 Education, research, culture

Education, research, innovation: The future prospects of the G20 states

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This article analyses the extent to which the G-20 countries are equipped to meet some of the key challenges that lie ahead. The so-called Group of Twenty (G-20) is an association of the leading industrialised and developing economies and includes Germany. These countries first met up in 1999 to discuss global economic and financial issues and since then meet on a regular basis.

The G-20 nations represent two thirds of the world population, account for four fifths of global trade and together produce nine tenths of the worldwide gross domestic product.

On the global markets, enterprises are facing an ever increasing level of competition. Only those offering high-quality or unique products and services are well positioned to face this pressure. This requires highly-trained and skilled staff, creativity and innovation.

Accordingly this article focuses on the fields of education, research and development as well as the enterprises' capacity for innovation in its analysis of the G-20 states' prospects for the future.

Relevant issues in this context are how to secure a new generation of experts in important future-oriented sectors, the level of investment in education and research as well as the effectiveness of different educational systems. Another interesting aspect is the extent to which knowledge is successfully transferred from the educational sector to the world of business. Useful indicators to measure this are the number of patent applications and the export of high technology products.

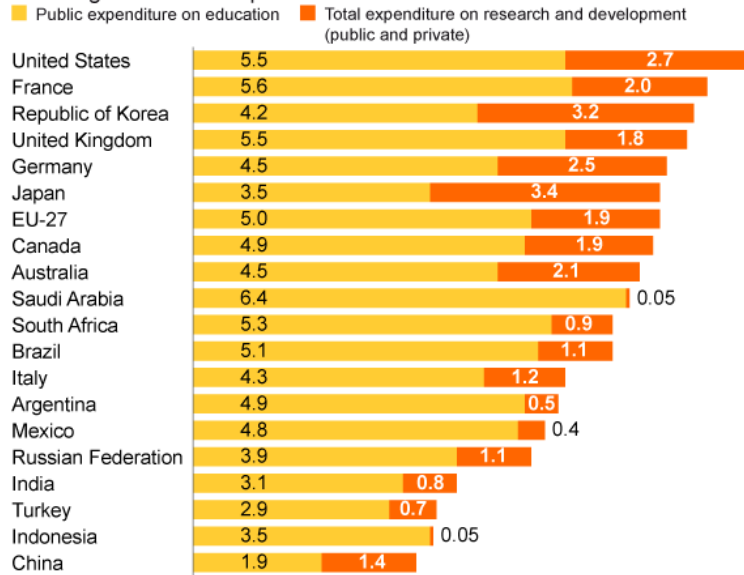
Investing in the future

What emphasis do the G-20 states place on education and research? According to UNESCO data, public expenditure on education, measured as a share of the gross domestic product (GDP) in 2007, was above average in the United States, France, Saudi Arabia and the United Kingdom. With a rate of 4.5%, Germany was among the medium-ranked countries. It fared better as far as overall expenditure on research and development is concerned: With a value of 2.5% of GDP, Germany ranked fourth among the G-20 states, behind Japan, the Republic of Korea, and the USA. In Saudi Arabia, Indonesia, India, Mexico, Argentina, South Africa and Turkey, R&D expenditure amounted to less than 1% of the GDP.

In 2002 the EU Member States agreed on a target of 3% of GDP for investment in research and development.

Expenditure on education, research and development, 2007

in % of gross domestic product



Expenditure on education for China: 1999, and for Turkey, India, Russian Federation: 2006.
Expenditure on R&D for Indonesia: 2005, and for Australia: 2006.

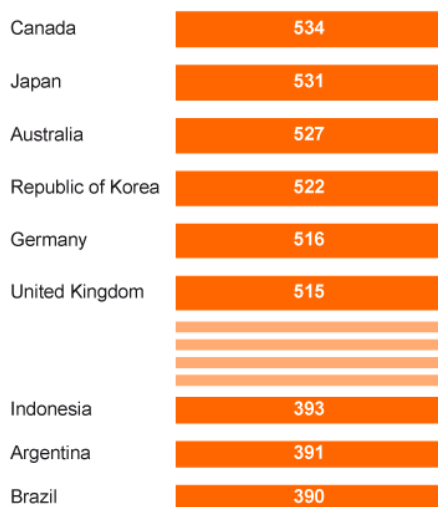
Source: UNESCO, EU-27: Eurostat.

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PISA: Educational systems put to test

Measuring the results of educational systems is a complex task. The PISA study organised by the OECD provides data which guarantees for a certain degree of international comparability. The

**PISA study, 2006:
Mean performance on the science scale**
Selected G-20 countries



Source: OECD

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average results of pupils in natural sciences – particularly relevant in many newly emerging economic sectors – differ considerably from one G-20 state to the next. While the South American G-20 countries and Indonesia failed to reach the 400 point mark in the 2006 PISA survey, several countries including Germany, the United Kingdom, Japan and the Republic of Korea achieved values of over 500. The low scorers were however not only limited to Latin America but also included Mexico (410) and Turkey (424). Unfortunately no data was available for China, India, Saudi Arabia and South Africa.

