Digital Readiness and its Effects on Higher Education Students' Socio-Emotional
Perceptions in the Context of the COVID-19 Pandemic

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This is an accepted manuscript of an article published by Taylor & Francis in Journal
of Research on Technology in Education on October, 25, 2020, available online:

<http://dx.doi.org/10.1080/15391523.2020.1846147>

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Abstract

The current study investigated how ready higher education students were for emergency remote teaching due to the COVID-19 pandemic and how this influenced their socio-emotional perceptions. Results of $N = 1,826$ higher education students indicate that they seem to be ready for digital learning. A k -means cluster analysis revealed two groups of students that significantly differed with respect to their readiness for digital learning (in terms of technology equipment availability, prior experiences with e-learning, and skills for digital learning). Finally, students' socio-emotional perceptions, that is, stress-related emotions (worries, tension, joy, and overload) as well as social and emotional loneliness significantly differed due to cluster membership. Hence, the study points a need for support of higher education students in successfully coping with the challenges of emergency remote studying.

Keywords: Readiness for digital learning, COVID-19 pandemic, cluster analysis, socio-emotional perceptions

Efforts to control the spread of the COVID-19 virus have affected all sectors of society worldwide, including the higher education system that switched to digital higher education (emergency remote teaching according to Hodges et al., 2020). Despite already established digital learning platforms and the usually good technical equipment of students (Zawacki-Richter et al., 2015), it would be misleading to assume a general ability of the so-called “digital natives” to use technology in academic contexts (Lei, 2009). The same is true regarding the acceptance of technology (Judd, 2018; Stephan et al., 2019). Hence, in 2020, higher education students are expected to do more than cope with a pandemic and the restrictions and uncertainties that follow it; they must also contend with digital learning. Students need (likely better) technical equipment, relevant skills and tools for using hard- and software, and for interacting virtually with their lecturers and peers. Students might perceive this exceptional situation as burdensome. Hence, the current study investigates students’ readiness for digital learning, students’ socio-emotional perceptions, and the relationship between the two.

Theoretical Background

Since the beginning of the 21st century, online learning became entrenched in higher education worldwide (Falvo & Johnson, 2007; Kasim & Khalid, 2016; Zawacki-Richter et al., 2015). Currently, the development of skills and devices for quality digital learning are becoming even more important. For example, perceived usefulness and perceived ease of use have been proven to be important for the acceptance of technology (Davis, 1989; Rodríguez-Ardura & Meseguer-Artola, 2016); findings that can also be applied to the field of education (Dumpit & Fernandez, 2017; Granić & Marangunić, 2019; Scherer et al., 2019).

Higher Education and Challenges for Digital Learning

Social relations and interactions are especially important for the experience of learning satisfaction in online learning environments (Richardson et al., 2017). Students’ relationship with teachers and learning content is highly relevant for learning; so, too, are the relationships

between students and their peers (Weidlich & Bastiaens, 2018; Zhao et al., 2005). In an online learning setting, students need to feel that they are engaging in human-to-human interaction and have the opportunity to develop personal relationships (see Lowenthal & Snelson, 2017 for an analysis of different understandings of social presence in the online learning environment). The sense of belonging to a meaningful learning community is emphasized as an important factor of students' learning experience in online learning, especially because it is difficult to make their social presence perceptible in the online environment (Oh, et al., 2018; Joksimović et al., 2015). Research shows that online learning communities can help to create a feeling of connectedness to other students and this may be seen as a resource for knowledge construction and knowledge growth (Akcaoglu & Lee, 2016; Cho & Tobias, 2016). But developing a learning community takes time and is only accomplished with conscientious effort (Beth et al., 2015). Above all, teachers must be easily available for students both online and, if possible, in person to avoid feelings of isolation (Hall & Villareal, 2015; Hunt, 2015; Israel, 2015). Moreover, studies have shown that students' sense of belonging to meaningful online learning communities is related to their engagement and learning achievement (Joksimović et al., 2015; Tomas et al., 2015).

