NERA 2017 keynote:

**Education and the future of society**

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**1. Current debates about education**

Education is hotly debated in Denmark as well as in the other Nordic countries and many other countries. Politicians, stakeholders in the private and the public sectors, the media and most citizens agree that education is a very important issue for Danish society. “People are the raw material of Denmark” is a saying often encountered, and so the education of people is of course important. Here are two examples of issues currently being discussed:

(1) Denmark has a strong tradition and system of upper secondary vocational education, based on a combination of school-based teaching and company-based training, based also on strong links to the labour market through the involvement of the social partners in development and governance. However, in recent years fewer and fewer young people have enrolled in vocational education and according to manpower forecasts too few skilled workers will be available in ten years, when many of the presently active have retired. This is lamented from many quarters and some measures have been taken, including raising the social status of vocational education (through restricting access, paradoxically). However, what work in industry and in services will be like, what changes that are likely to occur – that is seldom seriously discussed.

(2) The quality of higher education is another much debated issue. One of the questions often discussed is whether students study hard enough and actually use the time prescribed in ECTS credits to go to lectures, prepare, write papers and go to exams. A related question is whether colleges and universities provide sufficient teaching and oblige the students to put in the prescribed study time. Quality is discussed as doing the prescribed quantity of work, the same way it has generally been in industry. But what skills are needed and will be needed in the future, and how these skills can be taught and learned, are a minor theme which is mostly discussed in terms of employment rates for different fields of study.

These issues are not unimportant, but in the bigger picture they are not very important. They reflect a pragmatic focus on the here-and-now, even when they argue from manpower forecasts, and they reflect little interest in or energy for thinking ahead and considering more fundamental changes and challenges. What I will do in this presentation is outline and discuss some of these more fundamental challenges for education. I will focus especially on technological changes, but also on their embedding in institutional and societal contexts.

These are the main topics I will discuss:

* The fourth industrial revolution and it consequences
* Work and learning
* Educational institutions and learning
* New technologies, education and learning
* Implications for educational research

A word of warning: there are many different fields of knowledge involved here, and my knowledge is limited. So in parts of the presentation I will discuss thing that I really know too little about. But I think these things are important, so I hope you will bear with me.

**2. The fourth industrial revolution**

Important changes are taking place in technology and in the use of technology in business and society. One of the labels given to these changes is ‘the fourth industrial revolution’ (Schwab, 2017). Like other such labels, like the ‘knowledge society’ and the ‘risk society’, it is too simplistic to cover the phenomena it tries to describe. Still it does say something, and I will use it in this presentation.

Calling it ‘the fourth’ of course refers to three previous industrial revolutions. These are generally assumed to be:

* First industrial revolution, in the decades before and after 1800. Mechanical production (for instance in textiles), railroads, steam engines.
* Second industrial revolution, in the decades before and after 1900. Electricity, assembly lines, mass production.
* Third industrial revolution, approximately 1960–1990. Digital revolution, semiconductors, computers, PCs, internet.

The fourth industrial revolution involves new technologies with an impact upon many areas of life. Physical technologies include driverless cars, 3D printing, advanced robotics and new materials (for instance strong nanomaterials). These technologies are more or less here. Currently they are very expensive, but no doubt they will become cheaper.

The World Economic Forum has done a survey among 800 executives and experts from the information and communications technology sector, asking them to estimate of the likelihood of ‘tipping points’ being achieved in 2025. Results include (Schwab 2017, p. 26):

* 10% of people wearing clothes connected to the internet: expected by 91.2%.
* 90% of population using smartphones: expected by 80.7%.
* First city with more than 50,000 people and no traffic lights: expected by 63.7%.
* First Artificial Intelligence machine on a corporate board of directors: expected by 45.2%.

The main direction of change is the combination of information technology and computing power with many different things. For instance, electronics represent about 40% of the cost of many modern cars, so you could say that a car is now a computer on wheels. The *internet of things* is a broad concept for many different types of relations between things and people through connected technologies. Sensors are a crucial part of this, and they are becoming smarter, smaller – and cheaper. An example of application is remote monitoring, where packages, pallets and containers are equipped with sensors and can be tracked as they move. Sensors placed on products and assets also make it possible to do constant monitoring and base repair work on the probability of failure. It is increasingly possible to predict the performance of an asset, and this opens new possibilities to organise and price services. For instance, health insurance companies are considering making the offer to customers that if they agree to wear a device that monitors their wellness (sleep, exercise, food, etc.) and agree to share this information with the company, they can get a discount or a premium (Schwab, 2017, p 100).

