

THE IMPACT OF COVID-19 ON STUDENT WELL-BEING AND LEARNING

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Abstract

Since the outbreak of the COVID-19 pandemic, student well-being and learning have become a global concern. However, the transition to online teaching might not affect all students in the same way. This study investigates how COVID-19 restrictions affect student well-being and approaches to learning differently, and what role well-being plays in the relationship between COVID-19 impact and students' approaches to learning. Data consists of 57,744 answers from the "The Danish Student Survey", collected from October to December 2020. The impact of the COVID-pandemic was measured by a COVID scale, based on four questions regarding the corona situation. Students were either categorized as low, moderate- or highly affected by COVID-19. Linear regression analyses were used and the findings revealed that COVID-19 affected students differently. Students highly affected by COVID-19 restrictions had a significantly lower score on well-being and a higher score on a surface approach to learning. We found no clear association regarding student's deep approach to learning. Well-being mediated the relationship between COVID-19 impact and students' approaches to learning. Hereby, higher education institutions should take student well-being into account and be aware that a one-size-fits-all approach can be misguided when developing new online initiatives.

Keywords: COVID-19; well-being; learning; approaches to learning

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Introduction

The outbreak of the COVID-19 pandemic had a large impact on students in higher education globally (Van de Velde et al., 2021; Belghith et al., 2020; Plakhotnik et al. 2021) and in Denmark (Haslam et al., 2021; EVA, 2021a). The COVID-19 pandemic caused worries, anxiety and loneliness, and the large change in restrictions, social isolation and physical distance induced major mental health consequences (Pedrosa et al. 2020; Chaturvedi, Vishwakarma, and Singh 2021; Son et al. 2020). Worries about becoming ill, someone close becoming seriously ill and not being able to see family and friends were some of the factors, which influenced students and young people's lives (Varga et al. 2021; Schwartz et al. 2021; Hoffmann et al. 2021). The experience of cancellation of study activities and internships also challenged student's well-being (Belghith et al. 2020; Mseleku 2020; Aucejo et al. 2020). Especially young people and students in higher education were affected and experienced mental health problems during the first lockdown (Varga et al. 2021; Thygesen et al. 2021; van de Velde et al. 2021).

In Denmark, all higher education institutions closed down on the 13th of March due to a rapid increase in the spread of new coronavirus (SARS-CoV-2) (The Local 2020). The Danish Government introduced national restrictions and lectures, classes and exams were rescheduled into online teaching. Some of the restrictions were increased physical distance, social isolation, a ban for visiting vulnerable people and a ban of assemblies of more than 10 people. In Denmark 43% of the students at some point felt lonely in 2020 (35% in 2018), and 55% of first year students agreed that online teaching had a negative impact on their social belonging (EVA 2021b). However, the literature is still sparse and the area need to be further investigated. The large sample in this study will contribute to a better understanding of how COVID-19 has affected student well-being in higher education in Denmark.

The lockdown also caused a rapid shift from class-based to online teaching with consequences for students' learning (Pedrosa et al. 2020; Mseleku 2020). Students reported a loss of interest, a lack of interactive teaching and communication, a shorter time to solve online tests as well as more tiredness (Mahdy 2020). The lockdown also caused a lack of motivation in studies (Tan 2021) and a reduction in a number of learning activities (Haslam, Madsen, and Nielsen 2021). In Denmark, 58% of the students experienced a reduction in their educational development and 56% had a poorer understanding of what they have been taught from online teaching (UCN 2021). Access to join group discussions, feedback from the lecturers and students' overall satisfaction also decreased compared to pre-pandemic circumstances (UCN 2021). However, studies also found that some students actually benefited from the COVID-19 pandemic. Online teaching can be more flexible and increase the opportunities for self-study. More time to learn and do other activities can also make online teaching more convenient (Mahdy 2020). The contradictions in these findings need to be further investigated. Therefore, this study aims to give a deeper understanding of how COVID-19 have affected students' approaches to learning.

