Non-Digital Competencies for a Digital World: Why Higher Education Needs Humanities and STEM Disciplines

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Abstract
Forecasts on the future of the workplace abound. Predictions vary from a “smart,” network-based, and still human-centered organization of work to scenarios in which artificial intelligence and algorithms take over repetitive as well as complex jobs by 2030. Either way, questions arise regarding the set of skills that will be necessary for successful participation in the workplace and what role higher education will play in shaping and providing these skills. Currently, demand for graduates from the STEM (Science, Technology, Engineering, Mathematics) disciplines is high in politics and industry. In addition, the workforce also needs people who are able to harness technological developments for the economy as well as for society. Think tanks have described the skills necessary to establish this connection between technological progress and societal needs. They show that skills from the humanities and the social sciences are as necessary as technological capabilities because future members of the workplace—and, even more importantly, responsible members of society—need to contextualize technological developments. Thus, the challenge will be to combine digitalization in higher education with critical thinking, creativity, problem solving, communication, and social and ethical reflection.

1 Introduction

Do you remember the day when you queued up in front of the registrar’s office to enroll for your undergraduate program? Being surrounded by people who were as excited and enthusiastic about the new phase of life as you were—and maybe meeting people who later became lifelong friends? And do you remember your first lectures? Frantically trying to take notes and make sense of what the professor said—while at the same time trying to chat with the person next to you? Students who have recently started a university degree program will have to cherish a different set of memories. Application and enrollment are organized through online platforms—without students physically meeting fellow students—and lectures are quite often based on online material and no longer require notetaking; if, that is, there are classes at all and the coursework is not provided by a learning-management system that allows for individualized spatial and temporal schedules.

In addition to emptying the hallway in front of the registrar’s office and the lecture theaters, digital media have also changed the in-
tended learning outcomes of higher education: for one, both the objects of scientific interest and research methods have changed. This change is reflected in the content and design of classes as instructors (re)design course content based on their scientific or scholarly interest and, in addition, transfer their professional research routines to the seminar room (Kerres). Students profit in two ways from these adaptations. On the one hand, the alignment of research, teaching interests, and professional routines improves the quality of individual teaching (Schneider and Preckel 24, 30). On the other hand, by observing and imitating instructors’ actions, students develop digital-media competencies naturally. Thus, even if digital change is not explicitly reflected in curricula, it has found its way into higher education via individuals who have a high affinity for the digital and design the intended learning outcomes of their courses in a corresponding fashion.

However, there is also a need to acknowledge digital technologies at an organizational level in higher education, since labor-market expectations regarding graduates’ abilities have changed. “Employability” today covers skills and competencies that are directly related to digital technologies. The discussion regarding exactly which skills and competencies would be necessary in the digital age started in the first decade of the twenty-first century. Firms as well as scholars became interested in the learning and social behavior of the so-called millennials. People growing up around the turn of the century became accustomed to a digital-media driven environment early on. It was therefore (rightly) expected that this particular socialization would shape their learning behavior and social organization. In addition, in the first decade of the new century it became obvious that information and communication technology would also change the millennial generation’s labor market. Accordingly, the question of how to prepare for the new environment drew a great deal of attention. Political organizations and private think tanks have established research groups to predict necessary labor-market skills.

For instance, the corresponding working group of the OECD argues that those competencies that enable people to deal with the results of technological change would be most valuable (cf. Ananiadou and Claro 5). That is, future workers should be able to process data and interact with others in the use of the data. The working group has framed “4 Cs of Twenty-First-Century Skills”: Critical Thinking, Creativity, Collaboration, and Communication (see also Battelle for Kids). Interestingly, although the motive to name these skills was digital change, the competencies do not directly relate to technology.

While the OECD has decided to stay at an abstract and broad level—which is reasonable given that the period for which their prediction is meant to be valid is the whole of the twenty-first century—other organizations have tried to give a more detailed description and, in consequence, to address their forecast to a shorter period. For instance, the Institute for the Future at the University of Phoenix has discussed what
skills would be needed in 2020 (Davies, Fidler, and Gorbis 6–12). They describe a set of ten skills (which will be presented in more detail in section 3) that, on the one hand, overlap with the 4 Cs and, on the other hand, are more closely related to digital changes such as the introduction of new media and big data. They expect that future members of the workforce will need to be literate with respect to data and algorithmic thinking.