This changes the way business and the economy works. One impact is shifting customer expectations: we live in an on-demand world where smartphones are used to assess and order products and services and where traffic directions are provided instantly. Planning this conference, we discussed the need to guide people around, and we do provide some help, but I am sure that most of you will use the online interactive maps on your smartphones or other hardware. Another impact is the transformation of business operating models into digital models: digitalisation makes it possible to organise services and production through digital platforms. ‘While the third industrial revolution saw the emergence of purely digital platforms, a hallmark of the 4th industrial revolution is the appearance of global platforms intimately connected to the physical world’(Schwab, 2017, p 58).

Business models increasingly use digital intelligence and analytics. Computer power is used to predict the actions of people in different situations. Commercial and entertainment platforms use algorithms to predict the preferences of customers and users, and the same mechanisms are spreading to other fields like online medicine. This raises fundamental issues of trust. It also means that cyber-security is crucial for companies in order to avoid the risk of having ideas or information stolen or ‘just’ the risk of breakdowns in the digital infrastructure.

The fourth industrial revolution is changing the nature of work and the patterns of employment. Trends are often ambiguous, but the main trends in the industrialised world seem to be that there is generally less job creation, more on demand work, fewer stable full-time jobs, especially in fields that can be automated and less direct links between types of education and types of employment.

An important factor is how much automation and robot work will substitute for labour. This is debated among economists and other social scientists. There is no doubt that employment in some types of jobs will be dramatically reduced, the question is rather if employment other types of jobs will increase sufficiently to compensate for this.

Two researchers from the University of Oxford have tried to estimate which professions are most and least probable to be replaced by robots. Here are some examples of jobs most and least likely to be automated (Frey & Osborne 2013, p. 57 ff.).

Most prone to automation:

* Telemarketers, 0.99
* Legal secretaries, 0.98
* Hosts and hostesses, restaurants, lounge and coffee shops, 0.97
* Secretaries and administrative assistants, except legal, medical and executive, 0.96

Least prone to automation:

* Physicians and surgeons, 0.0042
* Psychologists, 0.0043
* Human resource managers, 0.0055
* Anthropologists and archaeologists, 0.0077

The overall picture seems to be that the fourth industrial revolution is creating fewer jobs in new industries than previous revolutions. Also the character of employment seems to be changing, because of business models as well as new technology, towards fewer stable full-time jobs and more independent workers performing specific tasks. Many digital platform businesses classify workers as self-employed, so businesses are free of the requirement to pay minimum wage, employer taxes and social benefits. This means that levels of fragmentation, isolation and exclusion increase. The concept of the ‘precariat’ (Standing, 2011), a new social class living without predictability and security, is an attempt to describe this development. Klaus Schwab from the World Economic Forum is enthusiastic about the fourth industrial revolution, but he strongly argues that it is necessary to limit the downside of the ‘human cloud’ while still allowing the labour market to grow and people to work in different ways.

**3. Work and learning**

While some important new technologies are emerging, the economic and societal character of this ‘revolution’ is not revolutionary; it is rather a continuation of a development over several decades where knowledge, innovation and learning have emerged as key elements in the economy. My Aalborg colleague Bengt-Ake Lundvall has called this *the learning economy* (Lundvall & Johnson, 1994). The concept attempts to capture how acceleration in the rate of economic and technical change imposes a strong transformation pressure on increasingly open economies. Behind the acceleration of change lies shorter product life cycles and intensified global competition as well as the politically driven deregulation of financial markets. At the level of the firm, this leads to an intensification of competition, because the markets select in favour of change-oriented and innovative firms. At the level of the individual it is experienced as a permanent need to renew skills and competences in order to remain employable.

Drawing on empirical analysis of EU-wide data, Lundvall and other researchers have identified four different modes of work organization (Lorenz & Lundvall, 2006; Lundvall et al, 2008). The modes represent different combinations of task complexity, autonomy, learning opportunity and responsibility.

* Discretionary learning organisation, where task complexity is high and employees have good opportunities but also responsibility for learning and problem-solving
* Lean organisation, with some opportunity for learning, but less task complexity and responsibility
* Taylorist organisation, with little autonomy for employees
* Traditional organisation, with some autonomy but low task complexity

According to the survey data, discretionary learning is most widely diffused in the Netherlands and the Nordic countries; here a majority of employees operate in jobs that are demanding both in terms of skills and in terms of autonomy. Discretionary learning is also diffused, but to a lesser extent, in Austria and Germany. The lean model is most in evidence in the UK, Ireland and Spain. Both Taylorist and traditional forms are more present in southern European countries such as Portugal, Spain, Greece and Italy.

