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WHITE PAPER FOR THE ROYAL ACADEMY ANNUAL SCIENCE-POLICY MEETING

RESEARCHER-BASED EDUCATION AT UNIVERSITIES

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CONTENT

	Foreword: Researcher-based education at universities	P. 3
1	Universities' background	P. 10
2	Education programmes for society	P. 16
3	Danish universities today	P. 23
4	Can education quality be measured?	P. 27
5	New forms of digital learning	P. 34
6	Conclusion with recommendations	P. 38
	References	P. 42
	Annex 1 - 3	P. 44

FOREWORD: RESEARCHER-BASED EDUCATION AT UNIVERSITIES

The theme for the Royal Academy Annual Science Policy Meeting and the White Paper 2018 is "Researcher-based education at universities". **Not just research-based, but researcher-based** because it is the individual researcher who disseminates knowledge based on their own, and others, research. Teaching and transfer of knowledge from researcher to students has taken place at quality universities for almost a thousand years. Not just as one-way communication, but as a true academic dialogue between students and and educators.

The three White Papers in 2016, 2017 and 2018 have been written in continuation of each other and are linked together. White Paper 2016: "The meaning of science for society" examined the characteristics of the sciences and their societal importance. White Paper 2017 launched "Universities in the Blue Ocean" as a metaphor for how universities in the future can sail under a clear blue sky to new and unexplored waters. The paper recommended innovation as a way of raising the level of quality. Universities have strong research, but global development is occurring at breakneck speed and we face our own challenges on the home front in Denmark in

the education area with many graduates, declining budgets and tight bureaucratic control.

Section 1 of the White Paper 2018 looks at the universities' millennia of history with researcher-based education programmes and links it with the university rectors' Magna Charta, signed in Bologna in 1988, which determines research freedom and independence as a foundation for quality in both research and education (see Annex 1). Section 2 illuminates the value universities have for society, via the research and education of academics for the benefit of society. Section 3 examines the current status of the Danish universities from the viewpoint of the Royal Danish Academy of Sciences and Letters. And here we note the irregular framework conditions that dominate the different fields and universities. All in all, research at Danish universities remains strong, but the distribution of areas of strength varies. In many places, education is challenged by the increase in the number of students per teacher, which reduces the opportunity for researcher-based education, and thereby the quality. Section 4 examines problems with the evaluation of the quality of education programmes, and advocates for more than just introducing additional layers of control when a compelling method for the evaluation of teaching quality is currently lacking. Section 5 examines modern teaching methods in relation to researcher-based teaching.

Finally, in line with the recommendations from DI (Confederation of Danish Industry) and CO-industri (The Central Organisation of Industrial Employees in Denmark), in the "Research for the future" publication, we recommend strenghtening the research and teaching at universities for the sake of Danish society, but also for meeting the UN Global Goals. Research and well-educated academic graduates are essential for creative solutions to global challenges. We in Denmark must play our part in solving them.

University graduates are crucial to transferring existing knowledge and results from the latest research to society. This is more vital than ever before, because rapid development and globalisation means that at the universities, society as a whole and Danish industry are competing with

the entire world. That's how it is in a knowledge society. Education programmes for society, together with research, are a core task for universities. Strong graduates with critical academic approaches are a necessary foundation for the individual's opportunity for lifelong learning and for society's institutions. Education is an investment for our society in the future.

The White Paper 2018 argues for the importance of a slow pace in education programmes - with the opportunity for thorough immersion and contemplation within the framework of the standard length of studies. However, there should also be flexibility allowing international studies abroad and engagement in research.

Universities are houses where knowledge live and grow, nourished by ethos, creativity and curiosity, and where small and large questions are exchanged between students and researchers, who are also teachers. Immersion is necessary to harness this dream scenario. Unfortunately it is not present in all Danish universities. Universities educate a good 25 per cent of a cohort and even more are accepted. This naturally requires more resources. Both because there are more students and because of the wider recruitment base. Mass university factories with large class sizes are becoming the norm for many study programmes. If we in Denmark want to be among the best, we need to have the right conditions for the individual students. Universities in Denmark and researcher-based education lack the funding to fully realise their potential and as we highlighted in the White Paper 2017, the middle generations of researchers are particularly affected. Meanwhile, a variety of administrative and bureaucratic requirements and challenges take away more and more from the actual objectives - research, education and communication of knowledge. Universities in Denmark still try to achieve a high level of quality despite relatively fewer funds and increased regulation but luckily many enthusiats do all they can. Oxford and Cambridge, Harvard and Stanford, and Karolinska here in the Nordic area have budgets that are 2-3 times greater per student compared to Danish universities. It provides the opportunity for fewer students per researcher - an important prerequisite for real *researcher-based* education.

It has been proposed that the budgetary gap between more students and fewer funding resources can be bridged by 4.0 - the hip acronym for digitalisation, e-learning, m-learning, flipped classroom, robots and big data. It is internationally described as the fourth Industrial Revolution and also known as "Disruption". Denmark has its own Disruption Council as established by the Prime Minister. Unfortunately, 4.0 does not represent a saving in teaching at universities - quite the opposite. The new initiatives are of high importance in capturing the attention of the new generation of students glued to their iPads and smartphones. These students' motivation and engagement can be bolstered via the media they frequent. Properly utilised - they can supplement, increase quality and give a higher yield for students and create new opportunities for researchers and educators. Digitalisation provides the opportunity for new learning methods; but it still requires people and hours to utilise the opportunities. It takes time to develop and maintain technological platforms and out-of-class activities, and they cannot replace lectures or classroom teaching. We recommend knowledge-sharing on an international and national level in this area, and stress that digitalisation can never replace the human dialogue and the concrete meeting between students and teachers. Universities should invest in new technologies and improve competences allowing the possibility to combine mass education with individual learning and strengthen the students' ability collaborate and work innovatively in relation to shifting problems that reach far beyond the walls of the university.

Experience from the last year's study progress reforms tells us that they have made it more difficult for students to establish independent study programmes and meaningful exchange with the surrounding society. And these are exactly what the future needs. Immersion and a slow pace allow for the time needed to build up deep learning and detailed knowledge. They allow for time to reflect over why and how, and what one knows and has yet to learn. It is crucial to adaptability and lifelong learning - skills of key importance right now when society is changing so quickly and so noticeably.

At the moment, there is a lot of focus on measuring and weighing, accrediting and evaluating, also at universities. But is it possible to measure the

quality of education and teaching? There is not one easy, robust, reliable and generally recognised method. The current development of more and more time-consuming measurement methods in the education area comes across like the fool from the folk tale who loaded each individual stone onto the cart, until he could no longer move the cart. This layer upon layer concept continues to grow precisely because the right method has yet to be found. We need to find another path away from this development. It is worse than doing nothing, because a lack of trust in universities' own responsibility and management has resulted in too much management, control and theft of precious time. Our message is clear and simple: Stop control and over-regulation, universities must be unleashed to nurture the best graduates for a complex, global society, in which Denmark will flourish by having the best educated young people. And university management ought to do this.

