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# Understanding the Challenges of Rapid Digital Transformation: the Case of COVID-19 Pandemic in Higher Education

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**Abstract:** Rapid digital transformation is taking place due to the COVID-19 pandemic, forcing organizations and higher educational institutions to change their working and learning culture. This study explores the challenges of rapid digital transformation arising during the pandemic in the higher education context. This research used the Q-methodology to understand the nine challenges that higher education encountered, perceived differently as four main patterns: 1) Digital-nomad enterprise; 2) Corporate-collectivism; 3) Well-being-oriented; 4) Pluralistic. This study broadens the current understanding of digital transformation, especially in higher education. The nine challenges and four patterns of transformation actors serve as a starting point for organizations in supporting technological choice and strategic interventions, based on individual, group, and organizational behavioral levels. Moreover, five propositions, based on the competing concerns of these challenges, establish a framework for comprehending the ecosystem that enables rapid digital transformation. Strategies, prerequisites, and key factors during the (digital) technology development process benefit the cyber-society ecosystem. As a practical contribution, Q-methodology was used to investigate perspectives on digitalization challenges during the pandemic.

**Keywords:** COVID-19 Pandemic, Digital Transformation, Higher Education, Challenges of Digitalization, Rapid Digitalization, Q methodology

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## 1. Introduction

The purpose of this study is to provide a deeper understanding of socio-technical challenges arising from the COVID-19 pandemic in academic settings, particularly in higher educational (HE) institutions. In the first semester of 2020, the World Health Organization (WHO) declared that the coronavirus disease (COVID-19) had emerged across countries worldwide and was severely restricting social activities, including economics, business, learning, and teaching. The COVID-19 pandemic has significantly impacted lives, organizations, and societal and economic growth. This

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35 prompted each country to comply with the WHO recommendations and adapt policies to combat the virus's spread. Policy at the nation-state level also includes encouraging organizations, such as educational institutions, to comply with guidelines that government authorities have issued.

Due to the pandemic, millions of people are undergoing experiences of rapid “forced” transformations in many areas, such as the digitalization of business processes, working from home, or digital workplaces (Dery, Sebastian, and van der Meulen 2017), including teaching and learning activities (Burki 2020). This study defines digital transformation as organizational innovation and changes due to introducing new or disruptive digital concepts and technologies (Hinings, Gegenhuber, and Greenwood 2018; Schallmo and Williams 2018; Majchrzak, Markus, and Wareham 2016). The importance of studying the challenges of digital transformation (Majchrzak, Markus, and Wareham 2016) is mainly its status as a response to the COVID-19 pandemic that caused “forced” and rapid change in work and learning cultures in the HE context (Toquero 2020; Peters et al. 2020; Bao 2020; Nenko, Kybalna, and Snisarenko 2020; Crawford et al. 2020; Rumbley 2020; Burki 2020).

Generally, HE institutions in many countries lag behind other types of organizations. Urgent pressure is currently underway as a) COVID-19 directly affects millions of people in HE with different roles, including students and employees (Peters et al. 2020; Rumbley 2020); b) HE institutions historically have been adopting information technology to support the educational process for individualization and distance learning (Nenko, Kybalna, and Snisarenko 2020; Petersen et al. 2020; Kerres 2020); c) HE enables an analysis in the global context (Nenko, Kybalna, and Snisarenko 2020; Crawford et al. 2020); d) the intergenerational environment manages a higher number of participants in the future global workforce during and after the pandemic (Nenko, Kybalna, and Snisarenko 2020; Peters et al. 2020; Toquero 2020; Drane, Vernon, and O’Shea 2020).

Despite its importance, the study of COVID-19 pandemic HE challenges’ impact on digital transformation remains limited (Toquero 2020). Therefore, further identifying technology-oriented problems is necessary, due to the need to scale up online teaching, particularly regarding the multidimensional analysis of technological challenges on individual, group, and organizational levels. For the system designer and organizational management (Polites and Karahanna 2013; Te’eni 2001) to provide better sustainable technological interventions and strategic decisions (Polites and Karahanna 2013; Blakeney 1983), a three-level technology analysis is essential. Furthermore, few empirical studies on the combined subjective preferences of staff or faculty members and students address the challenges that COVID-19 poses. This results in strategic approaches exclusively directed to particular groups, leading to a slow response to rapid transformation (Rumbley 2020).

70 Therefore, the researcher applied the Q methodology, a mixed-method approach (Venkatesh, Brown, and Bala 2013; Ramlo 2016), combining the systematic literature review (SLR) (Tranfield, Denyer, and Smart 2003) and the Q-sorting procedure with studying subjectivity (Stephenson 1953; Watts and Stenner 2005; Thomas and Watson 2002). The Q methodology uses personal preferences to generate groups or factors representing differences and similarities among  
75 participants' competing concerns (Watts and Stenner 2005; Stephenson 1953).

In this study, we propose the use of the Q methodology as a novel method to determine digital-transformation challenges. We further conceptualize challenges based on a three-level analysis (individual, interpersonal/group, and organizational) of organizational behavior (Blakeney 1983; Staw, Sandelands, and Dutton 1981; Te'eni 2001) and identify four factors as a pattern of  
80 viewpoints, including 1) the digital-nomad enterprise; 2) corporate-collectivism; 3) a well-being-orientation; 4) pluralism. This study explores different viewpoints based on distinct and consensus challenges that students and lecturers faced. It outlines the priority of particular COVID-19 issues or challenges. The results also provide five in-depth insights into these challenges that caused a rapid digital transformation in the HE context, based on factor analysis.

## 85 **2. State of the Art**

Educational institutions are one of the sectors that the COVID-19 pandemic has affected heavily worldwide (Toquero 2020; Crawford et al. 2020). To curb the spread of this virus, most governments temporarily closed educational institutions, globally impacting 144 countries and more than 67% of the world's student population, from primary school to HE (UNESCO 2020).  
90 Various studies on HE already report difficulties that students and employees face due to the pandemic (IESALC-UNESCO 2020; Marsicano et al. 2020; Owusu-Fordjour, Koomson, and Hanson 2020; Peters et al. 2020). Some challenges are common; others vary by country or institution (Marsicano et al. 2020), depending on such factors as cultural and social life, technological infrastructure, and financial and economic conditions.

95 This section publishes the studies and challenges reported from different regions, regarding the COVID-19 challenges that HE faced, based on three levels of behavioral analysis (Blakeney 1983; Staw, Sandelands, and Dutton 1981; Te'eni 2001): individual, group, and organizational (Staw, Sandelands, and Dutton 1981). Studies show that digital transformation is a dynamic process of organizational change (Hinings, Gegenhuber, and Greenwood 2018; Majchrzak, Markus, and  
100 Wareham 2016) affecting each individual (Hinings, Gegenhuber, and Greenwood 2018; Majchrzak, Markus, and Wareham 2016), and a different subjective experience based on the scope and degree of observation (Maldaner et al. 2019; Hinings, Gegenhuber, and Greenwood 2018; Majchrzak, Markus, and Wareham 2016).

