Higher Education Institutions between a global and a local challenge

Giovanni Natile[1]
Chemistry Department, University of Bari Aldo Moro, Italy

This contribution deals with the trust in HEIs (Higher Education Institutions) that can be challenged by the increasing emphasis on utility. Three issues will be addressed in this order: the quest for technology transfer, the quest for education in response to labour-market needs and the quest for research addressing major societal challenges. For each of these issues, a brief description of the state of the art will be given first and, subsequently, the role that HEIs can play will be envisaged and how HEIs can gain social prestige and legitimization.

The quest for technology transfer

In the invitation to the symposium, on which this volume is based, Lars Engwall noted how in the last few decades there has been a tendency of politicians, and of opinion-makers in general, to stress the role of HEIs as motors of economic development and to point out how crucial investments in research and the share of the population entering higher education are for economic growth and welfare. This trend is general and worldwide, and has solid foundations in several documents and directives of the European Commission. For instance, in 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 is 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 KETs (Key Enabling Technologies) (see Figure 1 for ten revolutionary technologies in the last decade that even science fiction could not have predicted). It was envisaged that those regions mastering these technologies would be at the forefront of managing the shift to a technology-based economy, which is a precondition for ensuring the welfare, prosperity and security of citizens. Hence the deployment of KETs was deemed not only of strategic importance, but also indispensable for addressing societal challenges ahead, such as fighting climate change, overcoming poverty, strengthening social cohesion, and improving resource and energy efficiency.

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

[1]Email: giovanni.natile@uniba.it

Figure 1

Ten revolutionary technologies in the last decade that even science fiction could not have predicted

The same document [1] calls for a broadly shared EU (European Union)-wide strategic vision about the technologies that the EU wishes to master in research and production, which is a pre-condition for bringing the EU into a breeding space of innovation. Finally, it proposes 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 KETs.

The KETs were seen to span the fields of nanotechnology, micro- and nano-electronics, photonics, advanced materials, and biotechnology. None of these KETs are in the domain of the 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 strengthening social cohesion, mentioned above, for which KETs are required in the field of the humanities and social sciences.

This trend in the industrial policy framework of intercepting HEIs is general, and the role that HEIs are asked to play in the technology transfer can be appreciated by looking at various issues of Tech Transfer News. Looking more closely at just one issue of Tech Transfer News (that of 18 May 2011) [2], we find that one article deals, in general, with the involvement of universities in start-up formation and mentoring; another article reports that more than 100 companies spun off by the University of Utah in the last 6 years; a third article reports the growing trend among universities to allow students to retain the rights to their intellectual property; whereas a fourth article reports an attempt by 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, another article announces a distant-learning event on international patenting focusing on China.

HEIs have always played a role in technological advancement and in underpinning the science and technology needed for innovation. However, the increasing commitment to innovation, ultimately resulting in growth and jobs, is accelerating the rate of transferring research achievements from the laboratory to the market. This is posing new challenges to HEIs, and they are more and more committed to meeting these challenges. There is a great deal of industrial interest in the research outcome performed in HEIs, and HEIs can gain trust not only among entrepreneurs, but also from the general public in showing how they can contribute to developing solutions in a changing world and be a primary actor in transferring the results of new discoveries to the market place.

The quest for education in response to labour-market needs

Post-secondary education

However, the task of technology transfer and commercialization addressed in the previous section should not distract HEIs from their major duties, which are the generation of knowledge (i.e. breakthrough science) and the transmission of knowledge (i.e. education). Let me address first the aspect of education.

Personally, I have a scientific background and have been involved mainly in chemical organizations, such as EuCheMS. Therefore I will refer generally to the hard sciences even though similar problems can also affect the humanities and social sciences.

In the same document of the European Commission mentioned earlier [1], HEIs were asked to provide appropriate vocational training in response to labour-market needs, to ensure that natural sciences and engineering are given their deserved place in the education system, to increase the percentage of graduates also by attracting international talent, to improve multidisciplinary experience and skills, and, finally, to introduce environmental studies into engineering and business curricula.

The development of qualifications needs also to draw on the kind of learning experiences that enable students to reach their potential and has to take into consideration the current and probable 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.

