CHAPTER 10

Digital Transformations in Higher Education in Result of the COVID-19 Pandemic: Findings from a Scoping Review

Sabine Wollscheid, *Antonia Scholkmann*, *Marco Capasso*, *and Dorothy Sutherland Olsen*

Introduction

There is a growing understanding that upcoming trends in higher education (HE) should be regarded as divided by an invisible line marking world events, before and after the COVID-19 pandemic (Laterza et al.,

An early version of this paper has been presented at the NOS HS Workshop 1: 30–31.3.2021 responsible University of Agder (UiA)—Centre for Digital Transformation (CeDiT https://cedit.uia.no/): Understanding digital transformations of teaching and learning in Nordic higher education and beyond.

S. Wollscheid (✉) · M. Capasso · D. S. Olsen
Nordic Institute for Studies in Innovation, Research and Education (NIFU), Oslo, Norway
e-mail: sabine.wollscheid@nifu.no

A. Scholkmann
Aalborg University, Aalborg, Denmark

R. Pinheiro et al. (eds.), *Digital Transformations in Nordic Higher Education*, https://doi.org/10.1007/978-3-031-27758-0_10

2020). At the same time, there is increasing research addressing digital transformation in higher education (DTHE) related to the COVID-19 pandemic, already in 2020 (e.g., Garcia-Penalvo & Corell, 2020; Pazos et al., 2020). In 2022, the pandemic is still ongoing, and this fact is also reflected in growing research activities (e.g., Deja et al., 2021; Garcia-Penalvo, 2021; Scholkmann, 2022; Toprak et al., 2021).

Already before the onset of the COVID-19 pandemic several studies had investigated aspects of DTHE in different countries (e.g., Benavides et al., 2020; Bond et al., 2018; Sjöberg & Lilja, 2019). In their systematic literature review, Benavides et al. (2020) show that DTHE is an emerging field of inquiry that is fragmented across several disciplines. At the same time, they point out that none of the proposals on digital transformation (DT) that were included in the review, have been developed in a holistic way (Benavides et al., 2020). A systematic review on DT carried out by Reis et al. (2018) across a broad variety of sectors found that most of the references were related to technological change in business, followed by new technology in industry, and that education was lower down the list with only 8percent of 206 publications falling into this category. In this sense, we can state that, pre-COVID, higher education was not a frontrunner on DT, and also the understanding of what DT actually meant for higher education was only emerging.

Drawing on studies that have addressed DT in other fields, the phenomenon has been understood as being broad in outreach and "(…) about adopting disruptive technologies to increase productivity, value creation and the social welfare" (Ebert & Duarte, 2018, p. 16). Additionally, based on their literature review, Reis et al. (2018) pointed out that DT is not a goal in itself, but a means to the end of improvement. With respect to their focus on DT in the business world they conclude that DT means "the use of new digital technologies that enables major business improvements and influences all aspects of customers' life" (Reis et al., 2018, p. 418). Albeit talking about value creation, business and customers we conceive that these definitions hold value also to an understanding of DTHE, as they point out the innovative and transformation potential of new technologies which permeate all areas of life.

However, for the purpose of this chapter we want to argue that DTHE should not only be understood as the outcome, however transformative, but also as the process of transformation. So, as a starting point, this chapter draws on an understanding of DTHE as "a much broader process of change that implies substantial (cross-cutting) organisational

adaptation, in addition to the effective implementation of digital platforms and solutions" (Pinheiro et al., in this volume). Defining DTHE under a processual perspective allows to link it to conceptualizations of organizational learning that take into account the emergent quality of new solutions (e.g. Argyris & Schön, 1996; Brandi & Elkjaer, 2015). We want to argue that such a perspective is highly suited for our purpose, since the DTHE instigated by the COVID-19 pandemic (and written accounts thereof) have been about processes of learning and change as much as about outcomes.

Understood as the "highest disruptive event in […] recent history" (Fassin, 2021, p. 5305), the COVID-19 pandemic and its outbreak in March 2020 has led to many initiatives to uphold the provision of HE in digital mode, and colleagues world-wide took the opportunity to accompany those with research (OECD, 2021). Using digital technology seemed to be the only alternative to freezing an exponential spread of the virus. The experiences gained when going digital because of the pandemic can be regarded as facilitating transformations in procedures and cultures of higher educational institutions (HEI) comprising teaching and learning. This was done by upgrading and further integrating technologies that already existed to a larger scale, which forms the ground or services to the university community (Coral & Bernuy, 2022).

An exploratory literature search in medio 2020 revealed a dynamic field of inquiry comprising empirical studies and academical discussion papers on the topic of digitally transformed HE. However, while most of these publications claimed to contribute to the topic, the impression emerged that the multiplicity of intentions, perspectives, and voices represented made it hard to extract a common understanding of DTHE. From this backdrop, this chapter presents the findings of a scoping review that systematically retrieves, selects, maps, and describes the international literature on DTHE, published during the first year of the COVID-19 pandemic. We assume that the heterogeneity of solutions to, and interpretations of, the challenges caused by COVID-19 would especially appear in the literature published soon after the onset of the pandemic and before dominant solutions and interpretations are able to prevail. By focusing on journal articles published during the first year of the pandemic, we attempt to capture such heterogeneity both in terms of events, since actors have often had to improvise specific solutions in the absence of previous comparable events, and in terms of academic views on the events themselves. The scientific production on DT might have to accelerate

to inform practitioners and support those involved in handling the crisis without enough time to homogenize new theories. This process of accelerating research and publishing about a critical event and how to address it in HE has probably introduced short cuts in the peer-review process, which is traditionally a more long-lasting endeavor.