2020 is approaching and both forecasts date back ten years. Thus, it is worth asking about the extent to which they have actually been realized and how far they have reached into academia. The latter question will be addressed as part of an American–German comparison in sections 2 and 3. As to the former question, the debate has been continued, refined, and put into social context over the last decade (see, for instance, Martin and OECD, “Future”). The current debate focuses more specifically on connections between digital and physical environments. The use of digital technologies is not so much seen as a value in itself, but is rather discussed in relation to how far digital practices contribute to societal goals, which could include the creation of new values, reconciling tensions and dilemmas, and taking responsibility (OECD, “Future” 5). Thus, the context has been modified while the skills that are considered necessary to reach these goals have remained unchanged.

Predictions regarding job-market skills are obviously related to the future of the job markets themselves. Such forecasts have been provided by scientists (e.g., Goldin and Katz; Autor), international organizations (e.g., OECD, “Automation”; World Economic Forum), and major consulting firms (e.g., Manyika et al. for McKinsey). Independent of their origin, most recent studies formulate similar results: automation, which is driven by algorithms, artificial intelligence, and robotics, will lead to a replacement of around 15% (and up to 30%) of all jobs with a focus on complex rote activities. These losses will be more prevalent in advanced economies as higher ratios of wages to cost of capital stimulate investments in capital. However, all forecasts also see that losses in current jobs will be balanced by the creation of new jobs. One task of (higher) education will be to prepare as many people as possible for this change in occupational structure. As Ananiadou and Claro in particular point out, preparation for this shift needs the aforementioned skills for all workers. The new skills will be of particular importance for highly-qualified personnel as many of the new jobs will emerge at the interface between machines, human beings, and society.

In the European Higher Education Area, these perspectives on new skills and competencies are closely connected to the Bologna reforms, which provided a joint qualification framework for bachelor’s, master’s, and doctoral degrees. This framework also dictates that degrees will be awarded for a certain set of competencies. In their 2005 Bergen meeting, the members of the European Higher Education Area stipulated a framework for qualifications that covers competencies similar to those
listed in the OECD framework and the University of Phoenix set (Bologna Working Group 193). In addition to the aforementioned skills, the Bologna framework demands that university graduates also be able to reflect on social and ethical responsibilities, an aspect that is missing in workforce-centered analyses. I will come back to this difference in section 3.

In the description of both sets, the OECD’s “twenty-first-century skills” and the University of Phoenix “skills for 2020,” the terms “competencies,” “skills,” and “abilities” are used in a highly interchangeable way. In academic discussions of intended learning outcomes and their certification, distinctions between these terms are more pronounced. Thus, it is worth taking a closer look at the term “competency.” One definition states that competencies comprise an individual’s knowledge, cognitive skills, and abilities to mobilize motivational and psychosocial resources to solve problems in a particular context (cf. Weinert 27).3 While competencies have become the “currency” in higher education and are the basis for awarding certificates, the concept has been broadly criticized. One issue is that it presumes a degree of comparability of individual skills and abilities that does not exist due to those skills’ context dependence (e.g., Eraut 135; Mulder, Weigel, and Collins 68–71). Another issue—that is notably prevalent in the German discussion—is that the measurement of competencies is seen as superficial (see Mulder, Weigel, and Collins 77).

Ananiadou and Claro point to another aspect of the discussion that may be more of an American than a European issue: the definition is seen as representing the perspective of businesses and firms on educational outcomes (6). With respect to the competencies for the twenty-first century discussed in this article, this suspicion seems valid, as important groups who contribute to the definition of twenty-first century skills and their provision are actually driven by the economy.