The survey data further show that the access of workers to learning-rich forms of work is a key contribution to job satisfaction.

In his discussion of the fourth industrial revolution, Schwab notes that its technologies have great potential for bettering human conditions, but left to themselves they may increase social inequality. Lundvall makes the same point for the learning economy. The crucial role of knowledge and learning in the learning economy creates a risk of new social inequality. If the learning economy is left unattended by public policy, it opens up bigger gaps between well-educated and less educated employees.

This can be seen in differences across Europe in the degree of inequality in access to discretionary learning jobs. It turns out that there is a close relationship between the inequality of income in societies (inequality measured by Gini coefficients) and the degree of inequality in access to active learning in the workplace. The countries with the highest degree of income inequality (the United Kingdom and Portugal) are among those that have the most unequal access to discretionary learning. The countries that have the most equal income distribution (such as Denmark and the Netherlands) offer the most egalitarian access to jobs with discretionary learning.

For these reasons it is an important task for public policy to *design institutions and systems that regulate education and labour markets so that they promote processes of learning in work as well as in society.* Good public education systems are important for this; but it is also important to develop and use arrangements for learning that link educational institutions with workplace contexts. This is in line with many modern contributions to educational theory, and there is a rich literature on situated learning, work-based learning and related concepts (for instance, Lave & Wenger 1992; Ellström, 2002; Eraut, 2007). This indicates educational principles like organising learning through projects, identifying and solving problems, practising reflection and self-assessment, promoting understanding in several domains of knowledge and including a great deal of group-based work.

I will give an example where innovative practices along such principles were introduced in one part of the Danish adult education system (Rasmussen, 2012). This was a case study done as part of a larger research and development project called ‘Competence Development in the Periphery’.

In this case, a centre for general adult education established work-related courses in cooperation with a metalworks company. The courses covered general subjects like ‘Communication and collaboration’. The participants in the courses were employees, mainly low skilled. The company had started to outsource parts of the production to a new factory in Eastern Europe and in the future the Danish part of the company was to expand its flexibility in delivering smaller product series. The course studied was primarily tailored to the production workers, but there was also a special part for administrative staff and foremen. Much of the educational work took place in groups of eight to nine people with different job functions at the factory. It proved positive for the employees’ attitude that the course was mandatory for everybody and also that foremen participated. A key element in the teaching was that it constantly related theory and the participants’ everyday lives through examples and dialogue. This provoked the participants to voice their opinions, which the teacher then discussed with them. The course was evaluated through oral group examinations in the presence of the company’s director and foremen, and the participants also completed an individual test.

The evaluation study made of this course (Keller, 2005) showed that it resulted in increased focus on ‘talking things through’, which could potentially help decrease the level of conflict among employees and between management and employees. Because of a strict division of labour, employees often have knowledge only about the specific part of the organization where they work and the tasks for which they are responsible. Talking with colleagues in other functions was found to give them a different perspective on their own department’s practice or a greater overview of the workplace as a whole. It was also evident that some participants arrived at personal insights and self-awareness.

The course described here is one example of a kind of education that can help low-skilled employees handle the challenges of the learning economy. Other courses might focus more on the technical and knowledge skills needed for working with new technologies, but education in communication and collaboration will still be a key element because it enables workers to share skills and handle changes together.

**4. Educational institutions and learning**

The learning economy and the developments labelled as the fourth industrial revolutions are strong reminders of the importance of organised learning in and for different life settings and through the life course. But of course, the main trend in the history of education has been different. It has been the institutionalisation of education in separate institutional realities, in schools, colleges, universities. Much of the life of children and young people – and as higher education expands, increasingly also adults – takes place in and around such institutions. They are not only physical spaces, they are bearers of specific rationalities.

The history of modern systems of education is intertwined with the establishment and growth of nation-states. It is not that educational systems did not exist earlier, but they were generally much more diverse, serving specific needs such as the elites of the court and the church. Nation-states posed themselves the task of linking their populations to the state through a set of individual rights and obligations. These rights and obligations constituted citizenship. And in order for citizens to know and fulfil their obligations, states granted them some degree of right to education.