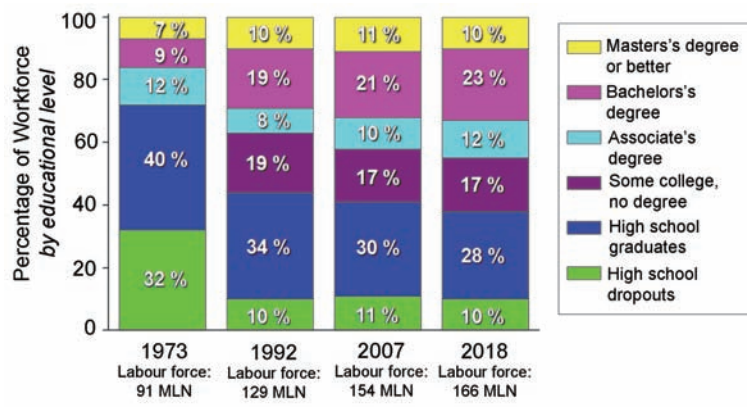
Although it is relatively easy to identify the needs of the current job market, it is more difficult to accurately predict future requirements. There is a big debate on how many technicians, managers and professionals will be required by 2020. Without entering into this debate in depth, a projection of jobs and education requirements through the next decade is essential in order to address the theme of utility in connection with the role of HEIs in education.

A 2008 Cogent Report for the U.K. [3] forecasts that, by 2020, there will be an undersupply of technicians, but an oversupply of managers and professionals. Furthermore, a recent study of the largest western economy, the U.S.A., carried out 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 U.S. economy that required post-secondary education increased from 28 to 59%. In addition, according to their projections, the future promises much the same, with a further increase in the share of post-secondary jobs from 59 to 63% over the next decade (Figure 2). The core mechanism at work in increasing demand for post-secondary education and training is singled out as the computer. Computerized procedures, by automating repetitive tasks, create decreasing demand for occupations that tend to require high school or less, such as production jobs which, indeed, are declining.

Moreover, as the economy evolves, post-secondary education, which is required in order to have access to a greater percentage of jobs, also becomes the threshold requirement for access to middle-class status and earnings. In 1970, only 26% of the middle class had post-secondary education and training, by 2007, 61% of middle class workers had such background (Figure 3).

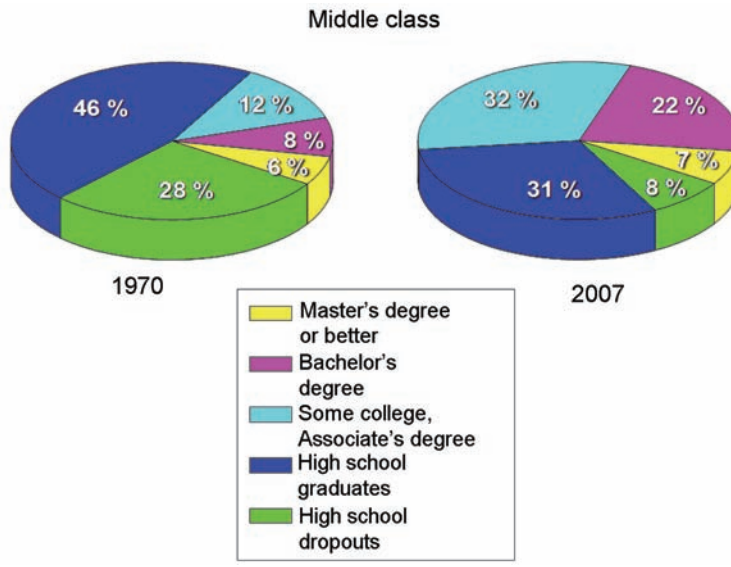
Furthermore, the educational composition of the upper class (the three highest family income deciles) appears to favour workers with some college

Figure 2



Percentages of workforce by educational levels (how they evolved between 1973 and 2007 and how they are foreseen for 2018) in the U.S. economy
Data taken from [4]. MLN, million.