Socio-Emotional Perceptions of Digital Higher Education

In addition to technical equipment, students' previous experiences and common media usage behavior (Brandtzæg, 2010; O'Brien & Verma, 2019), or their skills for the use of digital (communication) media (Hong & Kim, 2018) might impact students' experience of and engagement in digital learning (Kim et al., 2019). Of importance are aspects of digital (in)equality with respect to the availability of technology and the skills needed for its effective use; as are, for example, spaces that offer an appropriate learning atmosphere (Beaunoyer et al., 2020; Li & Lalani, 2020; Tam & El-Azar, 2020). Students seem to be a little less satisfied with online courses and slightly prefer face-to-face courses (Allen et al., 2002; Israel, 2015; Tratnik et al., 2019). For example, compared to face-to-face teaching, students enrolled in

online courses show a significantly higher level of technology-related fear, anger, and helplessness (Butz et al., 2015). The limited social exchange that resulted from the COVID-19 pandemic may foster negative emotions, as well. There is evidence that social isolation can trigger stress-related emotions and reduce well-being (Beaunoyer et al., 2020; Miller, 2020). In fact, "Keep a pulse on students' emotional health" is one of four challenges identified by the OECD to promote digital learning and online collaboration (OECD, 2020, p. 2). Technology can be a tool, but it cannot replace face-to-face interaction (Miller, 2020).

Apart from the social component, there are many other factors that explain how and why students experience and appreciate online courses. For example, students' experience with e-learning is related to their general life satisfaction (Vate-U-Lan, 2020). In addition, the content focus of the course (engineering sciences and natural and life sciences vs. social sciences and humanities) appears to be an important factor in the perception of online learning opportunities (Davidovitch & Yossel-Eisenbach, 2019). Students of varying study subjects or different genders seem to differ in equipment or skills (e.g. Senkbeil et al., 2019; Tondeur et al., 2016). These differences might impact students' later experiences and behavior. Furthermore, the digital readiness of students, that is, "technology-related knowledge, skills, and attitudes and competencies for using digital technologies to meet educational aims and expectations in higher education" (Hong & Kim, 2018, p. 304), is related to academic engagement and thus, to their learning outcomes (Gratch-Lindauer, 2008). Digital readiness and an online learning environment rich in materials contribute to the well-being of students (Topal, 2016).

To achieve a balance between learners' individual characteristics and the content, educational, and technological conditions that ensure quality of online learning is a long process that cannot be quickly and fully realized in times of crisis. The exceptional situation caused by the COVID-19 pandemic is rather a stress test for the higher education system, the lecturers and tutors, but especially for the students themselves. In order to understand how

ready students are to manage this situation, research needs to investigate student preconditions from the beginning, that is, before dealing with solely digital teaching and learning formats.

Aim and Research Questions

The current study is situated in the exceptional situation of emergency remote teaching and learning. That is, students neither actively decided nor were prepared for a digital semester. Consequently, the study investigated the readiness of higher education students solely for digital distance learning in the context of the COVID-19 pandemic. As indicators of student readiness for digital learning, the study focused on the availability of technological equipment like notebook availability, prior experiences with technology-based learning, as well as self-assessed skills for digital distance learning. Furthermore, students' socio-emotional perceptions with respect to the COVID-19 pandemic were analyzed. Earlier studies in the context of digital learning (skills, technological equipment, or socio-emotional perceptions with digital learning) usually investigated these variables during and/or after studying (Butz et al., 2015; D'Mello, 2013; Stephan et al., 2019). Due to the distinct situation of the summer semester 2020, the current study adds to earlier research approaches by investigating student readiness for digital distance learning and their socio-emotional perceptions directly before the summer term 2020 started. This allows the assessment of student preconditions in a manner as unbiased as possible. That is, students had not yet made any positive or negative experiences with online learning for the current term.

There are several variables that fall into the socio-emotional spectrum. Our selection was guided by two considerations. The COVID-19 pandemic was a highly stressful event (Ahorso et al., 2020; COSMO, 2020; National Center for Immunization and Respiratory Disease, 2020; Zhang & Ma, 2020). Therefore, we focused on stress-related emotions. Stress-related emotions are those that can either be caused (e.g. worry) or negatively affected (e.g. joy) by stress (Gierveld & Tilburg, 2006). From a social point of view, we believe that the most striking consequence of the COVID-19 pandemic was social (physical) distancing and

possibly associated feelings of loneliness, also referred to as a global loneliness virus (Newmark, 2020) or loneliness epidemic (Courtet et al., 2020). Thus, we focused our research on emotional and social loneliness.

In the context of the COVID-19 pandemic, the current study investigated the following research questions:

Q1: How ready (in terms of technology equipment availability, online learning experience, and skills) are higher education students for digital distance learning?