Here, differences between the European and the American organization of educational processes become visible. The OECD discussion of twenty-first-century skills—although the OECD is an intercontinental cooperation that began in Europe—has a clear American focus. The agencies that, according to Ananiadou and Claro, promote the 4-C model and provide educators with support are all American and indeed business-driven. For example, Ananiadou and Claro name the “Partnership for Twenty-First-Century Skills” (an American organization that assembles firms as well as school authorities) and the Cisco-Intel-Microsoft “Assessment and Teaching of Twenty-First Century Skills” project as main actors in the field. They also describe criticism of the 4-C competencies within the American education system; for instance, they name the “Common Core” project as an example of a competency building project that was founded by an association of state authorities in education. In contrast to the focus on the 4-C competencies, the Common Core has a stronger emphasis on “content and a broad liberal arts curriculum” (Ananiadou and Claro 6) and argues that critical thinking

3 I have used a definition from a German cultural source here. For a discussion of “competency” as a social construct and in transnational comparison see Eraut as well as Le Deist and Winterton.
is a valuable skill only if it connects to factual knowledge in a certain area. The criticism of the 4-C model implied by projects like the Common Core does not attract further interest in the rest of Ananiadou and Claro’s study. Nonetheless, the critical view expressed by state leaders in education is similar to that expressed in the qualification framework of the European Higher Education Framework. Thus, differences between economy-based and society-based perspectives follow the same lines as differences between American and European perspectives.

As I will argue in section 2, the contrast between economy-driven perspectives on qualifications and a more academic-based focus is actually inherent in the different education systems. American education has traditionally had a stronger market orientation. I will show that this strong connection between the education sector and the economy has advantages when it comes to dealing with digital change. However, it also has its shortcomings, as it neglects societal aspects of development. I will focus on the German example as a representative of the European Higher Education Area (which is, of course, highly differentiated) and show that although a less market-oriented approach will slow down the incorporation of twenty-first-century skills into higher education, a slower pace might also have advantages.

In particular, a slow pace will allow perspectives from the humanities and the social sciences on the societal consequences of digital change to be connected to technological options provided by the STEM disciplines. As I will argue, such a multidisciplinary approach will enable societies to reconcile the needs of business and society in twenty-first-century skills.

2 Higher Education, Markets, and Societies

In their comprehensive analysis in *The Race between Education and Technology*, Goldin and Katz state that the twentieth century was both the “American Century” and the “Human Capital Century” and that both attributions are closely connected (1-2). They see the reason for this coincidence in the fact that America had already implemented a primary and secondary education system at the dawn of the century. Unlike most European countries at the time, the American system provided free elementary schooling (and more) to the majority of the people. The average number of years of schooling steadily increased until the end of the 1970s. During the same period, productivity grew through technological change, the benefits of which could only be realized by a workforce that possessed the necessary human capital. Thus, for the larger part of the century free public schooling ensured that the average American was up-to-date when using and further developing contemporary technologies. This match ensured economic growth, the fruits of which were reaped not only by capital owners but also by workers. Thus, growth went hand in hand with a reduction of inequality (a task not
easily accomplished in the economic setting of the twentieth century). As Tinbergen argued as early as 1975 (11-28 and 79-96), this reduction in inequality was directly related to education. Thus, publicly financed education promoted productivity growth and contributed to a reduction in inequality, thereby benefiting capital owners and workers at the same time. Remarkably, tertiary education in America has always been costly and to a certain extent market-based. As this barrier to entry into higher education had no disruptive effect on productivity until at least the 1970s, it can be argued that providing the majority of the population with secondary education sufficed to meet the human-capital needs of the productive sector.

In the last decades of the twentieth century, the extension of free public education began to stall and did not expand to tertiary education. The economy still grew (at a slower pace), but inequality was on the rise. Economic analyses have shown that the ongoing growth was caused by an extension of working hours and not by an increase in productivity. Thus, the stall in the extension of average education can be seen as one factor that contributed to the slowing of productivity growth. At the same time, the separation of growth and equality has, according to Goldin and Katz, been rooted in a mismatch between the human-capital needs of the economy and the average level of education.

It is worthwhile to compare the American development during the twentieth century with that of Germany. All German states had compulsory primary education as early as 1835. Primary education became publicly financed with the Weimar Constitution in 1919—which was comparable to the American situation of the time. However, America had increased publicly financed education to secondary levels early in the century (enabling the economy to master the crisis of the late 1920s more successfully than Germany did), while in Germany secondary education remained a luxury good until the late 1950s. Just in time to match the human-capital needs of the German economic miracle, fees were waived for secondary schooling, thus giving the majority of the population access to those abilities required for the workforce. As in the American example, inequality decreased—a process that found its height in the 1970s with the so-called “Golden Age of the Welfare State.” While inequality also began to rise in Germany in the last two decades of the twentieth century, it did not reach the American level.