105 The digital transformation process also emphasizes dynamic action, not limited to biophysical characteristics (Schallmo and Williams 2018; Kane et al. 2015). Furthermore, the focal point of digital transformation is not primarily the technological aspect but, rather, the strategic approach (Matt, Hess, and Benlian 2015) to the process of changing human behavior (Kane et al. 2015; Majchrzak, Markus, and Wareham 2016), in terms of attitudes, culture, and working methods, through the emergence of various digital technologies (Hinings, Gegenhuber, and Greenwood 110 2018; Kane et al. 2015). These three levels of behavioral-analysis help explain the dynamic patterns of perceived challenges, based on three observation points that occur in an organization during a transformative process. Moreover, understanding the challenges based on a specific level of influence helps organizations and information system designers provide better interventions and strategies (Blakeney 1983; Polites and Karahanna 2013; Matt, Hess, and Benlian 2015; Vial 2019).

## 115 2.1 *Individual-level analysis of challenges*

The individual level of analysis refers to the characteristics and conditions inherent in persons, due to the rapid transformation of the learning or teaching environment to one that is virtual or technologically facilitated. The studies on different conditions of students and employees include those from Pacific Asia, Africa, and the European regions. For example, the problems encountered 120 include fear of future careers and lack of online learning or teaching competencies (Wang et al. 2020; Peters et al. 2020; Bao 2020; Kerres 2020; Drane, Vernon, and O'Shea 2020; Owusu-Fordjour, Koomson, and Hanson 2020), issues of well-being in Europe, Pacific-Asia, and Australia (Drane, Vernon, and O'Shea 2020; Kerres 2020; Marsicano et al. 2020; Toquero 2020; Peters et al. 2020), difficulties in concentrating and finding appropriate materials, and student self-discipline 125 (Bao 2020; Toquero 2020; Owusu-Fordjour, Koomson, and Hanson 2020). In comparison, lecturers tend to refrain from providing online materials (Abidah et al. 2020; Kerres 2020). The individual level provides two starting points for classifying challenges, relating to well-being and lack of competencies as an initial classification.

## 2.2 *Group- or interpersonal-level analysis of challenges*

130 Analysis at the group or social level refers to the attributes and conditions inherent in a group, or human-to-human interaction facilitated by technology during the pandemic. Problems and challenges arise in different countries concerning this analysis at the group level. For example, in Pacific-Asia and Europe, there was a lack of activity, diversity (Wang et al. 2020; Bao 2020; Owusu-Fordjour, Koomson, and Hanson 2020; Nenko, Kybalna, and Snisarenko 2020; Rumbley 135 2020), and equal opportunities (Wahyuningsih 2020; Obiakor and Adeniran 2020; Owusu-

Fordjour, Koomson, and Hanson 2020) in group academic participation in a virtual class. Moreover, cyberbullying, intolerance, and arrogance toward other races, generations, competencies, and vulnerable groups (Peters et al. 2020; Owusu-Fordjour, Koomson, and Hanson 2020; Bezuidenhout 2020; Drane, Vernon, and O'Shea 2020) occurred, along with uncomfortable  
140 learning/working conditions at home involving students and parents (Abidah et al. 2020). Thus, the literature emphasizes the challenge of social inclusion and diversity at the group-analysis level.

### *2.3 Organizational-level analysis of challenges*

The organizational level of analysis refers to the elements and conditions inherent in an organization, which support the business through technology. The challenges reported from Pacific  
145 Asia are the lack of an adequate learning environment, the increased workload of teachers in preparing online learning, and the lack of scientific data to support the development of responsive strategies (Toquero 2020; Abidah et al. 2020; Wahyuningsih 2020; Bao 2020). The cancelation or postponement of academic events is a common challenge worldwide, due to the difficulty of digitizing certain activities (Crawford et al. 2020; Rumbley 2020). The European and Australian  
150 regions reported a lack (in the context of rapid implementation) of response plans and management strategies (e.g., data privacy, data protection) (Kerres 2020; Owusu-Fordjour, Koomson, and Hanson 2020; Bezuidenhout 2020; Rumbley 2020; Drane, Vernon, and O'Shea 2020). Furthermore, many countries have concerns about a reduction of international mobility for both students and employees and the need for sufficient resources to sustain a virtual environment  
155 (Nenko, Kybalna, and Snisarenko 2020; Owusu-Fordjour, Koomson, and Hanson 2020; Bezuidenhout 2020). Overall, reports reflect a need for strategic development to support the rapid mobilization of organizational capabilities and strategies for promoting flexibility of work and learning, due to the rapid changes in the organizational working environment.

This section does not cover all countries or regions. However, the identified challenges provide  
160 an initial overview of all, based on a three-level analysis for use on a broader scale. Furthermore, regarding solutions to challenges, studies from several countries have already appeared, proposing recommendations and approaches for exit strategies (Toquero 2020; Petersen et al. 2020; Wang et al. 2020; Rumbley 2020; Drane, Vernon, and O'Shea 2020). For instance, one proposed exit  
165 strategy includes utilization of technology surveillance, a self-reporting system for symptom analysis, an isolation-tracking app or low-cost bracelet for measuring body temperature, an isolation enforcement system with multi-language support, all the way up to long-lasting battery life (Petersen et al. 2020), all generally applicable and customizable across countries and organizations.

### 3. Method

This study used a mixed-method approach, employing the Q methodology (Stephenson 1953; Ramlo 2016) to investigate subjective opinions in an online format (due to social distancing). Stephenson (Stephenson 1953; Watts and Stenner 2005) initially developed the Q methodology for the study of human subjectivity in the field of psychology. It has already attracted attention in various fields, including technology and information systems design and human-computer interaction (O'Leary, Wobbrock, and Riskin 2013; Nurhas, Geisler, and Pawlowski 2019). The Q-study approach serves to explore and validate the existence of particular viewpoints (Thomas and Watson 2002), stressing not the population's demographic characteristics but the participants' perspective patterns (Watts and Stenner 2005; Stephenson 1953; Thomas and Watson 2002). The Q methodology's advantages over other approaches to this study context are:

- It has already been utilized to examine technology use in the workplace and higher educational contexts (Wingreen and Blanton 2018; Mettler and Wulf 2019; Ramlo 2012; Mettler, Sprenger, and Winter 2017).
- It requires no large number of participants to obtain a good result, as the focus is on the population of viewpoints rather than population characteristics (Watts and Stenner 2005; Mettler and Wulf 2019).
- With no need to perform multiple stages of the sorting process to reach participant consensus, it offers more certainty of time and process (Ramlo 2016; Watts and Stenner 2005; Nurhas, Geisler, and Pawlowski 2019).
- The statements/opinions can appear in online/offline settings in the form of text, sounds, images, or videos (images with sound), for more flexibility and accessibility (Watts and Stenner 2005; Nurhas, Geisler, and Pawlowski 2019).

This study employed the Q-methodological approach in response to different priorities, personal experience, and subjective preferences regarding challenges (Watts and Stenner 2005; Stephenson 1953) faced during the transformation to work in a virtual environment. Furthermore, the Q methodology presents a set of conceptual and methodological approaches to investigating observed transformational phenomena for use in developing theory or hypotheses. The approach is suitable for abductive reasoning when formulating propositions based on observing the identified patterns of viewpoints (Nurhas, Geisler, and Pawlowski 2019; Watts and Stenner 2005; Ramlo 2016). Therefore, for this study, we argue that the Q methodology can provide a better understanding, through a deeper analysis of prioritization, individualization, competing concerns, and rationale for subjectivity, of challenges among various stakeholders in HE (Fabian et al. 2021; Godor 2021).

