Chapter 2
From Lines of Development to Scenarios

Abstract After examining the current developments in the field of knowledge and competence requirements, university teaching and technology, and their effects on a digital society through various background studies, this chapter focuses on modeling and developing different scenarios and discussions with regard to technology and social developments. Different economic and social requirements as well as new forms of didactics and learning environments will lead to necessary changes in higher education. It should provide a link between continuing and higher education by identifying new ways of recognizing skills acquired informally. Strong support most notably for new students, should combine performing, developing, and explorative teaching and learning situations. Meanwhile, it will be essential for the didactics of the future to be sensitive to the needs of learners and offer individualized support for student-learning paths, making education independent of time and place. Finally, selected approaches to developing future scenarios in higher education focusing on institutions and governance issues, technology, and social developments are discussed in more detail.

The study assumes that higher education will change by 2030 as a result of developments in the following areas:

- Knowledge and competence requirements emerging from the economy, as well as social changes in an increasingly digitalized world;
- New developments in didactics, arising from didactic discussions of the subject;
- Digital technologies and new uses of technology that enable new forms of learning and learning environments.

As a first step, this study used methods of systematic analysis, based on the literature review, data analysis, interviews, and expert discussions, to identify likely potential changes in the future higher education landscape. To scan the higher education horizon (Amanatidou et al., 2012), these analyses have been condensed into future scenarios in the second step; they have been validated and further developed

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through a broad discussion with experts from the university sector, politics, and students. In addition, innovative practical examples have been sought from all parts of the world and incorporated into the developing scenario, as possible future models.

Detailed information on all of these areas can be found in the appendix.[1] The following section presents the most important results of the investigation, which have significantly influenced the scenario-development process.

2.1 Background Studies

2.1.1 A Literature Analysis and the Future of Higher Education

The Big Data approach was initially used to carry out a literature and citation analysis, with specialist literature[2] identified via the Web of Science database. The central search terms were as follows: higher education/universit[y/ies], futur[e], digital, work, competenc[y/ies], and labo[u]r [market/force]. A total of 15,249 predominantly English-language articles, published during the last 40 years, were included in the analysis (83% were published during the last ten years).

This data set was analyzed thematically to determine the importance of certain topics in the literature. Ten thematic terms were used for the analysis; these were searched for in titles, abstracts, and keywords. The thematic terms covered the following areas: learning; knowledge; skills (competency, skills, learning); teaching; students; the labor market; work; technology (technology, digital); other aspects of digitization (digital divide, data security); and higher education. A meta-analysis of the main topics by discipline provides the first glimpse into discussions about the future of universities. This analysis, however, has focused on selections in which the words "*future*" and "*university*" appear together ($n = 8359$). Figure 2.1 compares the priorities of the educational sciences, psychology, business studies, and computer science.[3]

This comparative analysis clearly shows the thematic focus of the contributions by discipline; the findings can be summarized in the following three core statements:

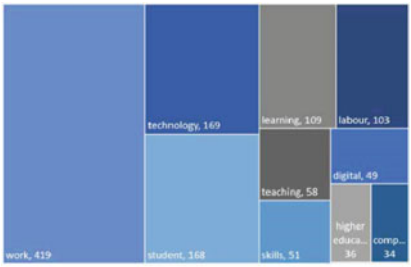
1. The economic view of the future of universities is clearly focused on students, within the context of the labor market and labor market requirements.

[1] The appendix is only available in German.

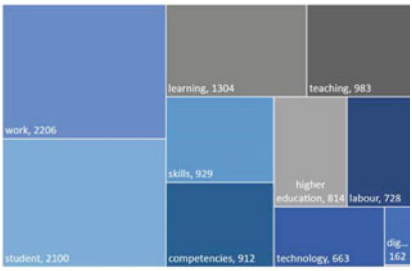
[2] This database holds and provides an index of published literature (in particular, articles from scientific journals) in a wide range of disciplines, including medicine, the natural sciences, humanities, the social sciences, and economics.

[3] Individual contributions can also be assigned to several disciplines.

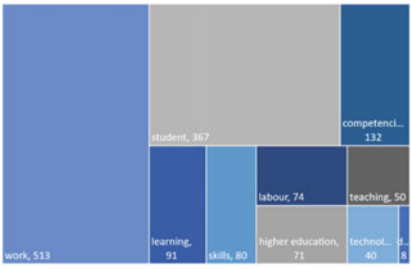
Literature from the field of computer sciences (n=441)



Literature from the field of education sciences (n=2686)



Literature from the field of psychology (n=607)



Literature from the field of business studies (n=629)

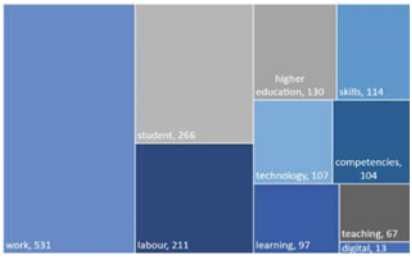


Fig. 2.1 Frequency of named keywords in the body of literature studied (The terms "digital divide" and "data security" do not appear in all of the illustrations because they occurred so rarely). *Source* Own illustration

2. By contrast, the educational science perspective emphasizes the role of learning and the skills and competences that students must acquire to succeed in the labor market.
3. Technology and digitization are thematic focal points for computer science only.