Danish research is international and of high quality. It is crucial that we achieve the same in the education area - including having the best and most modern forms of learning.

The universities combination of the Humboldt model's respect for tradition and research freedom, the Stanford model of engagement with society's need for innovation, and the Folk High School's respect for the individual student's meaningful development results in graduates who are driven by their own curiosity, creativity and critical thinking with a desire to learn. Students who have been vaccinated against *fake news* and alternative facts; and who can constructively meet the constant new demands of businesses and institutions. Universities need good framework conditions to develop their potential – for the benefit of the country's future. Our Nordic neighbour Sweden has increased its funding for education and research considerably. Denmark can draw inspiration from them.

As a new initiative, the Committee on Science Policy has invited central stakeholders in possession of significant knowledge about the universities' education area to enter into dialogue with the committee, including students, educators, rectors and the Young Academy. We would like to thank

you for the valuable information and inspiration (see guest list in Annex 2). Thank you also to head of the secretariat Søren Burcharth and editor Marita Akhøj Nielsen for text contributions and editorial services, and to the members of the Committee on Science Policy for their work on this White Paper. Thank you to Katie Rice for translating the White Paper.

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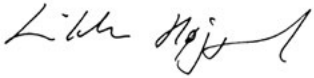

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RECOMMENDATIONS

1. Researcher-based education should continue as the foundation for universities – despite increased intake of students. Only by doing so, can it result in valuable, competent, creative and critical graduates prepared for lifelong learning.

2. The ratio between students and professors/associate professors/assistant professors should be improved, in order to reduce the current high number of students per teacher. Either by fewer students or funding for more teachers.

3. Universities should have stability, independence, and freedom to act in respect of the Magna Charta Universitatum, and excessive management should be removed.

4. University study environments should be optimised via modern forms of learning where appropriate.

5. Denmark needs excellent universities to succeed in the global competition and contribute to solving the UN Global Goals. The necessary funding must be provided for this.

1 UNIVERSITIES' BACKGROUND

Since universities' formation in the middle ages, they have been a part of an international network. The academic educational journey, *peregrinatio academica,* took many Danes to a southern European or a German university. It may have been the oldest university in Paris or the newer ones in Rostock or Cologne. The latter was a model for the University of Copenhagen, founded in 1479.

That Copenhagen even had a university was due in large part to Christian I's journey to Italy in 1474, which resulted in a papal bull the following year giving permission for the founding of a full university comprised of *higher* and *lower* faculties. The lower arts faculty covered natural sciences and the humanities, and was preparation for the proper studies at the higher faculties such as theology, law and medicine. The University of Copenhagen thereby not only became a part of the international network, but it also allowed participation in that really kicked off from the end of the 1400's. The discovery of America in 1492, questioned common religious beliefs, just as the invention of the printing press in the 1500's prompted a rapid distribution of new scientific insights. Academics could now quickly seek

out knowledge in research libraries housing the latest scientific publications instead of predominantly canonical texts as had been the case. And as scientific historian David Wootton writes, it was in this process that the modern "fact" was discovered - i.e. reliable information that could be proven. Meanwhile, mathematicians claimed that they could much better understand the world than philosophers thanks to the newly discovered experimental methods. Scientists in the Catholic south and the Protestant north exchanged experience and observations, and copied each other's experiments like never before. And this was in spite of the religious conflict dividing Europe. Tycho Brahe is a well-known Danish example.

In previous centuries, Danish academics have sought out new knowledge and inspiration abroad, while learned foreigners – to a more modest extent – have journeyed to Copenhagen. The travelling student could visit multiple universities on their *grand tour,* and the journey could last for several years. Thereby creating a particularly aristocratic educational ideal. In the middle of the 1400's, the Dutch nobleman Jean de Lannoy stressed the importance of learning for the nobility, so as to avoid being outmatched by the well educated middle class. During the 1500's, humanities education was considered an even more important qualification if one wished to join the elite ranks, and thereby achieving influential and administrative positions. And it was probably for the same reasons that the University of Copenhagen employed the Spanish Carlos Rodriguez as a professor of the well-reputed Romance languages in 1650's. Back then, as it is today, special academic international capacity could give the university a lot of prestige.

Until 1914, the academic educational journey was the primary opportunity to come into contact with leading learned experts in Paris, Bologne, Uppsala or Oxford. And many research-related breakthroughs of the modern age can be attributed to these trans-national connections. However, the character of the journey began to change slowly during this period. The classic *grand tour* was replaced over time with a specialised focused study abroad e.g. the historian Kr. Erslev's time in Berlin with J.G. Droyson, which directly inspired the source critical breakthrough in Denmark in

the beginning of the 20th century. Niels Bohr's stay with Ernest Rutherford in Manchester in 1912 initiated his great breakthrough with the Bohr model of the atom.

MAGNA CHARTA UNIVERSITATUM

The special academic tradition was interrupted by the two Word Wars, but in 1988 the European university rectors drafted a Magna Charta Universitatum (see Annex 1) at a meeting in Bologna, that determined that,

> universities, as keepers of the humanist tradition, can recognise neither geographical or political boundaries. Mutual knowledge of, and influence from, different cultures is vital to the work of universities. The same is true of the universities' need to be independent of all political, economic and ideological power.

In other words, the rectors' joint declaration emphasises the importance of maintaining and developing the historic rights of universities. In continuation of the Magna Charta, the EU has developed new academic exchange programmes for researchers as well as students - even with direct reference to the *peregrinatio academica* of old. The crucial difference between the new and the old networks is that the educational journey is no longer just for the elite in society. Teacher and student mobility is now fully integrated in almost all existing study programmes within higher education. As further highlighted by the Magna Charta, universities today should address all of society "and that the cultural, social, and economic future of society requires, in particular, a considerable investment in continuing education." Universities today must contribute even more ideas to a high-speed society, which uses scientific innovation like never before. A world in which everyone is interconnected and robots take on even more work functions, not just in manual labour, but also academic tasks such as translation, advanced mathematics equations and medical diagnoses. Paradoxically, it is universities' historical demand for taking the necessary time and immersion that is a prerequisite for this rapid development known as the fourth Industrial Revolution. The path to new knowledge is often laborious and unpredictable, and for this reason we must continue to ensure the

fundamental need of universities to work independently and within other time-frames than those of the surrounding society.

UNIVERSITIES - INVESTMENT OR EXPENSE?