Figure 3



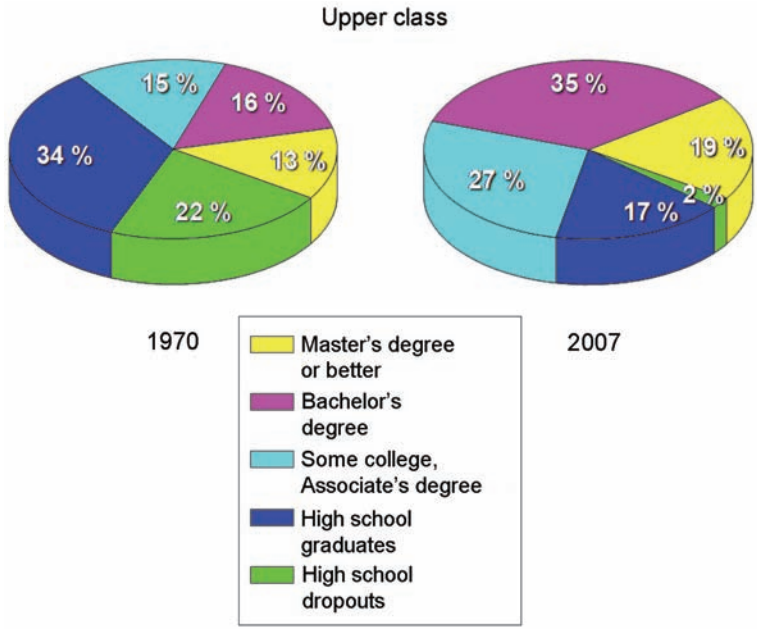
Composition of middle class by educational levels (how it evolved between 1973 and 2007) in the U.S. economy
Data taken from [4].

education or higher. In 1970, 44% of the upper class had post-secondary education and training. By 2007, this percentage had risen to 81% (Figure 4).

The emphasis on post-secondary 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 is disappearing where people left high school to go to work in the local industry and then worked their way up. People are no longer trained in industries; they are educated or trained in HEIs, go to work in occupations and progress in an occupational hierarchy. Some occupations are tied tightly to particular industries (healthcare occupations, for example), but more and more occupations are dispersed broadly across industries.

In this context, employers should be considered among external stakeholders even if they might not contribute to the financing of HEIs. Employers can also provide useful information to assess the quality of the output of educational institutions, since they are the final users of the skills and competences produced. The financing of universities, particularly in Europe, has long been calculated essentially according to the number of enrolled students, with the risk of producing perverse forms of competition with the effect of lowering the quality standard. Now, other performance criteria are needed to measure efficacy and efficiency. In proposing a study programme, HEIs should know whether there is a real demand for the kind of skills to be produced and whether the curriculum envisaged is adequate for the desired goals. HEIs can also gain a lot of trust if they pay attention to students' careers once they get their degrees and enter the market place.

Figure 4



Composition of upper class by educational levels (how it evolved between 1973 and 2007) in the U.S.A. economy
Data taken from [4].

Master's and Ph.D. degrees

It is interesting to note that in the U.S.A., in contrast with the steep increase in the percentage of the work force that requires a post-secondary education in the period 1973–2018, the percentage of work force requiring a master's degree or higher has increased in the period 1973–2007 from only 7 to 11%, and it is projected to remain constant or slightly decline in the period 2007–2018 (down by 10%) [4]. However, although the percentage decreases slightly, the absolute number remains constant, i.e. it will be necessary to produce at least the same number of people with a Master's degree or Ph.D.

Concerning the most highly educated category of workforce, there appears to be a general consensus on some basic points [5]:

- A greater proportion of science graduates pursue careers that require a graduate qualification compared with those from other subjects
- Ph.D. programmes are recognized by industry as providing an innovative workforce with the knowledge and skills needed to pose and answer difficult questions
- Ph.D. students are recognized to be the lifeblood of any discipline, and HEIs are requested to support and nurture their capability
- Ph.D. holders 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
- Training in science provides a unique combination of manual, theoretical, analytical, numerical and problem-solving skills, which are highly prized

As it appears, Ph.D. programmes are the link between education and the other major mission of HEIs, research, which will be addressed later on in this chapter. For this reason it could be useful to devote a few more words about the highest level in education.

A side discussion during the EuCheMS general assembly held in Bled, Slovenia, last October [6] concerned the particular case of higher education in chemistry in Europe. The general trend summarized above was fully confirmed, with some additional peculiarities. It was observed that first, there are 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 a greater attraction for more highly motivated students. Secondly, there are decreasing job opportunities for lower-level degrees in chemistry; on the other hand, there are better opportunities, also in terms of job qualifications, for higher-level degrees and, in particular, Ph.D. degrees. Thirdly, only approximately one-third of Ph.D. holders find jobs in their own field and in their own country; approximately another third find a job in their own field, but in another country (which can be Europe, but also the U.S.A. or South America); and, the final third will find employment in a related field or in business. Fourthly, the number of Ph.D. students coming from the same university is decreasing, whereas an increasing number are coming from other universities or from abroad.

