HIGHER EDUCATION INSTITUTIONS BETWEEN A GLOBAL AND A LOCAL CHALLENGE

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This contribution concerns the aspect of "Utility" in relation to the trust in Higher Education Institutions (HEIs) and represents the last of the four themes in which this Symposium on "The role of trust in higher education: ethical and quality standards in research and teaching" is divided. Therefore, after having debated how the trust in HEIs can be challenged by the advance in Information Technology, the Strengthening of the Media and the Increasing Call for Accountability, we are now addressing the final point, that is how the trust in HEIs can be challenged by the Raising Stress in Utility.

Quest for Technology Transfer

In the brief description of this last topic Lars Engwal, who inspired this Symposium, noted how in the last decades there has been a tendency of Politicians, and of Opinion Makers in general, to stress the role of HEIs as motors of the economic development and to point out how crucial for the economic growth and welfare are the investments in research and the share of the population entering higher education.

This move is general and worldwide, and has solid foundation in several documents and directives of the European Commission. For instance, in the Communication 512 of 2009 [1], under the heading "preparing for our future: developing a common strategy for key enabling technologies in the European Union" it was stressed how "a significant part of goods and services that will be available in the market in 2020 are as yet unknown", but the main driving force behind their development will be the deployment of Key Enabling Technologies (KETs) (in Figures 1 and 1bis are shown 10 ten revolutionary technologies that in the last decade even science fiction couldn't have predicted). It was envisaged that those regions mastering these technologies will be at the fore front of managing the shift to a technology-based economy, which is a precondition for ensuring welfare, prosperity and security of citizens. Hence the deployment of KETs was retained not only of strategic importance but also indispensable for addressing societal challenges ahead, such as fighting climate changes, overcoming poverty, fastening social cohesion and improving resource and energy efficiency.

KETs were seen knowledge intensive and associated with high Research & Development (R & D) intensity, rapid innovation cycles, high capital expenditure and highly-skilled employment.

The same document called for a widely shared and EU-wide strategic vision about the technologies that the EU wishes to master in research and production, which is a pre-condition for developing the EU into a breeding space of innovation. Finally, it was suggested the setting up of a high-level

expert group, composed of Member States' industrial and academic experts, tasked with developing a shared longer term strategy for Key Enabling Technologies.

The KETs were seen to span the fields of Nanotechnology, Micro- and Nano-Electronics, Photonics, Advanced Materials and Biotechnology.

As you can see, none of these KETs is in the domain of Humanities and Social Sciences: The reason is that the deployment of these KETs is intended to take place in industries which, in turn, should contribute to their development. However there are societal needs, such as fostering social cohesion I already mentioned, for which KETs in the field of Humanities and Social Sciences are required.

This move in the Industrial Policy Framework intercepting Higher Education Institutions is general and the role that HEIs are asked to play in the Technology Transfer can be appreciated by looking to the last issue of Tech Transfer News (18 May 2011) [2]. If we look more closely to the list of articles, we find that one article deals, in general, with the involvement of Universities in Start-up formation and mentoring; another article reports the more than 100 companies spun off by the Utah University in the past six years; a third article reports the growing trend among Universities to allow students to retain the rights to their Intellectual Properties, while a fourth article reports an attempt of business students from Miami University of Ohio to commercialize a product invented by university faculty. In the same issue it is also reported that the National University of Science and Technology of Moscow has created an office of Technology Commercialization and, finally, in another article is announced a distance learning event on International Patenting focusing on China.

This is the scenario in which HEIs have to operate: first to contribute to identify a strategic vision about the Technologies that the EU wishes to master in research and production; second to provide appropriate vocational training in response to labor market needs; third to maintain and possibly further increase the prestige HEIs' Research has in the Society by intercepting its needs and addressing major societal challenges.

Quest for Education in response to labor market needs

The task of Technology Transfer and Commercialization addressed in the previous paragraphs shouldn't however distract HEIs from their major duties, that is Generation of Knowledge (Research) and Transmission of Knowledge (Education). In the remaining part of my presentation I will address these two latter issues trying to highlight risks and opportunities.

I will address first the aspect of Education and soon afterwards that of Research.

Since I have a scientific background and I have been involved mainly in chemical organizations, such as EuCheMS, I will refer generally to Hard Sciences even if similar problems can affect also Humanities and Social Sciences.