Previous research has mainly focused on the impact of COVID-19 on either students' well-being or learning. To our knowledge, no studies have investigated to what extent well-being plays a role in how COVID-19 affected student learning. Previous literature has already found a close link between well-being and students' approaches to learning (Heikkilä et al. 2012; Stoliker and Lafreniere 2015). Students with a high level of well-being tend to adopt an increased deep approach to learning. In contrast, students experiencing a low level of well-being, tend to adopt a surface approach to learning (UFR 2019). Thus, it is plausible to expect that well-being might mediate the effect of COVID-19 on students' approaches to learning. This study will try to address this research gap by examining how well-being mediates the relationship between impact from COVID-19 restrictions and students' approaches to learning.

Our contribution to the research is three-fold. First, the study investigates how the COVID-19 restrictions affect students in higher education in general. Students in higher education were sent home for a long time and in Denmark, most higher education institutions remained closed until the beginning of August 2020 (The Government 2020). The COVID-pandemic has had different impacts and caused different restrictions across countries (Varga et al. 2021). Therefore, it is important to get a better understanding of how students in higher education in Denmark were affected by the pandemic. Second, this study investigates the impact of COVID-19 on student well-being. Third, we investigated how COVID-restrictions affected students learning and how student well-being mediated this relationship.

Theoretical background

The perceived impact of COVID-19 on student well-being

During the COVID-19 pandemic, students faced many challenges. The transition to online teaching changed students' daily lives dramatically. Change in concentration and sleeping patterns, reduced social interaction and concerns regarding academic performances were some of the consequences associated with the pandemic (Son et al. 2020).

Herrmann et al. (2012) described a model explaining how the study environment affects student well-being. The model consisted of five elements influencing student well-being among university students. The first element was students' background characteristics (age, gender, GPA and self-efficacy), while the second element were student perception of the study environment divided into an academic and social element. Background characteristics and perceived study environment affect student integration in their studies, which have an impact on well-being. All indicators of perceived social study environment were highly correlated with student well-being (Herrmann, Jensen, and Lassesen 2012). Especially students' perception of available social/academic events and opportunities to meet fellow students correlated

with student well-being. Other studies support that changes in the study environment due to the COVID-19 pandemic have affected students' well-being (Varga et al. 2021; Pedrosa et al. 2020; Mseleku 2020; Aucejo et al. 2020).

During COVID-19, the student environment was almost non-existent to many students and students' sense of belonging decreased. It is most likely that the transition from face-to-face to online teaching has changed students' perception of the study environment, followed by a subsequent impact on student well-being. Based on this assumption we developed our first hypothesis:

H1: Students experiencing a high impact from COVID-restrictions have a lower level of well-being compared to students experiencing a low impact from COVID-restrictions.

Students' approaches to learning

Students' approaches to learning (SAL) was introduced in 1976 by Marton and Säljö as a theoretical concept, referring to students' intention regarding their studying and learning, as well as their learning processes (Marton and Säljö 1976; N. Entwistle 2009). There is a theoretical distinction between the two approaches: deep approach to learning and surface approach to learning, and both approaches have been widely used in the literature.

Students adopting a deep approach to learning show interest, try to understand learning in a broad perspective (Postareff, Mattsson, and Parpala 2018), and are able to relate to other research (N. J. Entwistle 1991). They are more motivated and show a higher level of self-efficacy (Postareff, Parpala, and Lindblom-Ylänne 2015). A deep approach is associated with a positive perception of the teaching-learning environment (Postareff, Mattsson, and Parpala 2018) and a high level of peer support (Coertjens et al. 2016). In contrast, students adopting a surface approach to learning, to a higher extent focus on rote learning and study to pass the exam (Postareff, Mattsson, and Parpala 2018;

Lindblom-Ylänne, Parpala, and Postareff 2019). They try to memorize what they learn, use a more reproducing approach, see information as unrelated bits and are not able to analyse and understand learning in a broader perspective (N. Entwistle 2009). A negative perception of the teaching-learning environment, such as low motivation and interest are found to be associated with a surface approach (Rossum and Schenk 1984; Lawless and Richardson 2002; Lindblom-Ylänne, Parpala, and Postareff 2019). In general, students' learning approaches are individual and differ depending on how the students interpret the task (N. Entwistle 2009). Students do not have either a surface or a deep learning approach, but use different learning approaches in different disciplines (N. Entwistle 2009). Students' approaches to learning are found to be related to the perceived teaching-learning environment (Parpala, Lindblom-Ylänne, and Entwistle 2013) and learning outcome such as academic achievement (Kim J. Herrmann, McCune, and Bager-Elsborg 2017).

