



Galvanizing Science Education for Fostering an Innovation Culture in the Arab Region

Comments of EURASC experts, whose qualities are listed at the end of the document.

I. MACRO LEVEL

A. The cause and effect analysis of the situation , similar experiences, and best practices addressing the identified four drivers of change

Prof. Vincenzo BALZANI and Prof. Margherita VENTURI

“First of all, we should be aware that it will take much time to improve the situation because of all the difficulties mentioned in Mr. Nazar’s document. Several of the proposed goals have not yet been achieved in our Europe. This, of course, does not exonerate Europe to make any possible effort to help the progress of Arab countries.

The first cause of the unsatisfactory situation is a low education level. Therefore there are the two following needs:

- (i) Creating first class leaders, which can only emerge in countries with democratic governments. Democracy is indeed the unquestionable requirement to improve the education level of leaders.
- (ii) Creating a national program for improving education for children. Science education is a particularly important part of a general education program; it should be carried out following modern approaches that start from every day concrete facts and hands-on experience to move curiosity and stimulate children to ask questions, learn from mistakes, give meaning to words. The preliminary and unavoidable step, of course, would be to create a group of suitably trained Arabian teachers; it can be done by sending European teachers to Arab countries for short courses aimed at educating the future Arab teachers. European teachers, on their side, would strongly benefit from such an experience.”

Prof. Luiz BEVILACQUA

“The scientific improvement alone doesn't determine the global economic and social growth. Brazil and Korea were at the same development stage in the 70’s but after 45 years the differences between both countries are evident. I suggest that the committee in charge of

preparing the developing strategies for the Arab Countries spend some time analyzing the two cases.

Certainly socio-political context, international conjuncture, cultural values and tradition play important roles in the determining factors that foster the integrated growth of any country. An important aspect is whether the commercial or industrial culture prevails among the Arab society. If the commercial activity is more attractive it will be necessary to induce very important cultural transformations. In this regard the suggestion stated in the document (“**opt to create technology incubators within each science faculty or college focusing on the research areas where each college has an advantage**”) must be carefully considered. The question of having expensive initiatives must be compared with the outcomes. It is a tendency to implement low cost enterprises that usually will return low value output. In general trying to reduce too much the investment is worst than no investment at all. I believe that well organized technology parks can help the industrial development of any country. Incubators in the university campus may be valuable but the government has to be aware that the main driver is the researcher interest which is not always matching the country's priorities. I think that a couple of well organized technology parks as converging point for people in colleges, universities, technical universities and industry as well, could be of great help. The technologies complexes can play an important role not only to enhance the technological output but can also stimulate the cultivation of the industrial entrepreneurship.

The decision to create technological colleges is very important and highly advisable. Some people are much more concerned with practical solutions, they are more creative in doing things than in elaborating theoretical questions. A problem that may arise, depending again on the cultural environment, is the recognition of this type of education by the general public. It would be strongly advisable **not** to establish certificate barriers (university, college, technicians) blocking the access to higher salaries. Salaries should reward much more the competence than the diploma. Creativity is not an exclusive aptitude of people getting their education in research universities. I think that Mr. Nazar's document is very positive in these aspects.”

Prof. Pierre BRAUNSTEIN

Regarding training of Arabian experts in Europe, the “brain-drain of the experts should be considered, looking at what happened in Russia after the fall of the communist regime. The contracts clearly stipulated that the experts had to return to Russia. A follow-up mechanism is mandatory (annual report during ca. 3 years to document the acquisition of the competences of concern”.

Prof. Gennady S. BISNOVATYI-KOGAN

“In my opinion it is rather untimely to discuss the STI (Science, Technology and Innovation) problems in the Arab region. The main problem of this region for the moment is violence and terrorism. They are based on a poverty of people, and are ignited by fanatic propaganda and some external actions.

It is most important to win the struggle for peoples minds, and to bring up young generation

in respect of others opinions, tolerance, and freedom. From early age people should understand that the only way to overcome poverty is based on hard work, education and peaceful struggle for their rights. This process should start from the elementary school. The EU could help by preparing teachers for the school education, which could learn the children of the region these ideas.

In the prosperous countries of this region the innovation and other topics have the same problems, and ways of their solution, as in other similar countries on the globe. “

Prof. Giorgio de MICHELIS

“It is well known that pushing an underdeveloped country into Innovation is difficult. Success stories are therefore a good point for trying to understand which can be success factors in it. I suggest to consider three countries who were successful in this difficult move: India, South Korea and Israel.