In the period after World War II, the average level of education in Germany (as in many other European states) had not only matched, but actually overtaken, that in America. In the German case, the reason behind this faster development of human capital could have lain in the special institutional background of secondary and higher education after World War II. While the German Constitution does not explicitly name education as a basic right, the entitlement to education is seen as an immediate consequence of the basic rights named in the first 19 Articles. In particular, Article 12, which names the freedom of occupational choice,

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4 In Prussia in particular it was actually “compulsory education” and not “compulsory schooling.”
has been regularly interpreted by the Federal Administrative Court as entitling students to freely choose the university and subject they prefer. In this way, the Court has put strict limits on universities’ ability to restrict access to their (bachelors’ and state examination) programs. The basic right to free occupational choice also puts constraints on tuition fees, as they would constitute restrictions to this free choice.\(^5\) As about 65% of the current high-school cohorts reach a university entrance qualification (\textit{Abitur} or \textit{Fachabitur}), the constitutional right entitles the majority of the population to publicly financed tertiary education.

In light of Goldin and Katz’s argument, such a high average level of education forms the basis for a highly productive workforce. We might, in addition, assume that the aforementioned twenty-first-century skills can only be fully acquired through higher education. Consequently, we should see German students much better prepared for the labor market than their American counterparts, as higher education is very costly in America. However, the story does not end here. The result of higher education cannot be secured by mere access: it requires effort (and talent) on the part of the students and permanent activities to enhance programs on the part of the universities. Here, the market-oriented American system is at an advantage over the German system, as it provides better incentives for enhancement.

Notably, the German system does not merely protect students’ rights but, at the same time, also the rights of academics. In reaction to the “Gleichschaltung” of universities during the National Socialist dictatorship, the 1949 German Constitution emphasizes the freedom of the academy. Academics are free to choose the content of their curricula.\(^6\) Consequently, curriculum development is a balanced process that needs to align the interests of individual academics and institutions at the regional and federal levels. Such a balanced process ensures that changes are the result of societal consent, but it does not support rapid adaptation to changes in the economic, technological, or social environment of higher education. In contrast, a market-based organization of the education system that also allows for top-down processes within organizations provides both incentives for rapid adaptation to environmental changes and the means to carry out these adaptations. The American higher education system has such a market orientation and is, consequently, able to quickly adapt to changes.

However, does this ability to quickly adapt to the needs of the economy actually mean that the American system is better suited for the current changes and the development of twenty-first-century skills? The answer depends on the role that we see higher education playing in society. If we take Goldin and Katz’s perspective and assign the university the task of providing the economy with a workforce that possesses the necessary human capital, a market-based education system will be at an advantage in providing human capital that matches business needs.\(^7\) Students who need to pay for their education will choose universities

\(^5\) The State of Hesse (like others) has implemented this basic right by including a general tuition waiver into the State Constitution.

\(^6\) A considerable group of academics sees this fundamental right as being already threatened by the Bologna reforms, as the definition of a qualification frame influences content. However, the German Federal Constitutional Court, in its ruling on the North-Rhine-Westphalian system of accrediting programs (February 17, 2016), has provided a frame that aligns the constitutional rights of researchers with the Bologna system of quality assurance.

\(^7\) However, this advantage is counterbalanced by the fact that tuition fees—which come with a market-oriented system—that are not supplemented by a means-tested public support system deter low-income students.
that offer those abilities (and certificates) that are most sought after by firms. Universities will align their programs to labor-market demands and might even form partnerships with firms. American universities have reacted to these current labor-market needs by, among other things, designing new digitally-based forms of teaching in addition to their classical programs. Some high-ranking universities have started platforms for massive open online courses (MOOCs) like Coursera, edX, or Udacity, and provide a world audience with education in small nuggets. The content mixes academic and business interests. It covers courses designed by academics who present the insights of their research (there are courses on model thinking as well as advanced theoretical economics and quantum mechanics), thus extending the lecture theater to a global audience. In addition, such platforms are used to encourage cooperation with firms that use the platforms to manage their employees’ advanced training.

MOOCs have not yet replaced classical fee-based bachelor’s or master’s degrees; nonetheless, they have become an important form of advanced training and have thereby shown that it is possible to attract a major audience to digital tertiary education and that learning can be broken down into small pieces (which are called micro-degrees if a student’s performance is certified). It is to be expected that these insights will have an impact on the structure of higher education in general—and that they will spill over into the European arena.