Our exploration of the literature during this time span thus allows us to refine the concept of "digital transformations" (DTs), in plural (Laterza et al., 2020). Laterza et al. (2020) argue that we live in a time when the speeding up of digitalization is leading to even more diverse and uneven paths of development. To speak of this concept in singular terms reduces this complexity and multidimensionality, and at the same time reinforces some of the techno-deterministic assumptions of much of the literature on DTs. To add to a holistic understanding Laterza et al. (2020) suggest moving towards more pluralistic and systemic understandings of DTs that take into account the complexity related to the processes under study. The authors refer to three analytical dimensions in the study of DTs, namely the contextual dimension, that of mediators at the system level and types of effects associated with the adaptation of digital platforms and technologies in HE.

Aim and Research Questions

The purpose of this scoping review is to provide an overall description of the literature comprising both, empirical studies and conceptual papers. We aim to identify and describe different forms of DTs in HE published during the pandemic. Further, we address some knowledge gaps in the field of inquiry with implications for further research on DTHE.

Understood as a method of secondary research, a scoping review approach is suitable for examining and describing broad, complex, and dynamically developing research areas, such as DTHE, identifying knowledge gaps and clarifying core concepts (cf. Levac et al., 2010; Tricco et al., 2016). Scoping reviews also describe knowledge according to core characteristics, such as time of publication, geography (country of study), and discipline (Anderson et al., 2008). Drawing on a scoping review approach, the chapter addresses the following research questions:

1. What does international research tell us about DTHE related to the COVID-19 pandemic? Specifically, how can the body of literature on the topic of DTHE and the pandemic be described in terms

of characteristics such as geography, perspectives, and disciplinary background?

2. How is the concept of DTHE related to the COVID-19 pandemic period, understood in the international literature? Specifically, which conceptual understandings of DTHE can be distinguished, and how are they distributed across the body of material included in the scoping review?

Method: Scoping Review Approach

The review includes empirical studies and conceptual papers dealing with digital transformations at different levels in HE, related to the first year of the COVID-19 pandemic as outlined before. We assessed material in English (mostly journal articles) published between March 2020 and February 2021. The relatively short publication period is defined by the scope of this review, DTHE during the first year and critical phase of the pandemic, which implies a temporal restriction to this period.

To identify relevant literature the search strategy was underpinned by the inclusion of key criteria drawing on the Population-concept-context (PCC) framework recommended by the Joanna Briggs Institute for scoping reviews (Institute Joanna Briggs, 2015) (cf. Table 10.1).

Thus, we excluded material dealing with DTs in HE before the COVID-19 pandemic and addressing other, lower levels of education.

Table 10.1
PCC-framework for this scoping review

Criteria for inclusion	
P-Population	HE
C-Concept	DTHE
C-Context	COVID-19 pandemic
Time span	March 2020–16 February-2021
Publication status	Peer-reviewed journal articles (with abstracts in English)
Language	English
Material	Abstracts of empirical studies and conceptual papers

Source Authors' own

Search Strategy

First, we conducted a systematic literature search in Web of Science (WoS)—namely Web of Science Core Collection—comprising the world's leading scholarly journals, books, and proceedings in the sciences, social sciences, and arts and humanities and navigate the full citation network since 1975. Further, we searched for literature in the educational database ERIC (Education Resources Information Center), which includes peer-reviewed journal articles and books.

Second, systematic searches were conducted by combining search terms related to the three elements of the PCC-framework. The following search string was applied in WoS and adopted in ERIC: (digital* OR *learning) [Topic] and ("higher education" OR university OR "tertiary education") [Topic] and (Cov* OR Corona OR pandemic) [Topic].

Further, supplementary searches for the given time period were conducted in national resources for the Scandinavian countries by combining the search terms "digital*", "higher education" and "pandemic". We further conducted an additional search in Google Scholar using the terms "digital", "higher education and pandemic", "corona" and "covid".

Data Collection

For assessing the scope of the search, we aimed to retrieve a representative set of publications for the time span between March 2020 and February 2021. The search strategy was validated by two experts, one expert in the field, the second author of this paper (Antonia Scholkmann) and one expert on systematic retrieval, our research librarian at NIFU. We were aware that our search for DTHE related to the COVID-19 pandemic, might require an update after February 2021, as we expected an increasing number of studies over time. At the same time, however, we assumed we had reached data saturation in our original data collection. Thus, we limited the scope of this review to the first period of the pandemic. We are, however, aware of the limitations and biases in the process of data collection of a dynamically developing body of literature. We included some additional publications that we retrieved strategically, limited to the publication period between March 2020 and February 2021.

We imported all entries into the reference manager software Endnote, where we screened titles and abstracts. We used an EXCEL spreadsheet for the extraction of descriptive data and mapping of studies. A screening manual for screening of titles and abstracts was provided based on the eligibility criteria. We independently screened all titles and abstracts retrieved by the literature search. The selected references for inclusion were screened a second time. Each of us screened a subsample of references. In case of disagreement, we discussed the decision which resulted either in inclusion or exclusion.

All four authors coded and extracted data from a subsample of studies, independently, addressing the research questions above. They exchanged their extraction results for cross validation in pairs. This procedure was done using EXCEL spreadsheets including the following information: First author, publication year; country; population; source; methods; understanding of concepts of DTHE. All four authors were involved in mapping the results by using data in EXCEL spreadsheets for mapping and narrative/ thematic synthesis of the main findings according to the review questions.

The selection of eligible studies consisted of several steps. During the first screening, the authors pre-screened together approx. 1138 references/publications (titles and abstracts) retrieved by the literature search in electronic databases (medio February 2021). This first screening resulted in 471 references for further inclusion. A pilot sample of 65 references was initially screened and validated by first and second author, which resulted in further exclusion of six references not addressing the review question, e.g., dealing with students with disabilities and digitalization, or with health outcomes that were related to the COVID-19 pandemic. During the second screening, each of four authors independently screened a subsample of the included references resulting from step 1. Among the sample of 471, 45 were excluded due to the following reasons: poor information/no findings reported; not related to the pandemic; not specific for HE; not DT mentioned; neither research nor conceptual paper. Further, 73 references were assessed as unsure; for validation inclusion or exclusion was discussed in a meeting between the four reviewers. Sixty-one of these were included and categorized as *knowledge for* and/or *knowledge about* DTHE (cf. next chapter). Ideally, the screening process in a scoping review should follow a systematic path and proceed in a linear way. In practice, however, we iteratively moved back and forth between