Well-being and learning

The link between students' learning and well-being has been discussed in the literature, also prior to the COVID-19 pandemic (Vaez and Laflamme 2008; Yu, Daniel, and Zhu 2018; Duffy et al. 2020). The experience of stressors and mental health symptoms can have a negative impact on students' academic performance (Duffy et al. 2020), while the feeling of loneliness and burnout can affect students' academic experiences (Stoliker and Lafreniere 2015). Hereby, the findings show that a low level of well-being is associated with a more negative learning outcome. A Finnish study has also examined how student approach to learning, study profiles and sense of well-being were linked among a group of first-year students. Students with a study profile related to a surface approach tended to perceive higher levels of stress and exhaustion compared to students with a study profile associated with a deep approach to learning (Heikkilä et al. 2012). A Danish study also found that a higher score on the well-being scale was associated with a deep approach to learning, while a lower score was associated with a surface approach to learning (UFR 2019). A surface approach is more often associated with

higher levels of anxiety and fear, due to lack of meeting the academic requirements (N. Entwistle 2009). The fear of failure can lead to a downward spiral causing a loss of interest and less effort being put into work. This link is also supported by other studies (N. Postareff et al., 2018; Rossum et al., 1984).

Impact of COVID-19 on student learning

The COVID-19 pandemic caused disruptions in students learning opportunities due to the large amount of online teaching (Hill and Fitzgerald 2020). Lack of interest, reduced study motivation, decreased peer support, time management challenges and a reduction in the teacher-student relationship affected students teaching-learning environment negatively during the pandemic (Hill and Fitzgerald 2020; Haslam, Madsen, and Nielsen 2021; Pedrosa et al. 2020). Lockdown also had an impact on the academic performance of almost all students but to varied degrees (Mahdy 2020). Nearly half of the students were highly affected, while only 6% of the students were slightly affected by the pandemic and lockdown. Especially students attending practical sessions were challenged due to the online circumstances (Mahdy 2020). However, not all students have felt the same impact from COVID-19 on learning and academic achievement. In Denmark, students with a high GPA from high school had a more positive attitude towards online teaching compared to students with at lower GPA (EVA 2021b). Other studies found that some students actually benefited from the shift to online classes. They found it easier to interact with lecturers and get individual tutoring sessions online, which improved the student-lecturers relationship (UCN 2021). In addition, flexibility, comfort and greater accessibility of content materials were also positive aspects of the transition to online learning (Hasan and Hassan 2020). Thus, we expect that COVID-19 affected students' approaches to learning differently:

H2a: Students experiencing a high impact from COVID-restrictions are less prone to exert a deep approach to learning compared to students experiencing a low impact from COVID-restrictions.

H2b: Students experiencing a high impact from COVID-restriction are more prone to exert a surface approach to learning compared to students experiencing a low impact from COVID-restrictions.