This insight leads to the conclusion that a comprehensive view of higher education in 2030 must unite all perspectives into one picture of the future. The following sections present the findings on and expectations of future higher education obtained from the literature and data analysis, as well as from expert interviews on the three perspectives mentioned.

2.1.2 Knowledge and Competence Requirements of a Digital Society

According to the German Rectors' Conference, "Universities are the 'engines' of economic and social innovation in Germany and a key sector for the road to 'Industry 4.0'" (HRK, 2018). They are characterized by the promotion of professional development, the transfer of knowledge, and practical education. Accordingly, it is a priority for higher education to prepare for central trends and movements in society, but also to shape such developments. It is not enough to focus solely on the new generation of university graduates. Technological progress in a digital world—coupled with demographic change—means that **higher education** must finally be **opened to all**. With regard to 2030, the "Action Council on Education" (Aktionsrat Bildung) writes: "In view of the accelerating pace of technological progress, however, it will be less and less sufficient in future to cope with the structural change in occupations through the arrival of graduates with new qualifications" (Blossfeld et al., 2017). Older workers will also need new skills.

The particular challenge of the twenty-first century is to ensure that all parts of society benefit from the increasing integration of digitization into society. Discussions about future requirements of the labor market, due to the effects of automation, artificial intelligence, and Big Data-based algorithms, point to massive changes. It is expected that this dynamic will result in the majority of graduates **changing career paths several times** during their lives (Manyika et al., 2017; OECD, 2017a). In many sectors of the labor market, employees will require retraining and new learning to reposition themselves as capable of implementing the technologically improved processes that will increasingly define their workplaces. It is the task of business, interest groups, and politicians to promote and facilitate this process of change.

Many recent studies of labor market developments have addressed the polarization expected as a result of increasing digitization. The trend is toward tasks that require more advanced professional skills, coupled with social, and emotional skills as the study of selected OECD countries has shown (Nedelkoska & Quintini, 2018). In addition, the labor market is eroding. Professions that require mid-level qualifications (i.e., high-level technical training but no academic degree) and involve moderately

difficult routine tasks, appear to be declining. Such professions are costly enough to justify investing in their replacement but routine enough to be susceptible to replacement by automation (OECD, 2016; Zenhäusern & Vaterlaus, 2017).

However, another OECD analysis has shown that, in most sectors of the economy, the decline in employment at the intermediate-qualification level is fully offset by growth at the high-qualification level (OECD, 2017b). To date, the two sectors that have experienced the greatest changes in this direction are the paper and publishing industry and the financial and insurance sectors. In the wholesale and retail trade and hotel and restaurant sectors, employment by skill level has declined, contrary to the general trend (i.e., jobs are being cut in these sectors). Even when such transformations do not lead to job losses, an analysis of job markets in Germany and Austria has shown that wages for employees unable to make this change are declining (Südekum, 2018).

Where these analyses are broad in scope, they conceal differences between occupations that require an intermediate level of skill. An analysis based on the US data has shown the same decline in medium-skilled jobs, with weak growth in some sectors. Holzer has identified "new medium-sized jobs" that are currently being created in the labor market (Holzer, 2015). The professions involved include specialized health technicians (e.g., phlebotomists, X-ray technicians), paralegals, security services, cooks, managers of food and beverage companies, retail managers, and field representatives. In contrast to the "old middle," most of these modern workplaces expect their employees to carry out relatively complex technical, administrative, or communicative tasks. An expanding and differentiating working population needs more opportunities to engage in higher education at different phases of life; learners from this group also have very different educational biographies.

The central role of economic institutions is to find new forms of organization, production, and supply processes to ensure their economic survival and success. As **learning also takes place within business enterprises**, it makes sense to integrate learning experiences more effectively through exchanges between companies and universities.

It is the responsibility of the education system **to educate and train future and current workers, ensuring that they acquire appropriate knowledge and skills**. The education system must ensure that current workers can benefit from new developments, while also enabling new generations of entrepreneurs to become reflective and innovative and to create new businesses that operate sustainably in a global world.

Workers must be resilient enough to cope with change; they must be able to reposition themselves throughout their careers. They must also be creative enough to solve problems and develop new ideas for future progress. Many people are expected to work in jobs that do not exist today. A work report proposed 21 such jobs, including Human–Machine–Teaming Managers, Big Data Detectives, AI-based Personal Health Technicians, Digital Tailors, and Personal Data Brokers (Pring, Brown, Davis, Bahl, & Cook, 2017). Although such jobs are unlikely to represent a large section of the future labor market in 2030, all employees will need to be tech-savvy. A central aspect of many workplaces will revolve around enabling people (with different

backgrounds and specializations) and machines to work together in teams to exploit the possibilities of personal data securely while protecting personal identity. What is certain, therefore, is that the **mix of standardized knowledge, new knowledge, and transversal skills** in all training programs will have to be reviewed regularly in the future (OECD, 2018b; Universities UK, 2018).

The demand for university graduates in the labor market, both in terms of employment levels and relative wage premiums (European Commission/EACEA/Eurydice, 2018), indicates that university graduates are already acquiring some of these competences through their studies or as students. However, this is not the whole truth. A European survey of new recruits found that graduates were much less likely to feel underqualified in their new jobs (i.e., that their current skills were below their job demands in self-assessments) than were employees whose formal education was below university level (CEDEFOP, 2018). Nevertheless, the same study also showed that more than a fifth of all graduates felt poorly prepared for their new jobs.