In the same document of the European Commission I already mentioned [1], HEIs were asked to provide appropriate vocational training in response to labor market needs, to ensure that natural sciences and engineering achieve their deserved place in the education system, to increase the percentage of graduates also by attracting international talents, to improve multidisciplinary

experience and skills, and, finally, to introduce environmental studies into engineering and business curricula.

Development of qualifications needs also to draw upon the kind of learning experiences that enable students to reach their potential and has to take into consideration the current and likely future needs of Society. Moreover, Education should provide support for students when they enter the changing employment landscape where a job for life is rapidly being replaced by a mobile model where people move across diverse jobs with increasing frequency.

While it is relatively easy to identify the needs of the current job market, it is more difficult to accurately predict future requirements. There is a big debate on how many Technicians, Managers, and Professionals will be required by 2020. Although I don't want to enter in this debate, a projection of Jobs and Education Requirements through the next decade is essential in order to address the theme of Utility in connection with HEIs' role in Education.

A 2008 Cogent report for UK [3] forecasts that, by 2020, there will be an undersupply of Technicians but an oversupply of Managers and Professionals.

In addition to the already mentioned 2008 Cogent Report concerning UK, it could be useful to consider some figures concerning the largest Western Countries economy, that is the USA. A recent study carried by the Georgetown University Center on Education and the Workforce [4] shows that over the past three decades higher education has become a virtual must for American workers.

Between 1973 and 2008, the share of jobs in the USA economy which required postsecondary education increased from 28 percent to 59 percent. And, according to their projections, the future promises much the same with a further increase of the share of postsecondary Jobs from 59 to 63 percent over the next decade (Figure 2). The core mechanism at work in increasing demand for postsecondary education and training was identified to be the computer. Computerized procedures, by automating repetitive tasks, cause a decreasing demand of occupations that tend to require high school or less, like production jobs which, indeed, are declining.

Moreover, as the economy evolved, postsecondary education, which is required in order to have access to a greater percentage of jobs, also became the threshold requirement for access to middleclass status and earnings. In 1970 only 26 percent of the middle class had postsecondary education and training, by 2007, 61 percent of middle class workers had postsecondary education and training (Figure 3).

Also the educational composition of the upper class (the three highest family income deciles) appears to favor workers with some college or better. In 1970, 44 percent of the upper class had postsecondary education and training. By 2007, 81 percent of upper class workers had postsecondary education and training (Figure 4).

The emphasis on postsecondary preparation for new hires means that workers will tend to be attached more to the occupation they will be filling, than to the specialized industries in which they work. The day where people left high school to go to work in the local industry and then worked their way up is disappearing. People are not trained any more in industries, they get educated or trained in HEIs, go to work in occupations, and progress in an occupational hierarchy. Some

occupations are tied tightly to particular industries (health care occupations for example) but more and more occupations are dispersed broadly across industries.

The national Center on Higher Education Management System (NCHEMS) [5] estimates that for the USA. an additional 8.2 million postsecondary graduates will be needed by 2020, nearly 1 million increase per year, and, at current cost, this would require an increase of 158 billion dollars by 2020. Additional 36 billion dollars have already been included in the Obama's reform of the postsecondary financing system. This leaves 122 billion dollars which have to come from the state and/or local budgets. It is recognized that, in the current budget climate it will be difficult for states to come up with their share and it is recommended that federal and state governments engage postsecondary institutions as partners in finding ways to pay for achieving this goal. The auspices are that, together, they develop reforms that result in both cost efficient and good quality postsecondary education and training programs.

It is interesting to note that, in contrast with the steep increase in the percentage of work force which requires a postsecondary education in the period 1973-2018, the percentage of work force requiring Master's degree or better has increased in the period 1973-2007 only from 7 to 11 percent and it is estimated to remain constant or slightly decline in the period 2007-2018 (down to 10 percent). However, although the percentage slightly decreases, the absolute number remains constant, that is it will be necessary to produce at least the same number of people with Master degree or PhD.