Q2: What are students' socio-emotional perceptions related to digital distance learning?

Q3: Do students' socio-emotional perceptions depend on their readiness for digital learning?

Method

Procedure

In this paper, we report on the results of the first measurement of a longitudinal study during the summer semester 2020 in Germany. The study was administered as an online survey with three measurements. Directly before the summer term 2020 started, all students enrolled at a German university were invited via e-mail to participate in an online survey. They were informed that the online survey will take approximately 20 minutes; that it is about students' digital readiness (in terms of equipment, previous experiences, and self-reported skills for digital learning) as well as their emotional and social perceptions regarding the upcoming term. The online survey was carried out in the German language and administered via Unipark Questback EFS (unipark.com). In accordance with the institutional commissioner for data protection, participants' privacy was protected; all data has been anonymized; and participating students were not disadvantaged due to non-participation. Informed consent of the participants was obtained by virtue of survey completion.

Instruments

First, socio-economic questions regarding age and gender were addressed. Students were asked to provide information about their current semester, their studies (they should indicate at which of the five university faculties they are enrolled: Humanities, Social Sciences, and Theology; Sciences; Business, Economics, and Law; Engineering; or Medicine), and their intended degree (the program they are studying: bachelor, master, state examination, doctoral degree, others). Due to the shutdown at the beginning of the semester (including a curfew, closed schools and kindergartens), students were asked to detail their private situation (number of household members, number of children with on-site childcare).

Students' Digital Readiness

As indicators for students' digital readiness, we assessed four aspects: their equipment, earlier experiences, and self-reported skills for digital learning in terms of digital tool application and information sharing behavior.

First, students were asked to provide more information on the availability of digital equipment (desktop-PC, notebook, tablet-PC, mobile phone, wearables, scanner, printer, internet availability, and the possibility to study at a quiet workplace without disruption). For each device, students indicated whether they had access to them. Furthermore, their experiences with nine different e-learning tools employed for learning at the university (downloadable lecture notes/literature, lecture recordings, live streams of lectures, digital media in courses, online learning modules, online communication and collaboration, other online-supported learning opportunities, e-tests, online self-tests) were assessed using questions with a yes/no answer format (see Froebus & Bender, 2019). Finally, to assess students' self-reported skills for digital learning, we implemented two scales from the Digital Readiness for Academic Engagement questionnaire (DRAE, Hong & Kim, 2018). Those scales were chosen as they best represent skills necessary for the ad-hoc change to digital learning. Both scales turned out to be internally consistent (digital tool application with 4 items: $\alpha = .77$, e. g. "I can manage software or apps from a computer or mobile devices.");

information sharing behavior with 4 items: $\alpha = .85$, e. g. "I can interact with classmates using real-time communication tools, for example, video conferencing tools or messengers.").

Students' Socio-Emotional Perceptions

To assess students' socio-emotional perceptions at the beginning of the digital term, two standardized instruments based on a 6-point Likert scale (ranging from "not true at all" to "absolutely true") were applied. First, stress-related emotions were measured with a short German version of the PSQ – Perceived Stress Questionnaire (PSQ-20; Fliege et al., 2001). In particular, we assessed students' worries (e.g., "I fear I may not manage to attain my goals."), tension (e.g., "I feel tense."), joy (e.g., "I feel I am doing things I really like."), and overload (e.g., "I have too many things to do.") – each with five items (Cronbach's $\alpha = .82 - .89$). Second, emotional loneliness was assessed with a scale based on six items (e.g., "I miss the pleasure of the company of others.", $\alpha = .68$) and social loneliness with five items (e.g., "There are many people I can trust completely." (to be recoded), $\alpha = .88$) by Gierveld and van Tilburg (2006).

Sample

Students were recruited from one large full-scale German university with about 38,500 students. The online survey was completed by 1,826 students who had not yet participated in their first online course in the current term. Their mean age was 23.3 years ($SD = 4.6$) with 53.1% females. Across all five faculties of the university, students participated voluntarily in the survey (Faculty of Humanities, Social Sciences, and Theology: $n = 520$; Faculty of Sciences: $n = 221$; Faculty of Business, Economics, and Law: $n = 387$; Faculty of Engineering: $n = 444$; Faculty of Medicine: $n = 280$). Similarly, students among different degrees participated in the online survey (bachelor: $n = 674$; master: $n = 456$; state exam: $n = 647$; doctoral degree: $n = 36$; others: $n = 27$). About 15% of the students reported living in a single household, and 5% lived together with children with on-site childcare. These numbers

are comparable to the living conditions of the total population of higher education students in Germany (Middendorff et al., 2017).