The Q methodology involves developing a set of statements (Q-set) or the process of conceptualizing various preferences around the topic, based on the concourse (Ramlo 2016; Watts and Stenner 2005). The Q-set can be developed based on interviews, literature, experts' opinions, websites, or social media analysis (Nurhas, Geisler, and Pawlowski 2019). It is then presented to purposefully selected participants (P-set). The P-set sorts the Q-set into the Q-pyramid, and the sorting result is called a Q-sort. In analyzing the Q-sort, factor analysis identifies the patterns of similarity, difference, and consensus that exist between the participants (Watts and Stenner 2005; Ramlo 2016).

### *3.1 Development of Q-set from the literature*

The researcher used a systematic literature review (Tranfield, Denyer, and Smart 2003; Webster and Watson 2002) to develop the Q-set—i.e., to conceptualize the challenges of the rapid digital transformation associated with COVID-19. As this study used the Q methodology as the primary approach, the systematic review of the literature served only to develop the initial conceptual model for the Q-set, for presentation to the P-set. Thus, the focus was not on presenting and conducting a detailed meta-analysis of the literature. The objective was to consolidate scientific evidence or knowledge fragments using an organized and documented procedure (Tranfield, Denyer, and Smart 2003). The review process started by applying keywords (“COVID-19” AND “higher education”) to Scopus and Arxiv databases on April 30, 2020. The inclusion criteria were articles in English that analyze HE, published during the COVID-19 pandemic (starting in January 2020) and discussing the challenges or problems that students or HE employees have faced. The excluded articles are thematically outside of the university context and include no discussion of (digital) technology's role. Then, 31 publications were extracted based on keywords. After applying the inclusion and exclusion criteria, 15 articles remained for the systematic selection process (including three from the Arxiv database). After combining the result of systematic selection with narrative review (see section 2), 29 articles were included for review (see Appendix 1). The co-authors discussed recommendations and disagreements until there were no further comments on adding or removing specific literature.

Manual and iterative coding were used to analyze the selected articles (Elo and Kyngäs 2008). The concourse or theory of communicability was applied as part of the Q methodology (Watts and Stenner 2005; Stephenson 1953). The concourse aimed to develop a set of general concepts covering a wide range of topics for the study context (Watts and Stenner 2005; Thomas and Watson 2002; Stephenson 1953; Mettler and Wulf 2019). The following process was applied for the manual content analysis:

- a. Each article was read carefully to extract and create a list of challenges for this study.



- b. A table listing all extracted challenges was created, including a column for labeling the level of analysis and iteration for generalization.
- c. Each challenge was labeled to one level of analysis based on the subject and the influence of the problem, whether it was personal, interpersonal, or organizational. Then, the challenges were sorted based on the group level of analysis.
- d. All challenges in the category of the individual level of analysis were read. The main concept of a problem was identified by a similar verb, object, and context. Similar challenges were combined and grouped to identify common objects. The process was iterative until all problems carried the label of a particular concept.
- e. Each concept was read carefully, discussed, and used to identify the general concept by taking the abstraction level higher, to cover several similar concepts of challenge.
- f. Processes “d” and “e” were applied to interpersonal and organizational challenges.
- g. After all challenges were labeled with a particular main concept, the proposed label was discussed in an online webinar with other academics and practitioners, to receive further feedback. Finally, based on the feedback, the main concept was refined.

### 3.2 *Q-sorting procedure and factor analysis*

For the data collection, the participants (P-set) were asked about their personal preferences regarding the challenges that have long-term effects, based on their personal experiences with the rapid digital change of educational activities as students or employees/lecturers. The number of participants for the study was 61 (students: 63.93%, staff/lectures: 36.07%; Countries: Australia:1.64%, Indonesia: 75.41%, Germany: 21.31%, UK:1.64%). Although it is not a Q methodology requirement, the number of participants for this study was sufficient to achieve a successful outcome (Mettler and Wulf 2019; Watts and Stenner 2005).

The list of challenges or the Q-set was randomly presented to the participants as a statement card. The participants were asked to rank and compare the Q-set in order of importance (from lowest [-2] to highest importance [+2]). They then placed the statement card in the q-sorting pyramid (see Figure 1). After filling out the q-sorting pyramid, the P-set was asked questions on the relevance, understandability, and completeness of the challenges (Likert scale: 1 = not fully relevant/understandable/complete, to 5 = fully relevant/understandable/complete), as well as the reason for placing statements in +2 (most important) and -2 (least important) categories.

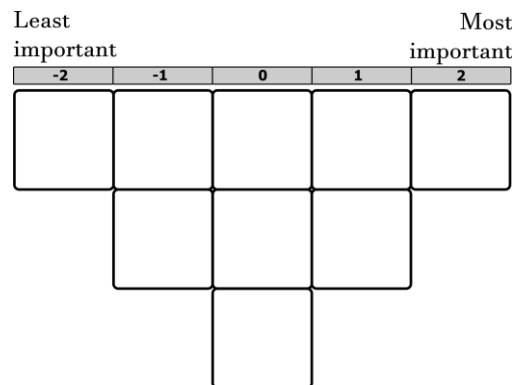


Figure 1. Design of the Q-sort grid or Q-pyramid

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The KADE software, a desktop application, was used to calculate the Q-factor analysis (Banasick 2019), calculating the factor correlation by applying the seven factors of centroid analysis. The varimax rotation (Watts and Stenner 2005) is more suitable for determining the factor without any prior hypothesis or knowledge of a group or classification of the P-set viewpoints (Watts and Stenner 2005). The composite reliability showed a high value ( $> .95$ ) and acceptable eigenvalues ( $> 1.0$ ). Furthermore, the number of factors was selected if the cumulative explained variance of all selected factors achieved a minimum recommendation of 60% (Hair et al. 1998).

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#### 4. Conceptualization and statistical factor representations

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In this section, nine challenges were conceptualized, grouped into three analysis levels, and presented as the Q-set. Four identified factors or patterns of viewpoints emerged from the Q-sorting and the factor analysis, based on the nine challenges. The four factors were the essential findings and resources for the analysis, to understand how the rapid digital transformation challenges were differently structured in an organization during the pandemic.

##### 4.1 Individual-level Challenges

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The individual level of analysis yielded three main effects of COVID-19. First were the consequences related to mental health, due to the extensive use of technology and isolation (Crawford et al. 2020; de Oliveira Araújo, Francisco Jonathan et al. 2020; Drane, Vernon, and O'Shea 2020; IESALC-UNESCO 2020; Marsicano et al. 2020) or the adverse effects of technology on mental health (S1). Second, changes in the skills and competence required during the pandemic (digital competence) were highly demanded to work and learn from home (de Oliveira Araújo, Francisco Jonathan et al. 2020; Graves and Karabayeva 2020; Ting et al. 2020;

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Masters et al. 2020), generally creating greater dependence on digital competency (S2). This challenge blurs the line between personal and professional activity (S3), relating to the role in HE or the effects correlating to the changes in working and learning environments (Abidah et al. 2020; Jowsey et al. 2020; Kerres 2020; Crawford et al. 2020; IESALC-UNESCO 2020). Table 1 shows the challenge at the individual level with examples based on the literature.