Without the ambition of a systematic analysis, I can suggest that in India the two key factors were the quality of the educational system and the growing number of students going to American Universities. This has created the terrain on which an important software industry has grown.

In South Korea, students moving between their country and USA injected innovation in the growing Chorean electronic companies helping them in short time to become competitive at the international level.

In Israel, there has been a strong start-up movement without strong companies in the ICT and other innovative sectors that became stable due to its links with the US start up movement. Israel, in any case, was not a typical underdeveloped country and its special links with USA should be taken into account.

Even, without being an underdeveloped country, Italy can be interesting in this framework, because its difficulties in the most innovative industrial sectors are well known. The Italian case shows that if there is not a functioning mechanism allowing to transform innovation into industrial performances, then even good initiatives at the level of start-up may fail.”

Prof. Herbert ROESKY

“Louis Pasteur wrote: „Science knows no country, because knowledge belongs to humanity, and is the torch which illuminates the world.”

First of all good educated teachers are needed, who are able to bring over the spirit of exciting science and technology to the young generation. In Germany there are several foundations like DAAD or Humboldt-Foundation who will support good teachers.

Second, like in India, a nation wide test for young fellows in science and mathematics is needed. Only those who are successful in the test are allowed with a fellowship to study at a good university in an Arab country or abroad. This is also the basis for students going abroad and a useful ranking system for the quality of the students. This is a percentage of 5% of excellent fellows.

Third, you cannot convince a politics making institution to support in general the improvement of the education. This has to be done stepwise, starting with 2-3 selected schools and universities in each country.

After getting this basis it is possible to start thinking about invention and innovation. Invention is about turning money into knowledge this is the step in general done at universities. Innovation is about turning knowledge into money this is mainly the step done by industry or entrepreneurs. It is important to think ‘invention’, and not only ‘innovation’.

Prof. Federico ROSEI

“The roundtable will undoubtedly play a major role in determining positive change, specifically combating poverty and promoting sustainability.

However, for significant long term change to occur, there needs to be a combined political and social willingness to embrace a new paradigm. This requires broader and bolder thinking and the moral courage to act and even take risks.

The recent, ongoing mass exodus of refugees from the Middle East (mostly Syria) and North Africa all across Europe has highlighted the flaws of our modern civilization, as well as the major divide in terms of willingness to help populations that are in dire need. While European countries have reacted very differently, going all the way from “we accept all refugees” to “we will not accept any”, Arab countries (consistently all the countries in the Arabian Peninsula) have refused any humanitarian help. This crisis is a strong indication that now more than ever there is a need for visionary thinking and leadership, towards peace and sustainability.

The primary concern for any society to promote its long term sustainable development should be to promote education, at all levels, starting from elementary school to promote curiosity among children (of both genders). Quoting Nelson Mandela, “*Education is the most powerful weapon we can use to change the world*”. Renewed efforts in education should be mirrored with investments in research, both fundamental and applied. Innovation is of course driven by need, however it is fostered by curiosity, which means that applied and basic research must coexist for best output.”

B. What possible solutions from within the region (national or regional in nature) could trigger the required transformative change

Prof. Vincenzo BALZANI and Prof. Margherita VENTURI

“The nations should be convinced that they must collaborate on any issue, particularly on scientific research. Creation of regional research centers for expensive scientific equipments would be not only convenient from an economic viewpoint, but also for improving exchange of knowledge and stimulating collaboration.”

Prof. Luiz BEVILACQUA

“In order to make effective the effort in education for a developing country industry must come into play. In the whole document Industry appears only once (**interface between Government and Industry**)”. Instead of "**commercialization**", at that stage "**industrialization**" should better apply. I suggest that in the preparation and implementation of a developing strategy as proposed in the document, that may open a promising future for the Arab Nations, representative of the most important innovative industries must come into play. University, Industry and Government should walk side by side in a very close cooperation unity. All the three must be present in the elaboration of the definitive document, particularly for planning and implementation of the key actions.

The document emphasizes scientific cooperation at regional (within the Arab community) and international levels (particularly with the EU). It is important to stress that effective international cooperation is only possible if there is a strong regional collaborative network. Recognizing graduate courses and diplomas among the universities and colleges inserted in the Arab community, exchanging students and professors, stimulating joint research should be a priority. The effectiveness of the international cooperation depends directly on the strength of the regional network.

