

HIGHTECH FORUM

Innovation and Qualification

A discussion paper from the High-Tech Forum*

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The leading members are responsible for the content: Prof. Dr.-Ing. Holger Hanselka, Prof. Dr. Anke Hassel,
Dr. Marion Jung, Prof. Dr. Manfred Prenzel, Frank Riemensperger, Prof. Dr. Birgitta Wolff.

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Education and qualification system as a public service

Germany is considered to be one of the most innovative economies in the world.^{1,2} Until the outbreak of the coronavirus epidemic, it enjoyed a phase of almost full employment. Nevertheless, key industries are undergoing a fundamental structural change which is driven by technological, social and geopolitical changes.

Specialist knowledge, training courses and occupations are changing in ever-shorter cycles.^{3,4} The Institute for Employment Research of the Federal Employment Agency, for example, determined that around a quarter of occupations will change significantly as a result of digitalization and that completely new occupations will be created.⁵ International comparative studies illustrate the qualification challenges associated with this. Germany, for example, is among the top 5 in the World Economic Forum's assessment of the overall education of its population. However, it ranks only 16th for workforce training and only 21st for teaching of a key future skill, digital literacy.³ Surveys of adults' basic skills also reveal worrying gaps, e.g. in reading skills, and wide disparities within the population, e.g. in technology-based problem-solving skills.^{6,7}

The resulting profound effects on society and the labor market require a new culture of learning and working.³ The foundations for the motivation and willingness for lifelong learning are already laid in childhood and basic education. Universal access to education is fundamental to the preservation of equal opportunities. Since education and the teaching of skills are based heavily on interactions and relationships, they have an enormous influence on personal development. Early experiences of self-efficacy, a constructive approach to mistakes, and experimenting and learning in groups are considered to be conducive to a positive learning culture. They should be integrated into everyday learning to a greater extent and should also include practicing problem-solving strategies.

The state invests considerable sums in the German education system and provides publicly-financed basic training nationwide. Together with strong social partners, it also supports dual vocational training programs and on-the-job training in innovation-relevant areas. In this context, the High-Tech Forum stresses that the educational mandate of the state and society as a whole extends to all phases of life and segments of society. In the future, skills development and continuing education and training must be more strongly professionalized, geared to specific target groups and, if necessary, tax-funded. The Digital Education Action Plan⁸ stipulated in the coalition agreement and the National Continuing Education Strategy⁹ formulated by the Federal Government are more important than ever. The goals should be promoted during this legislative period.

In line with the tasks of the High-Tech Forum, the paper concentrates on the role of the state and politics in providing an effective innovation infrastructure as a public service. This also includes an excellent education and qualification system in all phases of life. This paper focuses mainly on preparing for a career and working life. In the second section, it recommends measures for developing innovative capability and, in the third section, the resilience of the population. The fourth section discusses supporting lifelong learning in the vocational training system and necessary modernization measures. The fifth section deals with the framework conditions for preserving and utilizing knowledge and skills.



Fig.: Overview of this discussion paper's recommendations.

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Skills as the basis for innovative capability

For people to be able to learn, develop innovations and find their way in a constantly changing world, they need the best possible individual and organizational conditions.¹⁰ In view of the challenges in the innovation system, there is a long-term need to improve the learning culture and the handling of uncertainty in all phases of life.

Understanding and considering skills more fully: The rapidly changing world of work requires not only excellent professional qualifications but also a wide range of soft and self-help skills. Critical thinking, creativity, communication and cooperation skills, adaptability, self-reflection, openness and willingness to change are considered particularly important skills. These skills are not only developed in educational establishments and in employment. Studies show that even in industrialized countries, a large part of continuing education and training is not formalized.¹¹ Adults learn most in their everyday (working) life by means of practical application and exchanging ideas and information with other people.¹² The influence of diversity and gender parity in the workplace should not be underestimated either. This also applies to civic commitment, e.g. in clubs and associations, where a considerable share of skills development likewise takes place.