Table 1. Individual-level analysis of COVID-19 challenges

(Id) Main category	Example (Sources see Appendix 1)
(S1) Adverse effects of technology on mental health	Technostress, anxieties, the pressure of uncertainty, psychological pain and suffering, stress, loneliness, depression, information overflow, sleeping disorder, negative emotions, frustration and betrayal, well-being issues.
(S2) Greater dependence on digital competency (digital skills and intelligence)	Greater workloads, using new technologies, resources, and alternative assessment methods, financial management, re-upskilling to requirements of digital tools and techniques, the need to identify hoaxes and reduce “infodemic” misinformation, management of motivation and remote work and learning
(S3) Blurring the boundaries of personal and work-related (as employee or student) activities to use technology	Blurring work-home boundary, 14 days of self-quarantine, need for greater autonomy in working and learning, limited support for distance learning, increased need for higher Internet bandwidth, adapting to a confinement situation

#### 4.2 Group or Interpersonal-Level Challenges

On the group level, two main challenges of COVID-19 were identified. The first related to reducing socialization activities, due to the local government's strict role (lockdown or social distancing). Therefore, the first challenge at the interpersonal level (S4) lies at the point where the technology becomes necessary not only for professional activities but also to integrate social cues or facilitate social interactions (Abidah et al. 2020; Duong et al. 2020; Graves and Karabayeva 2020; Leite, Hodgkinson, and Gruber 2020). The second challenge (S5) is the growing attention to and awareness of the digital divide, the diversity of and the technical gap between different types of users, requiring socio-technical support to overcome various difficulties in using the technology (Bezuidenhout 2020; Drane, Vernon, and O'Shea 2020; Duong et al. 2020). Table 2 shows challenges identified from the social/group-level analysis.

Table 2. Group-level analysis of COVID-19 challenges

(Id) Main category	Example (Sources see Appendix 1)
(S4) Accelerating the adoption of technology for social facilitation	Lack of quality employee relationships, students unable to return to the family and gather with peers and friends, loss of contact and socialization routines, lack of access to counseling services, fears of infection and transmission of the virus to family members through direct physical contact, the need to develop telemedicine or distance healthcare, and lack of social cues when using technology.
(S5) Shaping technology toward digital inclusion, diversity, and equity	The need for consistent feedback and immediate response, digital divide, location infrastructure, different technology experiences, family supports, interaction at home, technology for vulnerable groups, negative perceptions of a particular group of students.

### 310 4.3 Organizational-Level Challenges

At the organizational level, four central challenges of COVID-19 were identified. The first was the accelerated use of new technologies and social media (S6). Emerging technology opens up a new possibility for digital collaborative work. Social media were used to share information, not only personal but also work-related content. High-speed Internet enables the extensive use of video platforms to deliver asynchronous content. Organizations were expected to adapt to emerging technologies to support business processes (Anderson et al. 2020; Jowsey et al. 2020; Leite, Hodgkinson, and Gruber 2020; Longhurst et al. 2020).

Second, the organization requires an agile and flexible (virtual) approach (S7) to continue to operate business activities remotely (Abidah et al. 2020; de Oliveira Araújo, Francisco Jonathan et al. 2020; Gonzalez et al. 2020; Graves and Karabayeva 2020; Weible et al. 2020; Weissgerber et al. 2020). The third challenge was to support more cross-functional collaboration (S8), to open new opportunities, gain different perspectives to solve a problem, and broaden existing resources (Weible et al. 2020; Longhurst et al. 2020; Kerres 2020; Jowsey et al. 2020).

The fourth challenge was faster adaptation and mobilization of organizational (resources) capabilities (S9) to support policies and strategies in pandemic conditions (de Oliveira Araújo, Francisco Jonathan et al. 2020; Graves and Karabayeva 2020; Kerres 2020). Table 3 shows the challenges that emerged from the analysis at the organizational level.

Table 3. Organizational-level analysis of COVID-19 challenges

(Id) Main category	Example (Sources see Appendix 1)
(S6) Acceleration	Extensive use of an online collaborative platform to support learning and

of the (ethical) use of emerging technologies and social media	working, the use of sharing video platform, 3d virtual resources, social media, increased awareness of data privacy protection, hoaxes, and infodemic across social media use, benefits of big data, artificial intelligence, machine learning, 5G optimization to tackle problems due to COVID-19, and the need to provide accurate and low-cost technology
(S7) Growing demands of technology for a flexible work/learning approach (independent of place and time management)	Remote work for employees, temporary suspension of teaching and learning activities, no transparent operational infrastructures due to lack of preparation, cancelation of networking events and gatherings, the transition to the virtual environment, disruption of academic routine, suspending or canceling educational activities, more time needed to prepare online learning materials, increased importance of working from home, reduced international activity programs, requiring fast response and immediate interdependence, forced to replace traditional learning with distance, blended, and online problem-based learning.
(S8) An increasing need for open and cross-functional (cross-disciplinary) digital collaboration	Increased collaboration between academia and educational institutions, and with private online platform services, cross-functional collaboration for strategic development involving multiple individuals and organizations, scientific expertise to shape the public policy responses
(S9) Rapid adaptation and mobilization of organizational resources and capabilities	Rapid technology adaptation policy, increased expectation of performance due to efficiencies of more IT use, delays in payment and depressed labor market, financial constraint or declines in income, reduce unnecessary jobs (administration and services), provide training for online learning approach, budget cuts, little to no organizational support.

330      The challenges of rapid digital transformation were conceptualized due to the COVID-19 pandemic, based on this literature as the Q-set input, which has personal, group/interpersonal, and organizational implications. Next, the result of the Q-sorting procedure and factor analysis for validating the challenges are presented, to explain different perspectives on how the challenges of rapid digital change were experienced during the COVID-19 pandemic.

#### 335 4.4 The pattern of viewpoints and validation of challenges

Based on the Q-sort and the factor analysis, four different patterns of viewpoints were identified with a cumulative variance of 68% ( $\geq 60\%$  as minimum value). The factor characteristics appear in Table 4.

Table 4. Factor Characteristics

Characteristics	Factor 1	Factor 2	Factor 3	Factor 4
Number of P-set	8	11	16	16
Eigenvalue	13,81	11,89	8,56	7,02
Exp. Variance	14%	19%	19%	16%
Comp. reliability	0,97	0,98	0,98	0,98
Standard Error	0,173	0,148	0,122	0,122

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Table 5 shows the Z-score of challenges, the rank of the Q-set within the factor, and the consensus statement based on the Z-score

Table 5. Factor Q-Sort Values

Id	xR	xU	Factor 1			Factor 2			Factor 3			Factor 4			Z-var
			Q	Z	R	Q	Z	R	Q	Z	R	Q	Z	R	
S1	3,52	3,70	-1	-1	8	-2	-1,64 <sup>D*</sup>	9	2	1,23 <sup>D*</sup>	1	-1	-0,85	8	1,158
S2	3,85	3,84	0	0,17	5	-1	-0,63 <sup>D*</sup>	7	0	0,5	4	-2	-1,5 <sup>D*</sup>	9	0,601
S3	3,36	3,13	0	0,37 <sup>D*</sup>	4	-1	-1,04	8	-2	-1,86 <sup>D*</sup>	9	-1	-0,74	7	0,638
S4	3,85	4,00	1	0,55	3	1	0,67	3	-1	-0,91 <sup>D*</sup>	8	0	0,32	5	0,395
S5	3,82	4,02	0	-0,74 <sup>D*</sup>	6	0	-0,1 <sup>D*</sup>	6	1	0,69 <sup>D*</sup>	3	2	1,87 <sup>D*</sup>	1	0,946
S6	3,90	3,93	1	0,76	2	0	0,54	4	1	0,8	2	1	0,5	3	0,018 <sup>C*</sup>
S7	4,13	4,00	2	1,85 <sup>D*</sup>	1	0	-0,1	5	0	0,22	5	1	0,52	2	0,553
S8	3,90	3,73	-1	-0,85	7	1	0,68	2	-1	-0,87	7	0	0,37	4	0,492
S9	4,00	3,98	-2	-1,12 <sup>D*</sup>	9	2	1,62 <sup>D*</sup>	1	0	0,19 <sup>D*</sup>	6	0	-0,48 <sup>D*</sup>	6	1,031

xR: mean value of relevancy; xU: mean value of understandability; Q: Q-sort Value; Z: Z-Score; R: Ranking; C: Consensus; D: Distinguishing; \*: significant at  $P < 0.01$

345

The overall value of relevance (Cronbach alpha = .805 or good) and understandability (Cronbach alpha = .793 or acceptable) gives a mean value of  $\geq 3.00$  as an indication of the proposed Q-set. For completeness, based on the open-ended questions, more than 80% of the

participants were identified as replying positively to the completeness of the proposed challenges.