Data Analysis

To test research questions Q1 and Q2, i.e. students' readiness for digital learning and their current socio-emotional perceptions, we performed descriptive and correlative analyses as well as analyses of variance using SPSS, version 26. Furthermore, a *k*-means cluster analysis regarding student preconditions for digital learning was used to group students (R package "factoextra" by Kassambara & Mundt, 2020). Clusters were validated internally (total within sum of square (wss), silhouette plot, and Dunn index, as well as via a cross-validation) and externally (via cluster differences with regard to study term, gender, and study subject). Finally, group differences in socio-emotional variables relative to cluster membership were investigated via multivariate analyses of variance (Q3). For all significant effects, measures for effect sizes were reported (partial eta squared).

Results

Table 1 reports on descriptive statistics (mean and standard deviation) of all variables under investigation as well as their intercorrelations (Pearson's *r*).

Students' Readiness for Learning with Digital Tools

On average, students stated that they had available more than half of the 10 given digital resources. Less than 1% of students reported not having access to a notebook, desktop-PC, or tablet-PC. About half of the tools for e-learning were known by the students. Interestingly, there is a big variance between the tools: 92% of the students are familiar with downloadable scripts, but live streaming (which is to be expected during the digital term) has been used by only about 6% of students. Further, online elements like learning modules or online communication have been used before by about 50% of the students. These numbers are comparable to the internal evaluation results for teaching and learning conditions based on the respective university's student survey distributed during the semester beforehand (see

Froebus & Bender, 2019). The numbers indicate that students already have had some experiences with digital teaching and learning. Finally, students' self-reported skills for digital learning (digital tool application, information sharing behavior), on average, can be regarded as high (mean values higher than 4.5 on a scale ranging from 1 to 6).

To further investigate digital readiness in our sample, that is, Q1, we performed multivariate analyses of variance with gender or faculty as independent variables and the four indicators for digital readiness as dependent variables. Male students reported higher digital readiness than female students (Wilks $\lambda = .81$; $F(4, 1591) = 97.72$, $p < .001$, $\eta^2 = .19$). Student digital readiness differed due to enrolled faculty (Wilks $\lambda = .90$; $F(16, 5624) = 12.46$, $p < .001$, $\eta^2 = .03$) with students enrolled at the Faculty of Humanities, Social Sciences, and Theology reporting lower levels of readiness and students of the Faculty of Engineering reporting the highest levels of readiness across variables. Finally, significant correlations with enrolled study term were evident (e.g., higher semester students reported more e-learning experiences, $r = .25$, $p < .001$).

Socio-Emotional Perceptions with Respect to the Digital Term

Referring to research question Q2, descriptive results of all socio-emotional variables are presented in Table 1. Student scores of the scales tension, overload, and worry of the PSQ-20 were about the average scale value. Joy, in contrast was perceived higher than the scale mean. Students reported average values of social loneliness and emotional loneliness.

Relationship Between Digital Readiness and Socio-Emotional Perceptions

To test for interrelations within as well as between student readiness for digital learning and their socio-emotional experience, we calculated Pearson correlations (Q3). First, small correlations were found between student equipment, their experiences with e-learning, and their self-reported skills for digital learning. In line with Hong and Kim (2018), a high correlation was found between digital tool application and information sharing behavior. Within the socio-emotional variables, high correlations were found for the four scales of the

PSQ-20 as well as for the two scales assessing social and emotional loneliness. Further correlations between the socio-emotional variables were of moderate size.

Intercorrelations between digital readiness and the socio-emotional variables were all significant and of small size. Essentially, the better the students were equipped with technology, the more experiences they have had, and the higher their self-reported skills for digital learning were, the less tension, overload, worries, and loneliness, and the more joy they reported. It should be noted that correlations of information sharing behavior seem most prominent, especially with regard to social loneliness. That is, students who feel capable of communicating via digital devices experienced less social loneliness.

Table 1

Descriptive Statistics (Mean and Standard Deviation) of all Variables Assessing Student Digital Readiness and Student Socio-Emotional Perceptions as Well as Their Intercorrelations (Pearson's r).