The question is how these informally acquired skills can be made more visible and gain recognition. Initial approaches are being developed in the Valikom¹³ and Profil-PASS14 projects. Jointly with the trade unions, they are to be used as the basis for developing a reliable and universally valid procedure for recording and recognition.¹⁵

Digital literacy as a "new" basic skill: Digitalization permeates almost all areas of life. Confident use of digital technologies is now considered a new basic skill along with reading, writing and arithmetic.¹⁶ This is not a matter of expert knowledge but of being able to confidently and reflectively use digital tools and working methods.¹⁷ Such digital literacy consists of a variety of skills.¹⁸ They include a basic understanding of hardware and software as well as the ability to continuously learn how to handle new applications. Above all, they form part of general skills such as media and source competence, particularly in relation to suggestions for algorithms, including an understanding of data protection. However, data literacy, which includes managing and interpreting data per se, is also important. There are currently serious skills gaps in these areas.¹⁹ As a result, we are seeing increased social inequality (digital divide). Only when basic digital literacy is assured, can we make online services available to the general public and expand them.²⁰ This particularly includes e-government and digital (continuing) education.

In order to develop this basic skill, the High-Tech Forum advocates free digital learning aids as a general rule. Every student must have access to high-quality technical facilities,

digitally accessible learning content and specific training and support services. It is important here that the process is accompanied by pedagogic and scientific support to prevent undesirable developments. In schools and training establishments, digitalization and information technologies should not be just a passive experience. From the outset, the focus should be on design possibilities and practical applications, for example by simply and cost-effectively assembling a computer (e.g. Raspberry Pi²¹), building and programming small robots (e.g. Roberta²²) or actively protecting privacy on the Internet. This can also help to promote more interest in and enjoyment of MINT subjects, particularly with regard to more equal opportunities for girls and boys.

Valuing and developing teaching skills: It is essential to significantly improve the quality of continuing professional development for teachers. Teaching staff in continuing education and training must be given sufficient time, freedom and application-oriented training in future-relevant skills. They must not lack professional support and technical equipment in their everyday work. New skills requirements may also lead to independent job profiles in the teaching profession, such as technology consultants and online education officers. Programs such as "Train the Trainer (CCI)"²³ have great added value in the professional field, as they focus on the personal development of trainers in addition to their specialist training.

Good working conditions are part of the esteem for teaching skills. For example, many positions in the continuing education and training sector are only filled by freelancers who are often not covered by social security, have no planning security, are not systematically evaluated and trained, and have no access to administrative support. Here, the High-Tech Forum proposes a critical review of working conditions and more minimum standards

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A forward-looking qualification system for more resilience

In view of the major challenges facing society, particularly global population growth during intensifying climate change, we can expect a number of stress tests for society and various health, environmental and economic crises in the future. Innovation and qualification are necessary to strengthen society's resilience in the face of uncertainties and crises.²⁴ An up-to-date and forward-looking education and qualification system is proactive, trains the general public in coping strategies, and promotes openness to innovation.

Identifying (future) skills and determining needs: Which professional, soft and self-help skills will be necessary in the future? Identifying changed skills requirements and developing and rolling out appropriate training programs needs to be systematized, continuous and supported. Here, the High-Tech Forum advocates an evidence-based dialogue between the social partners, the ministries responsible for education at state and federal level, and as the education providers and chambers of commerce. This dialogue should be scientifically supported in order to improve the data situation and identify further research needs. Evidence-based contact points exist, e.g. at the National Educational Panel.

Digitalization and a transition towards flexibility along the entire education chain: In terms of digitalization, there is an enormous need to catch up in practically all fields of education and training. The DigitalPakt Schule²⁵ represents a milestone in educational federalism, although it must be possible to draw down funds without bureaucratic red tape and to significantly speed up implementation. In addition to technical upgrading in educational establishments, content must be prepared more intensively for independent and online learning in order to reduce the dependence on classroom units and become more flexible.²⁶ Synergies due to sharing and joint use of high-quality teaching materials should be stimulated and, if necessary, promoted.

Adaptive test systems and software based on artificial intelligence can help to make learning more personalized. This is about complementing rather than replacing teachers. The efficiency gains from mixed online and offline learning formats could create mentoring capacities for smaller groups and application-oriented learning. At this point, the High-Tech Forum also stresses the need for nationwide broadband Internet access for all citizens as a fundamental part of state-run public services.

Improving social participation: Innovations and social challenges lead to a need for qualification throughout the whole of society. The High-Tech Forum emphasizes the need to teach entrepreneurial thinking and courses of action for sustainable development as early as in basic and initial training and to reinforce them in continuing education. In addition, extracurricular and target-group-specific educational offerings can encourage and motivate participation in new developments and political discussions. In Finland, for example, a basic course on the subject of artificial intelligence was

developed for the general public. It has since been translated into German and is run in cooperation with the GCCI [Association of German Chambers of Commerce and Industry].²⁷

The timing of continuing professional development and training must become more flexible and it must adapt in the best way possible to people's circumstances. Digitalization and new technologies, such as virtual reality, not only facilitate education that is independent of time and place but also access to new formats and educational content from all over the world. Web tutorials, podcasts, webinars and online courses (MOOCs) as well as coaching are now gaining increasing importance in knowledge transfer and qualification. There is a risk that quality assurance and proof of competence are scarcely possible for these informal continuing education and training courses. In order to use the potential of these instruments nevertheless, public educational establishments, including chambers of commerce, should increasingly act as providers and develop certification options.