As shown in Fig. 2.2, graduates were most likely to feel underqualified in the fields of engineering, medicine, and agriculture. The authors of the present study have assumed that this finding reflects (among other things) a constantly changing qualification context, due to the continuing development of new technologies, working methods, and techniques (CEDEFOP, 2018). Another study, based on the same dataset, has argued that the lack of standard knowledge in these specific areas is a less significant issue than deficits in soft skills, such as patient-communication skills and teamwork preparation (Livanos & Nunez, 2015). These deficits in the preparation and support of medicine are already widely discussed in Germany (Kuhn, Jungmann, Deutsch, Drees, & Rommens, 2018).

These data initially reflect the transition from education to working life. In an innovative environment, such learning curves are likely to be repeated, as jobs are reorganized and practices changed to make the best use of digital opportunities over

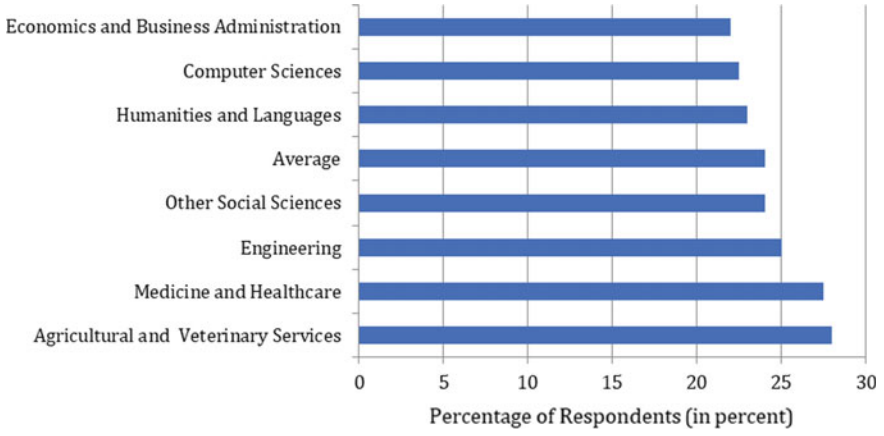


Fig. 2.2 Perception of being unqualified among graduates recruited by subject area (selected areas), share 2014 (EU-28). *Source* Cedefop European skills and job survey (ESJS)

the course of a career (Bessen, 2015). As **the question of the optimal knowledge and competence profile for employees** continues to arise and be debated, new learning options seem necessary.

Conclusion: Requirements for Higher Education in 2030

Higher education can contribute to meeting the challenges posed by changes in the labor market through the following measures:

- All higher education programs should review their learning objectives to ensure that they explicitly address learning that combines disciplinary knowledge, basic skills, transversal skills, and digital skills.
- As multiple skills will need to be combined and applied simultaneously in an (often international) teamwork environment, authentic learning that establishes a strong link to future workplaces will become an increasingly important didactic tool.
- As changes in the labor market increase, employees will require more frequent learning processes and experiences. To meet this need, opportunities to begin and leave degree programs should be made more flexible (e.g., through modules and credits). Learning opportunities should be provided in ways that allow people to complete aspects of learning alongside their careers.
- In the future, employees without a university degree will tend to work in occupations in which a high degree of automation can be expected. Their skill profiles are more likely to be deficient in basic, transversal, and digital skills; they are also less likely to receive further training over the course of their careers. Higher education providers can help to reintegrate such employees into formal education.
- Since informal learning (at least) takes place continuously throughout most people's lives, one way to activate further learning paths is to identify new ways of recognizing skills learned informally, as an aspect of formal learning paths, both during and potentially through higher education. Universities could establish themselves as important actors by providing accreditation and learning support to the whole population. To achieve a highly responsive higher education sector, it will be essential to strengthen the cooperation between continuing and higher education, as the current structure lacks clear linear pathways from higher education to career development. Supplements from continuing education alone are unlikely to resolve this challenge in the future.

2.1.3 *University Didactics-Related Challenges for a Digital Society*

This section investigates the university from an internal perspective, identifying the trends expected to shape university didactics in the year 2030. The term "didactics" denotes the relationship between content (What is to be taught?), activation/motivation (How do learners succeed in being motivated to learn?), and support (How are learners accompanied in learning?) (Reinmann, 2015).[4] For the period up to 2030, didactics are likely to focus on activating learners, rather than the range of courses on offer. Although this so-called "shift from teaching to learning" is not new (Barr & Tagg, 1995; Cedefop, 2009), it is likely to remain a dominant paradigm in the context of digitally supported learning arrangements that offer effective learning scenarios to heterogeneous groups of learners.

An analysis of the relevant educational and pedagogical literature, carried out within this study, confirms that the question of learning is prominent in higher education.[5] The topic includes student learning, student engagement, and students' capacity for self-efficacy and self-regulation. Even the assessment of learning outcomes is offered to students as individuals or in their role as "peers." The teachers and teaching disappear almost completely behind them.

The textual evaluation of relevant articles shows that a wide range of terms is associated with the topic "learning," corresponding to the new didactic triangle between active learning, technology, and network structures (see Fig. 2.3). New technologies, coupled with high user competence and acceptance and the network effects of social platforms, can support a more inductive and collaborative form of learning.

