

Accelerating growth Women in science and technology in the Arab Middle East

A report from the Economist Intelligence Unit



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About the research

Accelerating growth: Women in science and technology in the Arab Middle East is an Economist Intelligence Unit report that discusses the growing significance of women's contribution to science and technology in the Arab Middle East; how to improve methods of teaching tomorrow's scientists in the region; and ways to make the workplace a more attractive proposition for women. The findings of this briefing paper are based on desk research and interviews with a range of experts, conducted by the Economist Intelligence Unit.

The report is the final in a series of three Economist Intelligence Unit papers on research and development in the Middle East. The first two reports, *Laying the foundations: A new era for R&D in the Middle East* and *Fostering innovation-led clusters: A review of leading global practices*, were both published in 2011. The research was sponsored by the Advanced Technology Investment Company (ATIC). The Economist Intelligence Unit bears sole responsibility for the content of this report. The findings and views expressed in the report do not necessarily reflect the views of the sponsor. Christopher Watts was the author of the report, and Stephanie Studer was the editor. Trevor McFarlane also contributed to the findings in the report.

The Economist Intelligence Unit would like to thank the following experts who participated in the interview programme:

- HH Sheikh Nahayan Mubarak Al Nahayan, minister, Ministry of Higher Education and Scientific Research, UAE
- Najla Al Raway, project manager, strategic planning department, Abu Dhabi Education Council, UAE
- Abdallah Alnajjar, president, Arab Science and Technology Foundation, UAE
- Ilham Kadri, managing director for advanced materials ME&A, and commercial director for water and process solutions EMEA, Dow Chemical, UAE
- Reem Hamdan, assistant director-general for regulation and planning, Electricity Distribution Company (EDCO), Jordan
- Marshall Drummond, provost, the Higher Colleges of Technology, UAE
- Sultan Karmostaji, associate provost, student support services, the Higher Colleges of Technology, UAE
- Abdullatif Al Shamsi, director-general, Institute of Applied Technology, UAE
- Moneef R Zou'bi, director-general, Islamic World Academy of Sciences, Jordan
- Taghrid Samak, post-doctoral fellow, Lawrence Berkeley National Laboratory, US
- Fred Moavenzadeh, president, Masdar Institute of Science and Technology, UAE
- Bushra Ali Ahmed, director-general, Radiation Protection Centre, Ministry of Environment, Iraq
- James Carty, associate partner, Monitor, UAE
- Wejdan Abu Elhajja, dean, King Abdullah II School of Electronic Engineering at Princess Sumaya University for Technology, Jordan
- Gurpreet Jajj, operations manager, ODS2, UAE

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- Savaş Alpay, director-general, Statistical, Economic and Social Research and Training Centre for Islamic Countries, Turkey
- Rokhsana Ismail, founder, Yemeni Women Association for S&T Development, Yemen
- Nawal Al Hosany, director, Zayed Future Energy Prize and director of sustainability, Masdar, UAE
- Lamya Nawaf Fawwaz, executive director of public affairs, Masdar Institute of Science and Technology, UAE



Executive summary

From Algeria to Yemen, most nations in the Arab Middle East have been addressing the need to create economies that are sustainable in the long term. For most, this entails significant reform. As part of wide-ranging ambitions to create knowledge-based economies, Arab governments are fostering growth in science and technology in the region. In doing so, the region's leaders, from policymakers to business executives, are increasingly acknowledging the role of women in securing a sustainable economic future.

Yet significant challenges still need to be overcome. While young women are increasingly participating in science and technology programmes at school and university, there is room for further improvement in education standards overall. More Arab women than men are graduating in science, but not all are finding their way into post-graduate research or into the workplace. This is a clear sticking point in realising the region's economic vision.

This paper, based on desk research and on in-depth interviews with experts including policymakers, academics and business people, discusses the challenges faced by women in science and technology in the Arab Middle East. The research examines the role of women scientists and technologists among Arab nations; the state of science and technology education in the region; and the prospects for women scientists in the workplace.