Concerning the highest educated category of workforce, there appears to be general consensus on some basic points [6]:

1. A greater proportion of Science graduates pursue careers that require a graduate qualification as compared with those from other subjects.
2. PhD programs are recognized by industry as providing an innovative workforce with the knowledge and skills needed to pose and answer difficult questions.
3. PhD students are recognized to be the life blood of any discipline and HEIs need to support and nurture their capability.
4. PhD laureates may go on to use their skills and knowledge in areas outside of research and even outside of Science. For example, many become science teachers, science writers, entrepreneurs, policy makers, or work in regulation or patent law.
5. Training in Science provides a unique combination of manual, theoretical, analytical, numerical and problem solving skills, which are highly prized.

As it appears, PhD programs are the link between Education and the other major mission of HEIs, Research, that I will address later on in this presentation. For this reason I will spend a few more words about the highest level in Education.

In a discussion we had at the margin of the EuCheMS General Assembly held in Bled (Slovenia) last October [7], the major trends I just mentioned speaking about science in general were fully confirmed also for Higher Education in Chemistry in Europe with some additional peculiarities. It was observed that:

a) There is an increasing number of students taking scientific subjects and, among these, Chemistry: Although not necessarily the best students. It seems that Economics and Medicine still have greater attraction for more motivated students.
b) There are decreasing job opportunities for lower level degrees in Chemistry, on the contrary there are better opportunities, also in terms of job qualification, for higher level degrees and, in particular, PhD.
c) Only about one third of PhD laureates find jobs in their own field and in their own country, about another third finds a job in their own field but in another country (which can be Europe, but also the USA or South America) and, finally, another third will find occupation in a related field or in business.
d) The number of PhD students coming from the same university is decreasing, while an increasing number is coming from other universities or from abroad.

Up to now, HEIs in Europe have fulfilled the demand for more and better educated people which is at the bases of a knowledge-based economy and which is a precondition for ensuring welfare, prosperity and security of citizens. However, considering the economic crisis which has characterized the last couple of years, I don't know if HEIs will still be in the condition to accomplish their task or there will be a negative effect not only upon the number of PhD laureates but also on the bulk of knowledge which is necessary for putting man kind in a suitable position to address major societal challenges.

As the economic crisis will impact on sustainability of Higher Education, the increase of tuition fees can become, and in some cases has already been, the obvious answer. However, whatever happens in terms of tuition fee setting, it is important that the higher education system continues to be well funded and put in the condition to offer a diversity of course provision and approaches. There should also be good access to higher education regardless of the ability of the student to pay.

There is another aspect I want to mention. Globalization has deeply affected also the job market of people with higher level degrees, and couldn't be otherwise. With Master's graduated and PhD laureates free to go where their skills is required and appreciated, local or even national authorities could find unfair to fully support students only a fraction of which will ultimately remain in and contribute to the welfare of a given region. Such a change of attitude could greatly impact on HEI's funding, being Education one of the two major activities of HEIs.

Quest for Research addressing major societal challenges

Let now address briefly the second major "utility" connected to the activity of HEIs, Research.

In the past the image of Science was associated with individual genius and for a long time it has been possible for great discoveries to be principally the achievement of one person. Now it is no longer like that, we use an interdisciplinary approach and work in team. Thanks to internet, we no longer have to sit at the same workbench to collaborate. Research has become a truly global exercise, international cooperation has become essential, and to establish a European Research Area "without noticeable national, formal and research subject boundaries" has become a major aim of the European Union. It is because of globalization of research that researchers cannot any longer be constrained in a place or in a region, but they will tend to move where their research interests and job opportunities can be better fulfilled.

In this panorama HEIs have to keep high the standard not only of their education but also of their Research and operate with a global, as opposed to local, perspective.

Concerning Research funding, currently near term investments appear to be privileged, but this should not be at the expense of long term investments. Near term research may be more appropriately funded by the private sector. However, as it takes time to develop solutions and bring them to market, fundamental research in the long term needs major state investment in order to maintain strength [8].

Everybody should also realize that the output of investments into Research is much more than just an economic output. Fundamental science research plays a vital role in providing solutions to the most important technological and societal challenges facing the world, such as climate change, food supply issues, improving medical treatment, energy sustainability, to mention only some.

In general, up to now, European HEIs have been able to preserve their high standard thanks to the financial support provided, in large part, from public funds, either national or regional. I would like that it continues to be like that in the future but, I am afraid, things could change. There are rumors of fund cutting all over Europe despite the rhetoric of politicians. This will inevitably result in an increase of tuition fees paid by the students and in the HEIs seeking support from the Enterprises which will reduce to some extent the degree of freedom particularly in Research but, to some extent, also in Education.