These developments have been researched by historians and sociologists of education, in many specific case-studies as well as in analysis at a more general level. One important contributor has been John W. Meyer of Stanford University. In an early paper he described the development in this way:

[Modern educational systems] are extended as systems as classification, categorizing the entire adult populations by level and speciality; and (2) they are institutionalised, with their classifications often controlled by the state and enforced in daily life by rules about credentials written into law and applied in organisational practice. Almost everywhere education is made compulsory and universal by national law (Meyer, 1977, p. 65).

To Meyer, this shows that ‘formalized education systems are in fact theories of socialization institutionalized as rules at the collective level’(ibid.). The theories of socialization they embody are different from those of religion and the church. They draw on the secular individualism of modernity, which was diagnosed by early sociologists such as Max Weber and Emile Durkheim. Educational institutions are social and material manifestations of secular individualism.

The basis of educational institutions in secular individualism has contributed to making them levers of and contested ground for social equality. When educational institutions become very present and visible sites of public goods in the everyday life of citizens, it is also logical for citizens to claim equal access to these goods. So modern educational systems contribute to social equality, but many structures and processes reproducing inequality persist in and around them. Sociological and educational research has provided ample evidence for this. However, it is something else I want to focus on here: that the right to and the struggles over equality in education is an integral element in the *continued institutionalisation* of education. An example is what some researchers have called the principle of sequence (Archer, 1982). It means simply that when you complete one stage of education, the right to education can be interpreted as the right to also enter the next stage. When you complete the lower secondary leaving exam, you should have the right to enter upper secondary education. When you complete a bachelor’s degree, you should have the right to study in a master’s programme.

The principle of sequence is one of the mechanisms that make educational institutions grow. There are others, of course. And as educational institutions grow, collective interests and actors emerge from them and grow stronger. Teachers, parents, and educational managers become actors with significant influence on education policy, with differences connected to their roles in the educational system, but they share a basic interest in the expansion of institutionalised education. Even educational researchers become such actors, although I am sure that many of us feel our influence is very limited.

Expansion of institutionalised education often takes the form of *bigger institutions*, geographically located in urban centres. This is especially the case for schools and colleges beyond the primary stage, for vocational schools, colleges and universities, but to some extent it also happens at the primary stage. In the case of Denmark, it is significant that a reform of local governance structures introduced ten years ago, which created fewer and bigger municipalities, has resulted in a significant reduction of the number of *folkeskoler* (public schools for primary and secondary education), mainly because smaller schools have been closed or merged into larger and centrally located schools. There is an administrative logic in this, an idea that larger institutions and centralised management structures contribute to a more efficient use of the resources invested in education. But there is also a more general trend towards urbanisation, which can be seen all over the world, although of course in very different forms depending on the social and economic contexts.

Even in a country like Denmark, relatively small and homogeneous, with few barriers to internal mobility, the trend towards centralisation and urbanisation is noticeable. An interesting example of this was found in a regional development project carried out in North Denmark, the FlexVid project (Lolle, 2014).

The idea of the project was to create a basis for bringing higher education closer to the users, meaning both potential students and companies in need of educated employees. It was hoped that this would encourage more people to enrol in higher education. Four higher education professional programmes of the regional University College (UC North Denmark) were chosen for the project and a special organisation was developed for these programmes. It was a form of blended learning where internet based teaching and tutoring was combined with face-to-face teaching in the ordinary physical settings of the programmes. Local study centres were established in different parts of the region. The idea was that for much of the time students could remain in home communities around the region, and the practical training could be done in institutions close to these communities. A cohort of students was enrolled in these programmes. At the time of their application most of the students lived in thirety-five different towns outside of Aalborg municipality, where the regional university college has its main campus. But a survey done a month after the study started showed that number had been reduced to thirteen cities outside of Aalborg municipality. The teacher education students, for instance, had almost all moved to Aalborg. The students had good individual reasons for this, but the case still illustrates the centralising power of educational institutions.

**5. New technologies, education and learning**

The Flexvid project was also an attempt to use new technology to reorganise higher education in a way less dependent on a big, centralised educational institution. This raises the issue of how the technologies involved in the fourth industrial revolution can impact on the way that education and learning is organised.

A key element is the organisation of education, teaching and supervision through digital platforms. This is not new. Institutions for distance education have a long history, and they have been gradually incorporating new technologies in their work as these became available. The evolution of the Open University in the UK is a well-known example. But the rapid evolution and increasing power of digital technologies, combined with the fact that most people in the industrialised world now possess portable computers of one kind or another, has vastly increased the possibilities for platform-based education. One result is that many established educational institutions have added a digital presence to their activities, making their courses available to online students either for free or relatively cheaply. This is the MOOC phenomenon (massive open online courses), which emerged a few years ago and was given much attention.