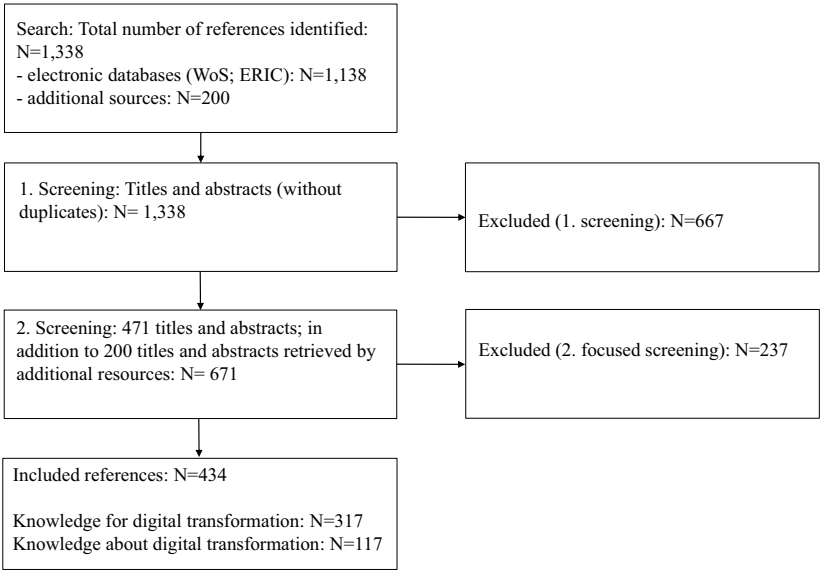

Fig. 10.1 Selection of references

the two screening stages. Finally, we ended up with a total of 434 references and the assumption that we had reached a point of saturation for the purpose of our analysis (cf. Fig. 10.1).

Analytical Categories: *Knowledge for* and *Knowledge about* DTHE

During discussion of the data and the iterative process of screening, we inductively developed two main categories in terms of DT: *knowledge for* DTHE and *knowledge about* DTHE, which we assessed as suitable to categorize our data.

Under the category *knowledge for*, we subsumed publications which addressed isolated aspects of DTHE, such as accounts of the implementation of new technology for the provision of teaching and learning as well as teachers' and students' evaluation of these, or the description and evaluation of a specific organizational change that had been implemented during the pandemic. Papers in this category offer research-based advice

which might also be useful for understanding and dealing with more wide-reaching DTs. However, papers in these categories only addressed isolated themes in DTHE, such as "what has been done?" and "how did teachers/students/other stakeholders think about it?" Publications in this category provide knowledge that can be applied when going digital (both ad hoc or in more structured ways). However, they do not explain or elaborate on longer-term processes of transformational change. They present new (and sometimes innovative) solutions to be implemented as part of larger DTHE in the sense of single-loop learnings (Argyris & Schön, 1996), yet they fall short on explanations on how these can form the basis for long-term transformative processes. Quotes from article abstracts that were considered for placing a paper in this category were for example (explanatory passages underlined):

> (…) investigating the effectiveness of distance education … universities in light of the Coronavirus pandemic and identifying the obstacles faced by university students. (Bataineh et al., 2021)

> (...) to show, through a real case application, how the digitization of information and the new methodologies for teaching urban planning techniques can contribute to improve the accuracy of the knowledge available at the micro/ building scale, which is at the basis of the definition of tailored regeneration practices. (Conticelli et al., 2020)

> (…) to examine if virtual reality can be a suitable option by placing lectures into a virtual setup. (Hopp et al., 2020)

Under the category *knowledge about,* we subsumed publications that looked at the bigger picture and provided reflection on multiple aspects of ongoing DTHE. Such publications were considered to generate knowledge about the processual aspects of DTHE, including critical reflections of these. The publications in this category also suggest an understanding of DTHE as a multifaceted phenomenon that goes across different aspects within the higher education system (Pinheiro et al., in this volume). Also, DTHE is understood as a complex interplay between technology, social, and "business"-aspects (Reis et al., 2018).

Papers in this category had to highlight broader organizational aspects, by describing connections and roles for an array of actors; normative directions, by praising past actions or advocating future ones; and/or

dynamics over time, by pointing also at long-term consequences and indirect effects of actions. We operationalized this in a set of five defining aspects out of which more than one, but not necessarily all of them had to be present in a paper. An overview of these four aspects and exemplary quotes can be found in Table 10.2.

Description and Mapping of the Literature

In the following, we describe the included body of literature, 434 publications, according to publication year, geography, main perspective, and discipline. In our analysis, we further distinguish between the two analytical categories defined above, namely *knowledge for* and *knowledge about* DTHE, which were inductively derived as a result of the coding process. Our descriptions and analyses draw on data we manually extracted from abstracts and titles of the included publications, and in combination with our interpretations. Thus, we are aware of the limitations related to this information.

All 434 publications, 17 percent ($N = 73$) were published during the first half of the pre-defined period (March–August 2020), while the great majority of 83 percent ($N = 361$) included articles published during the second part of this period (September 2020 and February 2021 and articles where no publication date was given) (cf. Fig. 10.2).

Further, we categorized 117 publications according to *knowledge about* DTHE, while we categorized the majority of 317 publications according to *knowledge for* DTHE. We assume that the category *knowledge about* suggests a greater maturity of thought and elaboration over time in terms of the concept of digital transformation compared to that of *knowledge for*. This is reflected in our finding a greater share of publications in the second half of the period (September 2020–February 2021), for *knowledge about*, we found 65 percent ($N = 70$), compared to the first half of the period (March–August 2020) with 27 percent ($N = 29$) (cf. Fig. 10.3).

For the *knowledge for*-category find the opposite picture with a larger share of papers published during the first period.

