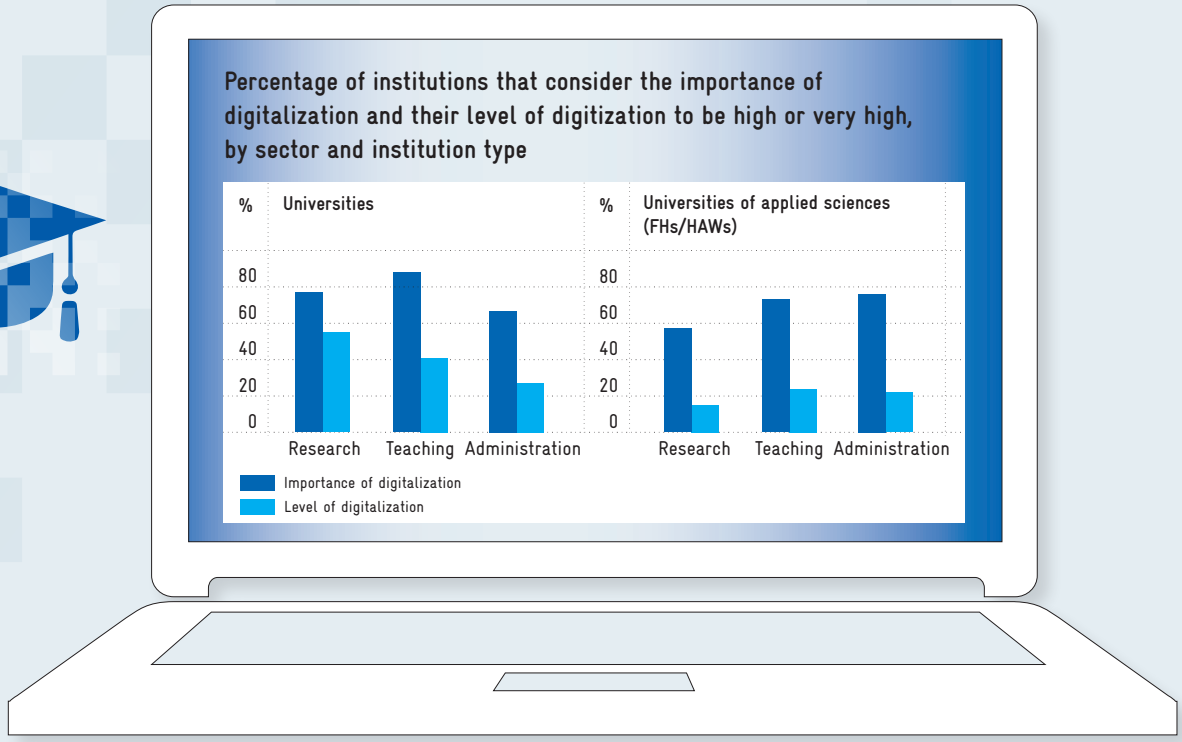
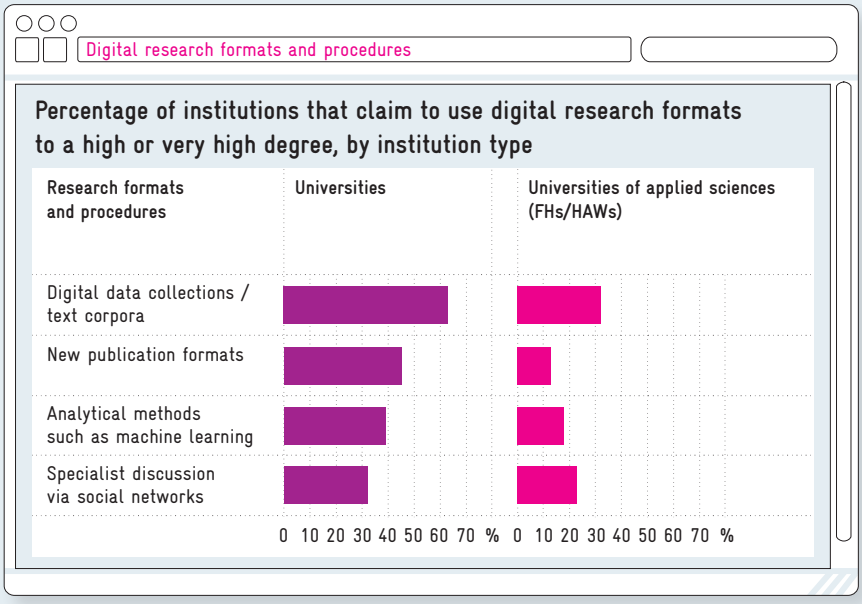
B 4 Digitalization of tertiary education institutions

Download data

German tertiary education institutions – according to their own statements – attach great importance to digitalization. However, this is not reflected equally well in the levels of digitalization achieved in research, teaching and administration. Significant development potential therefore exists for the continuing digitalization of German tertiary education institutions, above all in teaching and in administration.