After World War II, even more researchers decided to enter into a research collaboration with English and American universities, which has had a noticeable effect on the research culture in Denmark. Danish universities therefore have an odd mix of German and Anglo-Saxon research traditions and the emphasis varies from faculty to faculty. Today's mass universities have, to a lesser extent, accepted the British tradition for tutorials i.e. an intensive learning environment where small groups of students are trained in critical thought by a highly esteemed professor. However, there is primarily an economic reason that we in the education area continue to follow the German, or mainland European, tradition for large group lectures, even though this form of one-way communication has an uncertain pedagogical effect. Bringing the Danish universities within the reaches of the "leading" Anglo-Saxon level for student/teacher ratios, would be a significant economic investment, which Danish governments have previously been dismissive of. One can get the impression that education in Denmark is primarily seen as an expense and not an investment, which the recent political debate about "over-educating" is testament to. It is made more difficult because SU costs, in terms of political realities, are included in Danish reports of funding for education programmes. This means that there are high figures for costs associated with education programmes in Denmark, even though funding for teaching at universities is actually modest. The two should, in that respect, be treated as separate budget lines.

FOUNDATION AND FREE THOUGHT

Many researchers throughout history who have contributed to scientific breakthroughs have had the impression that what they had learned stemmed primarily from meeting a particular professor. A master, who had helped to form them. It explains then, that even highly esteemed researchers today typically describe themselves as a student of this or that scientist. The apprenticeship has also been a part of the university's sense of self since the Middle Ages. Distinguishing between the particular researcher-

based learning that we know from universities, and the many professional training programmes that are also characteristic of the Danish educational landscape, is of crucial importance. More and more education programmes at universities continue to be subject to a quality control and are viewed using criteria, which are not necessarily consistent with the founding ideas and historical work of universities. This is probably also down to education programmes not being accredited by the universities by themselves, but by a special accreditation institution. Furthermore, there has been liberal use of the description of "university" in naming new educational institutions (*University Colleges*) meaning that there is a greater mix between medium-long higher education programmes with professional aspects, and academic higher education programmes. Professional aspects have always been an important element of university education programmes, which the original higher faculties at the University of Copenhagen can also attest to (*embedseksamen* - diploma degree exams required to practice in certain fields). However, it is worth noting that universities' learning environments are built on a different rationale than medium-long higher education programmes, namely formation and free thought. This is also the case for education programmes for professions such as high school teachers, doctors and priests, etc. Flexible learning environments at universities have been a significant driver for all modern scientific innovation, and the Magna Charta underlines research, teaching and educational freedom as the guiding principle for the work of universities. According to this joint declaration, it is up to governments and universities to guarantee and promote respect for this fundamental standard.

Independence should not only ensure that universities have the freedom to follow new paths. It is also important that that they are not subjected to sudden economic and political interventions that, with the stroke of a pen, can bring universities and thereby research into a state of imbalance. In recent years, there has been an occasional trend that sees the central political organ trying to transfer society's standards for enterprise and acceleration onto universities, whereby education and research inadvertently become more about reproduction of already well-known knowledge, instead of foundation, reflection and generation of new ideas for the surround-

ing society. *Study progress reform* and *size configuration* of higher education programmes are the latest examples of a research policy that challenges not only universities' sense of self, but in particular free thought, which is a prerequisite for new scientific insight. Thus we balance on the edge of the principles enumerated in the *Magna Charta Universitatum,* to which the Danish Government officially committed to when signing the Bologna declaration in 1999. The declaration's first section emphasises precisely that the independence and self-determination of universities is a prerequisite for new scientific insight.

2

EDUCATION PROGRAMMES FOR SOCIETY

IS IT POSSIBLE TO EDUCATE TOO MUCH?

Since the end of the 1990's, and particularly via the globalisation settlement (*Ed. political agreement)* in the 2000's, Danish society through its elected officials has appealed to Danish universities to produce more high quality graduates. Graduates who will help maintain Denmark's prosperity in the new science-based economy, known by some as the fourth Industrial Revolution. In this section we will show how valuable researcher-based education has been for Denmark, and discuss the prerequisites needed for researcher-based education to continue to boost Denmark's knowledge, prosperity and growth in the future.

There is an ongoing debate on what roles universities' researcher-based education plays for value-creation in society. Opinions are currently being put forward that "too many are being educated" or that "too many academics are being educated" - meanwhile a fifth of every youth cohort is still not getting an education. So the question is directed particularly at higher education programmes. It is important to remember here that only a small minority of university graduates remain in the university sector.

Most end up working in a broad cross section of society, in the public sector, industry and the business community and they will be responsible for future high school education. The future is difficult to predict, but we are probably in the middle of a paradigm shift on our way into the fourth Industrial Revolution, where robots, algorithms and other technologies will significantly change our society. This means that many existing jobs, also for highly educated graduates, will disappear and will likely be replaced with new ones that we can barely fathom today. We also know that Denmark's most precious natural resource in this development is the ability to learn new things and seize the opportunities that arise along the way. In 2017, the consultancy firm McKinsey carried out the first large analysis of possible consequences of new technology in Denmark by 2030. It concluded that we can create even more new jobs in the future - if education and lifelong higher education is given priority. As stated by the managing partner at McKinsey Denmark:

> "If Denmark is going to deliver on the extremely high potential and come out on top by 2030, there will be a need to invest even more in education and further education of the workforce... If we do nothing, we will lose our competitive edge over time, prompting a drop in welfare and prosperity at the very least," says Kim Baroudy. (Berlingske Business, 6 November 2017)

WHAT USE IS EDUCATION?

If university education's usefulness is measured on the academics' ability to secure a relevant job, then the conclusion is that education is useful. Since 1996, the number of academics in the Danish labour market has grown by at least 100,000, and today numbers about 250,000 academics. The gross unemployment rate among academics in the same period has more than halved from 8.7 per cent to 4.2 per cent. The general rate of unemployment among academics is lower than that of the gross unemployment rate for the entire labour market (Danish Confederation of Professional Associations, 2016). We have achieved the target of 25 per cent of a youth cohort receiving a university education. In 2015, 19,612

students completed Bachelor's degree programmes - and almost as many graduated from the country's universities with a Master's degree (Danish Ministry of Higher Education and Science, 2016). The number of graduates has thereby doubled in the period, while graduate unemployment has fallen (Danish Confederation of Professional Associations, 2016). It shows that there is a need for academics in the labour market - no matter their education profile. There is therefore no justification for academics being considered useless to society. Meanwhile, numerous studies show that academic graduates are the group that creates the most value for Danish society during their lives. An academic creates societal value worth more than DKK 14 million, while someone who has pursued professional/vocational education creates DKK 4 million worth of value (Danish Confederation of Professional Associations, 2016). So not alone do university education programmes contribute to job creation, they contribute to the most valuable jobs in Danish society. And this is not just the case for the public sector and large established businesses, which traditionally have employed many university graduates. A new study carried out by DJØF (Danish Association of Lawyers and Economists) shows that employing an academic in an SME can lead to explosive growth (DJØF, 2017):

> The first academic on the payroll is like adding growth hormones to SMEs. In comparison with similar companies, that did not employ an academic, they achieve an average value growth of 38 per cent more. Even more value can be found if the first academic has an engineering background. In which case growth can be a full 48 per cent more than companies without academics (Jobfinder, 17 March 2017).