350 The following were some of the participants' comments on completeness:

- The proposed challenges are consistent with the study context of rapidly changing workspaces toward more digital-based environments due to COVID-19: *"The above list covers the main technology-related impacts caused by the drastic changes in the working environment and the digital learning caused by the COVID-19 pandemic . . ."*
- 355 • The set of challenges addressed a wide range of related issues: *"In my opinion, every problem that I'm currently fighting could be placed in at least one of those categories."* Comments of the other participants included: *"All the mentioned points should have already covered general issues."*

For the factor-analysis results, four different patterns of viewpoints or factors concerning the Q-set were identified. In this study, factors are similar to the types of actors, consisting of different  
360 roles—students (ST), employee (EM), or combination of both—and grouped by similar viewpoints. The differences between the factors, according to three levels of analysis, were highlighted.

Factor one (ST: 50.0%; EM: 50.0%) showed more concern at the organizational level, and the  
365 challenges were categorized as most significant (support for flexible learning/working) and least important (a rapid adaptation of resources).

Factor two (ST:54.5%; EM:45.5%) focused on the organizational-level challenges and identified personal mental health challenges as the least important.

Factor three (ST:81.2%; EM:18.8%), in contrast to Factor Two, emphasized the greater  
370 importance of personal challenges regarding the negative effects of technology on mental health and well-being, over organizational issues. Factor three also highlighted individual challenges regarding the separation of working and private time as the least important.

Factor four (ST:56.2%; EM:43.8%) emphasized social issues priority over personal challenges.

Furthermore, the value of the Z variance showed no consensus on the insignificance of certain  
375 challenges for the study context. However, a consensus appeared (value of the Z variance < .1) between factors for challenge S6, "the acceleration of the (ethical) use of new technologies and social media." The majority classified the challenge as positive (Q-sort value  $\geq 0$ ) or as an issue of medium- to high-level (+1 in factors 1, 3, and 4; 0 in factor 2) importance for rapid digital transformation. Therefore, the proposed challenges are valid for the study context.

## 380 **5. Factor interpretations and propositions**

The Q-methodology results offered consensus as well as distinct statements/challenges between factors (Nurhas, Geisler, and Pawlowski 2019; Ramlo 2016; Watts and Stenner 2005; Stephenson

1953). Following the logic of abduction as the core approach of the Q methodology, interpretations and a series of propositions were generated, based on observation of the patterns of statements identified by each factor, as well as an open-ended question on why participants placed certain statements at the extreme positions (-2 and +2).

Drawing on the consensus challenge between four identified factors regarding integrating new technologies (S6) in HE, the study's result supports the definition of digital transformation as organizational innovation due to the introduction of new or disruptive digital concepts and technologies (Schallmo and Williams 2018; Hinings, Gegenhuber, and Greenwood 2018). The use of emerging technologies is the main challenge that all types of actors perceived, including students, employees, or a combination of both groups, categorized based on their perspectives.

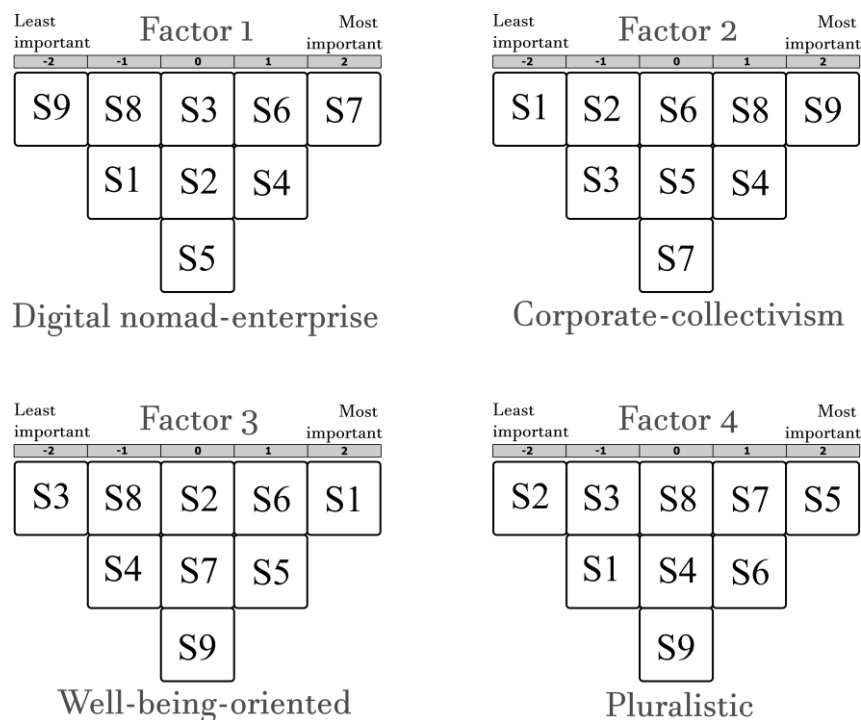


Figure 2: Identified patterns of subjective viewpoints about challenges or the placement of challenges in Q-Grid based on factor-analysis for each factor

The introduction of new technologies in the organization brings with it different problems and opportunities (Majchrzak, Markus, and Wareham 2016), especially in the rapid change precipitated by the COVID-19 pandemic. Different challenges emerged on a large scale and involved various channels, tools, and approaches, affecting the innovation ecosystem, including all stakeholders of the organization (students and staff) and third-party business processes, as well as the digitalization strategies of the business model (Kane et al. 2015). Therefore, the proposition regarding the extended definition of digital transformation was postulated.