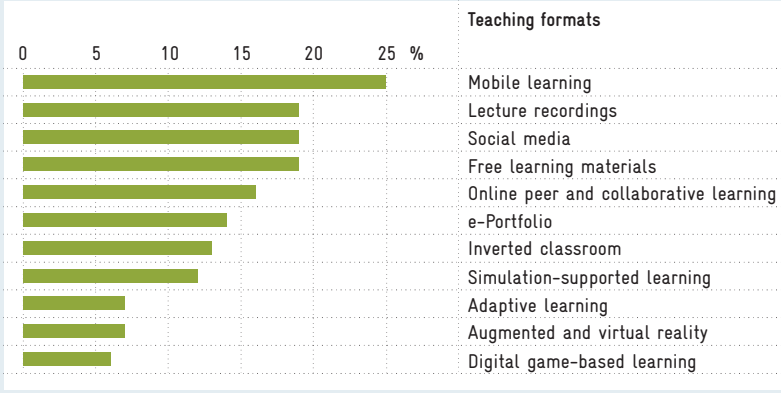
In terms of research, digitalization relates to the increasing application of computer-assisted procedures and the systematic use of digital resources.

Source: The information provided in the glossary and the figures refer to Gilch et al. (2019).

The digitalization of teaching denotes the permeation of digital components and learning tools through teaching and learning processes.

Digital teaching formats

Percentage of institutions that claim to use digital teaching formats to a high or very high degree



Glossary of teaching terms

Mobile learning
Mobile learning denotes all learning processes that use mobile, portable devices.

Open educational resources, OER
Open educational resources are teaching and learning materials not subject to a term of protection or provided under a free licence.

Online peer learning/collaborative learning
The terms online peer learning and collaborative learning denote forms of study in which at least two students share their knowledge and experiences online and solve problems together.

e-Portfolio
e-Portfolios are digital collections of learning process documentation and learning products. They help to map and visualize the learning process, and thereby evaluate it.

Inverted classroom
In the inverted classroom technique, dissemination of knowledge is transferred in self-study, usually through online tools and resources. Intermediary phases of attendance classes seize on specific aspects that posed problems for students during self-study and explore them in detail.

Simulation-supported learning
Simulations are interactive visualizations that use a simplified model to analyze an issue or situation, thereby making it possible to illustrate interrelated causes and effects.

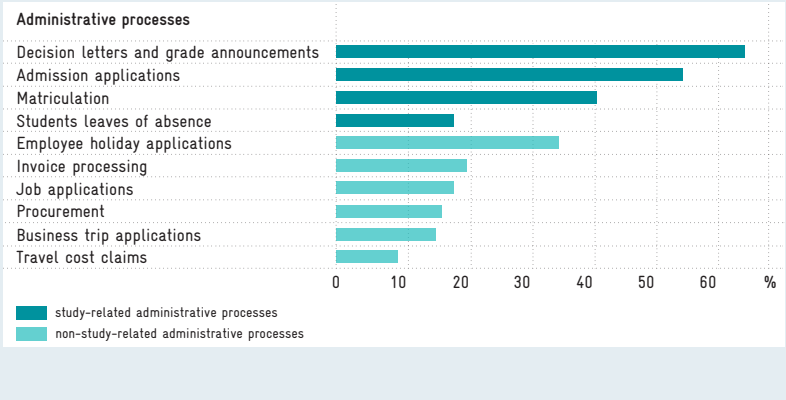
Adaptive learning
Adaptive learning is a teaching method that uses learning environments which tailor content to students' individual requirements and unlock certain content only when defined criteria have been met.

Augmented and virtual reality
Augmented reality is an experience in which perceptual information supplements objects in the real world. Virtual reality, on the other hand, involves complete immersion into a virtual environment.

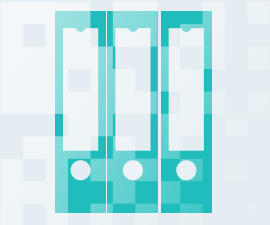
Digital game-based learning
Digital game-based learning is a digital variant of educational games. The structure and content of these games are shaped by pedagogical considerations; the objective is to achieve predefined learning outcomes.

Digital administrative processes

Percentage of institutions who claim to have fully digitalized the following administrative processes



The digitalization of administration involves reshaping administrative workflows to create a digitally networked process.



B 4 Digitalization of tertiary education institutions

The digitalization of tertiary education (TE) institutions is of central importance for research and innovation activities in Germany. In their dual role as educational and research institutions, TE institutions are responsible for training academic professionals for an increasingly digitalized world as well as exploiting the potential of digitalization for internationally compatible research and innovation activities. Following on from the Commission of Experts' 2018 report, which examined the issue of digital education,[399] this chapter assesses the extent to which TE institutions implement digital processes in their research, teaching and administrative work, as well as the challenges they face.

B 4-1 State of digitalization at German TE institutions

According to a survey conducted on behalf of the Commission of Experts, German TE institutions consider digitalization of their processes to be highly important. Indeed, 83 percent of TE institutions who responded stated that digitalization was a high or very high priority for them.[400] This is, however, not reflected in the level of digitalization of research, teaching and administration achieved to date (cf. infographic). There is therefore considerable scope to further digitalize German TE institutions.

Digitalization as a challenge for governance in TE institutions

The digitalization of research, teaching and administration is a major challenge for TE institutions. In contrast to commercial organizations, there are certain aspects specific to TE institutions that retard the digitalization process. According to the Imboden Commission, the governance of many German universities is characterised by a lack of efficiency orientation.[401] In addition, TE institutions have been suffering for years from structural underfunding, which makes it difficult to invest in digitalisation processes.

