at Alexandria University, I was in a special class of seven students and had direct access to microscopes, experiments, and the like. Today, with the large number of students involved, carefully instituted and interactive teaching methods can enable students to perform experiments through virtual reality technology. Such methods, which I have observed in Turkey and Malaysia, represent a totally different and better way for cognitive involvement than teaching students science largely through memorization. Faculty must be equipped with the latest techniques, through retraining and periodic updating, and perhaps



through sabbatical leave. Such faculty are to be evaluated and academically and financially rewarded according to performance.

To increase the level of skill nationwide, technical and vocational education must be enhanced and respected. This type of education empowers the society with know-how and improves the infrastructure. It is also time to stop admitting more students than universities have the capacity to teach, and to end the exaggeration of scores in obtaining degrees. In the 1960s, it was a great achievement for me to score over 90 percent in my bachelor's degree. Now we hear of 110 percent scores! Scientifically, 100 percent is the maximum meaningful score. I can understand so-called bonuses, but these should not be confused with actual grades.

Finally, the reform of higher education should begin with the restoring of the prestige of the university and faculty and by raising the admissions standards. I recall how emotional I felt on my arrival at the campus of the Faculty of Science, because of the high standing, the *hayba*, the university and faculty had in our society at that time. The campus should be the home of knowledge and culture, not a space for political and religious conflicts. It need not be policed for security. In all universities I am familiar with, students can have intellectual discourses on all subjects and organize all kinds of events under the supervision of their mentors and subject to university by-laws, and, if extra precautions are needed, these take the form of campus security staff, not a police force.

### *Research and Development Centers*

The third and final level of the education pyramid is scientific research. First, we should clarify a few misconceptions. No nation can establish a viable R&D program without commitment from its government in the form of long-term investment. In fact, without such backing I cannot see why the public in general and the private sector in particular should contribute to funding R&D. Second, developing nations can achieve progress on the international level in a relatively short time, contrary to the belief that such progress requires one or two generations. The proof came recently from a number of countries including China, India, South Korea, Malaysia, and now Turkey and Iran. Third, R&D is not a luxury, as some believe, reserved for rich or developed countries. This too is proved false, since developing, and in many cases poor, countries have crossed the chasm that divides them from developed nations by investing *more* generously in R&D. Fourth, there is a fundamental role for basic research in development, and this cannot be strong without a science base that integrates expertise in STEM.

Curiosity-driven basic research requires that creative scientists work in an environment that encourages interactions between researchers and collaborations across different fields. But such attributes cannot and should not be orchestrated by structured and

weighty management, as creative minds and bureaucracies are incompatible. Large buildings alone will not produce much without the right people. To distract faculty members with excessive regulations, research for-promotion incentives, or to involve them as political tools, is the beginning of the end. Without resources little can be achieved, no matter how creative the mind. Countries and institutions that provide the proper infrastructure and the funding for new ideas will be the home of new discoveries and the source of innovations.

The quest for new knowledge drives innovation, and without centers of excellence, young students and scientists will not be attracted to the profession of R&D. My own attraction to science was enhanced by the sheer joy of discovery, which began in Egypt with a school-age curiosity about why wood burns. When I look back and ask why Caltech, or the California Institute of Technology, where I have spent the last thirty years of my career, has garnered thirty-five Nobel prizes, it is because Caltech as an institution believes in such values. Its unique culture makes scholars enjoy the quest for the unknown, free from bureaucratic regulations and political hierarchy.

It is time for Egypt and other Arab countries to have such a vision and for governments to be determined to allocate substantial resources to establish R&D centers of excellence. These centers should be rising with at least equal priority to the media megacities recently brought into existence in several Arab capitals. As importantly, the centers must be granted independence in order to formulate their own academic and administrative structures. Among other things, establishing a merit system for scholars and elevating the prestige of the chair professor are important essentials. For young researchers, the government should increase the number of scientific missions it sends abroad. In turn, the research environment should be attractive to the scholars when they return to their homeland with the benefits of the knowledge they have acquired. Their missions abroad are a waste of money if they are forced to struggle with bureaucratic obstacles back home.

### **The Knowledge Chasm**

In the Arab world, we face the daunting challenge of reducing the knowledge gap with the rest of the world in many fields of endeavor. When I was a graduate student, America, after the launch of the Russian sputnik, had a vision to conquer outer space, and in 1969 Neil Armstrong walked on the moon. Today, America is sending space cars and possibly an astronaut to Mars. Scientists are searching for life on other planets with the potential of finding new resources or, in the case of some governments, with the desire to control the Earth from outer space.