Expert surveys and interviews carried out during the investigation of this complex of topics also reflect the diversity of future forms of learning. From the expert point of view, the question of how learning spaces can be structured, sometimes collaboratively and sometimes autonomously, will be relevant at least until 2030 (Schön, Ebner, & Schön, 2016).

The question of whether digitally supported methods should be used for learning is suppressed. Instead, a "fusion" of forms of learning can be observed, carried out more frequently on-campus and online. This structure requires **flexibility in the roles of teachers and students** and in the configuration of their interrelationships and learning content (Miyazoe & Anderson, 2013; Moore, 1993) (see Table 2.1). This poses a significant challenge for the future.

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[4] During an early phase of project development, the authors of the study were advised on university didactics-related challenges by Sandra Hofhues, whose suggestions were incorporated into this chapter and the in-depth report "A3 University Teaching Challenges within a Digital Society" (see Annex 6.1.3). The authors thank Sandra Hofhues for her support.

[5] Articles published in the following journals in 2017–2018 were evaluated ($n = 509$): *Internet and Higher Education, Research in Higher Education, Journal of Higher Education, Studies in Higher Education, Review of Higher Education, Community College Review, Assessment and Evaluation in Higher Education, Active Learning in Higher Education, Higher Education Research and Development, Journal of Computing in Higher Education, and Perspectives: Policy and Practice in Higher Education*.

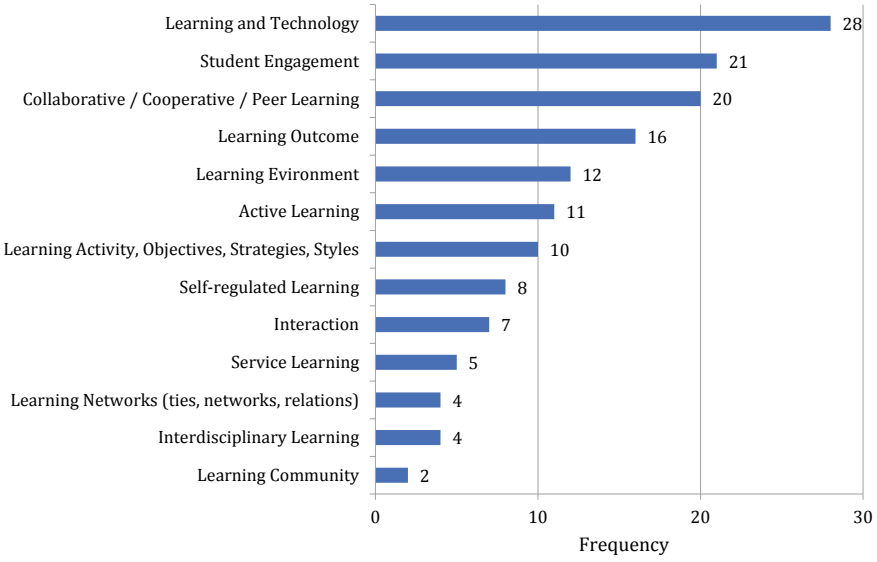

Fig. 2.3 Literature analysis—the evaluation of frequencies in the category "learning." *Source* Own illustration

Table 2.1 Various learning arrangements

Learning arrangement	Presenting	Moderating	Exploring
The teaching procedure is …	teacher-led, deductive	teacher-led, inductive	learner-led, inductive
The role of teachers is …	leading, guiding	developing, guiding	stimulating, advising
The role of the learner is …	receiving comprehensively	participating, thinking, instructing, working	working independently
The learning content …	is provided by teachers and received by learners	is determined by learners and teachers together and worked on by learners under guidance	is worked on by learners independently

Source Schön et al. (2016)

The expert survey particularly emphasized the need to reorient didactics, in the context of digitization. The standard model of classroom teaching needs further development. Presence learning will be combined with web-based learning processes. In addition, **new institutional formats for didactic self-reflection** and the development of teaching and learning cultures will be needed to keep pace with increasing

processes of change. Bottom-up developments, resulting from the active practice of teachers and learners, must be embraced.

By contrast, important trend reports on this topic highlight the qualitative changes that are influencing the demand for study programs. Demand will increase for lifelong learning courses, online and blended-learning courses, credential unbundling, and courses that add the greatest value to professional careers. These demands will ultimately lead to new types of offers being made in the field of higher education.

Sensitivity and openness in higher education will be necessary, especially in relation to learning content. Research shows that the **development of "studyability"** is a long-term process that usually starts in school but continues through the initial phase of education. In Germany, as in other countries, most universities have introduced support and bridge courses to meet this demand. The expert interviews emphasized the central importance of such support measures, which can respond to the differing needs of learners. In particular, attention must be paid to the future development and support of student-learning empowerment, i.e., students' competence at self-regulated learning, which is central to both "working" and "explorative" learning arrangements. As students from underrepresented groups are often uncertain about their choice of field (Hauschildt, Vögtle, & Gwosć, 2018), too much flexibility in educational design could exacerbate this uncertainty.

Digitization may offer some solutions. It has been shown that digital **bridge and support programs** can help to reduce student concerns by offering better study orientation (Bidarra & Rusman, 2017; Ubachs, Konings, & Brown, 2017). According to the experts, learning processes in higher education are individualized; more effective learning is achieved through learning analytics—for example, when the data generated in learning-management systems are evaluated and used to optimize learning processes. This also means that the higher education system must increasingly rely on the enhanced competence of teaching staff, who must understand how this information can be used to promote learning.