Alongside these internal problems, TE institutions face numerous external requirements – such as rising student numbers, a growing dependence on third-party funding, and the Excellence Initiative – which have rendered the governance of TE institutions' increasingly complex.[402]

One key method by which TE institutions can respond to the challenges of digitalization is to develop a strategy based on the university's profile, its target groups and its development objectives. However, in the survey conducted on behalf of the Commission of Experts, just 14 percent of TE institutions that responded confirmed that they have a digitalization strategy in place.[403] A further 41 percent said they were working to develop a digitalization strategy, while 31 percent have plans to do so.[404] The most commonly stated objectives pursued through a digitalization strategy include improving the quality and efficiency of administration and enhancing the quality of teaching.

The Commission of Experts believes it is a positive signal that a majority of German TE institutions either have or are working to develop a digitalization strategy. It recommends defining clear responsibilities for digitalization processes as part of these strategies.

Digitalization of research: German tertiary education institutions are well placed

In terms of research, digitalization relates to the increasing application of computer-assisted procedures and the systematic use of digital resources.[405]

The state of digitalization in research (cf. infographic) varies considerably between universities (Universitäten) and universities of applied sciences (Fachhochschulen, FHs / Hochschulen für angewandte Wissenschaften, HAWs). This can predominantly be ascribed to the differing structural orientations of the two TE institution types.[406]

Research information systems[407] have been fully or partially implemented at almost half of universities. In addition, around 30 percent of universities have implemented research data management systems[408] either in part or in full. Researchers' use of digital data collections is considered to be high or very high by 63 percent of universities. In addition, 45 percent of universities stated that they use new publication formats often or very often, while 39 percent use digital analysis methods to a high or very high degree.[409]

At universities of applied sciences (FHs/HAWs), less than 20 percent of institutions have implemented research-related IT systems (such as research information and research data management systems). One-third of researchers at FHs/HAWs use digital collections often or very often. Meanwhile, 18 percent of FHs/HAWs claim to use new publication formats often or very often. Only 13 percent of FHs/HAWs consider the level of use of digital analysis methods at their institution to be high or very high.[410]

Regardless of the type of TE institution, the level of digitalization in research depends to a large extent on the engagement of individual researchers and research groups.[411] Researchers at TE institutions use an array of digital tools to simulate, model, visualize, collect and evaluate data, as well as to publish research results – and do so of their own accord, without having to be supported centrally by their respective institutions.[412]

Nevertheless, this gives rise to wide-ranging requirements for training, consultancy and other services, for which TE institutions should develop and provide suitable solutions (cf. box B 4-1 for an example).[413] This is particularly pertinent as consultancy requirements will continue to grow as artificial intelligence and data science become increasingly important.[414]

Positive recent developments

The digitalization of research is currently being shaped by developments in several areas that are also of major significance for TE institutions. These areas include supercomputers, research data infrastructure and open access.

Box B 4-1

Example of good practice in research: the eResearch Alliance

Since its foundation in 2014, the eResearch Alliance has pooled the capacities of central infrastructural facilities at the University of Göttingen, the Gesellschaft für wissenschaftliche Datenverarbeitung mbH Göttingen and the Göttingen State and University Library.[415]

The eResearch Alliance provides a central infrastructure for researchers, faculties and research associations in Göttingen and beyond. Its aim is to provide researchers with IT services to enable them to make existing research methods more efficient and to facilitate the use of new research methods.[416]

To achieve this, the eResearch Alliance offers a variety of information, consultancy and training services relating to innovative information and communication technologies. Such services include research data management, research infrastructure to facilitate collaborative working with digital methods and tools, visualization options for research data and publication strategies. Furthermore, the eResearch Alliance offers individual IT consultancy and services for researchers.[417]

Supercomputers

Supercomputers are of growing importance for the field of research. For example, more and more powerful computers are needed to simulate neuronal networks and new medications, as well as to calculate climate models. While supercomputer capacities are steadily increasing, the pace just barely keeps up with demand for computing capacity.[418] As a result, German and European researchers rely on supercomputers beyond European shores, which can lead to issues in terms of data security, data protection, securing property rights and ensuring confidentiality.[419] The expansion of German supercomputer capacities will alleviate these issues to a degree. In September 2018 and January 2019, new supercomputers were commissioned at the Forschungszentrum Jülich and the Leibniz Supercomputing Centre in Garching near Munich, thereby supplementing high-performance computing infrastructure under the auspices of the Gauss Centre for Supercomputing (GCS).[420] The GCS is also working to develop an exascale supercomputer.[421]

In addition, the Federal Government and the Länder have agreed to create a national network called National High Performance Computing (Nationales Hoch- und Höchstleistungsrechnen), in which the strengths of the German high-performance computing centres are to be further developed. It aims to allow researchers at TE institutions to access the computing capacity they require when and where they need to, across Germany.[422] The Commission of Experts welcomes this commitment from the Federal Government and the Länder.