	<i>M</i>	<i>SD</i>	2	3	4	5	6	7	8	9	10
1 Equipment	6.58	1.54	.17	.17	.18	-.14	-.13	.16	-.13	-.09	-.08
2 Experience	4.60	2.14		.16	.21	-.09	-.11	.12	-.14	-.11	-.09
3 DTA	4.60	0.93			.60	-.16	-.14	.22	-.19	-.06	-.12
4 ISB	5.00	0.96				-.19	-.21	.26	-.22	-.20	-.11
5 Tension	3.07	1.10					.73	-.74	.78	.32	.38
6 Overload	3.02	1.04						-.55	.66	.25	.26
7 Joy	3.91	0.85							-.72	-.41	-.42
8 Worries	3.24	1.14								.35	.44
9 Social loneliness	2.43	1.01									.55
10 Emotional loneliness	3.08	0.84									—

Note. All scales range from 1 to 6 (except equipment ranging from 0 to 10 and experience ranging from 0 to 9). All correlations but that of DTA and social loneliness ($p = .008$) are significant at $p < .001$. DTA = digital tool application, ISB = information sharing behavior.

To provide further evidence on Q1, a *k*-means cluster analysis with the four variables that represent students' readiness for digital learning (technology equipment availability, e-learning experience, tool application, and information sharing) was performed. To estimate the optimal number of clusters, average silhouette width and wws were applied, both indicating two clusters as the best solution (average silhouette width for two clusters = .26).

A two-cluster solution with standardized variables revealed two distinct groups of students: (1) highly ready for digital learning, i.e. well equipped, high e-learning experience, high self-reported skills for digital learning, and (2) ill-prepared for digital learning with lower scores for all four variables. Table 2 provides descriptive statistics for the two clusters.

Table 2

Descriptive Statistics for the Two Types of Clusters (M, SD)

Cluster	Equipment	E-learning experience	Self-reported skills		<i>N</i>
			Digital tool application	Information sharing behavior	
1: highly ready for digital learning	0.22 (1.02)	0.30 (0.91)	0.62 (0.65)	0.60 (0.54)	1052
2: not ready for digital learning	-0.28 (0.90)	-0.40 (0.97)	-0.81 (0.76)	-0.78 (0.93)	801

Several analyses were performed to validate the cluster solution. First, in addition to the silhouette coefficient as a measure for internal cluster validation, we report Dunn coefficients (Dunn = 0.01, Dunn2 = 1.31) and average distances between and within clusters. Average distance between clusters ($M = 3.07$) was larger than average distance within clusters ($M = 2.22$). Finally, a cross validation was used with a subsample. This led to a high correlation between the two samples, Cohen's $\kappa = .82$, $p < .001$. As measures for external

cluster validation, we investigated student characteristics per cluster. An univariate analysis of variance with cluster membership as the independent variable and study term as the dependent variables indicated that study term significantly differed with regard to cluster membership, $F(2, 1740) = 19.86, p < .001, \eta^2 = .01$. Students in Cluster 1 reported having more study experience ($M = 4.79, SD = 2.89$) than students in Cluster 2 ($M = 4.19, SD = 2.66$). That is, students who are well equipped regarding digital devices, who have high skills, and high experience with e-learning are those enrolled in higher semesters. Furthermore, a chi-square test indicated significant differences for gender, $\chi^2(1) = 111.40, p < .001$. Standardized relative numbers indicate a higher proportion of males in Cluster 1 and a higher proportion of females in Cluster 2. Similarly, a chi-square test indicated significant differences between students enrolled in different faculties, $\chi^2(8) = 74.28, p < .001$. As expected, students enrolled at the Faculty of Engineering were more strongly represented in Cluster 1.

Finally, to investigate whether and how digital readiness influences students' socio-emotional perceptions (Q3), we performed a multivariate analysis of variance with cluster membership as the independent variable, and socio-emotional variables as dependent variables. Significant and small to medium differences due to cluster membership were found for all variables (compare Table 3). That is, students of Cluster 1 experienced less stress-related emotions and reported fewer instances of loneliness.