Much was made of the fact that elite universities made their teaching available to outsiders for free. Of course the precondition for this was that teaching, course development and course materials had already been paid for. But more ambitious forms of online teaching involve activities directly for the online students, such as teacher presence in chatrooms and feedback on assignments and essays. When institutions have gained the immediate publicity benefits of going MOOC, such activities will need to be funded, most often by the students. And in fact the development of MOOCs seems to be moving towards different business models, where an element of use payment is introduced, and platforms are increasingly run by private firms (such as Coursera), who then collaborate with the established institutions, drawing on their status in the education system.

Another element is the use of digital technologies to monitor learning in order to improve teaching and the organisation of learning environments. Information about the background and the activities of students, and also about the elements of learning environments, is increasingly available in digital form. It is a logical step to integrate such data and use them to get better knowledge about how learning takes place and how teaching resources can best be used, no matter whether the provider is a traditional institution or an education platform. This is often called *learning analytics.* It basically involves integrating data and using statistics to trace the behaviour of learners and perhaps to predict it (see, for instance, Renties et al., 2016). Part of the work has (as far as I know) focused on identifying students who are at risk of dropping out or failing exams. For such a purpose, models of student behaviour are developed through statistical analyses based on large amounts of data. Data may include background and personal characteristics of students; choice of subjects and courses; students’ progress as reflected in course attendance; exams; and comments from teachers. Models based on such data can then be used to interpret information about the progress of individual students. To put it very simplistically: when a student fails a certain exam the monitoring system will assess this fact on the basis of the student’s previous career and the models of student behaviour. If the data indicate a probability that the student may also fail the exam the next time, the system tells a teacher or coordinator: ‘Hey, here is a problem, you should perhaps do something.’ In principle, this is not different from what educational institutions have always done, but the combination of data and computing power does it much faster and more systematically, allowing for earlier intervention.

I will just remind you what I said earlier: such procedures are a key element in the fourth industrial revolution. Computer power predicts the behaviour and preferences of customers and users, and business models are based on this information.

Learning analytics can be a tool for better and more supportive organisation of education and learning. But like in business, there are risks involved. Human beings are complex and to some degree unpredictable, and the models of student behaviour will invariably miss something and so place misleading labels on some students. Labelling students – as lazy, as disturbing, as ‘good with his hands but not with his head’ – is a common practice of teachers and educational institutions. The labelling done by a learning analytics system will probably be less haphazard, but on the other hand it will be more anonymous and more difficult to challenge. So it is very important that predictions and the actions to be taken are assessed by teachers or supervisors. This is also emphasised in the scientific literature (for instance Gasevic et al, 2016). However, the institutional logic of costs and benefits may encourage the institutions to trust computer-based predictions too much.

The technologies of the fourth industrial revolution are not just a question of integrating data and using computer power. It is also about getting more data in order to monitor processes. As mentioned a key tool for this are sensors connected in networks. To get more precise information about student characteristics and activities, as well as about learning environments, it can be a logical step to use sensors such as motion detectors. For this conference, we have prepared evaluation sheets in order to know how many people participated in individual workshop sessions. But with a relatively simple visual and audio sensor in each room, we would not depend on the evaluation sheets (and the chairs’ ability to fill them in), we would have direct knowledge, not only about how many were there but also about how many said anything. And we could of course combine the sensors with a chip in the conference badges that you all carry around. Then we would be in a position to calculate how active – or less active – researchers from different countries and perhaps institutions participated in workshop sessions. Interesting, would you say? For the future of education it is important to be aware of the opportunities as well as the risks offered by these technologies.

To recapitulate: the changes in the economy and society, of which the fourth industrial revolution is only a part, call for organised learning in and for different life settings, through the life course. This is widely recognised and celebrated in the concept of lifelong learning, but in fact the main trend in modern education has been towards institutionalised education materialised in large and centrally located educational institutions. These institutions are necessary as sites for much of the educational activity in modern societies and also as sites where the right to education can be claimed. But in order to meet the challenges of the present, the borders between educational institutions and the surrounding society must be made more permeable, and education systems should work towards a balance between educational institutions and teaching and learning embedded in workplaces, in local contexts and in networks.

**5. Implications for educational research**

The developments and challenges I have tried to outline pose some demands on the business that we have met to discuss here in Copenhagen, the business of educational research. I will close this presentation with some comments on that.