Research data infrastructure

In November 2018, the Joint Science Conference (Gemeinsame Wissenschaftskonferenz, GWK) announced the creation of a National Research Data Infrastructure (Nationale Dateninfrastruktur, NFDI).[423] The NFDI is tasked with creating systematic connections between the many often decentralized, project-bound and temporary data resources in science and research.[424] To achieve this, the NFDI will set data management standards and, as a regionally distributed and cross-disciplinary knowledge repository, secure and make usable research data in the long term.[425] Contact points will also be set up to provide researchers with on-site support in preparing and using the research data.[426]

The NFDI is to be designed by users and providers of research data in cooperation with institutions of the scientific infrastructure, such as archives, libraries, (data) collections and specialized information centres. For this purpose, they will collaborate in consortia eligible for financial support.[427]

The Federal Government and the Länder intend to provide up to 90 million euros annually in the final stage of expansion by 2028 for the establishment and promotion of the NFDI. The Federal Government will bear 90 percent of these costs, with the Länder covering the remaining 10 percent.[428] The NFDI forms the national pillar for the planned European Open Science Cloud. In the future, this Cloud should link research data across Europe and disciplines.[429]

The Commission of Experts expressly welcomes the foundation of a National Research Data Infrastructure (NFDI) as an important step towards overcoming the fragmented research data landscape in Germany.

Open Access

Open access denotes unrestricted, direct access to scientific literature and other materials, usually free of charge and online.[430] As a result, publishers' business models that artificially limit access through paywalls and legal restrictions are being replaced by models in which publishing houses provide their services in return for payment from authors or third parties. The aim is to maximize the dissemination and usability of scientific information. This includes creating the possibility of bringing together all scientific information in the future, analysing it with the help of digital tools and evaluating it across disciplines – including using AI-based methods.[431]

The open access principle has grown increasingly popular in recent years. National and international scientific organizations have committed to implementing open access models in numerous agreements, such as the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, issued in 2003.[432]

The secondary publication right[433] for scientific authors, as recommended by the Commission of Experts, was added to the German Copyright Act (UrhG) in 2014.[434] It grants a certain group of state-funded scientists a contractually non-negotiable secondary publication right under defined framework conditions.[435]

To accelerate the transition to open access models, 16 national and international research funding organizations came together with the European Commission and European Research Council to form Coalition S. In their joint strategy, known as Plan S, they demand that researchers publish their research results in Open Access journals or repositories from 2020 onwards if the research work was financed by public funds.[436]

The German Research Foundation (DFG) – Germany's central research funding organization – has not yet joined Coalition S. While the DFG advocates open access models and supports Coalition S with a series of measures, it refuses to obligate researchers to use open access.[437] Above all, the DFG is fearful that the open access obligation demanded by Coalition S will mainly lead to an increase in publication charges. However, the DFG has announced that, in future, it will request that funding recipients publish the results of their research on open access platforms. Until now, the DFG has only recommended they do so.[438]

The Commission of Experts approves of this position. In the medium-term, the aspiration should be to transition to an open access system. However, researchers should retain the option of deciding for themselves where and how they publish the results of their research.

Digitalization of teaching: Digital teaching formats offer potential for development

In terms of teaching, digitalization denotes the permeation of digital components and learning tools through teaching and learning processes. As the survey conducted on behalf of the Commission of Experts shows, TE institutions primarily regard digitalizing teaching as a strategic element by which to improve the quality of teaching. Furthermore, digital learning formats provide a higher degree of flexibility, such as through time-independent and location-independent learning or individualized learning paths (cf. box B 4-2 for an example).[439]

Infrastructure for digital learning formats already exists

A central IT system that supports teaching is known as a learning management system (LMS)[440]. In the survey, 85 percent of responding TE institutions indicated that these systems have already been implemented either partially or in full.[441] However, most TE institutions only use their LMS as a structured document storage system.

Box B 4-2

Example of good practice in teaching: Hamburg Open Online University (HOOU)

Launched in 2015, the Hamburg Open Online University (HOOU) is a collaborative project between all of Hamburg's public TE institutions,[442] including the University Medical Center Hamburg-Eppendorf (Universitätsklinikum Hamburg Eppendorf). At the HOOU, Hamburg's TE institutions develop innovative teaching and learning formats and materials on a common platform, which are made freely available to students and civil society.[443]

The aim of the HOOU is to enhance classic attendance teaching at Hamburg's TE institutions with the possibilities of digital technologies. In addition, collaborations across institutional boundaries are to be simplified. The original feature of the HOOU lies in the creation of a digital space in which students, teaching staff and civil society can meet to work together on interdisciplinary, cross-institutional projects.[444] The HOOU also makes it possible to pursue individualized learning paths.[445]

To date, the HOOU has offered around 50 learning opportunities. In addition, users have access to a variety of learning materials, such as informatics tutorials and scientific visualizations.[446]

More demanding applications, such as forums, exams and peer grading by course participants, are exceptions to this.[447]

Furthermore, by their own account, almost 90 percent of TE institutions have established service centres (e-learning centres) to support teaching staff in using digital instruments and to develop digital teaching content.[448]

The use of digital teaching and learning formats continues to lag behind the infrastructural framework conditions. The survey shows that mobile learning and social media are used frequently at 25 percent and 19 percent of TE institutions respectively. Only 13 percent of institutions use inverted classroom formats to a high or very high degree. The proportion of responding institutions who said they use adaptive learning, augmented/virtual reality and digital game-based learning on a frequent or very frequent basis in their teaching was between 6 and 7 percent (cf. infographic).[449]