405

Proposition 1: *Digital transformation refers to behavioral changes, including competencies, values, or ethics, and organizational capabilities in the innovation ecosystem, due to the wide-scale adoption of emerging digital technologies, digital business concepts, and approaches.*

410

Based on the open-ended question and the reason S6 appeared in the +2 position, we identified two drivers of consensus across all factors on S6:

415

- **Voluntary ecosystem readiness:** the willingness of individuals, groups, or organizations to adopt new technologies based on a mutual understanding of the potential benefits of technology for a sustainable and resilient work ecosystem. One participant placed S6 as extremely positive: *“New technologies and social media make it more useful to achieve teaching and learning goals during a pandemic.”* Others highlighted the benefit of emerging technology to support daily activities: *“Because technological advances are significant to support human activities in today's world.”*

420

- **Involuntary ecosystem readiness:** the readiness of individuals, groups, or organizations forced to adopt technology because of the demands of their ecosystem. The analysis was based on participant comments: *“... is not ready for new technological development, especially for those who are less fortunate and have difficulty accessing the Internet”; “... see if everyone is already using 5G technology? If not, it is better to focus on using it first . . .”*

425

Considering Factor 1 (see Q-grid in Figure 2, top-left) as the starting point for the next investigation, this study shows the importance of defining organizational strategies and supporting policies for issue S7, the establishment of remote work and learning cultures (with flexible time and location management) that require minimal efforts to manage organizational resources and capabilities. As Factor 1 indicated a balanced number of students and employees (50% for students and 50% for employees), the digital transformation policies should include both actors in the implementation. The culture of working and learning at a distance influences the individual's life by blurring the line between professional and personal activities, referred to as digital nomadism (Richter and Richter 2020; Nash et al. 2018), which requires virtual collaboration and digital technologies to manage work across borders (Nash et al. 2018; Richter and Richter 2020). Therefore, the following hypothesis was proposed:

430

435

440 Proposition 2: *As the digital transformation is widely adopted and supported by the technological infrastructure, organizations (in this case, HEIs) should formulate policies and strategies to enable a remote (borderless) work/learning culture or "digital nomadism."*

Based on the subjectivity pattern of Factor 1 and Proposition 2, we define **Factor 1** as a **digital nomad-enterprise transformation agent** that focuses on the organizational dimension of challenges as conflicting concerns. This agent drives rapid organizational change by incorporating the flexibility of work style (in terms of location and space) as transformation enablers. One reason that this agent prioritizes S7 is the sustainability of such a work style in the future, after a pandemic situation. As a participant stated who put S7 in the [+2] position, *"because it is likely that in the long term, this digital lifestyle will continue to occur."*

450 By analyzing Factor Two (see Q-grid in Figure 2, top-right), also showing almost balanced numbers of students and employees, the greater importance of adapting organizational resources and capabilities (S9) was identified as the current state of the art regarding rapid transformation. This supports earlier studies on digital transformation resources (Hinings, Gegenhuber, and Greenwood 2018; Majchrzak, Markus, and Wareham 2016), including an open and cross-functional collaboration for social facilitation.

However, on the opposite side was an interesting pattern regarding the individual challenges posed by technology's negative impact on mental health and digital skills. Based on the pattern of Factor 2, the following was proposed:

460 Proposition 3: *Rapid digital transformation drives organizations to mobilize resources and capabilities but also reduces awareness of individual challenges regarding the negative impact of technology on mental health and the requisite digital competencies.*

Factor 2 shows the greater concern of rapid organizational adaptation (S9) and fewer individual needs and differences. Therefore, we define **Factor 2** as a **corporate-collectivist transformation agent** that prioritizes organizational challenges over personal significance (S9). This agent was chosen as a primary concern because of its view that the organization's adaptability is a natural process of surviving in a changing environment. The following is explicitly mentioned: *"Following the laws of nature, to survive during these changing situations and conditions, the first point that must be had is the ability to adapt quickly."*

Regarding Factor Three (see Q-grid in Figure 2 bottom-left), the patterns that suggest the university draw attention to the mental health and well-being of the students or younger adults were identified, as students often use digital technologies (Kircaburun et al. 2018). Concerning this factor, participants also considered the challenge of the unclear distinction between time for

475 professional and private activities to be the least important. This supports the previous study on the  
dark sides of social media (Salo, Pirkkalainen, and Koskelainen 2019), especially for students or  
younger adults as the future of the workforce for digital transformation. Therefore, the following  
was proposed:

480 Proposition 4: *The adverse effects of technology and the digital transformation challenges on  
mental health occur in all organizational roles, especially for HE and students, the future digital  
workforce.*

Based on the analysis of its Q-sort pattern, we describe **Factor 3** as a **well-being-oriented**  
485 **transformation agent**, the one who understands the importance of the well-being issue for driving  
rapid digital transformation. This agent argues for integrating the well-being issue into the digital  
transformation because of the dark side of technology that impacts users living not only in a state  
of pandemic: “*Without the changes that occurred due to the pandemic, the negative impact of  
technology has become a problem that continues to increase its destructive power.*”

490 Next, both Factor 3 (see Q-grid in Figure 2, bottom-left) and Factor 4 (see Q-grid in Figure 2,  
bottom-right) showed the importance of organization in supporting designs for well-being and  
creating awareness of design technology for social inclusion and diversity. Factor 4 (ST:56.2%;  
EM:43.8%) showed the importance of diversity and social inclusion (S5), already mentioned in  
studies on information system design (Andrade and Doolin 2016; Trauth and Howcroft 2006).  
495 However, this study, particularly Factor 4, indicates clearly (three factors other than Factor 1  
placed the issue of social inclusion ahead of digital competencies, on the same level of  
importance) that the issue of social inclusion and fairness was more critical for digital  
transformation than competencies. Therefore, we postulated:

500 Proposition 5: *The challenges of design technology for diversity, social inclusion, and fairness  
take precedence over the individual challenge of developing digital competencies to support rapid  
transformation.*

Following the analysis and Proposition 5, **Factor 4** functions as a **pluralistic transformation**  
505 **agent**, the one who empowers others to drive digital transformation collectively. This agent  
believes that rapid transformation should be inclusive, and workforce diversity is an essential  
driver of rapid transformation, especially in a COVID-19 pandemic. Based on this agent's  
competing concerns, emphasizing fairness and social diversity over personal competencies is a  
positive step. The issue of social inclusion and diversity is a concern due to the awareness of  
510 fundamental rights to improve the quality of life, inferred from the participants' comments for S5:

*“Everyone is entitled to the same basic rights”; “it is very important because the quality of life can be improved, for example, by designing digital technologies that ensure equality and inclusion, such as fair access to technology and the inclusion of all groups of citizens.”*

## **6. Significance and limitations of the study**

515 This section discusses the study's contributions and some potential research questions, based on the study propositions, identification of factors, and the implementation of the Q methodology. This study's limitations are also presented.

### *6.1 Knowledge Contributions*

Our analysis exposed voluntary and involuntary ecosystem readiness as two prerequisites for understanding consensus challenges of rapid digital transformation. Hence, our findings provide a novel insight into enabling aspects for all types of transformation that actors had to consider when prioritizing digital transformation challenges during the COVID-19 pandemic. Furthermore, we broaden the current understanding that from an organizational perspective, HE should not only focus on strategy, widely accepted as the transformation process's driving force (Matt, Hess, and Benlian 2015; Kane et al. 2015). HE should also assess the ecosystem's readiness for the transformation process, whether forced or voluntary, to empower different types of transformation agents. We presume that the inquiry (based on Proposition 1) expands the current digital-transformation concept. This paper proposes including innovation ecosystems and large-scale implementation in future studies (Schallmo and Williams 2018; Hinings, Gegenhuber, and Greenwood 2018).

The rapid digital transformation ecosystem is a systemic endeavor involving many stakeholders, not just from the university's internal team but also from the outside (e.g., strategic partners, consumers, and competitors). In addition to digital transformation strategies (Matt, Hess, and Benlian 2015; Kane et al. 2015), other vital elements must also be addressed, including business processes, digital products, and services. Data is another crucial element to consider at a time when bits and bytes are a new type of gold. Data is an integral part of promoting research and converting business models and services to a digital form, as during COVID-19 (Vial 2019; Hinings, Gegenhuber, and Greenwood 2018). Moreover, potential research questions concerning Proposition 1 should be explored further:

- 540 • Why can a rapid workplace transformation lead to successful or ineffective digital innovations?