Table 3

Descriptive Statistics, Separately for Each of the Two Types of Clusters (M, SD) as well as Significant Group Differences

Dependent variable	Cluster 1	Cluster 2	$F(1, 1836)$	η^2
Tension	2.90 (1.08)	3.30 (1.09)	59.19	.031
Overload	2.87 (1.02)	3.22 (1.03)	52.76	.028
Joy	4.08 (0.81)	3.69 (0.86)	97.79	.051

Worries	3.04 (1.13)	3.52 (1.10)	82.72	.043
Social loneliness	2.32 (0.98)	2.57 (1.04)	28.05	.015
Emotional loneliness	3.00 (0.85)	3.19 (0.82)	22.92	.012

Note. All effects are significant ($p < .001$).

Discussion

The present study surveyed students' readiness for digital learning with respect to their socio-emotional perceptions before the radical switch from traditional to digital teaching formats in higher education during the COVID-19 pandemic. The study is of particular relevance due to the exceptionality of the situation (cf. Kerres, 2020). As the survey was carried out before the onset of the digital summer semester 2020, the study's scientific merit lies in the unbiased assessment of the experiences and preexisting skills of students from a wide range of disciplines.

Regarding research question Q1, students' readiness for digital learning seems satisfactory. Less than 1% of students were without any access to a personal computer, and self-reported skills in the use of digital tools as well as information sharing behaviour were at a relatively high level. However, university administration should bear in mind that the sudden change to digital learning might provoke digital inequality (Beaunoyer et al., 2020). In addition, students without access to personal computers or internet might have been underrepresented in the current sample. A cluster analysis identified two groups of students: those with excellent preconditions for studying in a completely digital format (Cluster 1), and those with rather problematic preconditions (Cluster 2). The cluster solution was internally and externally validated. It reveals intra-individual differences regarding digital readiness in advance of emergency remote teaching and learning. This means that although the majority of higher education students were in Cluster 1, a considerable number of students belonged to Cluster 2 and thus, combine several aspects of disadvantage.

Concerning research question Q2, students reported average scores for tension, overload, worries, and emotional loneliness. Values higher than the scale mean were reported for joy. That is, students seem rather satisfied with the situation in advance of the upcoming term. Despite curfew at that time, students reported fairly low values in social loneliness, which indicates that they might be well connected via social media. An open question is whether this pattern remains stable and if not, how student socio-emotional perceptions develop during the term or how they are affected in the long run. Compared with face-to-face teaching, student stress values might increase during the semester due to higher workload during an online term.

Finally, students' readiness for digital learning and students' self-reported socio-emotional values were correlated (research question Q3). Students who were ready for digital learning (Cluster 1) reported less tension, overload, worries, social and emotional loneliness but higher joy. Although these effects were of only small effect size, this indicates that students who are not ready for digital learning might not only suffer from lacking equipment and skills to participate in digital distance courses but also that they might suffer from higher stress and loneliness.

Limitations and Prospects for Future Research

The current study provides important and arguably unbiased results regarding student preconditions and prior experience of an upcoming digital term. The study is limited by its sample—even though students were recruited from all faculties across a full-scale university, they all were enrolled at one specific German university that had already implemented tools for digital learning and teaching.

In addition, it must be noted that the current study does not provide evidence on how students experienced digital teaching but rather on their expectations regarding the upcoming term. As the current study is the first wave of a longitudinal study, it does not provide any information on students' socio-emotional perceptions prior to the COVID-19 pandemic. It

remains unclear whether the reported scores represent higher or lower stress-related emotions as well as more or fewer instances of loneliness than usual. Moreover, the variables under investigation – perceived stress-related emotions, social and emotional loneliness – are extremely subjective and cannot always be determined precisely. Survey methods and study conditions (type of survey, location of survey, and characteristics of the technology) can influence study results to a considerable extent (D’Mello, 2013). In addition, the comparison of the current results with earlier studies is hampered due to several reasons. First, samples are not comparable to the current one (e.g., validation sample of the PSQ-20 composed of only medical students, nearly 20 years ago; cf., Fliege et al., 2001; Fliege et al., 2005; the loneliness scales have been implemented with elderly people; Gierveld & van Tilburg, 2006). Second, if student samples were available, constructs have been assessed at different points in time during the semester (i.e., in the middle of the term with exams approaching; Büttner & Dlugosch, 2013). Third, if, for example, perceived stress-related emotions were higher compared to other samples, it would remain unclear whether this is due to the COVID-19 pandemic in general or due to digital teaching and learning in particular. Consequently, this first survey will be followed by further surveys in the middle and end of the semester. Such a longitudinal approach will enlighten our understanding of how students experienced the shift to digital distance teaching. This will make it possible to expand upon the findings.