Here are the key findings of the research:

Science and technology are critical in creating a knowledge economy in the Arab Middle East

To provide jobs for large, youthful populations, many countries in the Arab Middle East have ambitious plans to create knowledge-based societies. Currently, Arab countries rank between 42nd and 122nd in terms of the sophistication of their knowledge economies, according to the World Bank. Science and technology are key to further economic development in the region.

Women scientists and technologists must participate in the region's economic transformation

As Arab leaders target long-term economic development on the basis of human capital, they recognise that half of that human capital cannot be left idle. Encouraging more women to participate in science and technology would boost regional productivity and strengthen its long-term economic prospects.

Education reform in the Arab Middle East must continue apace

Despite ongoing educational reform, there is room for improvement in some parts of the Middle East. Experts say that education needs to focus more on science, technology, mathematics and foreign languages; and that students need to get excited about science at an early age. One successful programme is sending UAE students to South Korea for hands-on training in nuclear power plants.

Female participation in science and technology education is strong

Young women are achieving better grades than their male counterparts in science and technology at school. In fact, more Arab women than men are now enrolling for science degrees at university—and completing the courses successfully. In Saudi Arabia, for example, women picked up 73% of the bachelor's degrees taken in science in 2010.

A disconnect remains between scientific education and the labour market for women

After completing tertiary scientific education, women are less likely than men to pursue a career in science and technology. In Palestine, just 19% of scientific researchers are women. The bulk of efforts must go towards removing this sticking point if the Arab Middle East is to increase female participation in the fields of science and technology.

Initiatives are needed to motivate women scientists to participate in the workforce

One way to eliminate this sticking point is to lift barriers to greater participation of women in science. Employers can introduce policies such as parental leave and flexible shifts. The Abu Dhabi Company for Onshore Oil Operations has promised flexible working hours to female graduates, for example. Collaboration between industry and academia, mentoring initiatives, and conferences and workshops can also play an important role.

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A critical role for women scientists

Female participation in the workforce is low in the Middle East, at just 25%—far short of the global female participation rate of 52%.

Across the Arab Middle East, states have been pushing through reforms aimed at putting their economies on a sustainable footing for the long term. Some nations, such as those Gulf states rich in resources, plan to diversify their economies, reducing their economic dependence on hydrocarbons; others hope to lift their countries out of poverty. Many reforms in the region are focusing on economic liberalisation, in the hope of attracting investment and bolstering the private sector. Some are part of large packages, such as the Abu Dhabi Economic Vision 2030, which the emirate unveiled in 2008.

One reason for the flurry of activity is the nature of the labour market in the Arab Middle East. Public-sector employment is high, accounting for 33% of total employment in the region, and even exceeding 50% in middle-income Arab countries such as Egypt and Syria, according to the International Labour Organisation (ILO). In parallel, female participation in the workforce is low, at just 25% in the Middle East and 27% in North Africa, according to the ILO, far short of the global female participation rate of 52%. According to the League of Arab States, more than 4m young people enter the labour market every year; to satisfy this employment demand, it estimates that Arab countries will need to generate over 50 million new jobs by 2020.

Another reason that countries in the Arab Middle East are pushing through reforms is the demographic profile of the region. The Arab population is very young, with those aged 15–29 accounting for 25% of the total in Kuwait and the United Arab Emirates (UAE), and 34% in Qatar. According to the ILO, youth unemployment in the Middle East region amounts to 25%, and is as high as 46% in Algeria and 45% in Iraq—significantly above the global level of 13%. Moreover, unemployment among young women in the Middle East and North Africa is over 30%, compared with a world average of 14%. One expert interviewed for this paper points out that “the inability on the side of governments to provide quality education and an environment conducive to the creation of suitable jobs may well result in social cataclysm.”

Women in the knowledge economy

The scale of the challenges ahead is laid bare in data from the World Bank’s Knowledge Economy Index (KEI). The KEI takes into account the extent to which a country’s environment is conducive for knowledge to be used for economic development. The Arab states fare poorly, but to differing degrees: high-income nations, mostly Gulf states with plentiful hydrocarbons and ambitious investment programmes, are ranked between 42nd (the UAE) and 64th (Kuwait); the

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James Carty, associate partner, Monitor

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Sheikh Nahayan Mabarak Al Nahayan, Minister of Higher Education and Scientific Research, UAE

other Arab states, less wealthy than those in the Gulf, are ranked between 75th (Jordan) and 122nd (Yemen).