To some extent this could be beneficial since this will make researchers to pay more attention to practical problems and will put some more responsibility on the students. However I hope that Basic Research and Education, the two strictly intertwined, will continue to be, to a large extent, responsibility of the national and regional Institutions.

In this presentation a major attention has been put on Hard Sciences, and couldn't be otherwise being myself a chemist and having had responsibilities in scientific organizations. However, just like fundamental and applied research are two sides of the same coin, similarly developments in Hard Sciences cannot progress without simultaneous developments in Humanities and Social Sciences. Both of them equally impact on the quality of life and there is need for Key Enabling Technologies not only in the field of Hard Sciences but also in that of Humanities.

Final considerations

There is a final consideration I wish to make and it concerns the time perspective in which HEIs operate. There is no doubt that HEIs operate in the long run and in taking decisions they must keep in mind that what appears to be useful today cannot be like that in a few years time.

It appears to be a conundrum but Universities are fundamentally different from regular enterprises. While in the field of enterprises can happen that many of the today leading companies did not exist twenty years ago (and most of these are exploiting the commercial potential of science that is not too far removed from the laboratory [7]), in the case of HEIs it appears to be the other way round, the oldest Universities happen to be still among the best if not the best and, in this regard, to look to the date of foundation of a University can still be a valid criterion for selection (Figure 5). I don't have a good explanation for this, probably to the highest levels the transfer of knowledge and skill

can only take place by direct contact, without intermediacy, and decades if not centuries of experience can make the difference.

As a person who has spent most of his life in a University, I wish for HEIs to be as much as possible transparent, to not minimize the difficulties, to be reasonably selective, to be sympathetic with the alumni, to give time for individualities (as well as for promising new technologies) to nurture and flourish. There is a kind of parallelism between promising new technologies and alumni, both of them flourish best when they are neither left to fend for themselves nor mollycoddled for too long time.

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http://www.euchems.org/

[8] RSC News, December 2010: Investing in fundamental Research; March 2010: Science funding cuts.

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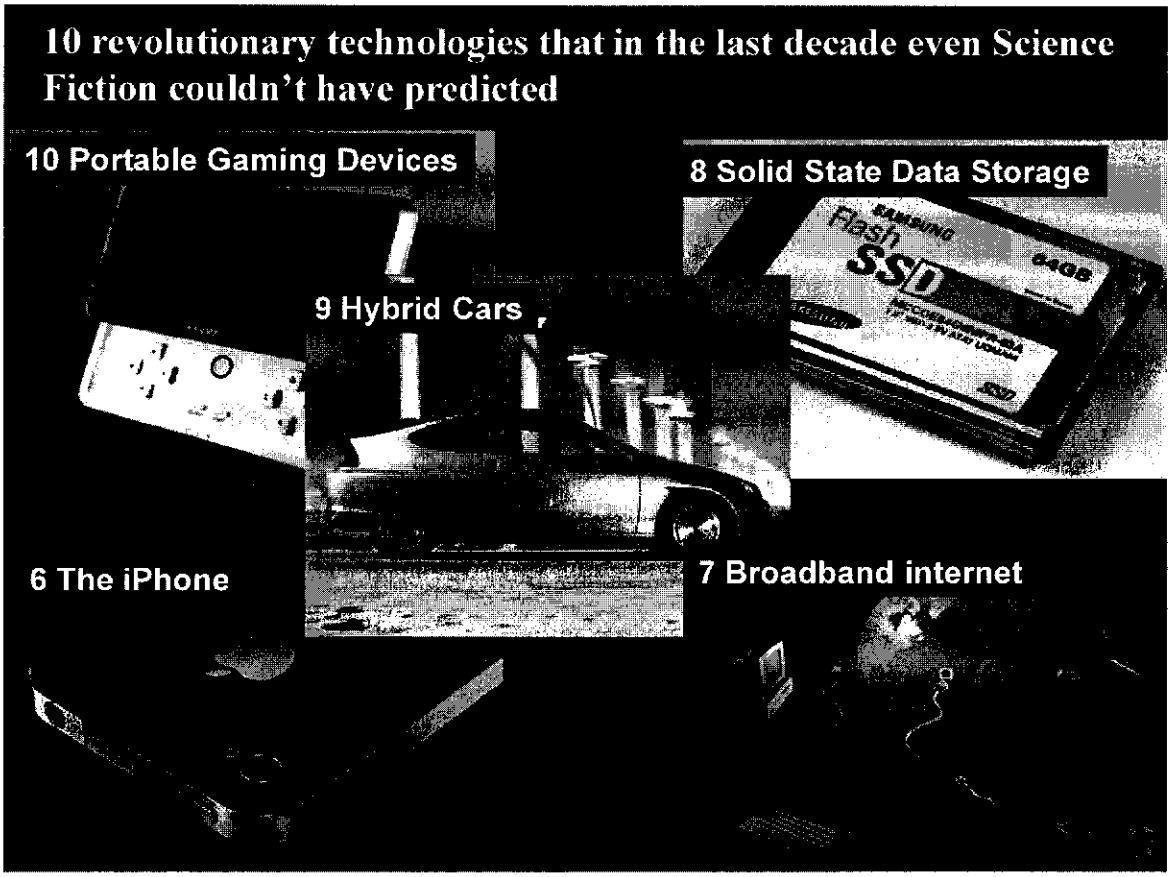
10 revolutionary technologies that in the last decade even Science Fiction couldn't have predicted
10 Portable Gaming Devices
8 Solid State Data Storage
9 Hybrid Cars
6 The iPhone
7 Broadband internet