Openness in higher education is needed to provide learning plans, objectives, and curricula. In addition to enabling students to acquire general skills (including soft skills and "learning to learn"), higher education teaches specific bodies of knowledge and skills required for particular fields of work or specializations (e.g., engineering or law); these build the foundation for workplace effectiveness. To identify and transmit such knowledge and skills, stakeholders must reach a consensus on the abilities needed in particular areas. In an era of digitization, this consensus will be subject to constant review (Eckert et al., 2018). Analogous to "Industry 4.0" (see Sect. 2.1.2), higher education needs a "Curriculum 4.0".

> As a Curriculum 4.0, we understand a curriculum that takes up the process of digital transformation in a targeted manner, both in terms of content and at the level of the skills and competences to be taught. (…) [We] view digital change in the context of curriculum development holistically as a technical, didactic, and content-related challenge. (Michel et al., 2018)

Effective and individualized university didactics must be based on educational research, which examines and improves learning and educational processes and

investigates the impact of learning arrangements. Both the literature and expert discussions revealed deficits in this area that must be resolved by 2030 if higher education is to become more effective and inclusive. In addition, the educational mandate must be increasingly reflected in society.

Michael Feldstein, a well-known expert from the American educational technology sector, published a pointed presentation on this situation at the beginning of 2019. In his view, new technological developments will only improve learning if educational research can establish a basic consensus on the central dimensions of the learning system:

> This is not something that could be 'overhauled' by the magic of machine learning. (…) We investigate complex processes that we largely cannot see. When we develop tools that give us visibility, we often lack the theoretical foundation (…) to understand what we see. With many things we learn, we do not yet know how to apply them, and much of what we can apply is separate from our still blurred picture of how learning works. (Feldstein, 2019)

Conclusion: Requirements for Higher Education 2030

The further development of higher education didactics will play a central role in creating effective and inclusive higher education for all. The following factors are particularly important:

- The provision of flexible higher education depends on didactics that are sensitive to the needs of learners and open to the needs of society and the labor market.
- Higher education is based on the didactic triangle between active learning, technology, and network structures; this triangle mediates, appropriates, and explores learning materials. Digitized solutions can support learning processes and interactions between learners.
- Up-to-date didactics for higher education in 2030 will include new institutional formats for didactic self-reflection; they will increasingly incorporate bottom-up developments from teaching and learning practice.
- Most learners need strong support, at least at the beginning of their study careers. This is particularly true for learners who finished school many years earlier. Learning arrangements should, therefore, combine performing, developing, and explorative teaching and learning situations that offer more or less support to learners, depending on their career and educational biographies. Digital and attendance phases are both needed, intertwined throughout the learning strategy or curriculum.
- During the learning phase, an open system of higher education will observe and react to developments outside the university or formal learning setting. One particular challenge will be to find didactic methods that bring structure and control to this open system, creating a learning path that remains transparent to students and teachers alike. Learning analytics and other methods of observing learning are recommended.

- Research on universities and education will be needed to underpin, critically question, and improve these processes.

2.1.4 Technological Conditions and Opportunities for Higher Education in a Digital Society

In its recommendations on the differentiation of universities in 2010, the Council of Science and Humanities emphasized the importance of universities as physical places and studies as social practices. Digitization was seen as a marginal topic, related to e-learning (Wissenschaftsrat, 2010). In the future, the **contrast between physical and virtual space will become less and less important**—in fact, the two spaces will "merge" (Schön et al., 2016) (see Fig. 2.4).

In 2030, higher education will be characterized by digital opportunities, digital technologies, and infrastructures, as well as support structures. To better understand these opportunities and challenges, two groups of experts were interviewed on the basis of these guidelines: The first group was composed of technical experts from "classical" universities in Germany, Austria, and Switzerland (11 interviews). The results of these interviews are summarized in the section, "Views from the mainstream higher education sector." The second group was composed of program leaders of innovative initiatives in or adjacent to higher education (11 interviews in six countries); these are discussed in the section, "Operational and strategic benefits of technology in higher education."

2.1.4.1 View from the Mainstream University Sector

Most experts agreed that video-based courses could be offered in supplementary or exclusively online formats. Through control questions and tracking, each individual's learning progress can be monitored and adapted to his or her needs, using

Fig. 2.4 New learning spaces that integrate analogue and digital approaches. *Source* Schön et al. (2016)

learning analytics. The availability of a range of online channels and materials makes it possible to reach students outside traditional teaching units. This enables learning, independent of location and time. Individual study (of specialist or less popular subjects) could become the norm.

Digitally supported scenarios, which previously featured text-based operations and limited learning environments, are now becoming more open. Voice control, for example, opens up completely new ways of interacting with learning environments. In the future, exchanges with teachers and other learners will become more fluent and natural for students. People with physical disabilities, who may find text-based operations difficult, will benefit from this format.

Big Data approaches that combine learning analytics and artificial intelligence (AI) can use chatbots and e-tutors to accompany students along the learning path. In such ways, the learning environment will adapt to the needs of individual students. As this can be done using models developed in the field of AI to predict learning performance, new learning environments will offer students improved adaptive learning.