Clearly, science and technology are important elements of any strategy to use knowledge for economic development. Equally, women can, and should, play a critical role: in an economy based on human capital, half of that capital cannot be left idle. Encouraging women into science and technology would have a significant economic impact, as James Carty, associate partner at Monitor, a UAE-based consulting firm, points out. “It would almost certainly help productivity,” he says, “and this would filter down into the economy, with lower dependency ratios and more spending power, which would boost economic growth.”

Indeed, the *Arab Human Capital Challenge*, a survey of Arab business leaders by the Mohammed bin Rashid Al Maktoum Foundation, echoes this point. Published in 2009, the report includes messages that remain pertinent today: “More than 90% of Arab CEOs believe that increasing female education will have a positive effect on the Arab world by enhancing the human capital value of women in the region,” write its authors. The region’s political leaders appear to agree. Sheikh Nahayan Mabarak Al Nahayan, the UAE’s minister of higher education and scientific research, is one: “The bottom line is that we need every individual in the country to participate in the development of the country, especially when Emiratis make up such a small percentage of the actual workforce,” he says. ■

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A sharper focus on education

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*Moneef Zou'bi,
director-general,
Islamic World
Academy of Sciences*

As it pursues its ambition to foster knowledge-based economies, the Arab Middle East faces a number of pressures. These include scaling back the public sector, empowering the private sector, investing in research and development (see the Economist Intelligence Unit's August 2011 report, *Laying the foundations: A new era for R&D in the Middle East*), and protecting intellectual property. Chief among them, perhaps, is continuing to improve standards

of education. Marshall Drummond, provost of the UAE's Higher Colleges of Technology, reports that only 10% of new student arrivals at the institution are adequately equipped to go straight into academic programmes; 90% spend one or two years on remedial foundation courses in English or maths, of which 30-40% do not make it through. "It is a big drain on our efforts and it is a big drain on the institution," Dr Drummond says.

A trip to NASA

Last March, UAE-based Space Ed-Ventures, a spin-off company of the Arab Youth Venture Foundation, announced that it was taking a group of 35 Emirati high school students for one week of intensive aerospace engineering and youth space training at the Houston Space School at NASA's Johnson Space Centre.

Space Ed-Ventures says that its programmes facilitate engineering-focused educational space training at NASA centres and space schools in the USA, as well as astronaut training at space camps in the USA and Europe. The company says its student-oriented space training includes intensive, hands-on and group-based science, engineering and technology projects.

Sessions last up to four weeks. For the summer, the company is offering one- and two-week programmes in July and August. The sessions are open to young people aged between 12 and 18, male and female, of any nationality in the Middle East region.

Hussain Al Ansari, who heads Space Ed-Ventures, says that this effort provides "youth with extra-curricular, hands-on educational projects and activities that are engaging and relevant. Taking subjects they learn in schools and applying this knowledge in the real world will have a massive positive impact on their perceptions and their future career opportunities."

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There is a divide between what universities produce in terms of graduates and current market trends and market forces.

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Moneef Zou'bi, director-general, Islamic World Academy of Sciences

Grade 8 girls score better than boys in maths and science tests across the majority of countries in the Arab Middle East region.

Experts interviewed for this research say curriculum content needs a sharper focus on science, technology, mathematics and foreign languages. “In the UAE, we are not really exciting kids about science and maths, and this is causing a real problem in gearing students towards those professions that are critical to this country,” says Abdullatif Al Shamsi, director-general of the Institute of Applied Technology (IAT) in the UAE. He points out that there is a lack of activities to engage young people in scientific practices from an early age. “We need more programmes, visits, activities and competitions to make these youngsters more interested in science and technology.” In late 2010, the IAT sent a group of 36 students to South Korea on practical training courses in nuclear power plants. In early 2012 another group visited NASA’s space centre in Houston (see box on previous page, *A trip to NASA*).