Figure 1

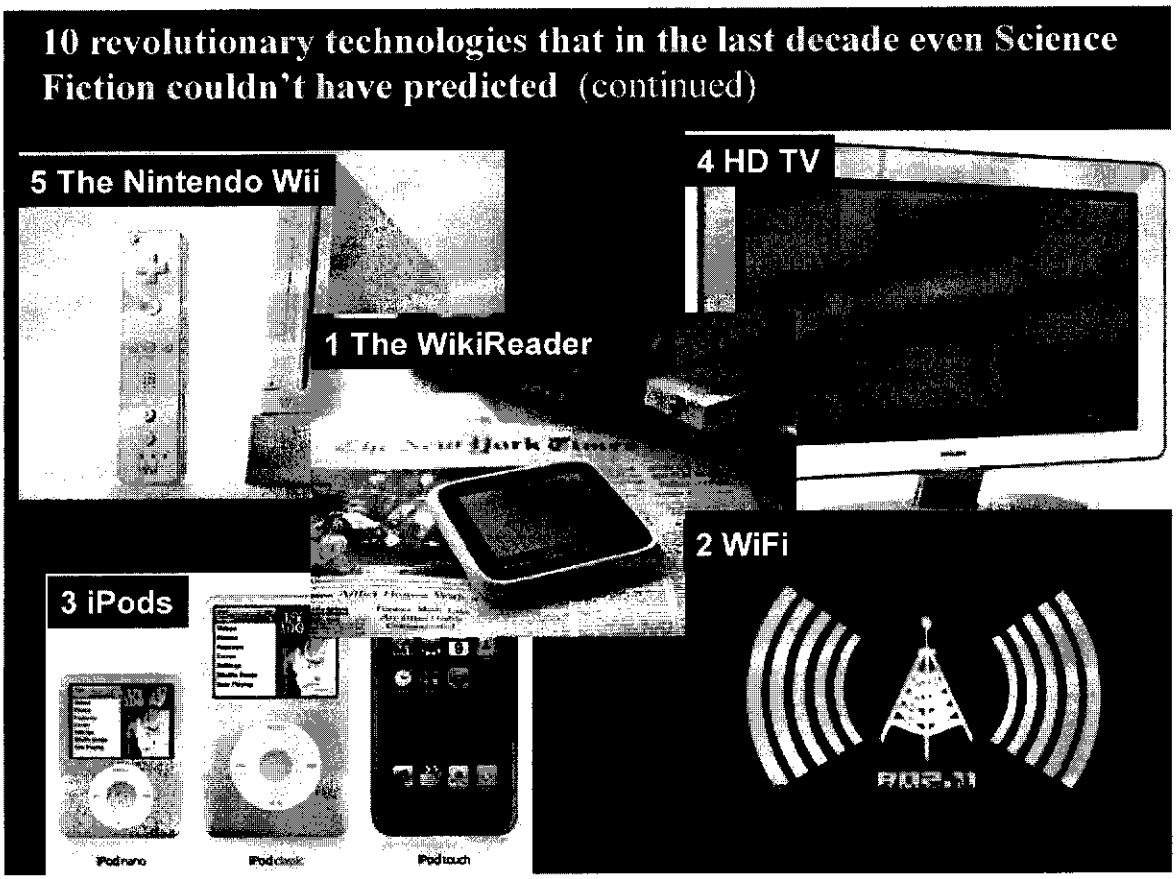
10 revolutionary technologies that in the last decade even Science Fiction couldn't have predicted (continued)
5 The Nintendo Wii
4 HD TV
1 The WikiReader
2 WiFi
3 iPods