Geography

For geography or country of study, we extracted information on *where* the study was conducted, found in the abstract or title. We argue that this is

Table 10.2 *Knowledge about* DTHE—operationalization and exemplary quotes (explanatory passages underlined)

(1) Study provides knowledge b*eyond students*	• goes beyond a description or evaluation of measures implemented to help students to continue their educations under emergency remote learning-conditions • also considers the views and roles of teachers, administrators, leadership/ management or technical staff	"Research-based transformative knowledge, real situations and practical resources for considering inclusive education curriculum concepts were found that are connecting educators, teachers, learners and communities during this time of crisis." (Pittman et al., 2021) "A survey of 405 students from the universities across Bangladesh revealed that faculty readiness, student readiness, and economic solvency positively impact the students' intention to adopt a technology-based design of higher education." (Kabir et al., 2020)

(continued)

Table 10.2 (continued)

(2) Study works towards providing some sort of *holistic* knowledge	• considers several aspects of education, for instance the social and the organizational	"The research findings show a significant variance between the respondents' perception of digital transformations maturity levels, and the core requirements of digital transformation maturity. The findings also show the lack of holistic vision, digital transformation competency, and data structure and processing as the leading challenges of digital transformation." (Marks & AL-Ali, 2020) "This case study is divided into three parts. The first part provides an analysis on the policies and guidelines implemented by the country's Commission on Higher Education. The second part interrogates and reflects on the responses, challenges, and best practices employed by universities in implementing these guidelines. Lastly this paper provides general recommendations and argues that Philippine Higher Education Institutions/ HEIs should form an Education Continuity Plan that outlines the procedures and instructions that should be followed in the face of a pandemic." (Cuaton, 2020)

(3) Study understands actors as being *integrated*	• actors in education or aspects of education are seen as interconnected, as e.g., in a system	"Our reflections consider social work education comprehensively, as an integrated system. We recount the human and emotional nature of our experience; approaches to interacting and collaborating with colleagues, partners, and stakeholders; ways of innovating on local, provincial, and national levels; and examples of how core social work values guided our work." (Archer-Kuhn et al., 2020) "The paper suggests pragmatic ideas to embolden each of the three strata encompassing the educational "ecosystem": institutions, faculty and students." (Colpitts et al., 2021)
(4) Study takes a *possibly critical* stance	• shows some reflection on whether and how digitalization is positive	"Universities have transitioned to online education in order to slow the spread of COVID-19. This transition mobilizes the technological utopian imaginary that digital technologies can rescue populations from the disease. It also raises the risk of deepening neoliberal educational reforms and, by extension, poses a threat to democracy itself. This commentary explores this risk and suggests ways to resist the resulting neoliberalization of education that it could entail." (Burns, 2020)

(continued)

Table 10.2 (continued)

(5) Study takes a *longer-term perspective*	• does not limit itself to a short period of interest (the pandemic and/or a specific temporary policy) • reflects on processes and consequences towards a time horizon beyond the pandemic	"This study was designed to address the problem of how higher education institutions, as organizations designed to promote learning, responded to the COVID pandemic and the suspension of in person instruction. The purpose of this paper was specifically to explore how institutions go about learning from the pandemic to better prepare themselves for the future that they will face." (Miller, 2021) "Communication, cooperation, coordination, and collaboration, along with positive organizational strategizing and support contributed to a successful transition during the COVID-19 pandemic; many of the approaches implemented during the emergency transition will continue into the future." (Mariani et al., 2020)

Source Authors' own

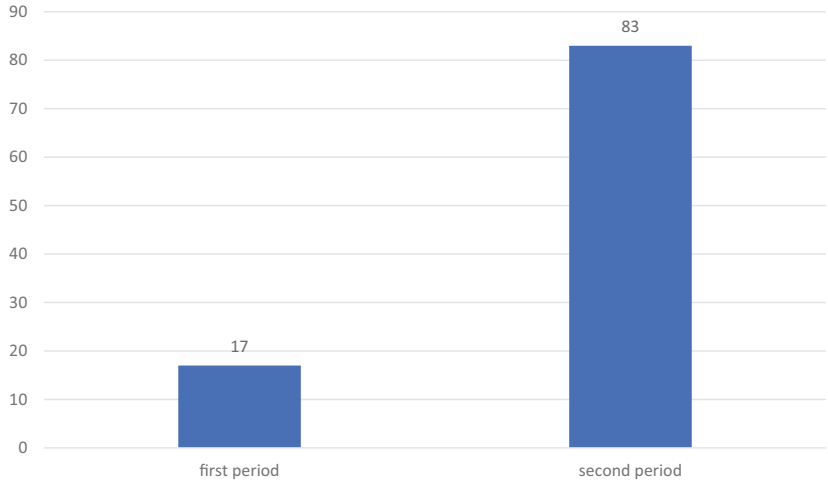

Fig. 10.2 Description of publications according to publication period (in percent), $N = 434$ (*Source* Authors' own)

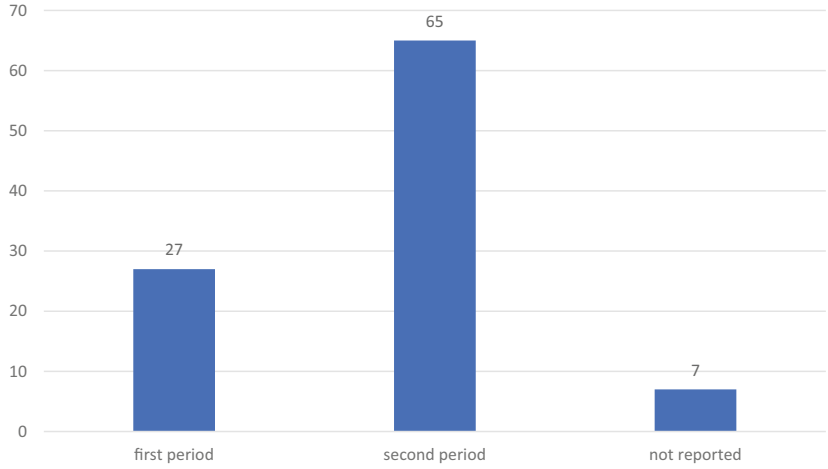

Fig. 10.3 Description of publications (*knowledge about* DTHE) according to publication period (in percent), $N = 117$ (*Source* Authors' own)

more valid than using information about the first author's affiliation as a proxy for study destination, even though this would have reduced the number of cases with no information about study destination. Fig. 10.4 describes the included studies according to geography, i.e., the country they were conducted.