Researcher-based education is the way to growth when there is a need to create new companies in Denmark and encourage the smaller ones to grow even more. Every now and again, it is highlighted by the Confederation of Danish Industry (DI) fulfilling, that having many academics carries a risk, because they can block the need for more skilled workers in the future. Therefore, DI would like to see a stop on increased admissions to higher

education programmes (DI in *Berlingkse Tidende,* 5 November 2017). Here we must remember that there is a big difference between 250,000 academics and the entire workforce, and that value creation would be significantly greater by focusing on the 20 per cent currently NOT getting an education, instead of reducing admissions to the section of the workforce that creates the most value. On the contrary, there are no predictions suggesting that graduates with a researcher-based education are not useful.

WHAT ARE THE FUNDAMENTAL PRINCIPLES IN ACADEMIC EDUCATION FOR SOCIETY?

The differentiating factor between researcher-based education and other forms of education is the production of graduates, who combine a deep, core subject specific knowledge, a methodical and reflective ability to constantly learn, and an ability to be flexible in using knowledge to solve concrete problems. Researcher-based teaching does not just involve knowledge being taught which is based on research, or that there is a research justification for the specific methods. The crucial element is that the teaching is *researcher-based*. That the teaching is provided by researchers who are an active part of the global ecosystem for the creation of new knowledge and not just disseminating or reproducing it. A *researcher-based education* is the best guarantee for ensuring education programmes are taking place where the the knowledge - which will characterise future generations - is being tested and challenged. It is vital that the ambition to create new knowledge is a key part of an education programme. And the best way of ensuring this is to make it researcher-based.

There is a very close link between supporting and establishing opportunities for strong research environments and being able to offer the best possible teaching. This does not mean that every single teacher in every single subject must teach their research speciality. But it does mean that the methodical, critical approach, the daring, curiosity and ambition needed to carry out research at an international level, also permeates education programmes. It is the best way to future-proof education programmes in a time where there is enormous uncertainty about our future society and needs. It creates a foundation for education programmes, that will establish fundamental principles and core knowledge, and have an eye towards

flexibility and adjustment later on. When we speak of *researcher-based education* rather than *research-based,* it is to signify the importance for future graduates that they are given education with the particular qualities that only researchers can bring to the students.

The starting point for research is that knowledge is rarely absolute. There is always the possibility to be wiser, just as the knowledge of how a field has developed over time provides insight into where future possibilities lie. New knowledge is not acquired overnight, it requires sustained immersion and a slow pace, together with the will to engage – no matter whether it is in social sciences or robot technology. Fundamental insight is the cornerstone for a researcher-based education and produces strong, flexible and robust graduates who can master qualified reflection and have a thorough approach to learning and thereby acquiring and translating new knowledge in a relevant context. They are principles that stimulate curiosity and creativity, but also ensure that a thorough immersion and broad in-depth knowledge are necessary for a solid foundation for lifelong learning. Lifelong learning is of increasing importance, because our society is changing so rapidly that it will be impossible to predict what form necessary core subject specific knowledge will take in 20-30 years. We have no illusions that a researcher-based education is a guarantee for ensuring core subject specific knowledge is always optimal in relation to the future. But we are convinced that it provides the best possible conditions for being able to acquire new skills - skills that future academics need to develop throughout their lives. These can be acquired through universities and through completely different forms of education, which offer the chance to develop personal competences. A long time scale is needed if society is to be able to sustain the best possible level of knowledge at any given time.

So no: "over-education" is not a risk, but shifting and prioritising within university education must be discussed, just as there is a need for much greater flexibility in future lifelong education. Even though it is far from all education that can, and should be, researcher-based in the future, researcher-based education is still a prerequisite for our society being able to develop the ability to "learn to learn". Researcher-based education feeds

the rest of the education system and is a knowledge bridge to development in the public and private sectors.

EDUCATION'S INTERACTION WITH SOCIETY

Universities have a central role as player in society, both in terms of their research and their education programmes. The ability of researchers to interact with society and respond to society's central problems affects the content of the researcher-based education programmes and helps create a foundation for relevant education programmes. Therefore, active collaboration with both the public and private sectors is crucial to ensuring that education programmes relate to society's central problems - in the short and long term. Likewise, it is a fundamental premise of the nature of research that researchers follow the tracks and ideas that are most promising - no matter if their relevance is currently visible. University education should also feature this aspect, because it creates innovation and development opportunities for a society. Finally, researcher-based education programmes also have a more fundamental objective in helping a society to distinguish between knowledge, bias and wishful thinking - a task that has become radically more important as "alternative facts" and "social bubbles" flourish with help from social media. No matter how the future will develop, we must assume there will be a need for new skill combinations, just as our knowledge will develop exponentially in certain areas. It is therefore a given that future education must be lifelong.

One of the great challenges in university education today is the limited opportunities to develop graduates' personal competences and individual strengths, because many educational institutions are mass universities with large groups, quick run-throughs and very limited opportunities for individual adjustment and dialogue. It is far removed from the "*21st Century Skills*", which leading universities and business leaders consider necessary for the future: "critical thinking and problem solving, creativity and innovation, communication and cooperation" (P21, 2015). As mentioned in section 1, Danish society lacks the will to invest in education programmes of a comparable international level to those in Oxford and Cambridge, Harvard and Stanford.

Going forward, universities will have to develop a number of new shorter, longer, and more flexible forms of education aimed at post-Master's degree educational levels. The quality of the foundation is therefore particularly important, because so many building blocks are needed during life following the primary academic education. In some situations it could be that graduates need to update their core subject knowledge with new knowledge, while in other cases, graduates may need a brand new type of supplemental skills, for example if an engineer needs to know more about ethics relating to big data in the health sector, or a social researcher needs a deeper understanding of the implications of artificial intelligence. Educational offers are becoming increasingly global, including in the growing option of *Massive Open Online Courses* and *online learning* from the world's leading universities. Danish society has a vested interested in seeing Danish universities sustain their global competitiveness and not ending up as second-rate suppliers in the global knowledge ecosystem. It is also evident that as a small country, we cannot master everything. Therefore it will be important as we move forward, to prioritise areas where Denmark can continue to produce research and education at the highest level. It will mean that all universities cannot equally master all areas, and we will see universities starting to specialise more in relation to research and education - so that they may maintain a level of knowledge necessary for, and relevant to, universities and society.