Engineers and scientists wanted

The shortage of skilled labour is often seen as a key issue when analysing the employment situation. Many enterprises are keen to employ engineering and science graduates.

When examining the years 2006 to 2008, the shares of graduates in natural science courses were highest in Saudi Arabia (25%), the United Kingdom and Germany (about 13% each).

The Republic of Korea (25%), the Russian Federation (22%) and Japan (18%) were amongst the leading countries as far as the proportion of graduates in engineering courses is concerned. When examining the total of those two educational fields, which are particularly relevant for a country's future prospects, only the Republic of Korea and Saudi Arabia achieve a share of more than 30%. Germany as well as France, Mexico and the Russian Federation are of the next countries in line with rates between 26 and 28 percent. What is striking is the low share of engineering and science graduates in the United States (15%), Argentina (13%) and Brazil (12%).

Higher education graduates by subject group, 2006 to 2008

in percent of all graduates

Country ¹	Engineering, construction	Natural sciences	Total
Republic of Korea	24.8	7.6	32.4
Saudi Arabia	7.1	24.6	31.7
Russian Federation	21.5	5.8	27.3
France	15.6	10.6	26.2
Mexico	15.4	10.8	26.2
Germany	12.9	13.1	26.0
Indonesia	16.8	5.8	22.5
EU 27	12.3	9.7	22.0
Turkey	13.7	8.2	21.9
United Kingdom	8.4	13.2	21.6
Japan	17.7	3.0	20.7
Italy	13.8	6.6	20.5
Australia	7.6	10.9	18.4
United States	7.0	8.4	15.4
Argentina	5.5	7.2	12.6
Brazil	5.2	6.8	11.9

* Data for the most recent year available in the indicated period.

¹ China, India, Canada and South Africa: no data available.

Sources: UNESCO, European Union 27 (EU-27): Eurostat.

Science hotspots

According to the most recent surveys, there was less than one scientist per 1,000 persons employed in India and Mexico. In 2007, Japan was the country with the largest number of scientists (11.3 per 1,000 persons in employment). A look back shows that the increase in this share from 1997 to 2007 was particularly high in China, the Republic of Korea, South Africa and Turkey. These countries recorded growth rates of over 80%. Only one G20 state witnessed a drop in the proportion of scientists amongst its workforce. This was the Russian Federation, where the share decreased by 16%. With 7.4 scientists per 1,000 persons employed (2007), Germany is one of the higher ranked countries. Compared with 1997 the share here has risen by 21%.

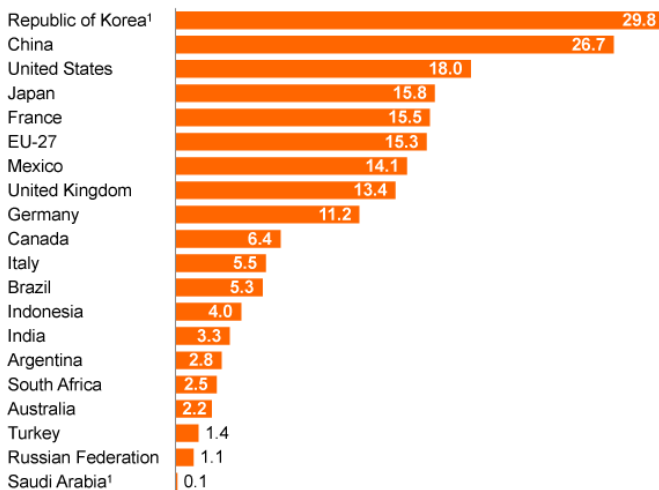
Patents: Recipes for the future?

Worldwide flows of capital and goods are increasing year by year – the globalisation of economies is becoming more and more evident. But this not only means increasing competition, it also offers enterprises more opportunities to establish themselves on the world market. This however requires a high degree of innovation and creativity. The number of resident patent applications per one million inhabitants is considered a key indicator of an economy’s capacity for innovation. With more than 2,600 patents applications per one million inhabitants in 2007, Japan and the Republic of Korea had a substantial lead over the other G-20 states. They were followed by the USA (800, rank 3/20) and Germany (582, rank 4/20). Within the European Union, Germany is top of the list.

Exporting innovation: When ideas become products

The future of the global market also depends on the export of high-tech products. This includes aerospace, mechanical engineering and telecommunication products, computers, pharmaceuticals, scientific instruments, electrical equipment and chemical products. In absolute figures, China was ahead of the USA and Germany in 2008,

High technology exports, 2008
in % of total exports of goods



achieving high-tech exports of over US-\$ 380 billion. In relation to total merchandise exports, the export of high-tech products is of particular importance in Korea and China. Since 2004 these products have accounted for more than a quarter of total annual exports in these two countries. In Germany, France, Japan, the USA, Mexico and the United Kingdom, high-tech products made up between 10 and 20 percent of all exports. Particularly low shares were recorded in the oil-exporting countries of Saudi Arabia and the Russian Federation as well as in Australia and Turkey.

¹ Data of 2007

Sources: World Bank. EU-27: Eurostat.

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