- How can the rapid digital transformation of the environment be managed to provide sustainable benefits, even after the COVID-19 pandemic?
- What ecosystem characteristics will lead to successful/unsuccessful digital innovation during and after the pandemic?
- When and under what circumstances do organizations and individuals actively participate in or disengage from the transformation ecosystem?

Based on Proposition 2, this study offers new insights into the role of the digital-nomad culture, by incorporating remote work and learning culture as parts of the organizational strategic plan for rapid digital transformation. Present trends of flexible work are likely to continue following the COVID-19 pandemic. Therefore, the organization should embrace the latest digital work culture as a vital part of achieving rapid digital transformation success—more specifically, for HE, by stepping up research on digital nomads, including identifying competencies, barriers, and enabling factors for integration into the curriculum. Possible research questions for further studies on Proposition 2 are:

- What are the barriers and competencies needed for digital nomadism?
- How do we promote the development of digital-nomadism skills?
- When should an enterprise embrace digital nomadism or not adopt it as a strategy for digital transformation?

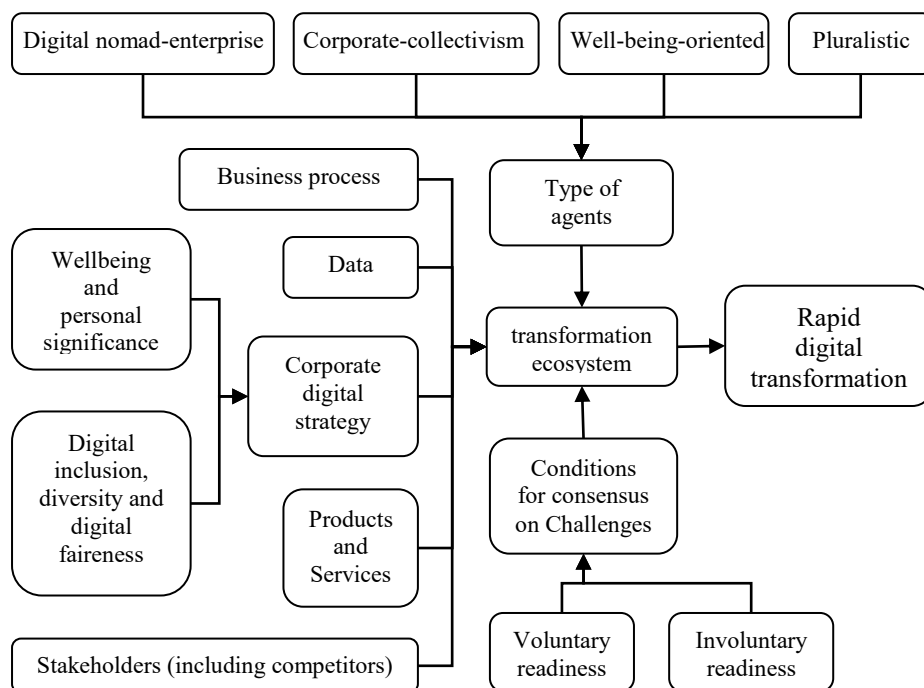


Figure 3: Framework for understanding rapid digital transformation

In response to the COVID-19 pandemic, where individuals were exposed to the digital environment on an unprecedented scale, this study proposes integrating the importance of the organization in promoting individual mental health awareness and supporting digital capability development (based on Proposition 3 and 4) in the development strategy for the rapid digital transformation process. Our recommendation is consistent with previous studies that demonstrate the importance of promoting human well-being to maximizing the benefits and adoption of information systems design (Mettler and Wulf 2019; Calvo and Peters 2014; Pawlowski et al. 2015), particularly in the "digital pandemic" that exposes the negative side of technology. Regarding Proposition 3, future studies could address the following research questions:

- How will companies balance necessary rapid digital transformation and reduce the negative effects of digital technology?
- What is the determinant of a rapid digital transformation that influences or affects individual mental well-being positively or negatively?

For Proposition 4, the following research questions could challenge the research community:

- How do we raise awareness of the importance of digital mental health with different stakeholders after a pandemic?
- What are the personal and technological characteristics that have an impact on digital mental health awareness?
- How does understanding digital mental health change during and after a pandemic?

This study further reveals how digital inclusion and digital fairness (Proposition 5) profoundly impact rapid digital transformation. We argue that our research contributes to the ongoing literature in several ways, by advancing the importance of digital inclusion and fairness as the primary issues for successful transformation at a rapid pace and on a larger scale. One of the critical issues that previous studies' portrait of the digital-transformation strategy lacks is digital inclusion and fairness (Vial 2019; Matt, Hess, and Benlian 2015; Kane et al. 2015). Although the COVID-19 pandemic scale might not be similar to the size of a firm or organization, its relevance depends on the situation. Creating a new digital business model that encourages innovation, workforce inclusion, and diversity is one of the necessary prerequisites (Majchrzak, Markus, and Wareham 2016; Nurhas et al. 2019; Dery, Sebastian, and van der Meulen 2017) for organizations of all sizes. Moreover, a wide range of research questions can apply following Proposition 5, such as:

- What are the differences in awareness of the workforce's diversity, social inclusion, and fairness to support digital transformation, before and after the COVID-19 pandemic?
- How can social inclusion, labor diversity, and equity in technology design be promoted during the rapid digital transformation process?

- What are the obstacles, enablers, and advantages of tackling these problems for digital transformation?

Overall, this paper sheds light on the necessary consent to rapid digital transformation during the pandemic, particularly in HE. Figure 3 shows the essential elements discussed in this section regarding the rapid digital transformation ecosystem.

## 6.2 Practical implications

This research examined four different types of transformation agents. The classification of agents in the digital transformation process indicates characteristics of the agent's attitude, which can guide strategic planning. Furthermore, following goal-oriented system-design principles, the proposed agents can serve as personas that describe the goal and difficulties of particular groups. HE could initially target Factors 2 and 3 as having higher values of explained variance (19%)—e.g., designing technological features, including virtual work-management platforms, real-time collaborative systems to support synchronous and asynchronous work for Factor 2, and digital nomadism strategies (Richter and Richter 2020; Nash et al. 2018) focused on prioritizing collective goals and work.

Furthermore, universities can reflect or assess the current level of readiness for digital transformation, to allow for the identification of critical competencies, values, mindset, or ethics that support or hinder the strategic transformation plan for the integration of new technologies into the organization's activities (Hinings, Gegenhuber, and Greenwood 2018; Kane et al. 2015). The proposed element can be a checklist for readiness to go digital. As a result of Propositions 3 and 4, an organization can utilize design to promote well-being and develop human potential (Calvo and Peters 2014; Mettler and Wulf 2019). Technology developers can harness positive psychology by integrating the principles of well-being, engagement, positive relationships, and meaningful accomplishment as primary or secondary goals for technology (Calvo and Peters 2014).

Based on Proposition 5, this study shows that an organization should raise awareness of social inclusion and diversity, which remain undervalued, to a corporate strategy in the digital transformation context. To ensure technology development for social inclusion, such features as an option to customize the technology's appearance, font size, and inclusion of voice interaction could accommodate a particular group of people with special needs. Another example is face recognition; image data to train models and identify faces should include images faces from different backgrounds, races, and skin tones, to prevent misidentification for particular groups (Bacchini and Lorusso 2019).