Certainly, how students learn is just as important as what they learn. Traditional learning methods linger in some Arab countries, such as copying from the blackboard, with little interaction between teachers and pupils. Many experts say that teaching should foster students’ analytical skills and encourage pupils to take initiative and engage in critical thinking. Improving teacher training is crucial at both high school and university levels, but remains difficult to implement in some states where teachers are state employees in relatively secure jobs. There are some signs of ongoing change, however: in the UAE, private educators including Mosaica and GEMS are among those that are driving improvements, including introducing performance-related bonuses for teachers.

Despite significant investment in new universities across the Arab Middle East, there remains room for further improvement of standards in tertiary education. Cairo University was the only tertiary education centre in the Arab world to appear in the latest ranking of the top 500 universities in the world compiled by the *Journal of Shanghai Jiaotong University in China*. Meanwhile, no Arab

university has ever been included among the top 400 world universities ranked by the *Times Higher Education* in the UK.

“Essentially the higher education system in the majority of Arab and developing countries is at least a generation out of date as far as market demand and current jobs on offer are concerned,” remarks Moneef R Zou’bi, director-general of the Islamic World Academy of Sciences (IAS), a Jordan-based science and technology advisory body affiliated to the Organisation of Islamic Cooperation (OIC). “There is a divide between what universities produce in terms of graduates and current market trends and market forces,” he says (see box on following page, *Closing the school-work mismatch*). Even where governments have invested heavily in universities, some experts comment that funds have been sunk, first and foremost, into building lavish campuses and attracting foreign faculty.

Experts interviewed for this research recognise a need for continued educational reform across much of the Arab Middle East. Yet, points out Mr Carty of Monitor, there is a misalignment between governments’ ambitions and what is practically possible. “These visions for knowledge-based economies are looking at the next five or ten years,” he says, “whereas reforming the education system that will churn out the graduates needed to carry out these visions will take 15 to 20 years.” Dr Drummond of the Higher Colleges of Technology admits that the colleges of the UAE will struggle to meet demand for engineers that local industry anticipates in the next three years.

The reverse gender gap

While education in some parts of the Arab Middle East still has some way to go before meeting international standards, girls are outperforming boys in science and maths. According to Trends in International Mathematics and Science Study data, developed by the International Association for the Evaluation of Educational Achievement (IEA), Grade 8 girls score better than boys in

Closing the school-work mismatch

Overall, employers in the Arab Middle East say they are dissatisfied with education in the region. In a survey of Arab CEOs conducted by the Mohammed bin Rashid Al Maktoum Foundation, only 54% say that the region's education systems are producing students with adequate skills; just 48% say that this calibre of students is provided in sufficient quantities.

Yet only 35% of Arab CEOs have communicated to the education system which skills are likely to be in demand. "There is [only] nominal effort to ask the private sector what it needs," says James Carty, associate partner at Monitor, a UAE-based consulting firm. "By and large, these programmes are designed by academics."

What is it that employers are looking for? Three executives share their views:

- Gurpreet Jajj, operations manager at ODS2, a software firm, recently hired a new staff member in the UAE. The position required

a computer science background as well as skills in English and communication. "A lot of candidates had a technical background; only a few of them had the soft skills," says Mr Jajj.

- Ilham Kadri, an executive at Dow Chemical in the UAE, says the firm is investing in manufacturing reverse osmosis membrane in Saudi Arabia. "We will hire highly specialised people to support our operation," she says. "Today we cannot find these people locally, so we are in talks with the King Abdullah University of Science and Technology."

- Reem Hamdan, assistant director-general at Electricity Distribution Company based in Jordan, says that her firm is increasingly interested in areas such as renewable energy and energy efficiency. Yet graduate engineers do not have even a basic knowledge of these topics. "We have to send them to a lot of training workshops," Mrs Hamdan confirms.

In Saudi Arabia, 65% of all enrolments in science degrees in 2010 were by women, versus 40% a decade earlier.

maths and science tests across the majority of countries in the Arab Middle East region. This is particularly evident in high-income Arab nations, where boys routinely underperform by a significant margin in relation to international norms. Furthermore, figures from the United Nations Educational, Scientific and Cultural Organisation (UNESCO) show that while 8% of Arab boys have to repeat a year in school, for girls the figure is less than 6%.