Orr et al. have analyzed how these new trends will change the organization of higher education in Germany. They expect that by 2030, the German bachelor’s and master’s system will also be complemented by smaller units of content and certificates. These smaller units will meet different sets of demands. Orr et al. predict that there will be additional education models for different groups of students: those who want to start with a basic academic education (at a lower level than the bachelor’s degree) and acquire further (academic) skills in smaller units throughout their work life; those who are interested in supplementing a vocational education with academic instruction; those who need support in managing the transition from school to university; and perhaps others. While Orr et al. base their prediction on market orientation, the way in which this transformative process has already begun reveals the participative nature of the German system. For example, the German Rectors’ Conference has established a standing committee on digitalization in academia. This committee, among other tasks, develops recommendations for universities regarding how to deal with micro-degrees and other nugget-like forms of digital learning.

Quite clearly, the German system will, as a result of its participative structure, change more slowly than the American system. This slow pace contains both risks and opportunities: firms that recognize the value of the digital content supplied by the American platforms might base their professional training on these micro-degrees. By entrusting
the design of courses that meet firm-specific demands to individual academics, they might even design their own training systems. Thus, classical academic education and the skills demanded by the labor market might develop in different directions—universities might lose their significance as institutions that provide training in competencies required by the labor market.

With these considerations in mind, it is worth returning to Ananiadou and Claro’s criticism of the OECD’s twenty-first-century skills, mentioned in the introduction: why should academia foster this economy-driven perspective on competencies? It is clear that people need employment to earn their living and—as Goldin and Katz have pointed out—that firms need personnel with human capital that matches current technologies. However, by following the market, we might end up in a society similar to the one described by Yuval Harari in his 21 Lessons for the Twenty-First Century: artificial intelligence and biotechnology might (and will, unless they are regulated) reshape productive processes in such ways that the vast majority of humankind will be irrelevant for production. The “4 Cs” of critical thinking, communication, collaboration, creativity demanded by the OECD as twenty-first-century skills—although they seem to involve social questions—might even accelerate these changes if they are developed merely by elites and in a market context. The qualification frame of the European Higher Education Area demands the ability to reflect upon these developments from social, scientific, and ethical perspectives. The German participative system provides the basis for actually implementing this demand in the design of programs.

By slowing down the pace at which they adapt to labor-market demands, universities can contribute to embedding technology-driven changes in education within a societal context. New technologies and also new sets of content and skills are typically introduced by individuals. In order to turn them into features borne by the whole organization, they need to undergo a critical analysis by all members of the university community. An economy-driven perspective thus is balanced by other values, and the needs of companies and other social groups are reconciled.

If (German) universities become aware of this responsibility and of the options for social development that are available to them, they will be more important than ever. To describe the features of this responsibility, it is worth having another look at the twenty-first-century skills.

3 Another Look at Twenty-First-Century Skills

How can universities claim their role in providing the “4 Cs” to their students in socially responsible ways? A first step toward understanding the task could be to break the four large categories down into more accessible ideas. The Institute for the Future at the University of Phoenix has done so by defining ten skills for the future workforce:9

9 The perspective is—again—on abilities necessary for participation in the workforce. However, these skills can also contribute to societal development.
1 Sense-making—the ability to determine the deeper meaning or significance of what is being expressed
2 Social intelligence—the ability to connect to others in a deep and direct way, to sense and stimulate reactions and desired interactions
3 Novel and adaptive thinking—proficiency at thinking and coming up with solutions and responses beyond that which is rote or rule-based
4 Cross-cultural competency—the ability to operate in different cultural settings
5 Computational thinking—the ability to translate vast quantities of data into abstract concepts and to understand data-based reasoning
6 New-media literacy—the ability to critically assess and develop content that uses new media forms, and to leverage these media for persuasive communication
7 Transdisciplinarity—literacy in and the ability to understand concepts across multiple disciplines
8 Design mindset—the ability to conceive and develop tasks and work processes for desired outcomes
9 Cognitive load management—the ability to discriminate and filter information for importance, and to understand how to maximize cognitive functioning using a variety of tools and techniques
10 Virtual collaboration—the ability to work productively, drive engagement, and demonstrate presence as a member of a virtual team (cf. Davies, Fidler, and Gorbis 8-12)