As a further practical contribution, we demonstrated a novel approach to using Q methodology to study digital transformation. Applying Q-methodology as an alternative mixed-method

approach (Ramlo 2016) to socio-technical design study and digital transformation supports previous studies' use of the method for technology systems design (Nurhas, Geisler, and Pawlowski 2019; Thomas and Watson 2002; O'Leary, Wobbrock, and Riskin 2013; Mettler, 635 Sprenger, and Winter 2017; Mettler and Wulf 2019). This study shows Q-set development based on a systematic literature review and the factors based on different organizational roles. Thus, it supports understanding specific issues based on different factors to aid in customizing and personalizing technology (Mettler and Wulf 2019; Mettler, Sprenger, and Winter 2017) for rapid digital transformation.

640 Furthermore, we argue for more mixed-method research to uncover the subjectivity patterns of digital transformation preferences and understand how technology and digital work environments influence work. Based on Propositions 4 and 5, technology and system designers could apply the Q methodology by involving diverse stakeholders to identify equitable patterns, reducing design decisions based on the higher number of means representing only a majority of certain 645 communities. Moreover, system designers can present different alternative designs in the form of images (such as wireframes or mockups) as the Q set and ask participants which design features have importance for particular well-being determinants.

We also propose using the Q methodology to identify competing concerns or classify issues as an alternative method of minimizing the iteration process for consensus, especially in a rapid- 650 change environment (Nurhas, Geisler, and Pawlowski 2019; Watts and Stenner 2005). This study demonstrates the utility of the Q methodology for finding consensus patterns, based on Q-sorting or placement of statements in the Q pyramid (Watts and Stenner 2005). Furthermore, the Q methodology provides more sources for analysis, by revealing competing concerns, reasons for prioritizing certain issues, and patterns of difference grouped by participants' preferences when 655 sorting statements. We support previous studies by showing the use of this method to develop propositions and theories (Nurhas, Geisler, and Pawlowski 2019; Watts and Stenner 2005; Wingreen and Blanton 2018) from different analyses of each factor.

### *6.3 Study limitations and recommendations*

The study limitations include using the Q-methodology to generalize the four identified 660 patterns for contexts outside education. Although the Q-methodology results show a broader population (Watts and Stenner 2005) or generalization of study results (Mettler and Wulf 2019; Watts and Stenner 2005), research communities should examine the challenges for different types of organizations. Further research could broaden or develop the challenges to a more granular level of abstraction, explicitly stated because they can substantially influence the P-set engaged in a 665 specific organizational environment. Also, the proposed actor categories can serve as a solid



foundation for the initial actor classification inside an organization or research environment, facilitating the digital transformation of business operations.

Second, limitations exist in developing a concourse based primarily on literature, despite the Q methodology; other types of sources may offer faster results. Third, the limited inclusion of related articles and selected scientific databases as sources for searching related published articles potentially eliminates other relevant articles. Conversely, the present study utilizes the systematic review process as the initial development process of the Q-set, provides more general terms or levels of abstraction, and validates the proposed concepts covering a wide range of issues. This study also shows how the Q methodology can combine with other approaches to scientific inquiry. Future research on the application of the Q methodology to the digital transformation process could also begin with the design of a Q-set based on a systematic review of the literature, which could be expanded, integrated, and modified to conduct scientifically rigorous user-preference studies. In addition, we suggest that future research on digital transformation consider the subjective preferences of actors. Critical components of digital transformation involve both technology and people who are more or less likely to have subjective preferences about technological choices that influence the transformation process.

Afterward, we encourage researchers to empirically validate the framework, presented in Figure 3, across a variety of organizational types and stages of the digital-transformation process. Also, exploring the open research questions, presented in section 6.1, could reflect on and prepare for the possibility of a future post-pandemic digital industrial revolution, especially concerning how rapid digital transformation in enterprises and organizations benefits the cyber-society ecosystem by being mobile, inclusive, and equitable, and supporting human well-being.

## 7. Conclusion

The study presents an in-depth three-level analysis of the nine challenges of rapid digital transformation and four types of digital transformation agents, based on competing concerns in the HE context, due to COVID-19. In this study, Q methodology appears as a novel approach to the study of digital transformation during the pandemic. Further studies can also examine Q-method benefits for understanding different digital transformation issues in other industries or public institutions. Also, we highlight several propositions on the challenges of rapid digital transformation due to the pandemic. Our framework for understanding rapid digital transformation can redefine what digital transformation means and how to guide a rapid transformation process. We discuss several limits and make recommendations, including the need for (digital) technology research and development that addresses incorporating well-being determinants into the design

process. The design of a well-being-based system will benefit both individuals and enterprises,  
 700 facilitating the rapid adoption of digital transformation.

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 705 with participants from Indonesia and Germany.

## Appendices

Appendix 1: Concept matrix of selected literature

Literature	Concept-statement of challenge								
	individual			group		organizational			
	S1	S2	S3	S4	S5	S6	S7	S8	S9
(Abidah et al. 2020) <sup>#</sup>			x	x	x		x		
(Anderson et al. 2020)*						x			
(Bezuidenhout 2020) <sup>#</sup>					x				
(Crawford et al. 2020) <sup>#</sup>	x								
(de Oliveira Araújo, Francisco Jonathan et al. 2020)*	x	x	x				x		x
(Drane, Vernon, and O'Shea 2020) <sup>#</sup>	x	x			x				
(Duong et al. 2020) <sup>+</sup>				x	x				
(Gonzalez et al. 2020) <sup>+</sup>							x		
(Graves and Karabayeva 2020)*	x	x	x	x			x		x
(IESALC-UNESCO 2020) <sup>#</sup>	x	x	x	x			x		x
(Jowsey et al. 2020)*	x	x	x		x	x		x	
(Kerres 2020) <sup>#</sup>		x	x					x	x
(Leite, Hodgkinson, and Gruber 2020)*				x		x			
(Longhurst et al. 2020)*		x				x	x	x	x
(Marsicano et al. 2020) <sup>#</sup>	x	x							x
(Masters et al. 2020) <sup>#</sup>		x			x				
(Owusu-Fordjour, Koomson, and Hanson 2020) <sup>#</sup>					x				

Literature	Concept-statement of challenge								
	individual			group		organizational			
	S1	S2	S3	S4	S5	S6	S7	S8	S9
(Peters et al. 2020) <sup>#</sup>					x				
(Rumbley 2020) <sup>#</sup>	x								
(Ting et al. 2020)*		x				x			
(Toquero 2020) <sup>#</sup>				x					
(Wang et al. 2020) <sup>#</sup>				x					
(Weible et al. 2020)*							x	x	
(Weissgerber et al. 2020)*							x		x
(Wendelboe et al. 2020)*									x
(Wiederhold 2020)*	x	x		x		x			
(Zhai and Du 2020)*	x	x	x	x			x		
(Zhang et al. 2020) <sup>+</sup>	x				x				
(Zhou et al. 2020)*						x			

\* : from Scopus database; <sup>+</sup> : from Arvix database; <sup>#</sup> : from narrative review process (Presented in the section state of the art);

S1: Adverse effects of technology on mental health

S2: Greater dependence on digital competency (digital skills and intelligence)

S3: Blurring the boundaries of personal and work-related (as employee or student) activities to use technology

S4: Accelerating the adoption of technology for social facilitation

S5: Shaping technology toward digital inclusion, diversity, and equity

S6: Acceleration of the (ethical) use of emerging technologies and social media

S7: Growing demands of technology for a flexible work/learning approach (independent of place and time management)

S8: An increasing need for open and cross-functional (cross-disciplinary) digital collaboration

S9: Rapid adaptation and mobilization of organizational resources and capabilities

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