New technologies can also open and plasticize spaces via **virtual reality** and **augmented reality**. In three-dimensional space, products, machines, and processes can be experienced and manipulated, even if they do not yet exist. Thus, research-based learning can be implemented in practical ways and making use of all senses during a course of study (cf. DeYoung & Eberhart, 2018).

Of course, the idea of such learning arrangements is nothing new. To a large extent, the technology already exists (Altieri, 2018; Zick & Heinrich, 2018). However, such practices seem to be at the stage of practical testing and prototype implementation (proof-of-concept).

To make effective use of various forms of online teaching, augmented and virtual reality, and artificial intelligence, it will be necessary for **technical infrastructure and organizational processes to interact**. Teaching staff will also need training and support. Currently, the study respondents feel that bottlenecks have obstructed the provision of necessary resources and the will to plan, develop, and establish new university administrative, spatial, and learning scenarios.

For example, traditional university lecture halls will recede into the background, to be replaced with spatial planning concepts that meet the needs of modern students and teachers. Multifunctional rooms with flexible uses will enable new learning scenarios. It is possible to imagine students meeting in rooms outside the university grounds, such as “learning cafes” and “fablabs” (cf. Taddei, 2018).

Digital platforms, algorithms, and content can be developed together, taking advantage of national and international networking. Open licenses for products and services can promote the exchange and sharing of services, supporting the implementation of new learning scenarios (Ebner & Schön, 2018).

Nevertheless, the first institutional initiatives will be more expensive than previous programs, at least during the first conversion and implementation phase. The cost of the technical infrastructure will naturally increase, as will technology costs per student, which are incurred by institutions. It is important to prioritize digitization strategies at an early stage and to establish an innovation-friendly environment at

each university, enabling educators to experiment with implementing new teaching scenarios, and support the development of new learning paths for students.

Some of the experts warned against assuming that all students owned the necessary hardware for learning (e.g., a laptop or mobile phone). Appropriate support programs should be established to ensure that less financially well-equipped learners are given equal opportunities to become part of the educational landscape. Barriers can arise from the availability or nonavailability of Internet access (keyword "broadband expansion"), essential hardware (e.g., technical equipment for students), and suitable platforms (e.g., "guidelines for barrier-free web content," WCAG). The experts thus addressed the important issue of the "digital divide" (Hess et al., 2016) and the danger that digitization could lead to a new set of social disadvantages if such questions are neglected.

Finally, with a view to the future, the experts stressed that, although online teaching and virtual space will be more central and important in the university of the future, **attendance phases will remain important**. The experts assumed that some universities would continue to concentrate primarily on campus-based learning in 2030. Online universities would also establish themselves. This could lead to cooperation between the two types of universities, enabling them to achieve their goals as economically as possible. Such developments could present challenges for the recognition of learning achievements, especially if parts of the learning process took place outside the higher education sector.

2.1.4.2 The Operational and Strategic Benefits of Technology in Higher Education

During the expert discussions, it quickly became clear that true innovation rarely lies in technology alone, but reflects the way in which technology is used to consistently redesign educational experiences. The programming school 42, for example, uses a classic intranet to provide educational content, which is **not, in itself, particularly innovative**. What is new about 42 is the fact that its entrance examination is accessible to candidates with no prior qualifications; during "study" periods, any examination can be repeated until a student has achieved his or her learning objective. Although this approach can only be implemented with technology, technology alone is not enough. Another essential element is openness, which makes it possible to try something new and to question the old.

In the present analysis of higher education in 2030, the influence of digital technology has to be considered on two levels. On the one hand, traditional higher education institutions will increasingly integrate digital technology into their existing processes (the "operational" approach).[6] On the other hand, technology will enable entirely new

[6] A mirror image of this approach can be seen in most responses to the survey of German university digitization strategies (Gilch et al., 2019), in which digitization is used mainly to improve the administration of existing processes and to increase efficiency.

models, most of which will emerge outside or on the fringes of traditional universities; these will represent a digital transformation of higher education (the "strategic" approach) (Evans & Wurster, 1997; cf. Sollosy, Guidice, & Parboteeah, 2015).

Within the framework of operational use of digital technology in existing universities, technology-adoption theory provides a useful orientation framework. It states: "The most important thing in observing [the adoption of technology] is that, at all times, the choice is not between adoption and non-adoption, but between immediate adoption and postponing the decision until later" (Hall & Khan, 2003). Perhaps no profound changes have been needed so far because environmental pressures on higher education are not yet strong enough and requirements are not yet heterogeneous enough. A key question for the future of higher education is how long this situation will persist. Like other institutions with a long tradition, the higher education system is innovation-resistant. This is not necessarily negative. It makes no sense to follow every new technology trend. On the other hand, resisting innovation may ensure that important and positive changes are driven by others, putting pressure on existing higher education structures. Although universities can use innovations from the edge to drive their own transformations, this will require an **ambitious strategic reorientation**.

The potential of the strategic approach becomes clear when considering initiatives and institutions outside existing institutions. Some education providers have emerged outside the traditional higher education sector (e.g., 42); some have developed as start-ups (e.g., Minerva) and are not subject to the usual planning processes (e.g., MIT MicroMasters); they may exist in new, separate units within a university. This is where new models will emerge that force stakeholders to question and creatively rethink many things. Radical changes are likely to affect almost all aspects of universities, from campus design to ways of undertaking, testing, and accrediting learning, and the relationship between business and education. Relevant cases are presented in the following sections of this study as explorative examples. Common to all cases is the fact that their educational provision embeds the potential of digitization.