In combination, these ten abilities span a similar set of skills as the OECD’s “4 Cs” but provide clearer connections to actual tasks. A person in command of all these abilities would be able to understand and solve complex problems and to work in an interdisciplinary, intercultural team whose members are spatially dispersed, and would thus enhance productivity in a digital world. But a person with all these skills would also be able to contribute to solving the larger societal challenges (Wissenschaftsrat) that lie outside the economic sphere. This aspect has been explicitly formulated by the qualification framework of the European Higher Education Area (Bologna Working Group), which, in addition to the qualifications named by the University of Phoenix, demands the following:

Graduates of a “first cycle” of higher education (a bachelor’s degree) will have the ability, among others, to “gather and interpret relevant data (usually within their field of study) to inform judgements that include reflection on relevant social, scientific or ethical issues,” and to “communicate information, ideas, problems and solutions to both specialist and non-specialist audiences” (Bologna Working Group). Graduates of a “second cycle” (master’s degree) will be able, for instance, to “apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts...
related to their fields of study,” to “formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements,” and to “communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously” (Bologna Working Group).

The effects of the different abilities named by the two organizations might be illustrated by an example: social intelligence, novel and adaptive thinking, a design mindset, and the ability to engage in virtual collaboration have contributed to the development of social-media platforms like Facebook and networking algorithms like Google. But a person who combines these abilities with sense-making and supplements social intelligence with the social and ethical reflection of the European Framework will also be able to scrutinize the effects of these networks on social structures. On the one hand, information will become easily accessible and people in remote places will be able to keep in touch with others (to name just two main features of Google and Facebook); on the other hand, it will become possible to manipulate information and to produce hate speech and discrimination. A person with twenty-first-century skills would be able to formulate trade-offs between these features and to assess whether the effects are in line with the values of her home society. She would also be able to work in a team that develops forms of regulation that align these values and features. These abilities are particularly important for those who design regulation. It is necessary to formulate rules and sanctions that are actually implementable and that have the desired effect. To that end, it is essential to think one step ahead of that which has been regulated. That means it is necessary to understand the motives of technophiles who design these networks (transdisciplinarity / multidisciplinarity and social intelligence), to have an overview of technological possibilities for tracking non-compliance (computational thinking, new-media literacy, and ability to communicate with specialist and non-specialist audiences), to find the right rules (novel and adaptive thinking, design mindset, reflection on social and ethical issues), to collaborate with people from other jurisdictions to find regulations that are effective across borders (cross-cultural competence and virtual collaboration), and finally to develop ideas regarding how to start a democratic political process for the implementation (sense-making and, again, social intelligence and social and ethical reflections). Basically, people who work at embedding new technologies into a social system need all the technological skills of the inventors and, in addition, social and humanistic skills.

What can higher education contribute to the development of these skills? First of all, it looks like half of the skills are old wine in new bottles. Sense-making, social intelligence (probably framed instead as leadership abilities), novel and adaptive thinking, design mindsets, social and ethical reflection, communication with specialist audiences,
and probably also cognitive-load management (how many hours have you spent in the library, trying to get campus life organized?) have been at the core of most degree programs, and particularly of programs in the humanities, for decades if not longer.

So, what is new here? At least two things: first, the idea of twenty-first-century skills is that all members of a society should command them—not only the small elite that had access to university degrees just a generation ago (and extending the target audience is a goal shared by all of the organizations quoted here). Such an enlarged target audience fundamentally changes the role of education and educators. It demands a differentiated approach to subgroups of a heterogeneous population. Here, the digital technologies mentioned in section 2 help educators to deal with heterogeneity. Second, the ten skills named by the University of Phoenix and their extension by the Bologna group only work as a set; in order to handle digital technologies successfully, it is necessary to understand the technological and data-related aspects and the social consequences. In the end, higher education needs to connect both aspects.