To date, HEIs in Europe have adequately fulfilled the demand for more and better educated people, which is the basis of a knowledge-based economy and which is a precondition for ensuring the welfare, prosperity and security of citizens. However, considering the economic crisis that has characterized the world over the last couple of years, HEIs may no longer be in a position to accomplish their task, and there could be a negative effect on not only the number of Ph.D. degrees, but also the bulk of the knowledge that is required to put humankind in a suitable position to address major societal challenges.

HEIs will be more and more concerned about the possibility of attracting funds, students and researchers, being aware of the fact that by these means they can gain social prestige, legitimization and trust, and can compete effectively in the national and international higher education market place.

Sharing the costs of education

The NCHEMS (National Center on Higher Education Management System) [7] estimates that for the U.S.A., an additional 8.2 million post-secondary graduates will be needed by 2020, an increase of nearly 1 million per year, and, at current cost, this would require an increase of U.S. $158 billion by 2020. An additional U.S. $36 billion has already been included in the President Obama's reform of the post-secondary financing system. This leaves U.S. $122 billion that has 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 in post-secondary institutions as partners in finding ways to pay for achieving this goal. The hopes are that, working together, state and federal governments will develop reforms that result in both cost effective and high-quality post-secondary education and training programmes.

As the economic crisis will have impact on the sustainability of higher education, increased tuition fees can be, 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 able to offer a diversity of courses and approaches. There should also be good access to higher education regardless of the ability of the student to pay.

Higher education in Europe is generally not privatized; moreover, in many respect it is regulated with many European countries still having control over first-cycle degree fees and also demanding a quality assurance system in HEIs. Nevertheless, higher education is not immune from the market thinking that is now also prevalent in Europe. In spite of official governmental declarations, higher education is being treated as a product to be marketed, and a rating system for HEIs is seen as a helpful supporting instrument for this. Education is becoming a commodity that can be commercialized and sold on a market where the demand is growing, with our knowledge society. HEIs can see this as an opportunity to improve the education they provide. Students may be seen as consumers and consumers of education must obtain an education that is 'consumable'. Young people may become less interested in academic excellence than in employability. Consequently, HEIs may be more interested in offering curricula that fit the demand for vocational training and skills and professional profiles that are successful on the labour market. This latter aspect may guide the construction of curricula more so than the goal of making a young person an educated and ethical person.

HEIs have to be conscious of this change, which is intrinsic to the move from elite to mass higher education, and must develop strong partnerships with economic employers, good internship or apprenticeship programmes and good job placements to sustain the high trust that the public places in them.

Globalization

There is another aspect to be mentioned. Globalization has also deeply affected the job market for people with higher-level degrees, and it could hardly be otherwise. Holders of Master's and Ph.D. degrees are more free to go where their skills are required and appreciated, and only a fraction of them will ultimately remain in and contribute to the welfare of the region where the HEI is based. Such a change also brings in a political dimension. This is characterized by the growth of supranational organizations addressing policy and regulatory matters beyond the scope of individual nations [8]. Important players in Europe are EU, UNESCO, OECD (Organisation for Economic Co-operation and Development) and other international organizations, such as professional organizations. Although the Bologna Process was not organized by such supranational organizations, the decisions taken within this framework have far-reaching consequences for HEIs [9]. The European Commission is also aiming at expanding automatic EU regulation to cover most professions (under current regulations, only seven professions enjoy

automatic recognition throughout the EU: architects, dentists, doctors, midwives, nurses, pharmacists and veterinary surgeons). Harmonized training requirements for various professions, acceptable at high levels to all EU nations, would be a prerequisite. This represents a new challenge for HEIs, but also an opportunity for improving quality and increasing the trust in them.

The quest for research addressing major societal challenges

Another major 'utility' connected to the activity of HEIs, is research. In the past, the image of science was associated with individual geniuses, and for a long time it has been possible for great discoveries to be principally the achievement of one person. This is no longer the case: approaches have become interdisciplinary, and work is carried out in teams. Thanks to the Internet, it is no longer required to sit at the same workbench in order to collaborate. Research has become a truly global exercise; international cooperation has become essential; and establishing a European research area "without noticeable national, formal and research subject boundaries" has become a major aim of the EU. It is owing to the globalization of research that scientists can no longer be constrained in a place or in a region, but will tend to move where their research interests and careers can be better served. In this panorama, HEIs have to maintain the high 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 [10,11]. Neither is it possible to completely seperate fundamental from applied research since they are two sides of the same coin.