In the field of medicine, discoveries are made at the level of genes and cells, opening up new avenues for drug design and cures for disease. Today, scientists can take

adult cells from skin and convert them into stem cells that can be used to develop new tissues for the heart, eyes, and other parts of our bodies. Such discoveries were unimaginable twenty years ago.

In the microscopic world of nanotechnology, for the first time in human history, man can visualize objects in four dimensions, functioning on a time scale of a millionth of a billionth of a second, and in their 3-D space with a better than one-billionth-of-a-meter precision. This methodology, which my group and I developed recently at Caltech, has the potential of uncovering new phenomena in materials science and in biological/medical sciences.

These are just a few examples that demonstrate the chasm between the haves and the have-nots of knowledge. It would be naïve to think that the quest for useful knowledge is a luxury for society. Exploring for its own sake enables humans to discover the “unknown unknowns,” and not simply to polish our knowledge of the “known unknowns.”

## Epilogue

Civilizations rise through the power of knowledge. They fall when such power fades. Arab and Muslim civilizations reached their zenith when their leaders believed in the value of making new knowledge and in ensuring human rights and liberty of mind, the necessary tools for progress. Preserving knowledge is easy. Transferring knowledge is also easy. But making new knowledge is neither easy nor profitable—in the short term. It has, however, proved to be hugely profitable in the long run. Think of the impact of only two curiosity-driven discoveries, the laser and the transistor, which have now transformed world markets and human services. And there is more: knowledge is a force that enriches the culture of any society with reason and basic truth and enlightens people against bigotry and radicalism.

In the modern era, the Arab people have not been makers of useful knowledge, and they are facing major challenges. Some of these are crippling their influence and participation in the world market and others are threatening the foundation of their own culture. At the core of the problem is the challenge of a deteriorating education system. Without education there is no progress and progress does not lie in the ability to consume and acquire goods from abroad. Arabs are in need of a renaissance that is built on a modern education and a science base with its triad of basic research, technology transfer, and societal involvement.

The impossible is possible. I certainly have confidence that Egypt can succeed despite all the complexities and problems in education and scientific research, and in governance. Turkey and Iran are emerging as a real force in the Middle East, and without Egypt's force the Arabs will not be in the sphere of influence. Some Arab

and Muslim countries, including Qatar, Turkey, and Malaysia, have already made progress in the field of education, transcending the stereotypes currently associated with Muslim culture and religion. But no country can cut corners to development. Important changes and progress in the Arab world will only occur if there is a political vision and will from the highest levels of the state. In the past, and we in the Arab world have all experienced this, it was possible to enclose a whole country. Today, that is impossible. The poor and the rich alike have small satellite dishes on their roofs, which show them how things are around the world. The sky and the whole world are open to our children. The political upheaval in the Arab world is telling of the need for a speedy change.

As we work toward a better future, there should be no conflict between science and religion. Education, which etymologically derives from the Latin “to bring out” potential, is any act or experience that has a formative effect on the mind, character, or physical ability of an individual. Education eradicates ideological stubbornness. In Arabic the word *ta’lim* captures its essence; it is from *‘ilm*, or knowledge. Education is the process by which society deliberately transmits its accumulated knowledge, skills, and values from one generation to another. It is therefore in the fabric of civilization. We should make use of the minds humans are uniquely blessed with, and accept faith and reason as the bases for human life. Egypt utilized both in building its ancient civilization. It must do so again.

Taha Hussein, one of our great writers, said decades ago, “*al-‘ilm ka-l-maa wa-l-hawa’*.” (“Education is a necessity, like the water we drink and the air we breathe.”) Without *‘ilm*, there is no life. Arabs have an opportunity to regain their place in history. The reasons for backwardness are several. Colonization and occupation have certainly been part of the problem. The self interest of superpowers, and even uninformed prejudices against cultures or ethnic groups, have always been in the fabric of politics. But we cannot live in the past or in the present with conspiracy theories. We must first solve our in-house problems in order to light the future. With “Liberty, Knowledge, and Faith” (the motto of the Ahmed Zewail Foundation for Knowledge and Development in Cairo), I believe that Arab renaissance will launch the dawning of a new age. The choice is ours: either to become three hundred and fifty million people of the cave, *ahl al-kahf*, or three hundred and fifty million people of the cosmos, *ahl al-kawn*.

*This article is based on addresses given by the author at the Dubai Press Club and at the Cairo Opera House in 2010.*