It is crucial that universities have the opportunity to develop along the lines of the Blue Ocean (as detailed in the White Paper 2017), where they each can further develop their positions of strength where there is the greatest likelihood of being part of the leading global knowledge development. It requires universities to be daring and have the will to experiment, while society needs to show greater trust in universities having the ability to manage the greater freedom.

3

DANISH UNIVERSITIES TODAY

According to a detailed study from the Danish Council for Research and Innovation Policy (DFIR, 2016), Denmark holds its own quite well against other strong research nations e.g. measured by citations of research articles. DFIR concludes that we in Denmark have created an appropriate balance between basic funding and competitive funding, which can act as an incubator for the dynamic and quality found in excellent research environments.

On the PhD front, a new and thorough evaluation from the Danish Ministry of Higher Education and Science (2017), shows that in the space of a decade, universities have been able to double PhD production without compromising the academic quality and relevance in relation to the labour market. Thus, those with a Danish PhD have an employment rate of 94 per cent, which places Denmark fifth out of all OECD countries, and five percentage points higher than the employment rate for Master's graduates.

The Danish universities' capacity and value to society through the education of graduates with a researcher-based education is thus well-documented, and seen from an overall perspective, the eight Danish universities have the research power needed to deliver outstanding researcher-based education programmes.

SO WHAT IS THE COST?

If we start with the politically defined needs for university educated graduates, then our overall calculations of the direct and indirect research costs presented in last year's White Paper 2017 see the research part of the university system being under-financed by a good DKK 6 billion annually, if all researchers employed by universities in Denmark had access to the funding required to successfully compete on the global stage. This is reflected in a noticeable heterogeneity in the Danish university landscape, where some perform particularly well, while others have difficulty keeping up on an international level.

Today, the public sector allocates 1 per cent of GDP to research, corresponding to about DKK 17 billion annually. If the state alone was to cover the deficit of DKK 6 billion for research, it would require a change from the 1 per cent objective to 1.35 per cent. This would balance the research account and give everyone the opportunity to grow in a healthy knowledge ecosystem and thereby achieve international levels. It could also ensure a significantly better situation between the number of students and the researchers needed to teach them. It is worth investing in and is supported by the joint statements from DI and CO-industri, which recommend allocating 1.5 per cent of GDP to public research in their publication "Research for the Future".

STRESS AMONG STUDENTS IS A CONDITION OF UNIVERSITIES

Numerous student welfare surveys at universities suggest that the number of stressed students is on the increase. Universities therefore also have to repair society's ills - the stressed students obsessed with grades, who have been conditioned to focus on performance and short-term gains. It weakens the urge to learn to learn, and creates some decisive barriers to developing "*21st Century Skills*", which will be important in the future. The task

of changing an undesirable culture cannot be solved by universities alone. There is a need for public and private employers to also demonstrate that they are not just looking for those with the best grades, but apply a more nuanced view of the professional and personal competences. There are many students who rightly feel, that the fine words about the need for curious, flexible and independent workers in the future are not heeded, when the primary focus of recruitment is often on grades. We must have the principle of *non scholae, sed vitae* in universities again via excitement, quality, and engagement, and through researcher-based teaching. Employers of graduates have to demonstrate that they appreciate the will to learn something new independently and in collaboration with others, and the ability to be flexible and acquire new knowledge.

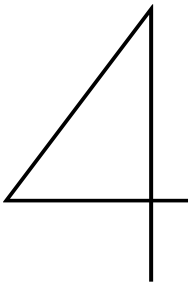
There are a variety of reasons for stress, but a lack of matching expectations between the one side - students themselves (and universities) expecting a high quality university education, and the other side - what is on offer at Danish "mass universities", is undoubtedly part of the cause. In many ways the situation leaves a lot to be desired, because students are not adequately exposed in a structured way to the research (and the researchers), that is the backbone of researcher-based education. To put it concisely: distinctive independent study, which should characterise a university because it matures the student's independence, can function if properly structured e.g. through a weekly meeting featuring intense and attentive discussion with the researcher. It is not sufficient to meet with the researcher in an auditorium after a lecture and get a summary feedback.

Universities must seize the new opportunities of the future, including implementing modern learning environments and develop new forms of teaching that further build on the researcher-based education and try to counter the drawbacks of the mass university.

THE UNPREDICTABLE FUTURE

Quality and diversity are the best way of future-proofing, as it is impossible to predict future needs. When "the robots arrive" should we educate robotics engineers who can make more robots, or humanists who can

relate to the brand new types of jobs now that robots have taken over the trivial physical work? Or both? Universities should naturally enter into a constructive dialogue with employers about where the demand lies and help ensure an optimal bridging between students interests and these main areas. The kick-off for the individual and the university should be researcher-based education of the highest quality that encourages the student to reach their greatest personal potential. All experience shows that if you can excel at one topic, you can also master another in the future.



CAN EDUCATION QUALITY BE MEASURED?

The Minister for Higher Education and Science has earmarked DKK 10 million in the National Budget 2017 for research into the measurement of quality in education programmes. And a further DKK 20 million has been allocated from the research reserve pool in 2018 for research into learning and education quality. There is clearly a focus on quality in education programmes - not least at universities. And whether it is educators, university management, politicians or the Ministry of Higher Education and Science, companies or relevant interest organisations, all are expressing viewpoints on the framework and conditions for maintaining a high qualitative level of teaching. There is a desire to produce graduates for society who can analyse and solve future societal challenges at an advanced and knowledge-based level. Meanwhile in recent years, a variety of parameters has developed that seek to measure the overall quality of education or from a more narrow academic and pedagogical angle: accreditation, evaluation, employer interviews, graduate surveys, reporting within the management hierarchy via performance appraisal systems, large-scale student polls, and satisfaction surveys. The censor institution, which has been the traditional tool for professional evaluation of whether the required goals

of the study programme have been achieved, has also been the subject of examination and proposed reform - also as an instrument for improving the quality of education.

What is education quality, and can it be measured? How can the quality of researcher-based education be measured? How do we measure if the education is researcher-based? And does the fact it is researcher-based figure as a parameter in the evaluation of the quality of university education programmes? There are no clear answers to these questions.

MANAGEMENT AND MEASUREMENT

In many of the management tools introduced by the Ministry of Higher Education and Science in the last 10 years, reporting and measuring of quality and relevance requirements are part and parcel of education programmes. The type of management tools that are centrally initiated can be divided into the following main categories: *Financial and employee-related regulation instruments, Contracts, Supervision, and Accreditation.* All Danish universities are governed by some general state financial and employee management and regulation mechanisms, such as the funding and taximeter system, job and title structure, salary policies, and auditing. These instruments are targeted at financial management and requirements for job qualifications and are therefore only an implicit measurement of education quality and researcher-based education, which cannot be documented or measured in this regard. In the development contracts between the ministry and the universities, there are typically 3-5 obligatory goals and 3-5 institution-specific goals, of which a number usually involve objectives for educational content and quality.