It should be realized that the return on investments in research is much more than just an economic return. 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 and energy sustainability, to mention only a few.

To date, European HEIs, in general, have been able to preserve their high standard thanks to the financial support provided, in large part, from public funds, either European or national. However, the situation is changing rapidly, and there are rumours of fund-cutting all over Europe despite the rhetoric of politicians. This will inevitably result in an increase in the tuition fees paid by the students and in the HEIs' seeking support from the business community, which will reduce to some extent the degree of freedom not only in research but also in education. This could to some extent be beneficial, since this would force researchers to pay more attention to practical problems and would place some more responsibility on students. However, it is advisable that basic research and education, the two strictly intertwined, will continue to be the responsibility of national and regional institutions.

Although major attention is generally paid to the hard sciences, as there is a direct link between scientific and technological developments, it should be realized that developments in the hard sciences cannot progress without simultaneous developments in the humanities and social sciences. Both of them equally impact the quality of life, and there is a need for key enabling technologies in the field of the hard sciences as well as in the humanities.

Final considerations

This is the scenario in which HEIs have to operate: first, to help identify a strategic vision about the technologies that the EU wishes to master in research and production, secondly, to provide appropriate vocational training in response to labour market needs, and thirdly, to maintain and possibly further enhance the prestige that research at HEIs has in society by intercepting its needs and addressing major societal challenges.

In the meantime, the position of the stakeholders in HEIs is changing. Increasing numbers of them want to have a say in the policy of HEIs and are interested in how the institutions develop. This has not occurred without having some effect on the governance of HEIs. In some institutions, the main decision-makers are no longer selected among academics; instead, external specialists are hired as managers. This is also the case for the board: external experts are often seen as those who will make a difference. In some cases this new type of management cohabits with traditional collegial governance. External managers are seen by policy-makers as better suited for accountability. HEIs have to prove that they are providing quality services. This can give HEIs a new chance to increase their trust, but this might require taking some risks, experimenting with new educational pathways, and innovating, mobilizing and infusing people with dreams.

A final consideration concerns the time perspective that 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 may not be so in a few years' time. It appears to be a conundrum, but universities are fundamentally different from regular enterprises. In the field of enterprises, it can happen that many of the leading companies today did not exist 20 years ago (and most of these are exploiting the commercial potential of science that is not too far removed from the laboratory); 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 do not have a good explanation for this, but probably at the highest levels, the transfer of knowledge and skill can only take place by direct contact, without intermediaries, and decades if not centuries of experience can make a difference.

As a person who has spent most of his life in a university, I wish for HEIs to be as transparent as possible, to not minimize the difficulties, to be reasonably selective, to be sympathetic with the alumni, and to give time for individualities (as well as for promising new technologies) to mature and flourish. There is a kind of parallelism between promising new technologies and alumni; both of them

Figure 5

The oldest universities in Europe (established before the discovery of America) with top ranking in 2010 (among the world's top 200 universities)

flourish best when they are neither left to fend for themselves nor mollycoddled for too long.

Comments by Erik De Corte[2]

Giovanni Natile's chapter highlights several important aspects of the utility perspective on HEIs by stressing on the following:

- The role of HEIs in economic development and in building and elaborating a long-term strategy for the so-called KETs that enable the development of

2 Center for Instructional Psychology and Technology (CIP&T), University of Leuven, Belgium (Email: erik.decorte@ppw.kuleuven.be)

new goods and services as well as the restructuring of industrial processes needed to modernize industry in the EU and make the transition to a knowledge-based and low-carbon resource-efficient economy
- The issue of identifying the future needs of society with respect to job requirements and qualifications
- The need to prepare students for a fast-changing employment world
- The important link between research and education

In reaction to Natile's contribution, I suggest some comments that are complementary to his ideas.

As stated in the paper, it is indeed the case that currently none of the KETs that are identified belong to the humanities or the social sciences. In this respect I fully agree with Natile that there is and will be a growing need for the development of KETs in those domains also. Two examples that I would like to put forward are educational and communication technologies. Let me elaborate this briefly for educational technology, referring thereby to aspects of Natile's presentation.