In general, nearly a quarter of publications were located in Asia (N = 107), followed by 99 publications (22.8 percent) in Europe and 58 publications (13.3 percent) for the Americas (North and South). The largest group of publications (N = 123; 28.8 percent), however, could not be classified according to geography based on information from the abstract. In these cases, we can assume that geography (country of study) plays a minor role for the study in the sense that the publication conveys information that is more generic or universally applicable.

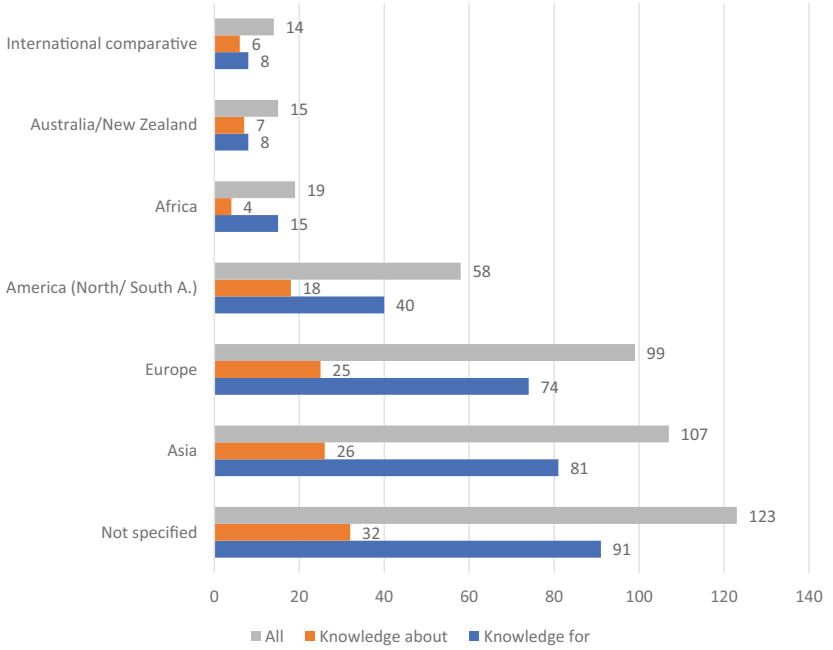

Fig. 10.4 Description of publications according to geography (*Source* Authors' own)

For the distinction between the two main categories, *knowledge for* and *knowledge about*, Fig. 10.4 shows that for all regions the majority of publications were classified as *knowledge for*. For Europe and Asia the ratio between publications communicating *knowledge for* vs. *knowledge about* is around three quarters vs. one quarter. For Africa and for not geographically specified publications, however, the ratio is roughly two-thirds vs. one-third, for the Americas it is roughly two to one, and for Oceania (Australia and New Zealand), the distribution across the two categories tends towards being equally distributed. Although further analysis would be needed to validate this, it is a possibility that, due to increasing total numbers in publications from a specific region, the gap between publications produced in the respective category has widened.

Disciplines

We manually coded information in abstracts and titles according to discipline or subject, reported by the authors. We preferred a manual and inductive coding by re-reading abstracts and titles instead of an automatic and pre-defined coding. In some cases, we collected several subjects or disciplines in one single category. To give an example, the category education included, "education", "teaching", and "teacher education". Small subjects were collected under the general category of "other disciplines". This procedure enabled a balance between coherence and reasonable number of categories (cf. Fig. 10.5).

In general, Fig. 10.5 shows the highest number of publications for the categories Science, Technology, Engineering, and Mathematics (STEM) ($N = 87$) and Medicine, Health science and Nursing ($N = 76$), in addition to the undefined categories not specified and general.

Distinguishing between the distribution of the two main categories (*knowledge for* and *knowledge about*) in all discipline-related publications the absolute number of *knowledge for* exceeds the number of *knowledge about*, with ratios between roughly three to one to two to one. The difference between the number of publications in each category is largest for STEM and medicine, health sciences, and nursing. For STEM, 69 publications are categorized as *knowledge for*, while 18 publications are described as *knowledge about*. We can find a similar pattern for medicine, health sciences, and nursing. However, in articles classified as general the number of *knowledge about*-publications ($N = 57$) exceeds the number of *knowledge for* ($N = 24$), which is an indicator that *knowledge about*

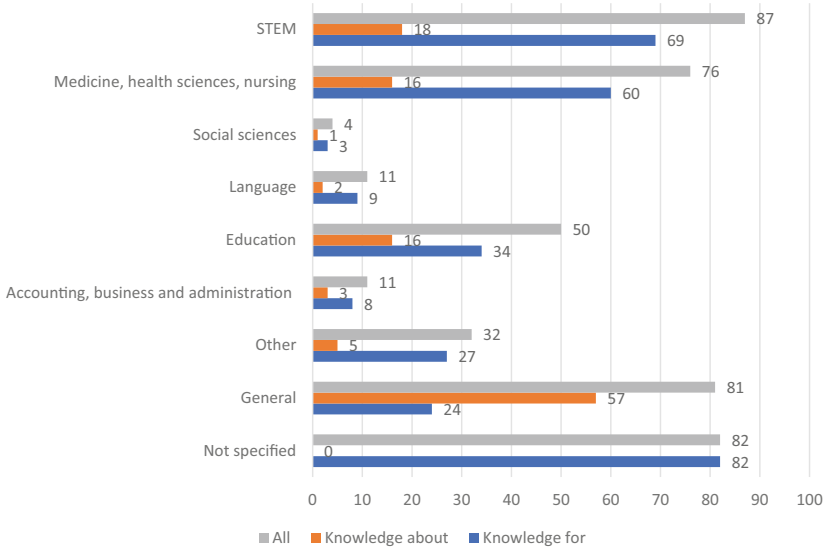

Fig. 10.5 Description of publications according to discipline (*Source* Authors' own)

DTHE is *not* tied to specific disciplinary contexts or constraints, but addresses the phenomenon more holistically (cf. above).