The ministry's supervision of universities forms the basis for follow-up and dialogue on university development and standards, and for strategic discussions. The quality of education programmes is also a central issue here.

Accreditation as a management instrument has been around for approximately 10 years. The objective is to strengthen the work of higher education institutions by developing education programmes of an even higher

academic level and relevance. There is a difference between education accreditation and institutional accreditation. Institutional accreditation is granted on the basis of requirements for the institutions' quality assurance system, and education accreditation is granted on the basis of requirements for the quality and relevance of the education programmes. And student evaluations form an important element in both accreditations. The many management tools and mechanisms are not rooted in universities and as previously mentioned, challenge the Magna Charta of the university rectors.

Universities must have a practice to ensure that education and teaching is based on a scientific foundation, one which is research-based, relevant and updated, and which is actively included in the ongoing teaching of Bachelor's and Master's degree programmes. Education programmes should be linked to relevant professional environments, educators' professional qualifications should be regularly developed, and they should have active contact with relevant research environments, just as students should maintain a connection to the relevant knowledge base through involvement in research activities.

The Danish Accreditation Institution and Universities Denmark use the STUD/VIP ratio as one of the measurements for researchers in education programmes. All researchers are tallied in the VIP group, even postdocs who form a significant portion, and who are typically not included in teaching at the Bachelor's level (Table 1). A more relevant measure is the ratio between the number of Bachelor's students and the number of professors, associate professors, and assistant professors, as it is this employee group who, through their own job description (50% research and 50% teaching), are the backbone of researcher-based education. This "STUD/Faculty VIP" ratio is unfortunately not systematically calculated by Universities Denmark. The University of Copenhagen has calculated the number of Faculty VIP to be approx. 2000. And with approx. 20,000 Bachelor's students, this means there are about 10 Bachelor's students/Faculty VIP. In comparison, Harvard and Cambridge have approx. 3 Bachelor's students/Faculty VIP.

TABLE 1. DEVELOPMENT IN STUDENT FTE (STÅ) PER VIP EDUCATION FTE FOR ALL UNIVERSITIES IN DK

YEAR	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
STÅ/VIP-FTE*	21,08	21,12	21,37	21,4	21,25	21,64	21,21	22,84	23,83	26,5

Source: Universities statistical report, Universities Denmark.

* The VIP category contains the following job categories: Professor with special responsibilities (MSO), professor with special responsibilities, professor, research professor, research professor with special responsibilities (MSO), visiting professor, clinical professor, fellow, associate professor, research associate professor (incl. substitute professors) visiting associate professor, assistant professor, research assistant professor, senior adviser, teaching associate professor, teaching assistant professor, fixed-term lecturer, research assistant, foreign associate professor (normally fixed-term), teaching lecturer, researcher, senior researcher, project researcher, scientific assistant, clinical assistant, graduate research fellow, research fellow (formerly senior research fellow), PhD scholar, postdoc, clinical lecturer, dental specialist education (education programme for dental specialists is considered a full-time employee), psychology graduate position, teacher in social theory and methods (special category within the social worker education programme at AAU), teachers on diploma and export engineer education programmes. STÅ stands for student FTE, which is calculated on the total number of passed ECTS per year, divided by 60 (60 ECTS = full study year).

Table 1 shows that the development in the STUD/VIP ratio, which is calculated from data from Universities Denmark, is stable from 2007 to 2012, but there is a noticeable increase from 2013 to 2016. Unfortunatly, there are no figures showing the real STUD/VIP ratio with VIP stated as *faculty*, i.e. Professors, Associate Professors and Assistant Professors.

UNIVERSITIES' EXPERIENCE OF MEASUREMENT AND ACCREDITATION

Based on a study of higher education institutions, the DEA think-tank has produced a status report on the experience of management on higher education programmes. With regards to accreditation, the main conclusion is that both education and institutional accreditation help support the quality tasks of the institutions and ensure the quality and relevance of education programmes. However, experience shows that institutional accreditation and particularly education accreditation are disproportionately resource demanding. This is particularly true when the accreditation occurs concurrently with other management initiatives with the same focus, e.g. evaluation and central reporting, and is considered problematic.

METHODICAL BASIS FOR MEASURING RESEARCH-BASED EDUCATION

As accreditation emphasises measurement of education quality and researcher-based education programmes, it is problematic that there are no adequate methods for measuring the quality of education programmes. A precise definition is lacking for what researcher-based education is, and we have listed examples of possible definitions in no particular order:

- The education programme takes place at a university
- Teaching is performed by researchers
- The students achieve insight into the newest research
- The students understand research methods
- The students carry out research type tasks/projects
- Graduates have the ability to absorb and utilise research knowledge
- The university has a high research level

A consistent characteristic of the possible definitions is that they are either too narrow or too broad - or that they are also too vague and difficult to measure. There is a need for a clear and precise definition, which makes it reliable and operational to measure education quality and researcher-based education. Alternatively, one must acknowledge that it is not possible to set narrower criteria for measuring education quality and standard for research-based education. The numerous concurrent evaluations, accreditations, and reporting imposed on universities are too many. Resources could be used more appropriately.

STUDENT EVALUATION OF EDUCATION QUALITY

In addition to the problematic definition, a number of international research results highlight the fundamental challenges with using standardised student evaluations to evaluate the quality of researcher-based education programmes, and that they can actually counteract quality development. Representatives from the Young Academy (DUA) have pointed out that a number of problems are associated with standardised student evaluations. As of direct relevance for researcher-based

education quality the following from the article can be highlighted:

THERE IS NO CONNECTION BETWEEN GOOD EVALUATIONS AND LEARNING OUTPUT

A meta analysis has examined the connection between students' learning output and their evaluation of the teaching. In the best case scenario, one would expect that students would give better evaluations to the most learning-effective courses. But that is not the case. "*Our up-to-date meta-analysis of all multi-section studies revealed no significant correlations between [evaluation] ratings and learning*" according to Uttl *et al.* in*"Studies in Educational Evaluation"*. Other studies show that programmes where students learn a lot, receive lower evaluations than programmes where they learn less. In summary, one cannot one cannot trust standardised student evaluations if we want to know how much students are learning. But they can tell us how satisfied students are and give an indication about which elements in the teaching plan can be improved.

STUDENT EVALUATIONS RELY ON WHETHER THEY EXPECT TO GET A GOOD GRADE

Another well-known problem is the so-called *grading leniency bias*. As Gilbaugh has demonstrated, students have a tendency to give better evaluations in courses where they expect to get a high grade: "*In one survey, 70 % of students admitted that their rating of an instructor was influenced by the grade they expected to get.*" Given that students' grade expectations have nothing clear-cut to say about the quality of teaching, uncertainty is created about what the student evaluations are actually saying.