In particular, the state must ensure that vulnerable and educationally alienated target groups are also covered by such measures. In addition to user-oriented formats, this also requires a more target-group-oriented approach via multipliers in the citizens' direct living environment. Migrant households, for example, will be reached by "district mothers".²⁸ Such programs should be evaluated, continued and made scalable.

In the High-Tech Forum's opinion, scientific communication with the general public also plays an important part and should be further developed. Community labs, makerspaces and science centers, where the future and innovations can be discussed and experienced, are increasingly being built in urban agglomerations, in part with substantial public funding. Equivalent offerings should also be promoted in rural areas, for example events or mobile concepts such as the "Turing Bus" project²⁹, the Innotruck³⁰ or the MS Wissenschaft floating science centre³¹.

Using periods of free time for qualification: The federal and state governments have created many tools for qualification and economic recovery in times of crisis. The High-Tech Forum advocates that periods without employment might be used in principle for qualification.³² Social partners, chambers of industry and commerce, the ministries of labor and employment agencies should initiate a needs assessment. It can be

used to determine future-oriented qualification programs for employees which are geared, for example, to the Sustainable Development Strategy.³³ Measures such as the short-time work allowance, the Work-of-the-Future Act and the Skills Development Opportunities Act must be made less bureaucratic, coordinated with each other and made more widely

known. Micro-enterprises and start-ups should be completely exempt from co-financing for continuing education and training measures. Special support for bottleneck professions should be considered in order to attract as many people as possible to them.

4

Supporting lifelong learning using the continuing education and training system

The continuing education and training system in Germany is very heterogeneous and depends heavily on people being proactive. Continuing education and training, if it is to ensure the skills of the workforce and the competitiveness of companies, must not only be of high quality and effective, it must also reach large parts of society. Educational differences are already significant and are more likely to increase over time.¹¹ Lifelong learning requires modernization and professionalization of the continuing education and training system.

Cultural change in continuing education and training:

In Germany, basic and initial training carries with it a very high social value. However, the High-Tech Forum considers there is an urgent need for action in the continuing education and training sector. The systems must mesh together more closely so that the need for continuing education and training and the culture of lifelong learning are already embedded in education. The High-Tech Forum recommends that there should be political stimulation for cultural change and stronger demands for lifelong learning. One way of doing this would be to introduce an individual right to continuing education and training that also conveys an expectation for those in employment to actually continue their education. Supported by professional advice and incentives for successfully completed qualification courses, this should provide greater motivation to continue their education and training to those target groups that have not done so in the past. Incentives could be the granting of pension points, extension of the examination bonuses already used or a better system of offsetting training costs against income tax.

Proactive employment agencies for lifelong learning: The employment agencies are nationwide and well-positioned. In view of the future challenges in the labor market, the High-Tech Forum supports further development of the agencies towards a more proactive role. In essence, it is a matter of maintaining and improving employability by identifying skills gaps and development opportunities at an early stage, and promoting appropriate qualifications.

Constructive thought should be given to reforming unemployment insurance towards employment insurance with the provision of an individual training budget for every citizen.

Creating more transparency in the continuing education and training market:

The continuing education and training market in Germany is not very transparent and is very heterogeneous. The diverse range of stakeholders can of course be advantageous if, for example, this ensures the provision of a high level of educational services geared to the target group. However, it can also be detrimental if the fragmentation results in a large number of providers and offerings whose quality and performance are difficult to compare or are not transparent. The High-Tech Forum argues for a broad-based economics of education study which aims to balance public and private education interests with the given incentive systems. For example, the costs of continuing education and training should be borne proportionally by the stakeholders who stand to benefit from the qualification. If the continuing education and training is in society's general interest and therefore has the character of a public good, this also concerns the public sector. The specifications for a study should be developed by a scientific working group, consisting of relevant education shareholders.