This connection can be established in two ways. First, the emerging field of digital humanities covers those collaborations between the humanities and STEM disciplines that apply STEM techniques to questions from the humanities. These collaborations allow for new research questions and, in addition, enable a broader analysis of known questions, in particular through the use of big data or new imaging technologies. In this respect, digital technologies affect academic fields in the humanities. However, in light of the considerations of markets and societies previously presented, it is also important to look at the second way in which this connection can be established, in those fields where the humanities can support STEM subjects. It is necessary to define curricula that provide students (and researchers) in classical STEM fields with the ability to reflect on social and ethical aspects of their work, to communicate them to non-specialist audiences, to enable sense-making and social intelligence for a broader group, and so forth. This could be the contribution of the social sciences and the humanities to new interdisciplinary programs.

One basic yet highly important question about any technology is whether developments that can be started should be started. This question should not be answered by technophiles alone. It is necessary for people who command all ten future skills and those from the Bologna frame to also participate. The question needs to be embedded within social, cultural, and ethical contexts—which means that answering it will require the involvement of people who are able to describe and understand these fields. It will require people who can assess the effects new technologies would have on social and economic equilibria and the ways in which different groups in different parts of the world would be affected by new technologies introduced in one country. It will also require people who are able to argue what a social consensus on these
new technologies might be, and who are also able to predict what might happen if the original forecasts regarding this consensus or the advantages and disadvantages of the new technology turn out to be wrong. It will require people who are able to develop answers to questions that are unknown today.

In short, answering this larger question will require input from people with the classical qualifications provided by the humanities. In addition, it is to be expected that new research questions will emerge from collaborations between STEM fields and the social sciences and humanities. Thus, both groups of disciplines will profit from and face new possibilities for development.

While these forms of collaboration have begun to take place in research, teaching programs that introduce the insights of the humanities into STEM subjects are still rare and need to be developed. For this development, it would be helpful to merge the advantages of the American system with those of the German system: if academics show more market-orientation and care more about the labor-market needs of students, they can accelerate the necessary development of new programs; if this development is based on a participative approach that includes perspectives from all fields of research and all university groups, it will serve not only the economy but society as a whole.

4 Conclusion

This paper has argued that digital media have changed teaching in higher education over the past 20-25 years. However, the full potential of digitalization for higher education has not been realized. In particular, an adaptation of the objects of interest and the desired sets of skills and competencies is still necessary. American institutions of higher education have taken the lead with respect to designing new programs and providing education in smaller units. New technologies have been used in these institutions to meet employers’ demands regarding employee skills and the accessibility of education.

Germany (as well as Europe as a whole) should focus on a different advantage of digital technologies: new technologies might not only contribute to raising productivity but also to shaping the social change that follows their introduction in a human way. To achieve this goal it is necessary to understand technologies as well as humans. Here, the humanities, social sciences, and STEM disciplines are called upon to cooperate and to design new curricula that connect ideas from all three areas—for the good of society as a whole.
Works Cited

Ananiadou, Katerina, and Magdalena Claro. “21st Century Skills and Competences for New Millennium Learners in OECD Countries.” *OECD Education Working Papers* 41. Paris: OECD Publishing, 2009. Web. 19 Dec. 2019. https://doi.org/10.1787/21852526154.

Autor, David H. “Why Are There Still So Many Jobs? The History and Future of Workplace Automation.” *Journal of Economic Perspectives* 29.3 (2015): 3-30. Print.

*Battelle for Kids*. Battelle for Kids, n.d. Web. 19 Dec. 2019. https://www.battelleforkids.org/.

Bologna Working Group. *A Framework for Qualifications of the European Higher Education Area*. Bologna Working Group Report on Qualifications Frameworks. Copenhagen: Danish Ministry of Science, Technology and Innovation, 2005. Web. 19 Dec. 2019. http://ecahe.eu/w/index.php/Framework_for_Qualifications_of_the_European_Higher_Education_Area.

Davies, Anna, Devin Fidler, and Marina Gorbis. *Future Work Skills 2020*. Palo Alto: Institute for the Future for University of Phoenix Research Institute, 2011. Web. 17 Dec. 2019. http://www.iftf.org/uploads/media/SR-1382A_UPRI_future_work_skills_sm.pdf.

Ernst, Michael. “Concepts of Competence.” *Journal of Interprofessional Care* 12.2 (1998): 127-39. Web. 17 Dec. 2019. https://doi.org/10.3109/13561829809014100.

Goldin, Claudia, and Lawrence F. Katz. *The Race between Education and Technology*. Cambridge. Cambridge: Harvard UP, 2008. Print.