I think it is evident that educational research must be committed to *grasping the real world.* This may of course be a controversial statement, for the nature of reality has been and is debated. So just to specify briefly: real means that the world, material as well as social, has a relatively independent existence. Human beings have helped produce it, but often it has taken forms that are beyond their control. The world is full of social practice, but much of this practice hardens into structures and institutions; Sartre’s concept of *the field of inert practice* (Sartre, 1991) captures this well, I think. The point is that structures and institutions harden, but not completely; they can change and they can be influenced, but sometimes changes are very difficult and slow.

Grasping the world means also a *commitment to empirical investigation*. This should not be understood in a narrow sense. I would say, for instance, that Jürgen Habermas has continually shown empirical commitment. This may sound strange to you, for Habermas has not done empirical studies in the strict sense since his early days as research assistant in Frankfurt. However, he has continually involved himself in contemporary political and societal issues and has taken pains to assess problems, arguments and their contexts. The most well-known example is probably his contributions to debates about the situation and development of the European Union (Habermas, 2011). In his theoretical writings Habermas has pointed out that even though philosophical and conceptual analysis is important for characterising issues like the relationship between modernity and rationality, it is not enough; it must work together with empirical social investigation and analysis.

Reality can be observed all around us, but it is not easy to grasp. It contains multiple layers, and the important elements, such as forces that drive reproduction or change of educational institutions, cannot always be found with the usual tools of empirical investigation. So it is necessary to *bring theoretical frameworks and concepts into play*, but of course also handle them with care, being aware that they may obscure important insights. Chris Argyris (1999) has given a good example of this in his research on organisational learning. He has shown that defensive routines are widespread in organisations. Employees, and not least the smart and well-educated ones, employ strategies to avoid threats against their work and their competence. In this way, they also avoid identifying the possible causes for such threats. Now, if an investigator looks at the organisation with the acknowledged tools of empirical investigation, giving a balanced and neutral description, there is a good chance that the workings of defensive routines will make him or her miss important problems that cause the routines. In order to grasp the organisational reality, the investigator needs to bring with him a theoretical concept.

Researching such issues as the technologies of the fourth industrial revolution and their impact also calls for a *materialist approach*. I mean materialist in the sense originally developed by Karl Marx. To him, materials objects, raw materials, technologies and bodies were forces of production which continually interacted with the social relations of production, the systems of the economy, law, power and ideology. Marx lived and worked in another age, but his analyses of the complex interaction of material and social elements are still in many ways valid and can give inspiration. To give an example from a field very different from education: Friedrich Engels, Marx’s collaborator, once wrote a brief study on the impact of the rifle on infantry tactics (Engels, 1972). He traced the evolution of military guns from the heavy, slow-firing and inaccurate muskets of the seventeenth century to the breach-loaded rifles of the mid-nineteenth century. This was a technological revolution that made frontal infantry attack very dangerous, and it has been argued that this was decisive for Prussia’s victories over Denmark and France at the time. But to Engels, the matter was more complex. He argued, for instance, that Prussia’s system of combining a standing, professional army with conscripts was just as important. The material and the social elements interacted. Today, when new technologies are often seen as driving societal change, the versatile materialist approach developed in the Marxist tradition is still relevant.

What I have said about balances between educational institutions and other sites of education and learning also calls for educational research that is *able to span these different contexts*. For example, it means that the concept of teaching should not be reserved only for schools, colleges and universities. Of course, most teachers operate in schools and colleges and they mostly meet students in situations organised according to what has been called the ‘grammar of schooling’. But still much teaching goes on in other settings like adult education centres, workplaces and voluntary associations. The concept of teaching should reflect this.

Educational research should be research of education, but also *research for education*. There is little disagreement about that, I think, but it still needs to be said. Doing educational research involves a commitment to informing and improving educational practices at all levels, from micro-spaces of teaching to education policy. However, the fact that it is research should also mean that it contributes not only new information about educational practice but also new perspectives and frames for understanding. This is, for instance, the point in the example from Chris Argyris that I mentioned earlier. Educational research must one way or another move beyond the logic of the fields of education and learning that it engages in.

The technological, social and cultural changes of what I have here called the fourth technological revolution present fundamental challenges for education. There are great risks, but also great opportunities for developing better educational systems and practices, that can support children, young people and adults in learning to navigate life and work. Educational research can and should help reduce the risks and use the opportunities as fully as possible.

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