As an orientation aid for those interested in continuing education and training, the High-Tech Forum proposes the setting up of a continuing education and training platform, involving key stakeholders. Similarly to the Higher Education Compass³⁴, the courses offered could be bundled there with the aim of increased transparency and comparability. It would be important to include both classic, formal qualification measures and more informal training courses such as webinars and online courses (MOOCs). In the long term, it would make sense to develop it further into a data-driven platform. Ideally, for each user account, skills would be regularly compared with developments in current employment and the right training program would be suggested at an

early stage. However, given the complexity of such a project and the need to consider data protection aspects and control rights, this idea would have to be developed over the longer term and, if anything, gradually.

For quality assurance and confidence-building, it would also be important for the key stakeholders, made up of continuing education providers, chambers of commerce, trade unions and the employment agency, to focus on developing a uniform certification system, as is also used by colleges and universities, for example, through the German Accreditation Council.³⁵ Such a method can also take existing systems into account, such as the German Qualifications Framework (DQR) and the Accreditation and Licensing Regulation for Labor Promotion (AZAV). It would be conceivable to consolidate this via a committee that develops the procedure and continuously evaluates and adapts it.

Supporting on-the-job training: Companies already invest heavily in the development of their employees and make a significant contribution to the training of skilled workers. The investment amounts estimated by the economy vary widely, ranging from EUR 11.1 billion³⁶ in 2015 to more than EUR 33.5 billion³⁷ in 2016. Here, better data availability would be important for estimating the costs of continuing education and training and the effects achieved.

High expenses for vocational training courses pose a challenge, particularly for small and medium-sized businesses. The temporary creation of tax-free qualification reserves should be made possible to encourage the innovative capability of SMEs.

In view of the shortage of skilled labor in some industries and areas, and to make better use of the workforce potential, the social partners should think about easing formal access restrictions. To make integration into the labor market easier, there should be improvements in opportunities for recognizing vocational qualifications and skills, often acquired informally and through practice. This offers great potential and opportunities, particularly with regard to many immigrants from the EU and third countries. Moreover, innovations such as technical assistance systems (e.g. augmented reality, virtual reality) enable low-skilled workers to perform more complex tasks. Promotion of such technologies can help to provide better working conditions for the low-skilled and to fill vacancies.

In regions providing a low level of vocational and on-the-job training, there should be support for increased networking between educational establishments and companies. Vocational schools, technical colleges and colleges are established partners in the education and training sector. As a result of their widespread distribution, their usually good technical equipment and their experience with different types of learners, they should be considered for an extended teaching assignment.

Strengthening the role of colleges and universities:

Universities have two important tasks to fulfil at once. On the one hand, they carry new knowledge into society (Third Mission, scientific communication, Citizens' University). On the other hand, they are growing providers in the continuing education and training market. In addition to their reputation, universities have the advantage of being able to award ECTS points for educational units that are successfully passed. In continuing education, modular curricula (e.g. micro-master programs, MOOCs³⁸) allow units to be completed individually and lead in total to an academic degree – even alongside work. Better cooperation among themselves and with other providers and platforms can be beneficial.

There are, however, limits to the continuing education activities of colleges and universities. European competition law, the German civil service law and the Capacity Regulation restrict the range of continuing education and training courses on offer at colleges and universities. For example, civil servants are not allowed to have any part-time jobs with the same employer; conversely, however, university teaching assignments in continuing education are also not credited against the teaching load.³⁹ Continuing education courses offered by colleges and universities are subject to EU competition law and they must therefore offer all continuing education courses on a full cost basis.

The High-Tech Forum sees great potential for universities and colleges in the continuing education sector, particularly in areas related to research and technology. The High-Tech Forum therefore proposes that adjustment of the general framework should be checked. In addition, budgets for continuing education should not be borne exclusively by the state budgets but should be supported by federal funds (Article 91b of the German Basic Law).

The decision of the Standing Conference of Ministers of Education and Cultural Affairs of the Länder in 2009 to allow access to higher education for vocationally qualified applicants without a university entrance qualification,⁴⁰ further increased permeability in the education system. In practice, however, there are several practical obstacles. For example, universities and colleges must think about target-group-specific programs, particularly to better integrate career changers. The admission criteria for master's courses, which are not always target-oriented and can be obstructive, should also be reviewed. The funding instruments BAföG [Federal Education and Training Assistance Act] and student loans should be closely examined for their effects. Attention should be paid to the interest burden of KfW Bankengruppe [a German, state-owned development bank] and the age limit, particularly with regard to continuing education.