Stakeholder Perspectives

We additionally looked at different perspectives from which the publication was written, based on potential stakeholders in HE. We distinguished between students, teachers, administrators, academics and ICT-support, and the HE institution as a whole. We further introduced two additional categories, one comprising both students and teachers as the community of learning, and teaching, understood as the applied or emergent pedagogical approaches. We are aware that the categories might be overlapping and non-exclusive and that the categorization is limited to the information found in the title and abstract (cf. Fig. 10.6).

Figure 10.6 shows that more than half of the publications address the student perspective ($N = 400$) perspective. Among these publications, the majority deal with *knowledge for* DTHE, which corresponds with our

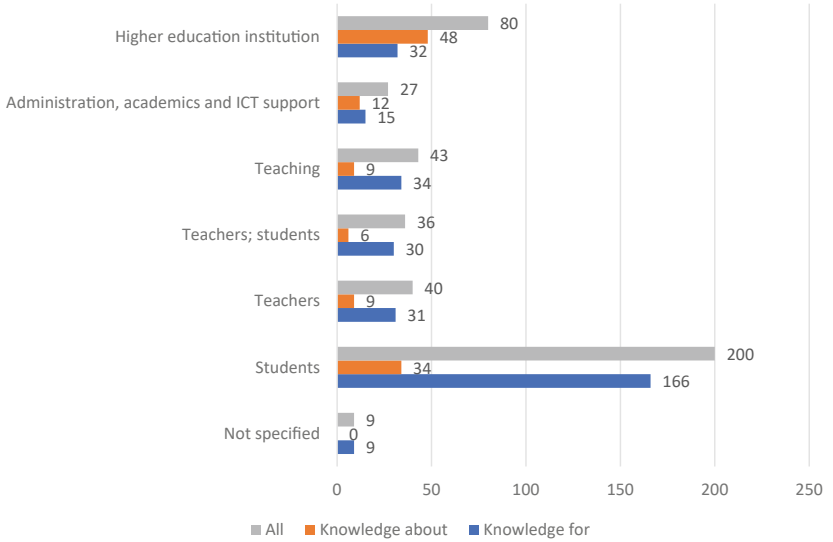

Fig. 10.6 Description of publications according to stakeholder perspective (*Source* Authors' own)

operationalization of this category, in which the learning and social experiences of students was one defining aspect. We found a similar picture for publications with the perspective or teachers, teachers and students and teaching, with smaller numbers in total, but still with the majority of publications being categorized as *knowledge about*.

For the perspective of the HE institutions, however, the general picture is different. Here, 48 publications, which is more than 50 percent, deal with *knowledge about*, while the remaining 32 publications relate to *knowledge for* DTHE. For administration, academics, and ICT-support the distribution is rather equal across the two categories. For students, however, 166 of 200 publications are categorized *knowledge for* vs. 34 publications that are categorized as *knowledge about*.

Discussion

The COVID-19 pandemic has led to important disruptions in HE. These were mainly related to initiatives to ensure the provision of HE in online-mode, partly accompanied by research. However, as elaborated in the introduction, the unprecedented situation created by the pandemic can be viewed as an opportunity to advance our understanding DTHE, which until this point had been understood as a niche compared to DT in other sectors (Reis et al., 2018) and not uniformly understood in itself (Benavides et al. 2020). From this backdrop, the main purpose of this chapter was to systematically retrieve, map and describe the knowledge communicated on DTHE in the international literature based on experiences gained in the first year of the pandemic, and to address knowledge gaps in a dynamic field of inquiry, with implications for further research on DTs in higher education.

Our scoping review shows that the great majority of publications produced in the first year of the pandemic provided a lot of *knowledge for* DTHE, and only a smaller part communicated *knowledge about*, as operationalized by us for this purpose. Given the novelty of the situation of having to convert all university activity to online media in a very short timeframe, it is not surprising that authors first and foremost tried to document their concrete experiences and reflect on their actions, which was by definition the content of the *knowledge for*-category. Most of the papers in the *knowledge for*-category are addressing students, student–teacher interactions, teachers, and teaching perspectives, accordingly. Also, the vast majority of articles in this category comprise STEM subjects and medicine and health. This effect can be explained by the fact that these disciplines together cater for large numbers of students in academic programs in many regions (e.g. Eurostat, 2020), and hence also present the largest group in our sample.

Among publications addressing the perspective of HEIs, however, we find a different picture. For these, the majority of publications is categorized as *knowledge about* DTHE. The same can be found for publications that were not classified according to discipline. Through both aspects—providing knowledge with a perspective on HEIs and not tied to a single discipline but with a boarder perspective—these findings seem to validate our categories. We considered *knowledge about* as leaning towards a social-constructivist and practice-oriented notion of organizational learning; hence, publications in this category partly refer

to changes in organizational culture (Cook & Yanow, 1993), situated learning (Lave & Wenger, 1991) and social learning (Brandi & Elkjaer, 2015). We did not search for direct references to explicit theories in the papers during the scoping process, but pragmatically defined publications in this category as accounting for more than the documentation and evaluation of isolated actions. The fact that a categorization in the *knowledge about*-category overlaps with papers taking an institutionally broad and transdisciplinary perspective confirms that our operationalizations worked as intended.

With respect to geographic region, the ratio of *knowledge for* vs. *knowledge about* contributions is most uneven in Asia and Europe. Since publications from these regions also account for the majority of publications in our sample in total it cannot be excluded that this gap increases with total numbers. This effect excluded, however, it needs to be asked whether other factors in geographic regions could contribute to a more even production *of knowledge for* vs. *knowledge about* DTHE, such as different academic traditions, or different institutional focus DTs during the pandemic.