Similar patterns are also evident among Arab universities. UNESCO figures show that in Palestine, 56% of undergraduate enrolments in 2010 were by women, compared with 47% a decade earlier. This is especially pronounced in science: in Saudi Arabia, for example, 65% of all enrolments in science degrees in 2010 were by women, compared with 40% a decade earlier. In science studies across most Arab states, the reversal of the gender gap—where women were previously under-represented, but are now over-represented—is distinct.

Furthermore, female science students appear to be outperforming their male counterparts. UNESCO's gender parity index data clearly show that women students are more likely than men to persevere to the end of their degree course, amplifying the reverse gender gap. For example, women accounted for 59% of science degree enrolments in Saudi Arabia in 2006 and 2007; yet by the time these women graduated in 2010, they made up fully 73% of science graduates. Thus a greater proportion of men than women had dropped out of their course along the way.

What is behind this reverse gender gap?

Especially in high-income countries, young men often have the option to pursue well-paid jobs in the army or the police force without the need to study; those living in resource-rich nations often lack the ambition to pursue further education giving the relative ease of entry into government posts. Meanwhile, women in the Arab Middle East are becoming increasingly independent, in efforts to earn good salaries and become

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If educated women cannot find suitable jobs, none of the investment in their human capital will benefit themselves or their societies to the extent that it should.

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Savaş Alpay, director-general, Statistical, Economic and Social Research and Training Centre for Islamic Countries

financially autonomous. The region's rising divorce rate may be one contributing factor. In Kuwait, 37% of marriages end in divorce, according to 2007 data from Booz & Company, a consulting firm, up from 32% in 1995, and 1.8 divorces per 1,000 population ranks Kuwait on a par with the Netherlands.

The evidence that more young Arab women are pursuing science and maths in school and university appears positive. In time, it is possible that their successes may even provide some impetus for young men. Yet the reverse gender gap carries dangers. Savaş Alpay, director-general of the Statistical, Economic and Social Research and Training Centre for

Islamic Countries (SESRIC) in Turkey, believes that the gender gap in science education can seriously harm an economy's R&D activities in a society where employment opportunities are not favourable for women. "If educated women cannot find suitable jobs, none of the investment in their human capital will benefit themselves or their societies to the extent that it should," he points out. "In countries where resources are limited, the opportunity-cost of this could be considerable." Clearly, if most of the region's science graduates are women, but these graduates are not joining the workforce, progress towards creating a knowledge society is likely to falter.

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The difficult transition from school to work

Women account for just 1% of researchers in Saudi Arabia, 19% in Palestine, and 22% in Libya.

In promoting female participation in science and technology in the Arab Middle East, much remains to be done. Worryingly, the narrowing (and subsequent reversal) of the gender gap in education over the past decade appears not to have led to an attendant narrowing of the gender gap in the region's labour market. According to data from the OIC published in 2011, women account for just 1% of researchers in Saudi Arabia, 19% in Palestine and 22% in Libya, markedly lower than the world average of 30%. More young women are studying science, technology, engineering and mathematics, but many are choosing not to pursue careers in these fields. This sticking point calls into question the realisation of the region's economic vision.

Consider the number of female scientists pursuing post-graduate research. According to the *UNESCO Science Report 2010*, women make up just 34% of participants in science master's courses in Saudi Arabia; female participation in science-related PhD programmes is even lower, at 29%. These figures are especially remarkable given that women pick up almost three-quarters of bachelor's degrees in science in the country. Similar patterns are evident across most of the Arab Middle East. As Dr Zou'bi of IAS explains: "While women perform well, it can be difficult for those wishing to pursue post-graduate study to do so, because of social, economic or family factors."

It appears that young women face few obstacles in pursuing science education through school and university, but that barriers appear later on. Looking back on her own career, Mrs Hamdan of EDCO says: "I cannot remember any obstacles in school or university; I guess the obstacles appeared at work." Some time after joining EDCO in 1993, she discovered that some department managers had refused to have her in their team because she was a woman. It is possible that, still today, attitudes such as these linger in the workplace and in society at large in the Arab Middle East.