These results are supported by a 2017 survey that examined digital teaching in TE institutions.[450] However, the survey also shows that a majority of teaching staff consider the technical equipment at TE institutions to be good.[451]

Incentives to develop digital teaching formats

In the survey conducted on behalf of the Commission of Experts, 62 percent of responding TE institutions indicated that they have put specific incentives in place to encourage teaching staff to supplement and develop their teaching with digital tools.[452] The incentives mentioned by institutions include the provision of additional personnel capacities in the form of substitute teachers and student staff (64 percent). Other measures include highlighting digital teaching formats as examples of good practice (53 percent), awarding prizes and bonuses to teaching staff (50 percent) and reducing teaching obligations (39 percent).[453]

Creating incentives for digital teaching by giving due consideration to the additional effort in the teaching loads entails further challenges for higher education institutions.[454] The digitalization of teaching is accompanied by significant one-time expenditure for initial set-up, but requires low expenditure for the subsequent use of teaching materials. The effort required to create such materials is only difficult to illustrate in a teaching load distribution system that has been based on attendance teaching to date. It is therefore necessary to develop incentive-compatible concepts.

A fundamental problem with the expansion of digital teaching formats is that teaching is still not the primary quality criterion upon which academic staff at TE institutions are evaluated. Furthermore, many teachers find the support and consultancy services currently offered by institutions' service centres to be insufficient.[455] Furthermore, it is difficult for the TE institutions to provide incentives for digital teaching, as there are uncertainties with regard to the legal requirements for teaching loads.[455]

International trends in digital teaching

German TE institutions have not yet expanded their digital offerings in response to the sharp increase in international demand for degree-level education. While globally oriented education platforms have become established in the USA, Asia and some European countries[457] and are developing new online services on a large scale,[458] German TE institutions primarily use their learning platforms for their own needs or within small-scale partnerships. Digital learning formats for the international market are mostly marketed by established overseas providers.[459] The most notable of these learning formats are open access online courses and massive open online courses (MOOCs), some of which are supervised by tutors and can sometimes lead to formal certification. The range of digital learning courses on offer is growing dynamically: between 70 and 140 new online courses are launched around the world every month. At present, 180 of the 6,800 courses available online are offered by German education institutions.[460]

Internationally, two in three new courses now offer the option of earning a formal certificate known as a micro-degree.[461] In addition, online courses are increasingly designed as MicroMasters programmes. MicroMasters programmes are multi-stage Masters courses with mandatory examinations which award MicroMasters certificates that can, in turn, be put towards a 'full' Masters course at a TE institution.[462] German organizations that offer MicroMasters programmes include openHPI, oncampus and Hamburg Open Online University (HOOU).[463]

In 2017, RWTH Aachen University became one of the first German TE institutions to offer a MicroMasters course via the international online learning platform edX.[464] Another way of using internationally available MOOCs is to integrate them in institutions' own Masters programmes. For instance, students at the Baden-Wuerttemberg Cooperative State University (Duale Hochschule Baden-Württemberg, DHBW) have the option of earning the credits required for their course of study by completing a MicroMasters programme offered by the Massachusetts Institute of Technology (MIT).[465]

Internationally renowned universities such as MIT and the École Polytechnique Fédérale de Lausanne (EPFL) have now implemented digital teaching platforms in order to attract exceptionally talented students who successfully complete online programmes to undertake attendance courses at the institution itself.[466]

In its annual reports, the Commission of Experts has repeatedly called for the growing importance of further education opportunities to be afforded greater attention to ensure that the digital transformation is a success.[467] In the view of the Commission of Experts, online learning programmes such as MOOCs and MicroMasters programmes represent important and useful additions to the existing range of teaching instruments.[468]

The Commission of Experts regrets the reticence of German TE institutions to engage in the systematic development and provision of innovative digital education and further education programmes.

Digitalization of administration: Non-study-related processes have ground to make up

The digitalization of administration involves reshaping administrative workflows into digitally networked processes.

The results of the survey conducted on behalf of the Commission of Experts indicate that study-related IT systems (such as study-focused campus management systems)[469] (cf. box B 4-3) feature a higher degree of implementation than non-study-related IT systems (such as computer-aided facility and enterprise resource planning systems)[470] – a trend discernible across all TE institutions.

Study-related administrative processes include, among others, processing admission applications, generating decision letters and issuing grade announcements, as well as student matriculation. These processes operate with a high degree of digitalization across TE institutions. For instance, 66 percent of responding institutions generate decision letters and grade announcements using fully electronic processes; 56 percent process admission applications in this manner. Furthermore, students can use a fully digital process to matriculate at 42 percent of responding institutions.[471]

By contrast, the degree to which non-study-related administrative processes – such as processing travel cost claims, business travel applications and procurement requests – have been digitalized is assessed as being markedly lower.[472] Less than 20 percent of responding institutions have fully digitalized these processes.[473] The assertion that German TE institutions have ground to make up in terms of the digitalization of administrative processes is confirmed by a comparison with the progress made at Swiss institutions.[474]

The digitalization of administrative processes at TE institutions is covered by the provisions of the Online Access Act (Onlinezugangsgesetz, OZG), which aims to advance the digitalization of public administration and entered into force in August 2017.[475] The OZG stipulates that, by the end of 2022, all administrative services provided by the federal government, the federal states and local authorities must be accessible online for the respective users via an online administration portal. According to the OZG implementation catalogue, TE institutions must make all administrative services that relate to a course of study (e.g. matriculation, applying for a leave of absence, awarding study places and issuing electronic copies of diplomas) available in digital form. The legislation also addresses support for potential applicants and when arranging student finance.[476]

To achieve these targets, the digitalization process and the internal networking of institutions' administrative systems will have to accelerate considerably in the years ahead.