Limitations and Implications for Further Research

Our method was informed by a scoping review approach to examine and describe a broad and dynamically developing field and to identify knowledge gaps and clarify core concepts (Tricco et al., 2016). Even though this approach aimed to reduce bias and increase transparency and rigor, it implied some limitations in time and resources. First, we have limited our literature search to the first year of the pandemic, i.e., literature published between March 2020 until February 2021 under the assumption that we have reached a certain saturation for the most critical phase. We are, however, aware, that we have missed further and later published studies of relevance. Second, given the ambiguity and non-standardized use of the term DT and a limitation to certain databases, we might have omitted references that have applied a different terminology. Third, given a relative broad research question and a relatively high number of included studies, we limited our coding and analysis to information found in titles and abstracts. Fourth, the scope of our review was limited to abstracts and titles in English, which might have biased the sample of included publications to countries with a high research activity in English language.

This means that countries, where other languages than English might dominate the academic discourse or co-exist, might be underrepresented.

The findings of our review point to a greater interest in *knowledge for* over *knowledge about* in academic writings during the first year of the pandemic, and a focus on hard sciences. With that, potentially underdeveloped research areas are *knowledge about* DTHE, and a focus on soft disciplines. Given the dynamic development of the field and drawing on these findings, a more specified review of the literature with a single focus on *knowledge about* DTHE might provide further insight into this topic over time. This type of review might build on a perspective based on theories of innovation and technological change.

Methodologically, the timeframe that we focused on (due to the urgency of the situation) can only provide a glimpse of developments that have been ongoing before the pandemic, and will continue to unfold in the upcoming years. Focusing on publications on DTHE from the first year of the pandemic provides an opportunity to look at this unfolding. When we look at a split between the papers in our sample, the larger share of those categorized as *knowledge about* DTHE was published in the second period. This indicates an increasing maturity and elaboration of the concept of DTHE over time and with the progression of the pandemic.

Also, the question is still unanswered on whether the COVID-19 pandemic in itself has actually started DTHE, albeit some of the authors of papers in our sample certainly believe this. However, in our review, several papers also mentioned how many of the digital technologies were already developed and many were in use before the pandemic. This would suggest that the pandemic has accelerated a wave of change that was already rolling. Since other areas of society, such as business and industry appear to have come further in their DTs, we may expect education to follow a similar pattern, which should be studied with a longer-term perspective and an eventual follow-up scoping review in a couple of years from now.

Additionally, we must be aware that although some of the technologies are shared across several sectors in society, and that we might expect to find new uses for communications technology in online education as DTHE progresses. Some of these technologies have been around for a while (Tømte & Olsen, 2013), but they may have undergone a rapid development during the pandemic. This also calls for further and future investigation. From a more timely perspective, a further study might draw

on a purposefully selected sample of full-text articles and elaborate more fine-grained dimensions of the category *knowledge about* DTHE, which can inform further primary investigations in different country settings with different innovation paths and in different disciplines.

References

Anderson, S., Allen, P., Peckham, S., & Goodwin, N. (2008). Asking the right questions: Scoping studies in the commissioning of research on the organisation and delivery of health services. *Health Research Policy and Systems, 6*(1), 7. https://doi.org/10.1186/1478-4505-6-7

Archer-Kuhn, B., Ayala, J., Hewson, J., & Letkemann, L. (2020). Canadian reflections on the Covid-19 pandemic in social work education: From tsunami to innovation. *Social Work Education, 39*(8), 1010–1018. https://doi.org/10.1080/02615479.2020.1826922

Argyris, C., & Schön, D. A. (1996). *Organizational learning*. Addison-Wesley Pub. Co.

Bataineh, K. B., Atoum, M. S., Alsmadi, L. A., & Shikhali, M. (2021). A silver lining of coronavirus: Jordanian universities turn to distance education. *International Journal of Information and Communication Technology Education, 17*(2), 138–148. https://doi.org/10.4018/IJICTE.20210401.oa1

Benavides, L. M. C., Tamayo Arias, J. A., Arango Serna, M. D., Branch Bedoya, J. W., & Burgos, D. (2020). Digital transformation in higher education institutions: A systematic literature review. *Sensors, 20*(11), 3291. https://doi.org/10.3390/s20113291

Bond, M., Marín, V. I., & Dolch, C. (2018). Digital transformation in German higher education: Student and teacher perceptions and usage of digital media. *International Journal of Educational Technology in Higher Education, 15* (48). https://doi.org/10.1186/s41239-018-0130-1

Brandi, U., & Elkjaer, B. (2015). Organizational learning viewed from a social learning perspective. In M. Easterby-Smith, & M. A. Lyles (Eds.), *Handbook of organizational learning and knowledge management* (pp. 21–41). John Wiley & Sons, Inc. https://doi.org/10.1002/9781119207245.ch2

Burns, R. (2020). A COVID-19 panacea in digital technologies? Challenges for democracy and higher education. *Dialogues in Human Geography, 10*(2), 246–249. https://doi.org/10.1177/2043820620930832

Colpitts, B. D. F., Smith, M. D., & McCurrach, D. P. (2021). Enhancing the digital capacity of EFL programs in the age of COVID-19: The ecological perspective in Japanese higher education. *Interactive Technology and Smart Education*, *8*(2), 158–174. https://doi.org/10.1108/ITSE-08-2020-0123

Conticelli, E., Marzani, G., Rosas, P. S., Santangelo, A., & Tondelli, S. (2020). A field-based learning experience in the time of Covid-19. *Territorio*

della Ricerca su Insediamenti e Ambiente. Rivista internazionale di cultura urbanistica, 113–126. https://doi.org/10.6092/2281-4574/7597

Cook, S. D. N., & Yanow, D. (1993). Culture and organizational learning. *Journal of Management Inquiry, 2*(4), 373–390. https://doi.org/10.1177/105649269324010