Addressing gender policies

If more Arab women are to pursue careers in science and technology, the factors underlying this sticking point must be identified and lifted. For a start, few Arab states have legislation in place prohibiting gender-based discrimination. The region performs poorly in the World Economic Forum's Global Gender Gap Index (which is based on equality in economic participation and opportunity, educational attainment, political empowerment and health): the UAE does best among Arab countries in 104th place among 135 nations—with all other Arab states behind it.

Furthermore, according to the World Economic Forum's *Global Gender Gap Report 2011*, Oman has no legal framework covering maternity leave; and

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in Qatar, Syria, Bahrain and the UAE, maternity leave is no more than 50 days. "We need to help make it more attractive to employ more women in these roles," concludes Mr Carty of Monitor, "and we need to create incentives for companies to employ women." Legislation is developing slowly; but currently, many workplaces, across both government and the private sector, offer little in the way of policies and support for female employees, such as parental leave, flexible working hours or child care.

Nevertheless, a number of private sector firms are bringing these practices to the region. The Abu Dhabi Company for Onshore Oil Operations last year said it would offer more flexible working hours to female graduates of the Higher Colleges of Technology that it plans to recruit in the future: the women will work morning shifts, or day shifts, rather than working to the usual 24-hour rotation pattern. One oil company operating in the Middle East has even developed a fireproof abaya. Meanwhile, Taghrid Samak, an Egyptian scientist, says small firms and tech start-ups are particularly flexible (see box, *Growing opportunities in the private sector*).

Another opportunity to eliminate the sticking point—the difficult transition between education and work for women scientists—is to intensify collaboration between industry and the growing ranks of female science undergraduates. In 2011, for example, Dow Chemical of the US finalised a co-operation agreement to establish the company's new Middle East and Africa Research and Development Centre at the King Abdullah University of Science and Technology (KAUST) in Saudi Arabia. Research at the centre will initially focus on water treatment, and later on oil and gas, processes, and infrastructure materials. Other possible initiatives include improving vocational education in partnership with the private sector, as well as summer jobs and internships for students, to bridge the divide between study and work.

Sponsorships and scholarships are another useful tool to strengthen ties between employers and undergraduates. While many students in the Arab Middle East are sponsored by potential employers, such as Abu Dhabi National Oil Company, or Etisalat and Du, two telecommunications companies, a clear majority

Growing opportunities in the private sector

Taghrid Samak is a post-doctoral fellow at the Lawrence Berkeley National Laboratory, a research lab of the US Department of Energy, Office of Science. She works in the computational research division at the lab, providing computational support to scientific research efforts spanning physics, chemistry and biology.

Growing up in Alexandria, in Egypt, Dr Samak excelled at her public high school, especially in science and mathematics. She went on to graduate in computer science from Alexandria University—one of only 70 students on the course. A year later, in 2005, a family move took her to the US, where she finished a master's course in computer science alongside a PhD.

Today, Dr Samak says, there are an increasing number of opportunities to work in the private sector in the Arab Middle East region. While some of her friends in the region have gone on to work for large technology companies such as Microsoft, Oracle or IBM, she points out that, increasingly, there are alternatives on offer.

Things are changing, remarks Dr Samak. "What I am noticing is that more and more of my friends have their own businesses. They are starting their own social enterprises, or non-profit organisations," she says. "These companies provide flexible hours and are better at accommodating the personal needs of female engineers, so it is a more convenient environment for them to advance their careers."

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Marshall Drummond, provost, the Higher Colleges of Technology, UAE

of sponsorships are handed to male students. “If there is a desire to get more women into the pipeline and get them gainfully employed, it might be a good idea to encourage more sponsorship of women,” says Dr Drummond of the UAE’s Higher Colleges of Technology. Likewise, education, training and careers fairs, such as the annual Najah event in Abu Dhabi, are an opportunity for employers to attract women into the workplace.