Box B 4-3

Example of good practice in administration: Technical University of Munich – TUMonline

TUMonline is the campus management system operated by the Technical University of Munich (TUM). Since going live in 2010, it has been continuously developed in terms of user-friendliness and process optimization.

TUMonline supports all IT processes connected to the study cycle. This includes overseeing admission processes and student, seminar, module and examination management, as well as handling accreditations, degree administration, evaluation and alumni management.[477]

In terms of studies and examinations, digital applications are available via TUMonline for the following administrative services: degree course and examination administration, producing transcript records and examination decisions, administration of final exams, producing diplomas and confirming accreditations and recognitions. Students can also use TUMonline to create new recognitions, generate advance printouts for proof of successful study and create matriculation certificate.

It is absolutely crucial that the system is user-friendly. From the outset, the aim has been to make the system easy to navigate, to ensure the layout and operability are as user-friendly as possible and to make ongoing improvements to the system.

TUMonline also provides users with a wide range of advice and support. Teaching staff, students and support staff can access instructions and tutorial videos on the functions of TUMonline.[478]

B 4-2 Challenges for the digitalization of tertiary education institutions

Potential of cooperation on digitalization not yet exhausted

Intensifying cooperation between institutions is a commonly used method of exploiting digitalized processes' potential to increase efficiency in tertiary education. According to TE institutions, the field of standardisable, non-profile-related processes are particularly fertile ground for such cooperation.[479] The survey conducted on behalf of the Commission of Experts revealed that TE institutions are engaged in associations and collaborative endeavours in the following focus areas: digitalizing teaching and learning (72 percent), digitalizing infrastructure (67 percent), digitalizing administration (58 percent) and digitalizing research (49 percent).[480]

A large part of the associations and collaborative endeavours are located within a single Bundesland (cf. figure B 4-4).[481] In all areas, the proportion of TE institutions engaged in associations and collaborative endeavours within their respective Bundesland is over 50 percent. International associations and collaborative endeavours are least common. It can be seen that international collaborative endeavours most commonly relate to the digitalization of research.[482]

The high level of cooperation within individual Länder can be explained, among other aspects, by the fact that the Länder governments not only support their TE institutions but also initiate, promote and demand collaboration projects themselves.[483]

Research: Collaborative endeavours in digitalization projects within specialist disciplines are particularly important, as subject specifics have to be considered – not only in research but also, for example, in terms of research data management.[484]

Teaching and study: Collaborative endeavours enable teaching materials to be created and shared and can even make it possible to offer a joint range of courses that a single institution would be unable to provide.[485] Collaborative endeavours to develop the skills of teaching staff play a major role, especially at state level within a Bundesland.[486]

Administration: TE institutions consider collaboration and inter-institutional service offerings on legal and technical issues to be particularly helpful – such as in relation to collaboration agreements, implementing regulations, data protection, IT security, procurement law, the publication of examples of good practice as well as the setup of digital infrastructure.[487]

Further collaboration is needed in relation to IT services. German TE institutions use various IT services (e.g. cloud services, video and media servers) provided by the institutes' own computing centres. These represent alternatives to commercial options offered by private-sector providers. To provide their own cloud services and media servers, institutions are forced to tie up a significant amount of already limited resources – which is why TE institutions work together to develop IT services.[488] One drawback of these alternative services is that they are usually funded at state level, precluding their use in other Länder.[489]

There is also a need for TE institutions to adopt coordinated approach when purchasing software licenses. Acquiring such licences can entail significant costs when institutions act alone. Centralized licence procurement is not generally in place at state level. As a result, it is difficult for TE institutions to negotiate favourable conditions with software providers.

Digitalization demands long-term funding

Digitalization is a resource-intensive, long-term task facing the tertiary education system – a system which has been subject to chronic underfunding for many years and which is characterized to a large extent by programme and project funds that are only temporarily available.[490]