Figure 1bis

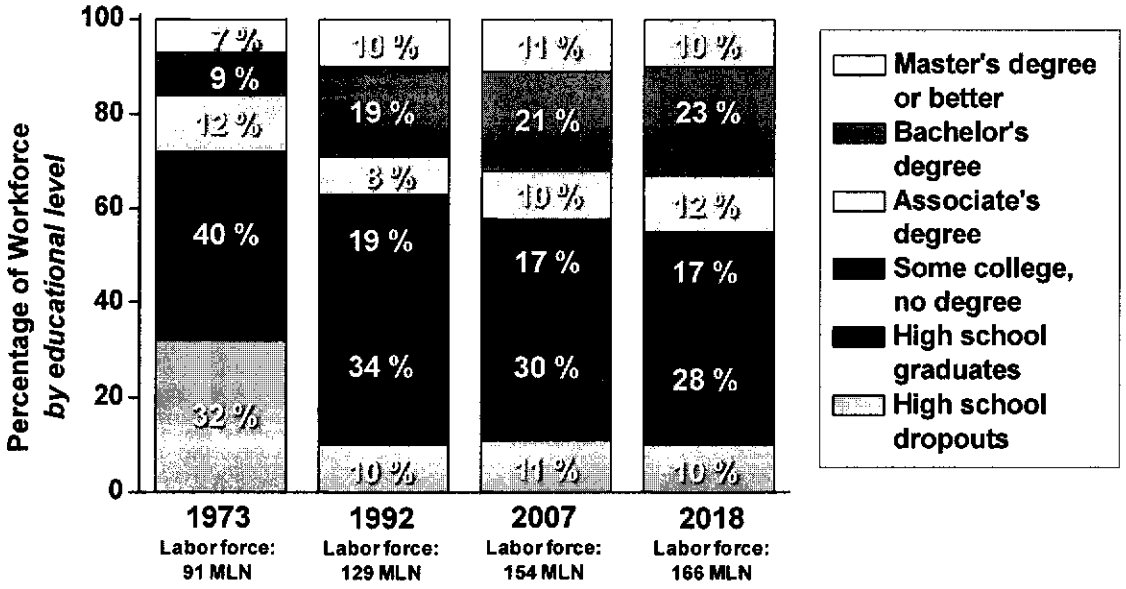
Percentage of Workforce
by educational level
100
80
60
40
20
0
7 %
9 %
12 %
40 %
32 %
10 %
19 %
8 %
19 %
34 %
10 %
11 %
21 %
10 %
17 %
30 %
11 %
10 %
23 %
12 %
17 %
28 %
10 %
1973
Labor force:
91 MLN
1992
Labor force:
129 MLN
2007
Labor force:
154 MLN
2018
Labor force:
166 MLN
Master's degree or better
Bachelor's degree
Associate's degree
Some college, no degree
High school graduates
High school dropouts