A further way to encourage qualified Arab women to pursue careers in science is to highlight success stories among women scientists by means of conferences, workshops and industry events—and give female graduates the opportunity to engage with these successful women scientists at first hand. Dr Wejdan Abu Elhaija, dean of the King Abdullah II School of Electronic Engineering at Princess Sumaya University for Technology in Jordan, confirms that female students from the university regularly visit high schools to encourage girls into science.

Other examples include the Women in Science Hall of Fame organised by the Embassy of the United States in Jordan, and the awards for women scientists granted jointly by the Elsevier Foundation and the Organisation for Women in Science for the Developing World.

Here, mentor and role model initiatives also have an important role to play. Examples of mentorship programmes include the Stars of Science initiative organised by the Qatar Foundation for Education, Science, and Community Development, and the TechGirls Exchange Programme of the US Department of State’s Bureau of Educational and Cultural Affairs (see box, *TechGirls and TechWomen*). For a role model, look no further than Mrs Hamdan of EDCO. She points out that as her female colleagues have seen her progression through the company ranks, it has inspired confidence in them too. “I think that is one of the most important issues in encouraging them,” she says.

TechGirls and TechWomen

In July 2011, the US secretary of state, Hillary Clinton, unveiled TechGirls, a mentoring initiative to take around 25 teenage girls from the Middle East and North Africa to the US for a 3–5-week exchange programme in June and July 2012. The programme is based on technology-related educational activities, with a focus on promoting the high-level study of applied technology.

The programme organisers say its goal is to empower girls to pursue higher education and careers in technology; link peers who share interests and abilities; develop the leadership skills of the participants; and promote mutual understanding among the people of the US and the Middle East and North Africa.

TechGirls is an offshoot of another US State Department initiative, TechWomen, a public-private partnership founded in 2010 to bring emerging female leaders in technical fields from

predominately Muslim countries to the US for one month. The initiative is implemented by the Institute of International Education and the Anita Borg Institute for Women and Technology.

Already, TechWomen has paired participants from Algeria, Egypt, Jordan, Lebanon, Morocco and Palestine with 24 technology companies in Silicon Valley and the greater San Francisco area, including Facebook, Google and Intel, as part of a mentorship programme. Now, TechWomen has expanded to include Tunisia and Yemen.

Besides visits to the US, the TechGirls and TechWomen programmes include trips by US mentors to the Arab Middle East to conduct workshops for local women interested in science and technology and for school-age girls with an interest in a career in technology.

Conclusion

The need to establish knowledge-based societies is pressing among nations in the Arab Middle East. Not least, jobs must be provided for the region's unemployed youth and for its growing workforce. As they do so, countries in the region must foster growth in science and technology, and they must promote participation of women scientists in the workforce.

Yet a number of challenges remain. Education reform efforts must continue across the region, in both curriculum content and delivery, in order to generate interest in science and maths. Equally, the legal and policy framework governing women's workplace rights needs strengthening, in line with other knowledge societies, in order to promote the participation of women scientists in the workforce after they have finished their education.

On the basis of desk research and in-depth interviews conducted for this report, it is possible to identify a number of priorities. These include the following:

Policymakers must actively promote participation of women in science. As the Arab Middle East region seeks to develop a knowledge economy, science and technology are key. Likewise, as the region aspires to maximise the returns on its human capital, the participation of women in science and technology is critical. This participation needs clear government backing.

Top priority must be given to educational reform, with a focus on curriculum content and delivery. Strengthening female participation in science education is a potentially positive factor in the region's economic ambitions, but poor education standards across the board remain a significant obstacle to realising these ambitions.

Measures are needed to foster a work environment that is more supportive of women. Barriers remain to pursuing careers in science, including legislation and policy—a clear sticking point for women scientists. Eliminating this sticking point is vital. Initiatives such as mentoring play an important role in promoting women in science and technology in the Arab Middle East.

While every effort has been taken to verify the accuracy of this information, neither The Economist Intelligence Unit Ltd. nor the sponsor of this report can accept any responsibility or liability for reliance by any person on this white paper or any of the information, opinions or conclusions set out in this white paper.

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