GOOD EVALUATIONS CAN MAKE TEACHERS REDUCE THE LEARNING LEVEL OF THE COURSE

One of the great dangers in giving too much importance to student evaluations in a standardised quality parameter is that it can lead to grade inflation. If the teacher's career and the educational institution's income is reliant on good student evaluations, it can result in the courses being made easier - something that Ryan *et al.* have demonstrated. This is exactly the opposite of what is needed the improve quality of education programmes.

STUDENTS GIVE BAD EVALUATIONS OF TEACHERS WHO REQUIRE HIGHER STANDARDS FROM THEM

The fourth problem is connected to the aforementioned and underlines that student evaluations can have unforeseen, negative consequences in relation to the development of teaching quality. Braga *et al.* have shown that students give poorer evaluations of educators who demand a higher standard from their students. A consequence of this can be the relaxing of requirements in order to avoid unfairly bad evaluations.

> The question remains: if a solid, robust and valid basis for measuring research-based education can be developed at all. Right now, it seems unlikely.

The Minister for Higher Education and Science's prioritisation of learning, academic foundation and the measurement of quality in education programmes is a particularly welcome initiative. Especially if it shines a light on researcher-based education and includes international research in the field - and if *bottom-up* involvement of stakeholders is considered. Likewise, students should have the opportunity to highlight their experiences of *best practice* in good and modern teaching, which stimulates and ensures excellent education programmes. On his appointment, the minister said: "*I am aware that it is difficult. But neither should it be easy. Academia is supposed to be difficult."* We are in complete agreement.

The ultimate goal for quality in education is the added value that education gives society and to the individual. This can in principle be measured in the form of lifelong income and quality of life. By its very nature, it can only be measured over very long periods of time, and therefore does not give a snapshot of any given education programme's quality. It could be useful to keep an eye on indirect measurements for the current development of education quality, but we must be prepared for the fact that an accurate overall measurement of the annual development of education quality simply cannot be found.

5 NEW FORMS OF DIGITAL LEARNING

High-quality researcher-based education requires good learning environments to facilitate and support the teaching for both students and teachers. Good learning environments are different now because the world is digital and global, and Danish universities face stiff international competition from those who offer e-learning, courses and full education programmes online.

Industry 4.0 or the fourth Industrial Revolution has brought new technological breakthroughs with digitalisation, big data, the interconnectivity of the Internet of Things, artificial intelligence and machine learning with automated problem solving, block chain technique, and robots for trivial tasks and as replacements for teachers. These new opportunities are already being used in education programmes at universities to strengthen learning environments. New concepts in teaching, derived from the technological revolution, have found their way to international and Danish universities: MOOCs, e-learning, educational IT, m-learning, flipped classroom, kahoot, clickers (Figure 2). All share the same focal point, namely seeking to increase

the individual student's learning through the smart use of new technological opportunities by activating the student and by making the virtual learning space available to all - also outside of scheduled teaching hours at the university. New technologies allow for a wide range of opportunities, and with YouTube videos, etc. students can replay a difficult derivation of a complex mathematical formula again when it suits them, also outside of the classroom setting.

Figure 2: New didactic concepts in teaching.

The great pedagogical challenge in this context, is to transform a YouTube experience to in-depth learning and understanding of the syllabus, so it does not just result in mechanical rote learning where the student can reproduce the content of the video. All research into learning shows that students learn best when they themselves are working with the syllabus, and YouTube videos do not ensure deeper learning. Only

when such videos are combined with active student processes, do they work, no matter whether they are classic calculation tasks, cases, exercises in experimental subjects, field trips, or other activities. Providing such a broad palette of learning activities demands a great effort from the course educators. It is not just about disseminating the subject content during lectures, but also creating short accompanying videos, a variety of exercises/cases, develop digital ways for students' self-training, being able to adjust the individual students' learning methods, as well as being at the forefront of the latest subject and didactic changes. *Flipped classroom* involves teaching that is turned on its head, i.e. students tackle the syllabus outside of scheduled teaching hours via a broad range of technological aids including digital lectures and exercises. When students then meet their educator at the university, teaching hours are focused on the areas that students found difficult or have questions about. The educator can, if the technological aids are intelligently designed, keep abreast of students' studies with these activities and thereby get an idea about causes of particular problems. These problems form the basis for the next teaching session at the university. It means that reusing lectures from year to year becomes more difficult and the educator has to make a teaching plan from scratch every time. The teaching for individual groups will also be different for larger programmes where there are several smaller parallel groups completing exercises. It should also be emphasised that there is great diversity at universities and between different fields. Some areas do not have small groups at all, and others do not use large groups. Future modern learning methods should therefore be tailored to the individual area.

EDUCATION FOR THE FUTURE

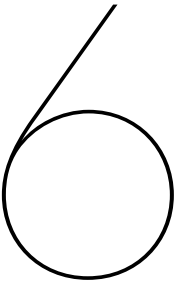
To ensure researcher-based teaching, it is essential that the teaching is carried out by excellent researchers. It is essential for motivating education that the individual student can see the relevance of the syllabus in relation to their own studies. Even though a wide range of studies, for example in natural sciences and technical education programmes, all contain the same form of mathematics, they should not all have the same type of teaching. Putting the individual student's own subject into perspective, is absolutely crucial to achieving in-depth learning. For ex-

ample, calculus for chemists is best learned with examples from chemistry, while a biologist will be better trained with examples from biology.

In a world with an international labour market, it is important that Denmark's education programmes are globally competitive, while also giving young people the skills needed in a future job market. How can we develop education programmes that make students ready for a globalised market? Can we build up students' knowledge of innovation and entrepreneurial ways, without it being at the expense of core subject knowledge? It is important that students are ready to step into the workforce when they have completed their exams. How can we at universities ensure that new graduates are career-ready, without it taking a toll on the academic level? Can one develop new digital forms of teaching that ensure parallel learning of career-boosting skills, while also achieving the same academic learning - learning of the highest quality? The digital revolution can facilitate good researcher-based teaching, but it is also a challenge because students have to be given the necessary digital tools to do well in future society.

To benefit from the opportunities offered by new technologies, it is important that learning environments at the country's universities support the activities that researcher-based teaching paves the way for. Modern learning environments at universities in Denmark and abroad see investment in the form of teaching facilities that encourage break-out sessions and have the necessary technology available to both students and teachers, with technical staff present who can assist with technical issues, and also participate in the pedagogical-didactic restructuring of the teaching process.

> Universities must use new techniques with the aim of strengthening researcher-based education. Modern digital teaching is still only a means and not the goal. With a citation from Søren Kierkegaard: "The Means of Communication become greater and greater, printing faster and faster, with incredible Speed - but the Communication becomes more and more hectic and more and more confusing" (Kierkegaard, 1847).