Figure 2

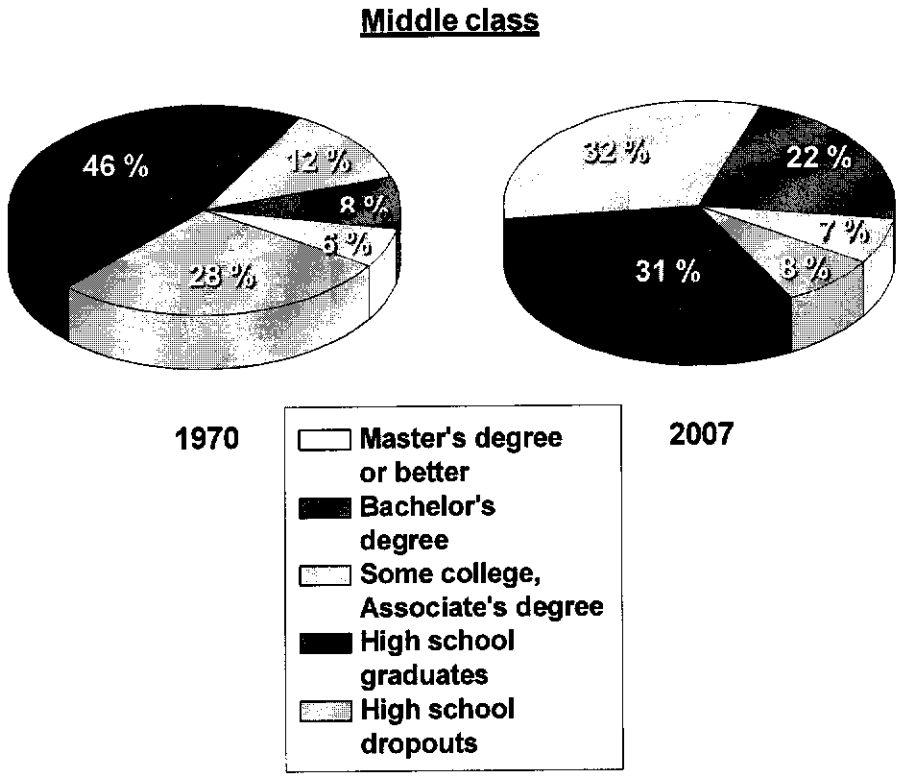
Middle class
46 %
12 %
8 %
5 %
28 %
32 %
22 %
7 %
31 %
8 %
1970
2007
Master's degree or better
Bachelor's degree
Some college, Associate's degree
High school graduates
High school dropouts

Figure 3

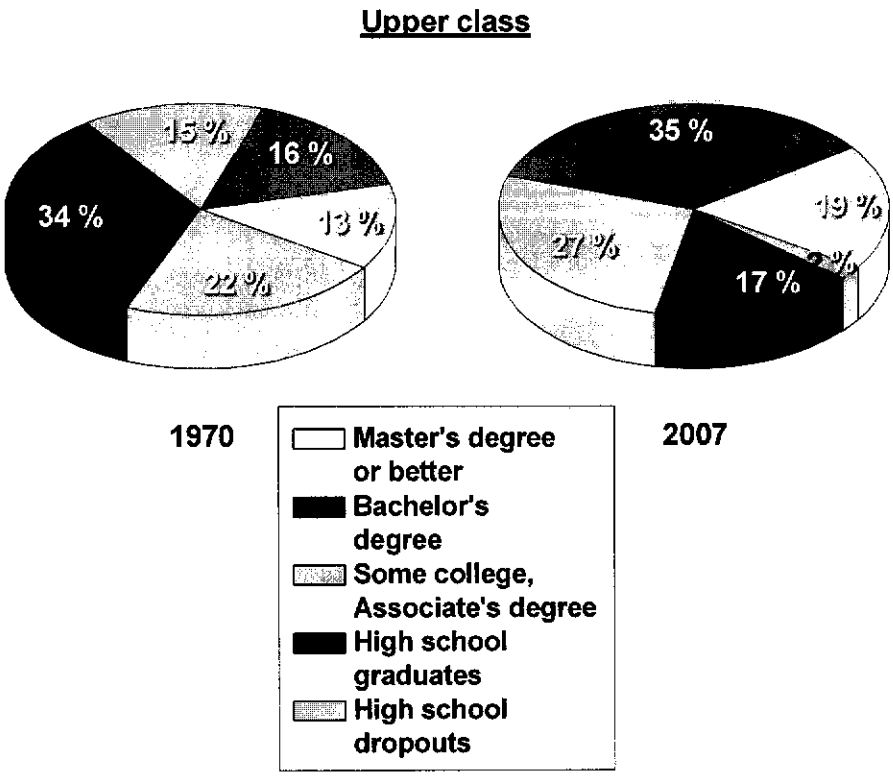
Upper class
15 %
16 %
34 %
13 %
22 %
35 %
19 %
27 %
17 %
1970
2007
Master's degree or better
Bachelor's degree
Some college, Associate's degree
High school graduates
High school dropouts