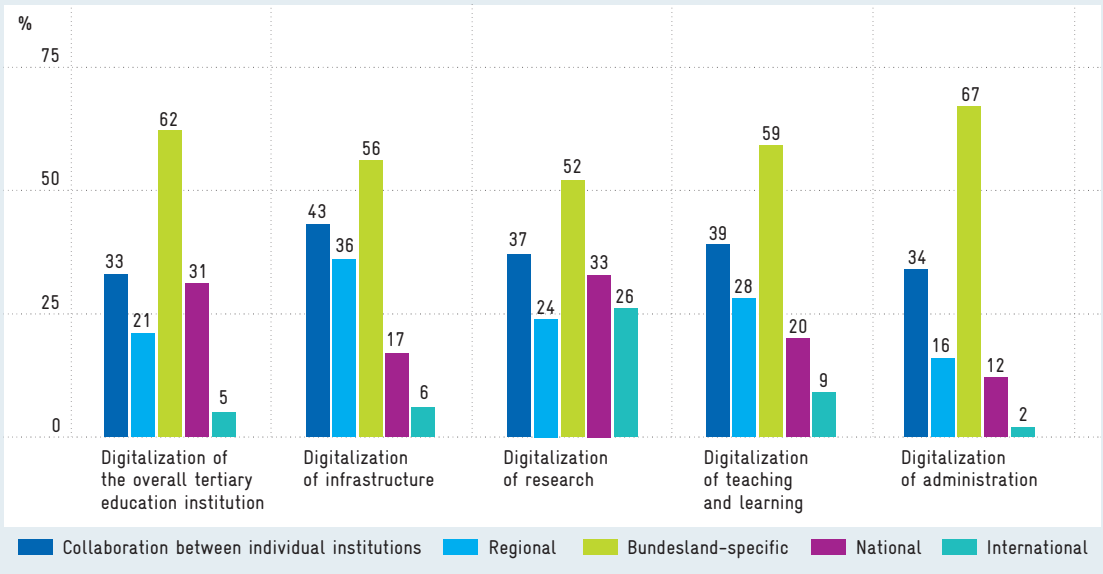
The Federal Government and Länder initiated numerous funding programmes and initiatives in response to institutions' digitalization-related funding requirements. Despite these measures, TE institutions name resource issues as a central challenge. Indeed, some institutions – primarily large universities and universities of applied sciences (FHs/HAWs) – finance the infrastructural requirements for digitalization through basic funds freed up by restructuring their budgets.[491] Most TE institutions, however, rely on third-party funding from Federal Government and Länder to finance their digital infrastructure. Since digitalization is a permanent task for TE institutions, project funds are not sufficient from a TE institutions' perspective to implement digitalization projects in a sustainable and coordinated manner on a broad scale.

TE institutions' representatives who responded to the survey said that project funding often leads to the creation of parallel structures and isolated applications[492] because IT software and hardware is repeatedly installed 'as new' in funded projects rather than being integrated in the existing IT landscape.

Fig. B 4-4

Download data

Scope of associations and collaborative endeavours to digitalize German tertiary education institutions as percentages



Source: Gilch et al. (2019: 130).

The result is growing complexity and fragmentation, which prevents synergies and has a negative impact on the usability of IT systems. Furthermore, the temporary and somewhat unpredictable nature of project funding makes it harder for institutions to set medium-term and long-term strategic goals for digitalization projects.[493]

Measures taken by the Federal Government and the Länder

The Federal Government is playing its part in promoting the digitalization of tertiary education through the programme agreed with the Länder (Quality Pact for Teaching), which aims to improve studying conditions and boost the quality of teaching. As part of the competitively structured Quality Pact for Teaching, the Federal Government will provide around €2 billion for projects in the TE sector between 2011 and 2020. Even though the Quality Pact for Teaching is not explicitly aimed at financing digitalization projects, a large amount of the funding is used for this purpose. According to the BMBF, digitalization and the use of digital technologies are important aspects in about half of the funded projects.[494]

In addition, the BMBF supports research into digital teaching methods in tertiary education and research data management. Funded research projects will examine the effectiveness of proven and innovative approaches and formats in digital tertiary education.[495]

In this context, the BMBF also promotes the German Forum for Higher Education in the Digital Age (Hochschulforum Digitalisierung, HFD), an independent national platform which encourages engagement with digitalization; it also brings together and advises institutions and actors from the fields of politics and business on the challenges the issue poses.[496]

The Federal Government addressed the issue of the digitalization of TE institutions in its coalition agreement.[497] The agreement announced that, in relation to digitalization, institutions would be supported in improving the quality of studying, teaching and research as well as enhancing the quality of administration and academic exchange. TE institutions and TE associations innovative in digitalisation are to be awarded funding via a competitive process. Support has also been announced for concepts to network institutions, such as teaching and learning platforms.[498]

The majority of German Länder have proposed digitalization strategies and concepts in recent years.[499] Most – but not all – of these digitalization concepts feature targets with a specific academic focus or which relate to TE institutions. In concepts that include corresponding targets, it is possible to determine various areas of focus. These are usually the promotion of the digitalization of teaching and learning as well as of research.

Recruitment of IT specialists hampered by inflexible tariff structures

TE institutions have reported serious issues due to a shortage of IT specialists. There are no significant differences with respect to the type and size of tertiary education institution.[500]

According to the institutions themselves, the main challenge in the recruitment of IT specialists lies in the established pay-scale groupings for IT specialists. A study conducted by the IT Planning Council (IT-Planungsrat) supports this assessment: it found that the most common reason given by candidates who withdrew their applications for public-sector IT positions was that the offered wage was too low.[501]

The shortage of skilled workers affects TE institutions in locations with strong, high-growth economies in particular, as they are in direct competition with companies prepared to pay higher wages for IT specialists.[502] TE institutions are also at a disadvantage compared to non-university research institutions (außeruniversitäre Forschungseinrichtungen, AUFs). The majority of AUFs financed by the Federal Government are subject to the Collective Wage Agreement for the Civil Service (Tarifvertrag für Einrichtungen der öffentichen Verwaltung von Bund und Kommunen, TVöD) as opposed to the corresponding wage agreement applied at Länder level (Tarifvertrag der Länder, TVL).[503] Compared to the TVöD, the TV-L lacks flexibility.[504]

Furthermore, the TVöD is subject to a supplementary guideline for employers issued by the Federation of Municipal Employers' Associations (Vereinigung der kommunalen Arbeitgeberverbände) for the recruitment and retention of skilled workers,[505] which will make it possible to classify newly appointed IT

specialists in higher groupings in salary tables and to consider allowances.[506]

TE institutions are also less attractive destinations for IT specialists due to the tendering of mainly temporary employment contracts. Many IT positions are temporary due to the prevailing project financing structure applied to digitalization projects in TE institutions (cf. p. 101). The situation at many institutions is further complicated by the aforementioned deficits in TE institutions' governance systems (cf. p. 94): the insufficient professionalization of management structures means that TE institutions are not making sufficient use of the legal options to make employment relationships more flexible.