CONCLUSION

Research and education are of benefit to society. They are not a cost, but an investment. Well-educated academics add significant value to society. In late 2017, a joint publication from DI and CO-industri was published: "Research for the Future", that argues strongly for Denmark ensuring investments for public research that correspond to 1.5 per cent of GDP. The Royal Danish Academy of Sciences and Letters would like to express its recognition of this fine and focused publication with clear recommendations, that align with our proposal of 1.35 per cent of GDP for universities' research. Such an initiative would seriously give universities the opportunity to display their full potential. Strengthening research, strengthens the opportunities for parallel researcher-based education. It is of benefit to the individual student and teacher, and just as important: it will benefit all of society, because there is a need for the most well-educated graduates in the future. Denmark has to be able to handle itself in a globalised world, where development is rapid, and where we both in universities and in industry, collaborate - and compete - with the entire international society.

The UN Global Goals are important for all of us and call on the best research and the best graduates, as new creative solutions can con-

tribute to a better future. Denmark, through its universities, must deliver the necessary knowledge, outstanding research and competent graduates, who possess innovation and its associated skills. Denmark does well with regards to current research parameters, but we have the impression that we are losing steam, because there is such significant development and investment in research and education in leading countries like the USA, China, and the rest of Asia, not to mention in many other strong European countries. Our neighbour Sweden has recently decided to increase funding for research and education in the coming years.

Economy is one thing. But the framework conditions at universities are also important. Put a stop to control and over-regulation. Universities can manage themselves and should be unleashed with respect to the university rectors' Magna Charta from 1988, which has since been supplemented by the Bologna model approved by all EU education ministers in 1999. We can produce the best graduates for a complex global society via researcher-based education, and Denmark will only survive if we invest even more in educating the next generation of students.

We have to look at universities and education programmes in an international context; perhaps we have been better at internationalising the research area and cooperating with the best international universities. But it continues to remain a giant task to internationalise the entire education area. We must look to history where international inspiration from foreign universities helped move Danish society forward, we cannot just follow; we must create development ourselves. Therefore, new graduates must be well-educated - and the best way to do so is with researcher-based education.

The universities' particular Danish model, which combines Humboldt and independent research, Stanford and innovation, and the Folk High School's idea of respect for individual development, already ensures that we have come quite far with the relatively modest funds invested in Danish universities, compared with the investment level at elite universities around the world. The Royal Danish Academy of Sciences and Letters recommends boosting opportunities even more:

RECOMMENDATIONS

1. Researcher-based education should continue as the foundation for universities – despite increased intake of students. Only by doing so, can it result in valuable, competent, creative and critical graduates prepared for lifelong learning.

2. The ratio between students and professors/associate professors/assistant professors should be improved, in order to reduce the current high number of students per teacher. Either by fewer students or funding for more teachers.

3. Universities should have stability, independence, and freedom to act in respect of the Magna Charta Universitatum, and excessive management should be removed.

4. University study environments should be optimised via modern forms of learning where appropriate.

5. Denmark needs excellent universities to succeed in the global competition and contribute to solving the UN Global Goals. The necessary funding must be provided for this.

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ANNEX 1

MAGNA CHARTA UNIVERSITATUM

PREAMBLE

The undersigned Rectors of European Universities, gathered in Bologna for the ninth centenary of the oldest University in Europe, four years before the definitive abolition of boundaries between the countries of the European Community; looking forward to far-reaching co-operation between all European nations and believing that people and States should become more than ever aware of the part that universities will be called upon to play in a changing and increasingly international society,

Consider

1. that at the approaching end of this millennium the future of mankind depends largely on cultural, scientific and technical development; and that this is built up in centres of culture, knowledge and research as represented by true universities;

2. that the universities' task of spreading knowledge among the younger generations implies that, in today's world, they must also serve society as a whole; and that the cultural, social and economic future of society requires, in particular, a considerable investment in continuing education;

3 that universities must give future generations education and training that will teach them, and through them others, to respect the great harmonies of their natural environment and of life itself.

The undersigned Rectors of European universities proclaim to all States and to the conscience of all nations the fundamental principles, which must, now and always, support the vocation of universities.

FUNDAMENTAL PRINCIPLES

1. The university is always an autonomous institution at the heart of societies differently organised because of geography and historical heritage; it produces, examines, appraises and hands down culture by research and teaching.

To meet the needs of the world around it, its research and teaching must be morally and intellectually independent of all political authority and economic power.

2. Teaching and research in universities must be inseparable if their tuition is not to lag behind changing needs, the demands of society, and advances in scientific knowledge.

3. Freedom in research and training is the fundamental principle of university life, and governments and universities, each as far as in them lies, must ensure respect for this fundamental requirement.

Rejecting intolerance and always open to dialogue, a university is an ideal meeting-ground for teachers capable of imparting their knowledge and well equipped to develop it by research and innovation and for students entitled, able and willing to enrich their minds with that knowledge.

4. A university is the trustee of the European humanist tradition; its constant care is to attain universal knowledge; to fulfil its vocation it transcends geographical and political frontiers, and affirms the vital need for different cultures to know and influence each other.

THE MEANS

To attain these goals by following such principles calls for effective *means,* suitable to present conditions.

1. To preserve freedom in research and teaching, the instruments appropriate to realise that freedom must be made available to all members of the university community.
2. Recruitment of teachers, and regulations of their status, must obey the principle that research is inseparable from teaching.
3. Each university must – with due allowance for particular circumstances – ensure that its students' freedoms are safeguarded, and that they enjoy concessions in which they can acquire the culture and training which it is their purpose to possess.
4. Universities – particularly in Europe – regard the mutual exchange of information and documentation, and frequent joint projects for the advancement of learning, as essential to the steady progress of knowledge.

Therefore, as in the earliest years of their history, they encourage mobility among teachers and students; furthermore, they consider a general policy of equivalent status, titles, examinations (without prejudice to national diplomas) and award of scholarships essential to the fulfilment of their mission in the conditions prevailing today.

The undersigned Rectors, on behalf of their Universities, undertake to do everything in their power to encourage each State, as well as the supranational organisations concerned, to mould this policy sedulously on the Magna Charta, which expresses the universities' unanimous desire freely determined and declared.

ANNEX 2

GUESTS OF THE COMMITTEE ON SCIENCE POLICY:

ANDERS BJARKLEV
Rector, DTU and Chair of Universities Denmark

HANNE LETH ANDERSEN
Rector, RUC

MIKKEL BILLE
Associate Professor, RUC and chair of The Young Academy

BENTE STALLKNECHT
Head of Department, University of Copenhagen

MAJA HORST
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ANNEX 3

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