The technology transfer must be considered carefully. Leading edge technologies are not transferred it is a natural attitude. Non-sensitive technologies may be transferred but in general are not further developed by the recipient. Not seldom the effective technology transfer happens in the opposite direction as expected, that is from the recipient to the donor. The reason is that good ideas can pop out in any environment but development and implementation of good ideas need a special environment. So I think it is better to stand on one's own legs than asking for a hand.”

Prof. Pierre BRAUNSTEIN

“Create a research organisation where scientist would have less teaching than in current universities.

Motivate the young kids/students by offering curricula on archeology, arts, medicine, sciences ... and remind them of the key place of sciences in their countries in the Middle Age. Why such a decline?

Corruption is rightly identified as a major issue: the training programmes should be managed by the European partner(s) (finances and selection of the candidates). One could then for ex. emphasize the gender issue. Women have a role to play in education and research!”

Prof. Klaus MULLEN

“Toward triggering transformative change it is necessary to establish broad and generally accepted programs to bring young researchers at all possible levels of their career paths to EU

countries. They must be exposed to research environments, develop their work ethics and learn to come-up with own ideas.

They would then be the nucleus around whom, when being back, small programs could be started by way of interaction and by way of teaming. For me, teaming and partnership are the most important mechanisms.

I emphasize again, however, that there is one important message to be conveyed: research is full of disappointments, frustrations and unsuccessful attempts, but it is the only way toward development. Society must reward these endeavors. On a long run, research will be more important for the future of the country than, for example, gambling at the stock markets.”

Prof. Giorgio de MICHELIS

“The main point is to build a clear picture of where innovative initiatives could bring value added at the country and regional level. This is not for establishing constraints but for having the possibility to monitor how things are going. This mechanism is not substituting all the action recalled in the report, that maintain their validity but risk to be too slow in generating value. Having clear objectives that allow a precise monitoring of the action done is fundamental.”

C. Global Support Mechanisms (particularly from the EU side) which could be used for Science and Engineering Education improvement towards an innovation and Technopreneurship Culture

Prof. Vincenzo BALZANI and Prof. Margherita VENTURI

“EU should finance Science and Engineering Education programs with the preferential participation of the Arab countries.”

Prof. Luiz BEVILACQUA

“Regarding the basic education, according to the document the Arab countries need to implement urgent actions to upgrade the presently low education standards. This is case of several developing countries. I suggest to call all the educated citizens to cooperate and contribute for free to enhance the education standards. Certainly is much better to have some math or phys classes given by an engineer or a university or college student than no class at all. I dare to make a suggestion that I strongly believe to be extremely important to launch the industrial development process in any country. It has been shown that state investment is necessary to stimulate the industrial growth. Industry is not going to take risks without rewarding immediate or future. Industry would never join in a ambitious project to make a human land on the moon. The state must pay for the adventure. The state knows that it is worth

taking the risk since the spin offs will contribute to improve an uncountable number of products that will be transferred to the common citizen. So I suggest that the Arab countries define a huge "impossible" project; ex: robotized paradise built in the desert with production of food, using solar energy and production of water from the atmosphere humidity enhanced by the evaporation of sea water. The important idea is that there is nothing available in the international market. Everything has to be invented (not innovated) , designed and produced in-house.”

Prof. Giorgio de MICHELIS

“EC (and/or other global support institutions) should couple their support to the actions indicated in the report with the creation of an independent support/monitoring of the action indicated in point B.”

D. Specific initiatives for galvanizing science and engineering education and the possible supporting mechanisms for these initiatives

Prof. Vincenzo BALZANI and Prof. Margherita VENTURI

“Organize in each Arab country shows and festivals dedicated to young students and aimed at demonstrating the beauty, the importance and the utility of science. These actions should encourage enrollment in university scientific curricula.”

Prof. Giorgio de MICHELIS

“To galvanize science and engineering education, policies of open innovation and crowd sourcing should be launched in order to keep the selection of young talents alive and for creating a supporting context for those involved in the educational programs.”

II. MICRO LEVEL

1. Role of innovation ; types of innovation having priority in implementation

Prof. Vincenzo BALZANI and Prof. Margherita VENTURI

“The Arab nations should be convinced that now a day there is no reason for spending money and brains on nuclear energy because its civil application is out of market and will be even more so in the future because of many unsolved, and impossible to solve, problems, particularly on disposal of radioactive waste.