Figure 4

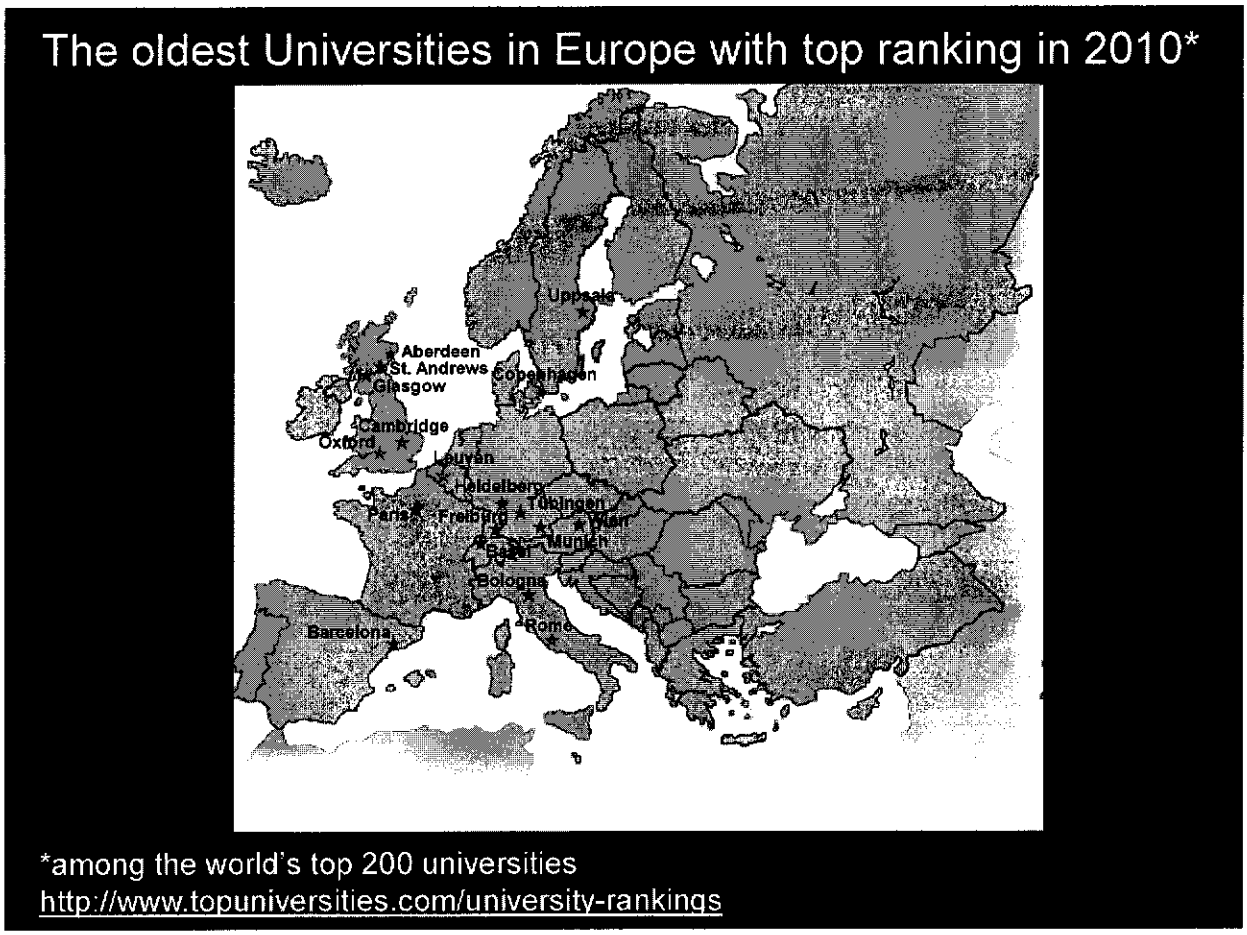
The oldest Universities in Europe with top ranking in 2010*
Uppsala
Aberdeen
St. Andrews
Copenhagen
Glasgow
Cambridge
Oxford
Leuven
Heidelberg
Tübingen
Paris
Freiburg
Wien
Munich
Basel
Bologna
Rome
Barcelona
*among the world's top 200 universities
http://www.topuniversities.com/university-rankings

Figure 5