Harari, Yuval Noah. *21 Lessons for the 21st Century*. London: Jonathan Cape, 2018. Print.

Kerres, Michael. “Digitalisierung als Herausforderung für die Medienpädagogik: ’Bildung in einer digital geprägten Welt.’” *Pädagogischer Mehrwert? Digitale Medien in Schule und Unterricht*. Ed. Christian Fischer. Münster: Waxmann, 2017. 85-104. Print.

Le Deist, Françoise Delamare, and Jonathan Winterton. “What Is Competence?” *Human Resource Development International* 8.1 (2005): 27-46. Web. 17 Dec. 2019. https://doi.org/10.1080/1367886042000338227.

Manyika, James, et al. “Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation.” *McKinsey Global Institute Report*. McKinsey & Co., Dec. 2017. Web. 19 Dec. 2019. https://www.mckinsey.com/~/media/mckinsey/featured%20insights/Future%20of%20Organizations/What%20the%20future%20of%20work%20will%20mean%20for%20jobs%20skills%20and%20wages/MGI-Jobs-Lost-Jobs-Gained-Report-December-6-2017/aspx.

Martin, John P. “Skills for the Twenty-First Century: Findings and Policy Lessons from the OECD Survey of Adult Skills.” *OECD Education Working Papers* 166. Paris: OECD Publishing, 2018. Web. 17 Dec. 2019. https://doi.org/10.1787/96e69229-93.

Mega, Carolina, Lucia Ronconi, and Rossana De Beni. “What Makes a Good Student? How Emotions, Self-Regulated Learning, and Motivation Contribute to Academic Achievement.” *Journal of Educational Psychology* 106.1 (2014): 121-31. Print.

Mulder, Martin, Tanja Weigel, and Kate Collins. “The Concept of Competence in the Development of Vocational Education and Training in Selected EU Member States: A Critical Analysis.” *Journal of Vocational Education and Training* 59.1 (2007): 67-88. Web. 19 Dec. 2019. https://doi.org/10.1080/13636820601145630.

OECD. “The Future of Education and Skills 2030.” Position Paper, 2018. Web. 19 Dec. 2019. https://www.oecd.org/education/2030-project/contact/E2030_Position_Paper_(05.04.2018).pdf.
OECD. “Putting Faces to the Jobs at Risk of Automation.” Policy Brief on the Future of Work. Paris, OECD Publishing, 2018. Web. 17 Dec. 2019. https://skillspanorama.cedefop.europa.eu/en/news/oecd-policy-brief-putting-face-behind-jobs-risk-automation.

Orr, Dominic, et al. “AHEAD—Internationales Horizon-Scanning: Trendanalyse zu einer Hochschullandschaft in 2030.” Hauptbericht der AHEAD-Studie, Arbeitspapier 42. Berlin: Hochschulforum Digitalisierung, 2019. Web. 19 Dec. 2019. https://doi.org/10.5281/zenodo.2677655.

Schneider, Michael, and Franzis Preckel. “Variables Associated with Achievement in Higher Education: A Systematic Review of Meta-Analyses.” Psychological Bulletin 143.6 (2017): 565-600. Web. 17 Dec. 2019. https://doi.org/10.1037/bul0000098.

Tinbergen, Jan. Income Distribution: Analysis and Policies. Amsterdam: North-Holland Publishing, 1975. Print.

World Economic Forum. “Eight Futures of Work: Scenarios and Their Implications.” White Paper. World Economic Forum, 22 Jan. 2018. Web. 19 Dec. 2019. http://www3.weforum.org/docs/WEF_FOW_Eight_Futures.pdf.

Weinert, Franz E., ed. Leistungsmessungen in Schulen. Weinheim: Beltz, 2001. Print.

Wissenschaftsrat. “Zum wissenschaftspolitischen Diskurs über große gesellschaftliche Herausforderungen.” Positionspapier, Apr. 2015. Web. 19 Dec. 2019. https://www.wissenschaftsrat.de/download/archiv/4594-15.pdf?__blob=publicationFile&v=4.

Zimmerman, Barry J. “Attaining Self-Regulation: A Social Cognitive Perspective.” Handbook of Self-Regulation. Ed. Monique Boekaerts, Paul R. Pintrich, and Moshe Zeidner. San Diego: Academic, 2000. 13-39. Print.