Conclusion: Opportunities for Digitally Supported Higher Education 2030

Technological development means that future learning scenarios are possible, but will require institutional and organizational innovation, not merely the use of new technologies. The following considerations must be taken into account:

- The impact of digital technology can be considered on two levels. On the one hand, traditional universities will increasingly integrate digital technology into existing educational processes. On the other hand, digital technology will be used to develop fundamentally new educational providers and programs. By the year 2030, these may supplement and partly replace the offerings of traditional universities.

- Technical development means that the contrast between analogue and digital learning scenarios can be dissolved. This offers opportunities to provide individualized support for student-learning paths. Learning can be independent of time and place; individual study (the study of specialist or less popular subjects) could become the norm for many students.
- With technology-based solutions, care must be taken to ensure that all students have access to technology and the technical support they need to use it. Otherwise, the digital divide may promote a new social divide.
- Through the use of digital technology, higher education providers can increasingly benefit from cooperation and exchange, jointly developing successful concepts and suitable learning materials.
- The effective use of these technologies within traditional higher education institutions will depend strongly on the capacity of institutions to implement innovation processes. Universities must be willing to make necessary resources available and to question existing administrative, spatial, and learning scenarios—or to replace them with new approaches.
- Furthermore, support will be provided for new, innovative education providers and models that can supplement the role of traditional universities.
- As a rule, innovations need spaces outside the organizational and planning processes of universities. They develop where they are protected from the "immune system" of traditional organizations. They can also be separate units within higher education institutions.

2.2 Development of Scenarios and Validation Discussions

Higher education in 2030 will be determined by the parameters listed in Sect. 2.1. Labor market requirements for new knowledge and competence will have an external impact on higher education. The reaction in higher education will be shaped by didactic models and digitally supported learning scenarios.

This complex structure of effects means that higher education will not have a single form, becoming, instead, more differentiated (Davey et al., 2018). To develop future scenarios in higher education, a literature search has provided the three approaches briefly described below:

2.2.1 Modeling that Focuses on Institutions and Governance Issues in Particular

After examining global developments in higher education, the OECD developed a four-field matrix based on two opposing pairs: the extent of globalization (global versus local) and the influence of the state (administration versus market). This resulted in the following four scenarios (OECD, 2008):

- **Higher education Inc.**—higher education with an international catchment area and market-oriented offerings. According to van der Wende, this model was the most likely future model at the time (van der Wende, 2017).
- **Open networking**—a form of higher education that focuses on stronger international cooperation (networking) and supply-oriented care. This approach has been strongly influenced by the Bologna Process, taking place in the European Higher Education Area and extending to 48 countries (European Commission/EACEA/Eurydice, 2018). A greater harmonization between systems and more use of digitization is expected to promote this process further.
- **New public responsibility**—a form of higher education that focuses on the national market and on market-oriented provisions, which must be accountable to the state. This approach reflects the increasing focus on the new management model; it includes, among other things, a performance-related allocation of funds (Orr & Jaeger, 2009).
- **Serving local communities**—a form of higher education that focuses on the national market and supply-oriented provision at the local level. This has been seen as a likely scenario in the event of a possible counter-attack against globalization (van der Wende, 2017).

2.2.2 Modeling that Focuses on Technology

The Holon IQ analysis has focused on the (expected) impact of technology on higher education (Holon IQ, 2018). It has proposed five models: Education-as-usual, Global giants, Regional rising, Peer-to-peer, and Robo Revolution. The first three models anticipate domestic changes in the higher education sector and roughly reflect the OECD models mentioned above. These contrast with the last two models, which can exist without conventional higher education. It is worthwhile to briefly present these two models:

- **Peer-to-peer**—This scenario is the other side of the OECD scenario, "open networking," since it does not involve institutions, but people, who build their own learning and cooperation networks. It proposes a module-based learning path that allows learners to collect "micro credits" as they pursue their own interests and build careers.

- **Robo Revolution**—The OECD did not consider this scenario because it paid little attention to the impact of digitization on higher education. In fact, the "Robo Revolution" is a sophisticated version of the peer-to-peer model, in which artificial intelligence and machine learning allow for better identification and presorting of learning materials, making it easier to identify relevant learning resources. Scalable personalized support can be provided by social bots.

2.2.3 Modeling that Focuses on Social Developments

The "Beyond Current Horizons" study in the UK has carried out an environmental analysis to develop three complete scenarios of future societies, from which six educational models have been extracted (Facer, 2009). For each societal scenario, two alternative models have been proposed for the education system—one with positive and the other with negative characteristics. The three scenarios bear the names: "Trust yourself," "Only connect," and "Loyalty points." It is worth presenting these scenarios and their corresponding models in more detail.