5

Applying, developing and protecting new knowledge

The substantial public and private investment in capacity building and knowledge gains also implies the claim to added value from this investment and to a certain protection of knowledge as an intangible resource. In the innovation system, patents and industrial property rights are an important indicator for the results of educational and research activities. As a value, they signal a return on investment. However, society will miss out on important innovations if new knowledge cannot be used where it can have a positive impact due to protectionist efforts. The political and legal framework must therefore achieve a compromise between protection and opening up.

Value creation and appreciation of human skills:

Our current economic system measures a company's value solely on the basis of monetary profit, without paying any attention to social added values and sustainability aspects. Entrepreneurial activities have beneficial and adverse effects – this must be assessed more comprehensively in terms of achieving sustainability goals. A new approach in the accounting process would bring social and environmentally relevant aspects to bear in the balance sheet. In these approaches, investments in employees, such as education and training, as well as fair pay are shown as positive values on the balance sheet. Such a methodology is currently being developed by the Value Balancing Alliance initiative.⁴¹

Industrial property rights, patents – protecting intellectual property: Results from research and development (R&D), which is carried out under a contract of employment or on behalf of a company, are in principle the company's intellectual property. It is important for companies that this know-how can be protected. It is not only since the reform of the Trade Secret Act in April 2019 that the protection of intellectual property been difficult. The line between innovation-promoting development and the theft of intellectual property has become thinner. SMEs in particular often cannot defend themselves against aggressive copying, such as product compositions or designs, especially from other economic areas. The German state could become active in this area and consider KfW guarantees in the event of legal disputes. An SME protection agency could act as an advisor and intermediary, preventing legitimate legal disputes from jeopardizing the existence of start-ups and micro-enterprises.

Similar to the law regulating tax incentives for research and development (Forschungszulagengesetz), expenditure on patent applications could be eligible for tax incentives for innovative SMEs.

Knowledge transfer between commerce and educational and research establishments: The German universities and colleges are well-placed in research. There is, however, a considerable need to catch up when it comes to transferring the knowledge generated to economic application. The main obstacles are the strict separation between basic research (academia) and business application. This leads to excessive

concentration on the education and training of young scientists (with more than 90 percent of students not pursuing an academic career) and a lack of knowledge and experience of business practice among students, university and college staff. Entrepreneurship cannot be learned in courses alone. However, the transfer of business knowledge combined with initial practical experience can help to ensure that the application of research is afforded a higher priority. Examples of this are the promotion of spin-offs and business cooperation as well as the presence of academic and entrepreneurial role models.

Universities, colleges and non-academic research establishments also contribute to the exchange of knowledge by offering an increasing number of business-related continuing education and training courses. The expansion of dual vocational courses helps to better combine theory and practice and realize career opportunities. The University Alliance for Small and Medium-sized Enterprises⁴² is a good example of how continuing education and training opportunities can be created away from urban centers and how skilled workers can be kept in the region.

Improved collaboration with companies is often hampered by the research establishments' sometimes different interpretation of contract research (100 percent fixed cost surcharge) and research cooperation (approx. 20 percent fixed cost surcharge). The resulting distortion of competition among the research establishments should be eliminated by a uniform interpretation of EU law and a definition by the Federal Ministry of Education and Research (BMBF). For SMEs in particular, collaboration with college, university and non-academic research establishments is essential for the development of innovations. The promotion of such SME-oriented collaboration should be further developed.⁴³ Examples include the Future Work Lab⁴⁴ and innovation vouchers, such as those given out by some German states such as Saxony-Anhalt⁴⁵ and Bavaria⁴⁶.



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About this discussion paper

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The positions presented in this paper do not necessarily reflect the views of the German federal government.

This discussion paper was produced by the High-Tech Forum team appointed to work on the topic of "Innovation and Qualification." Its purpose is to advise the German federal government on the implementation of the High-Tech Strategy 2025. The team comprises the following members: Prof. Dr.-Ing. Holger Hanselka, Prof. Dr. Anke Hassel, Dr. Marion Jung (spokesperson), Prof. Dr. Manfred Prenzel, Frank Riemensperger and Prof. Dr. Birgitta Wolff.

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Secretariat of the High-Tech Forum

Fraunhofer-Forum Berlin
Anna-Louisa-Karsch-Straße 2, 10178 Berlin, Germany
www.hightech-forum.de/en

Tobias Schaaf

Project Manager
schaaf@hightech-forum.de
T. +49 30 688 3759 1615

Contact | Press

Valerie Ponell

PR and Communications Manager
ponell@hightech-forum.de
T. +40 30 688 3759 1621

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