The future of the post-fossil fuels society, a goal that will be progressively reached in the

next decades, is the deployment of solar energy. The Arab countries, because of their geographic locations, are favorite in this regard and should prepare themselves to exploit the great opportunity offered by the energy transition by innovation.”

Prof. Luiz BEVILACQUA

“It is important to concentrate on higher-education. Two documents are attached, with some ideas about the university in the XXI century . The kernel of the Bologna higher education reform responds to the challenges of the new era (Appendix: 1. A short paper: "The university in times of cultural shock" where I present some fundamental ideas concerning the new university. 2. A power point presentation with a summary of the most important ideas that were the corner stones of a new University in Brazil founded in 2005, the UFABC).”

Prof. Pierre BRAUNSTEIN

“The themes of the research/education programmes should be defined by the Arabic countries, taking into consideration their natural resources, needs, etc... Agriculture in desartic areas has been successfully developed.. in Israel for ex.”

Prof. Klaus MULLEN

“Why can one here ask for the role of innovation at all? Innovation is the key. Here I comment on the concepts, e.g. at KAUST in Saudi Arabia to target topics which are close to the real needs of the country such as agriculture under extreme climate conditions, membrane technologies, energy technologies etc. An essential element there is interdisciplinary and an integration of science and engineering.

The issue of a coherent national innovation system is not my business, let others comment on that, but when I speak of teaming in research it is logical that there could also be teaming in organizational structures.

As to the spirit of change I reiterate that society and political decision makers must much more clearly define priorities. Economic and social progress depends upon scientific research and this must attract the best minds.”

2. **Type of programs the EU could devise to assist the Arab region governments in achieving their goals while setting up for a more effective partnership that would yield the science collaboration levels the EU seeks**

Prof. Vincenzo BALZANI and Margherita VENTURI

“Promote long period visits of EU scientists to Arab Universities and research centers. Collaboration programs will spring up spontaneously. Agreements between Arab universities/colleges and European universities to foster the mobility of the Arab students who in such way can attend courses in the receiving structure during one semester or one year.”

Prof. Federico ROSEI

“The European Union can play a major role in prompting such change, by opening its laboratories and university environments to students and researchers from Arab countries, who would come for short, medium or long term visiting stints to learn research practices and methodologies and then bring them back to their country of origin. This would require a dual investment, on one hand from the Arab countries to fund the exchange scholarships (similar to the ones created in Brazil, “science without borders”), also creating the right conditions to return; and from the EU, to fund suitable training programs as well as the infrastructure and live costs of research (operating funds).

In parallel, the EU and Arab countries should establish and jointly fund an “East-West” University, based in Istanbul (crossroads between Europe and the Middle East), to jointly train a new generation of diplomats, social entrepreneurs and political leaders who are sensitive to cultural differences.

This training should also include empathy (i.e., *the capacity to understand or feel what another person is experiencing from within the other person's frame of reference, i.e., the capacity to place oneself in another's shoes*). The recent refugee crisis is a strong indication that both Europeans and Arabs have a lot to learn in the arena of empathic action.

This “East-West” University could follow, for example, the high school model called “United World Colleges” (www.uwc.org): United World Colleges make education a force to unite people, nations and cultures for peace and a sustainable future. The proposed initiative would involve creating a similar concept at the undergraduate and possibly graduate level, placing emphasis on international and intercultural understanding as well as sustainability.

In a second step, Arab countries could create a network of engineering schools that educate at the highest level in engineering and promote innovation and entrepreneurship. Two networks are proposed:

- a) Mediterranean Institutes of Technology, built across northern Africa all the way to Turkey, across Jordan, Lebanon, Syria and Turkey; and
- b) Arab Institutes of Technology, built across the Arabian Peninsula and Iraq.

These institutes would follow the model of similar successful institutions in the west, so as to develop internationally competitive curricula and advanced research programs.

In a third step, Arab countries should launch a joint entrepreneurship fund which focuses on grand challenges for society, with emphasis on renewable energy, environment and health. This fund should help to establish start-up companies and help to bring back expatriates who were successful abroad and who want to come back to the Arab region.

The aim of all such initiatives is consistently to build capacity; not only in the areas of science and technology but also in other areas of importance for societal development.”

3. **Particular or specific program(s) currently functioning that could be used to bring the necessary change in the Arab region towards an innovation economy**

Prof. Vincenzo BALZANI and Prof. Margherita VENTURI

“Research on the deployment of solar energy, as mentioned above, and on technologies for waste recycling.”

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