- **Trust yourself**—In this society, citizens take responsibility for themselves. There are two educational models: **informed choice** and the **independent consumer**. In the case of an "informed choice," the educational model is based on the personal learning journey of an individual supported by mentors. The focus is on the individual's journey, within a process of lifelong learning. Educational outcomes are assessed in the context of the learner's previous and subsequent learning experiences. In the case of the "independent consumer," the focus is on the independent selection of standardized learning materials. This leads to two tensions. The first tension is a tendency for learners to accept materials provided by well-known "brand names." In addition, some learners lack the support to navigate this relatively complex system, especially if their social networks are unfamiliar with it.
- **Only connect**—This society is focused on the shared task of overcoming great environmental challenges, which can only be solved collectively. It has two educational models: **integrated experience** and **service and citizenship**. In the case of "integrated experience," the educational model is more inclusive than before, with learning taking place everywhere—at work, in care, during leisure time, and in educational institutions. This model sees education as integrated; learning is a collaborative and contextual open process that extends throughout life. In the case of "service and citizenship," the dominant view is that individuals must be taught to be good citizens. Learning is increasingly seen as something that happens outside people's social context, providing necessary input for employment, work, and well-being.
- **Loyalty points**: In this society, the relationship between individuals and businesses of all kinds is increasingly codified and formalized over time. Individuals are subject to a network of memberships and associations. These cover all areas of

life, controlling, and limiting the behavior of groups and individuals: work, personal interests, healthcare, family, leisure, and consumption. In this context, the state focuses on promoting social sustainability, ensuring that the many different perspectives and priorities within society do not pull strongly in different directions. This society has two educational models: **discovery** and **diagnosis**. In the case of "discovery," the model for education involves learners moving between different groups and associations, interacting with and contributing to the various knowledge communities they encounter. Through this process, learners build a portfolio of skills and contributions that are digitally captured, authenticated, and shared. In the case of "diagnosis," the educational model analyzes each individual's skills at an early stage and predicts which links and associations will fit that person best. As a result, people make fewer efforts to develop larger networks or affiliations; instead, they aim to be successful within a limited circle of associations. This leads to a less dynamic society with a high dependence on proximal networks.

The approach that was chosen for this study also begins with learners and their learning pathways. As the analysis above has shown, **learning will be the central feature of the digital world** and the key to social participation for a wide range of people.

This approach also ties in with an idea promoted by Barnett University, which calls its concept of open higher education the "ecological university" (Barnett, 2011). Barnett distinguishes between three visions of the university: the research university—which exists "in itself," i.e., for science; the entrepreneurial university—which exists "for itself," i.e., to support a company; and the **ecological university**—which exists "for others," being open to all and open to the world.

Figure 2.5 places students at the center of the system, surrounded by appropriate higher education resources that meet their learning needs. This perspective avoids the "digital-first" approach, which was prominent in the age of e-learning—namely, the idea that education should begin with technology, rather than with users and benefits (Andersson, Alaja, & Buhr, 2016; Buhr, 2015; Howaldt & Jacobsen, 2010; Rüede & Lurtz, 2012). By contrast, this approach emphasizes the idea that social contexts, such as education, are always about social innovation—how social processes can be reconfigured to achieve goals more effectively.

According to this approach, in 2030 the higher education landscape will be formed around various learning paths taken by students. As Fig. 2.5 shows, the AHEAD concept is based on four ideal learning paths in the university landscape of 2030. The resulting models of higher education are not exclusive but will coexist because they address different needs.

The AHEAD models have been further developed and validated in various cycles by different groups of experts[7]:

- Initial development by the AHEAD team in August 2018;
- Presentation of the models and discussion, in the context of the German Higher Education Forum on Digitization topic week, in September 2018;

[7]See the Methods section in the Appendix.

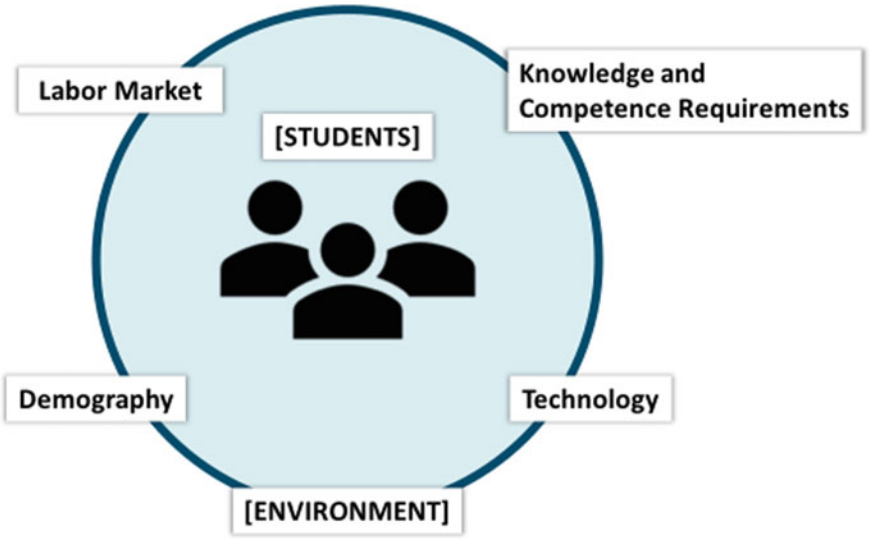

Fig. 2.5 Requirements for higher education from the perspective of students. *Source* Own illustration

- Further development and assessment from an international perspective, provided by the AHEAD Advisory Board, October 2018;
- An online survey of international experts from the higher education sector. The results of the survey are listed as exemplars in "marginal notes" in the model descriptions below.

These models are described and then characterized on the basis of their social drivers, didactic and technological solutions, and innovation potential in the next chapter.

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