He rightly stresses the need to provide appropriate vocational training in response to labour market demands. However, this labour market is indeed changing fast, and this requires more and more that students should be prepared for this reality; in other words, they should be able to move flexibly from one job to another. Taking this into account, the ultimate objective of education at all levels should be the acquisition in students of what is today known as adaptive competence, i.e. the ability to apply meaningfully learned knowledge and skills flexibly and creatively in a variety of contexts and situations (as opposed to routine competence, i.e. simply being able to complete stereotype tasks quickly and accurately without understanding). Such an adaptive competence involves in addition to the mastery of a flexible and well-organized knowledge base in a domain or discipline, the ability to self-regulate one's learning, thinking and reasoning, but also one's motivational and emotional processes, in task and problem situations [12,13]. Let me illustrate the importance of self-regulation as a component of adaptive competence with one example of relevant research findings.

Schoenfeld [14] videotaped high-school and college students working in pairs on unfamiliar problems during 20-minute sessions, and contrasted the solution processes with those of experts. The following is an example of the problems used in this study: "Consider the set of all triangles whose perimeter is a fixed number 'P'. Of these, which has the largest area? Justify your answer as best as you can". The solution processes were parsed into episodes representing different activities: reading the problem, analysing, exploring, planning, implementing and verifying. Timeline graphs were used to represent the course of the solution processes visually.

The results showed that the typical 'novice' solution process of students consisted of reading the problem, choosing quickly a certain approach to it and sticking to this approach, even when there is evidence that they are not making progress. Self-regulatory activity is totally lacking in their approach. This contrasted very strongly with the varied solution process of the experts: after reading the problem, they analyse it carefully before planning the solution process,

followed by verifying the plan, then sometimes getting back to analysis etc. Also, throughout these activities the experts often take a step backward to monitor their solution process. Planning, verifying and monitoring are major examples of self-regulation strategies.

In view of pursuing and achieving adaptive competence in a discipline among students, especially the self-regulatory components of it, but also the knowledge base, educational technology has the potential to make a significant contribution, although conditional on being well integrated into an innovative approach to teaching and learning in higher education (instead of being just an add-on to a traditional learning environment).

This brings me to another complementary comment. With respect to education, Natile focuses on the quantitative side in his paper, such as the increasing need for people with a higher level of education, especially post-secondary education. I underscore this viewpoint, but I would like to add that there is also a strong need for innovating and improving the quality of higher education. Indeed, developing self-regulatory skills in students and preparing them for lifelong learning, requires that they take more agency in and responsibility for their own learning [15]. Instead of being passive learners who absorb the knowledge presented by the teacher and the textbooks, they should become active learners who build and construct their own knowledge and skill, albeit with the guidance of the teacher, the support of technical tools and in collaboration with their fellow learners. One approach that explicitly attempts to implement these ideas is PBL (Problem-Based Learning), which originated in medical education, but has become more and more widely used in higher education over the past decade [16,17].

PBL is an instructional method in which students learn through facilitated problem-solving. Learning centres on a complex problem that does not have a single correct answer. Students work in collaborative groups to identify what they need to learn in order to solve a problem. They engage in self-regulated learning and then apply their new knowledge to the problem. In addition they reflect on what they learned and on the effectiveness of the strategies employed. Finally, the teacher acts to facilitate the learning process rather than to provide knowledge.

A third complementary remark relates to the fact that Natile addresses the utility theme from the perspectives of education and research. However, higher education has a third mission, namely community service or service to society. At present, the reputation of higher education in society at large is not always very favourable. Therefore it is an important challenge to improve the perception of and to foster the trust of the general public in higher education. In this respect, high-quality community services supported by the appropriate use of communication technologies can be deployed and have the potential of making a substantial contribution.

In conclusion, I agree with Giovanni Natile's ideas relating to the utility issue, but I think that the utility of higher education can also be strengthened through an innovative approach to learning and teaching in higher education that focuses on developing in students adaptive competence so that they are appropriately prepared for the continually changing needs of our fast-developing society, and are equipped with the skills and motivation for lifelong learning. Furthermore, high-quality services to society can significantly boost the perception of and the

trust in higher education among the general public. Developing KETs in these domains is a fascinating challenge for HEIs in the coming years.

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