Even though the study found significant results in socio-emotional perceptions due to cluster affiliation, it has to be noted that significant cluster differences regarding the socio-emotional variables were of small effect size. In the further progress of this study, the aspects of social interaction should be taken into closer account. Technology can promote social exchange, but ultimately it is social interactions that are important for students’ emotions, not technology. In turn, the emotional experience influences how actively the learner engages (Nummenmaa, 2007). It should be considered how these correlations develop, and how they may even influence student learning behavior.

Implications of the Study

The current study not only investigated students' readiness for online learning but also the relationship of that readiness with their socio-emotional perceptions. Students who are not ready for digital distance learning seem to suffer a double burden. First, they suffer from a lack of equipment and skills to participate in digital distance courses. Second, they suffer from more unfavourable, stress-related emotions and loneliness. Hence, the study points to a (higher education) student need for support in adequately coping with the challenges of emergency remote learning. The study results have implications for three groups of stakeholders who potentially can support students: researchers, administration and management, and lecturers.

First, regarding research, comparison and longitudinal studies are needed to better understand how students cope with the situation of emergency remote learning. The current study suggests that it is necessary to consider what different student groups require in such a unique setting. Groups of students who especially struggle with the current situation might be further considered in additional interview studies. With respect to social interaction which shifted to online interaction in the summer term 2020 (Li & Lalani, 2020; Miller, 2020), variables such as social embeddedness or social presence should be taken into account. For example, the Community of Inquiry model (e.g. Garrison et al., 1999; Garrison, 2007) provides a suitable theoretical framework to study course dynamics in online learning scenarios. In addition, research should evaluate potential support measures with regard to student engagement and student success. This seems of importance as future study terms will still be conducted online or at least with a higher frequency of online courses than usual.

Second, regarding administration and management, a plethora of support offers can be initiated within universities. In detail, the correlations of information sharing behaviour with students' socio-emotional perceptions indicate that (besides the provision of hardware) promoting skills for digital interaction might be needed to foster the socio-emotional

experience of students. For example, workshops or individual training regarding information and computer literacy might be a good start to bolster students' socio-emotional mental states (Beaunoyer et al., 2020). Hence, as the COVID-19 pandemic is not yet over, students still have to cope with digital or hybrid learning formats. This might be especially necessary for first-year students where such course content could be integrated in preparatory courses. For example, the university where the current research was carried out, plans to train mentors for first year students. Based on the results of this study, student counselling offices might provide students with information for learning and interacting in a digital study term. Here, it could be useful to create offers that especially address female students or students of humanities and social sciences. In addition, administration might provide financial support for the development of teaching concepts that stimulate digital interaction among students (for example, via supporting teaching projects, announcing topic-specific teaching awards, or initiating evidence-based discussions on platforms like intra-university teaching days).

Finally, lecturers should not only be coached in the use of technology and the special characteristics of digital teaching and learning, but also be made aware of the individual differences of their students. Lecturers should be aware of their teacher presence (Garrison, 2007) and might need to put more effort into creating spaces for interaction and communication (e.g., via webcam interaction, discussion forums, etc.) so that students experience group cohesion or so that they can discuss potential stressors.

Conclusions

The COVID-19 crisis influences all areas of society, including education. "While this is a strong stress test for education systems, this is also an opportunity to develop alternative education opportunities" (OECD, 2020, p. 1). Higher education students represent a population with relatively good prerequisites (high level of education, high skills for handling and communication via digital media, and to a great extent good access to technology). Still, some higher education students seem to struggle with the current situation. To mitigate

potentially negative effects for the latter group, research and practice in the field are well-advised to work hand in hand and jointly develop ways to investigate, analyze and shape this unprecedented situation. The study results should contribute to a better understanding of the sudden change to e-learning in higher education and lead to conclusions for educational practice. A university-wide and global feature to distribute and further develop best-practice examples for digital learning is presented via Open Educational Resources (OER). Hopefully, OER strategies will come to the forefront as the ongoing crisis continues to unfold.

Acknowledgments

We thank the university for supporting our study. We thank colleague Rudolf Kammerl for his support in the preparation and implementation of the survey. We thank Karin Lee and Miguelina Nuñez for proof-reading the manuscript.

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