Coral, M. A., & Bernuy, A. E. (2022). Challenges in the digital transformation processes in higher education institutions and universities. *International Journal of Information Technologies and Systems Approach*, *15*(1). https://doi.org/10.4018/ijitsa.290002

Cuaton, G. P. (2020). Philippine higher education institutions in the time of COVID-19 pandemic. *Revista Românească Pentru Educaţie Multidimensională*, *12*(1), 61–70. https://doi.org/10.18662/rrem/12.1sup2/247

Deja, M., Rak, D., & Bell, B. (2021). Digital transformation readiness: Perspectives on academia and library outcomes in information literacy. *Journal of Academic Librarianship*, *47*(5). https://doi.org/10.1016/j.acalib.2021.102403

Ebert, C., & Duarte, C. H. C. (2018). Digital transformation. *IEEE Software, 35*(4), 16–21. https://doi.org/10.1109/MS.2018.2801537

Eurostat. (2020). Tertiary education statistics. Vol. 2020. https://ec.europa.eu/eurostat

Fassin, Y. (2021). Research on Covid-19: A disruptive phenomenon for bibliometrics. *Scientometrics, 126*, 5305–5319. https://doi.org/10.1007/s11192-021-03989-w

Garcia-Penalvo, F. J. (2021). Avoiding the dark side of digital transformation in teaching. An institutional reference framework for eLearning in higher education. *Sustainability*, *13*(4). https://doi.org/10.3390/su13042023

Garcia-Penalvo, F. J., & Corell, A. (2020). The COVID-19: The enzyme of the digital transformation of teaching or the reflection of a methodological and competence crisis in higher education? *Campus Virtuales, 9*(2), 83–98.

Hopp, M., Pfiel, S., Schuster, R. M., Tiefenbacher, F., & Reiner, M. (2020). A debate about implementing immersive technology for higher education: Prestudy examining the usability of virtual reality for lectures. *Human Systems Management, 39*(4), 565–571. https://doi.org/10.3233/HSM-201058

Institute Joanna Briggs. (2015). *The Joanna Briggs Institute Reviewers' Manual 2015 Methodology for JBI Scoping Reviews.* The Joanna Briggs Institute. https://jbi.global/scoping-review-network/resources [Updated: August 11th, 2021].

Kabir, M. R., Islam, Md. A., & Deena, S. A. (2020). Explaining the adoption of technology-based design of higher education during and after COVID 19 period from a developing country perspective. *Interaction Design and Architecture(s)*, *46*, 88–119. https://doi.org/10.55612/s-5002-046-005

Laterza, V., Tomte, C. E., & Pinheiro, R. M. (2020). Guest editorial digital transformations with "Nordic characteristics"? Latest trends in the digitalisation of teaching and learning in Nordic higher education. *Nordic Journal of Digital Literacy, 15*(4), 225–233.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.

Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: Advancing the methodology. *Implementation Sciences, 5*, 69. https://doi.org/10.1186/1748-5908-5-69

Mariani, B., Havens, D. S., & Metz, S. (2020). A college of nursing's upward spiral during a global pandemic. *Journal of Nursing Education, 59*(12), 675–682. https://doi.org/10.3928/01484834-20201118-04

Marks, A., & AL-Ali, M. (2020). Digital transformation in higher education: a framework for maturity assessment. *International Journal of Advanced Computer Science and Applications*, *11*(12). https://doi.org/10.14569/IJACSA.2020.0111261

Miller, M. T. (2021). Do learning organizations learn? Higher education institutions and pandemic response strategies. *The Learning Organization, 28*(1), 84–93. https://doi.org/10.1108/TLO-09-2020-0159

OECD. (2021): The state of higher education. *One year into the Covid pandemic*. OECD.

Pazos, A. J. B., Ruiz, B. C., & Perez, B. M. (2020). Digital transformation of university teaching in communication during the COVID-19 emergency in Spain: An approach from students' perspective. *Revista Latina De Comunicacion Social, 78*, 265–287.

Pittman, J., Severino, L., DeCarlo-Tecce, M. J., & Kiosoglous, C. (2021). An action research case study: Digital equity and educational inclusion during an emergent COVID-19 divide. *Journal for Multicultural Education, 15*(1), 68–84. https://doi.org/10.1108/JME-09-2020-0099

Reis, J., Amorim, M., Melão, N., & Matos, P. (2018). Digital transformation: A literature review and guidelines for future research. In Á. Rocha, H. Adeli, L. P. Reis, & S. Costanzo (Eds.), *Trends and advances in information systems and technologies* (Vol. 745, pp. 411–421). Springer International Publishing. https://doi.org/10.1007/978-3-319-77703-0_41

Scholkmann, A. (2022). Innovation needs reflection. How experience from emergency remote teaching can become sustainable learnings through collective critical inspection. In H. Angenent, J. Petri, & T. Zimekova (Eds.), *Hochschulen in der Pandemie. Impulse für eine nachhaltige Entwicklung von Studium und Lehre* (pp. 104–115). Transcript.

Sjöberg, J., & Lilja, P. (2019). University teachers' ambivalence about the digital transformation of higher education. *International Journal of Learning,*

Teaching and Educational Research, *18*(13), 133–149. https://doi.org/10.26803/ijlter.18.13.7

Tømte, C., & Olsen, D. (2013). IKT og læring i høyere utdanning: Kvalitativ undersøkelse om hvordan IKT påvirker læring i høyere utdanning. *NIFU Report, 2013*, 32.

Toprak, M., Bayraktar, Y., Yorgun, S., & Ozyilmaz, A. (2021). Digital transformation, research university and restructuring of higher education: A model proposal for Istanbul University Faculty of Economics. *Journal of Economy Culture and Society,* (63), 67–92. https://doi.org/10.26650/jecs2020-801234

Tricco, A. C., Lillie, E., Zarin, W., et al. (2016). A scoping review on the conduct and reporting of scoping reviews. *BMC Medical Research Methodology, 16*, 15. https://doi.org/10.1186/s12874-016-0116-4