Significant uncertainty in relation to data protection and copyright law

Data protection poses problems for many TE institutions. There is considerable uncertainty regarding the implementation of data protection regulations in day-to-day operations. In particular, the European Union's General Data Protection Regulation (GDPR) is repeatedly cited as a problem in the digitalization of administration and teaching. Regulations set by the Federal Government and the Länder further complicate matters. TE institutions emphasize that, while data protection may not prevent digitalization projects from being implemented altogether, it does entail a significant degree of extra effort and reviewing work.[507]

Due to reservations and a lack of knowledge about the opportunities permitted by data protection legislation, TE institutions have only used learning analytics software[508] to a very limited extent.[509] Institutions' data protection officers often lack the resources to handle the scope and complexity of the topic.[510] If the issues surrounding data protection were resolved, learning analytics would offer a major opportunity to develop the quality and didactics of teaching and deploy resources more efficiently.[511]

The use of IT services offered by commercial providers by employees of TE institutions is another issue with implications for data protection. For example, Dropbox, Google Docs and Skype are popular and frequently used due to the high level of user-friendliness they offer. However, using such IT services is questionable from a data protection perspective because personal data can be stored on servers which are located outside the European Economic Area and which are not GDPR-compliant.[512] Until the IT services provided by TE institutions offer a similar degree of user-friendliness, user behaviour cannot be expected to change.

Studies have also repeatedly mentioned copyright law as a problem in the digitalization of TE institutions, since the provision and use of digital works (e.g. in key texts and materials, in teaching and in research) was only possible within narrow limits.[513] The Commission of Experts criticized the existing legal framework in its 2015 report and called for the introduction of a general exemption to copyright for scientific and educational purposes.[514] In copyright law, such exemptions limit the exploitation rights of originators in certain situations.[515]

The Federal Government took this criticism on board and, through the Act to Revise Copyright Law to the Requirements of the Knowledge-Based Society (Gesetz zur Angleichung des Urheberrechts an die aktuellen Erfordernisse der Wissensgesellschaft, UrhWissG), introduced such a general exemption to copyright for scientific and educational purposes.[516] Despite the remaining usage restrictions, the reform has, overall, provided more clarity and made it easier for teaching staff and researchers at TE institutions to copy and distribute published works.[517] The reform came into force on 1 March 2018. It is set to be evaluated after four years and is initially in force until the end of February 2023.[518] The Commission of Experts welcomes this development.

Recommendations B 4–3

Recommendations for tertiary education institutions

In the digitalization of the TE institutions, a technically complex task is compounded by inadequately developed governance structures. For digitalization to succeed, the TE institutions must continue to modernize their administration and overcome departmental thinking ("silo mentality").[519]

– In view of this, the Commission of Experts recommends that TE institutions develop a digitalization strategy with clearly defined goals and a suitably coordinated implementation plan. Such a digitalization strategy should go hand in hand with profile-building measures by TE

institutions – something the Commission of Experts has repeatedly advocated. The need for extra-occupational training should be taken into account in particular.
– TE institutions should increase their negotiating power by bundling the purchase of licenses on an inter-university basis. As yet, there is no institution or body that negotiates TE institutions' licences for software, platforms, cloud services, etc. The Ministries of Science and Culture of the Länder can provide support for this process.

Recommendations for education and tertiary education policy

– The digitalization of Germany's structurally under-financed tertiary education system is an ongoing task which requires long-term financing. The Commission of Experts recommends that the TE institutions should be supported through the introduction of a lump-sum digitalization payment. TE institutions should receive a specific amount per student with which to develop and maintain their digital infrastructure and applications and expand their digital teaching and learning offerings.
– The support for the digitalization of TE institutions through competitively awarded project funding should continue in order to incentivize innovative TE institutions and motivated individuals.
– If digitalization leads to increased efficiency at TE institutions and thereby creates additional financial leeway, these should be permanently available to TE institutions for qualitative improvements in infrastructure, teaching and research.
– In order to make it easier for TE institutions to recruit IT specialists, the Commission of Experts recommends that the Länder, in their capacity as public service employers, should introduce some flexibility into the existing pay regulations with an orientation towards the Collective Agreement for the Public Service (Tarifvertrag für den öffentlichen Dienst, TVöD).
– Digitalization presents comprehensive technical, organizational and legal challenges for TE institutions. Small institutions in particular find it difficult to make sufficient capacity available. The Commission of Experts therefore suggests that TE institutions should be supported through the creation of IT service centres and by strengthening existing advisory and support institutions.