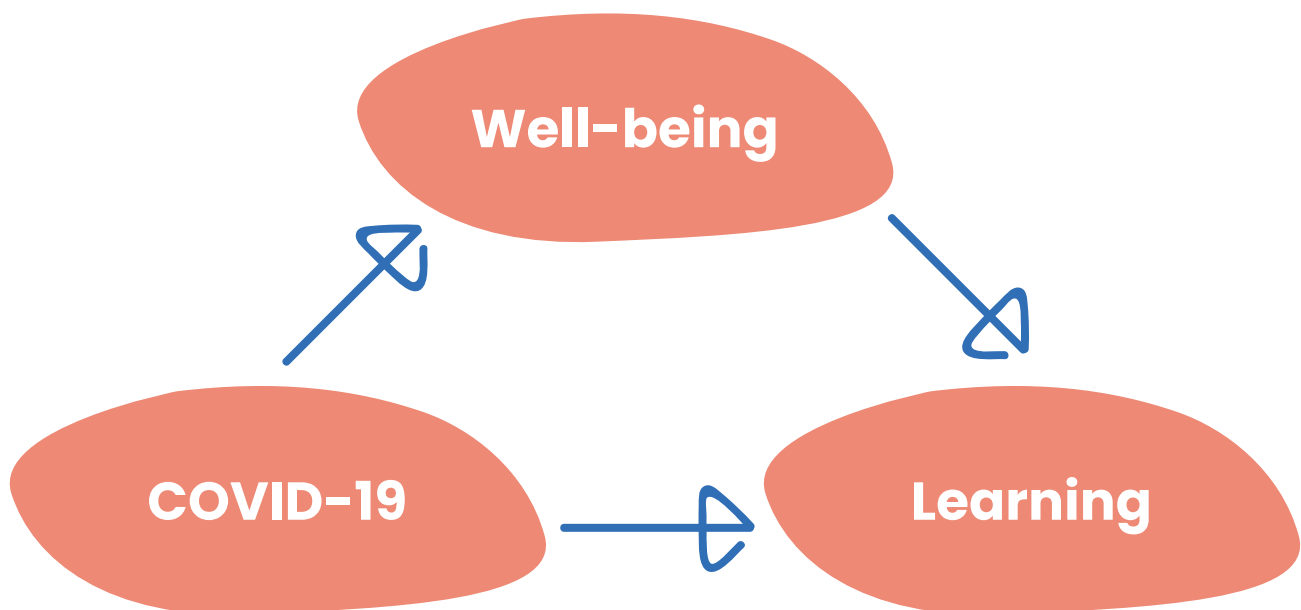
The mediating role of Well-being

Based on the previous sections it is likely that COVID-19 had an impact on both student well-being and students' approaches to learning. However, the literature is sparse, and to our knowledge, no studies have looked at to what extent the relationship between COVID-19 and student approaches to learning might be mediated by student well-being. It is plausible, based on previous findings in the literature,

that derived consequences from the COVID-19 pandemic such as social restrictions have increased the feeling of loneliness and reduced mood and sense of belonging among students. The reduction in well-being can affect students' learning outcome and perceived teaching-learning environment. The lack in study motivation and reduced interaction with peers and lectures can influence on students' approaches to learning (Parpala, Lindblom-Ylänne, and Entwistle 2013).

According to Agler and de Boeck (2017), mediation occurs when the effect from the independent variable (eg. COVID-19) to the dependent variable (eg. Deep- and surface approach to learning) is transmitted by a third variable (well-being) (Agler and de Boeck 2017).

Figure 1: Model of the direct and indirect effect of COVID-19 on student well-being and learning



It is likely that COVID-19 has affected student learning both directly and indirectly intervened by student well-being. Based on previous studies, we assume that well-being might play a role in the relationship between COVID-19 and students' deep and surface approach to learning. We developed the following hypothesis:

H3a: Well-being mediates the relationship between students' perceived impact of COVID-19 restrictions and deep approach to learning.

H3b: Well-being mediates the relationship between students' perceived impact of COVID-19 restrictions and surface approach to learning.

Method

Study design and study population

We used cross-sectional data from The Danish Student Survey conducted in fall 2020. Nearly all students at the tertiary level in Denmark (250.000) were invited excluding some study

programs outside the jurisdiction of the Danish Ministry of Higher Education and Science (<1%). Only full-time students and students enrolled in a higher education programme were included in the study. Non-active students and students studying elsewhere (eg. abroad), were excluded from the sample. In total, 94,717 students responded the questionnaire, resulting in a response rate of 37 percent.

The sample consisted of 65% female and 35% male students aged 18 to 73 (M=26 SD=5,96). The students ethnicity were as followed: Danish (82%), descendants (5%), immigrants (13%) and 1% of the students were unknown. 8% were enrolled in short cycle higher education, 46% in a professional bachelor's programme, 26% were academic bachelor's students, while 21% were master's students.

Measures

Students' approaches to learning

In The Danish Student Survey, deep approach and surface approach to learning are each measured through four items, cf. table 1. The students have answered to what extent they agree or disagree with the statements on a five-point likert scale: (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Strongly agree, (6) Unsure/ not applicable. All items measuring students' approaches to learning are theoretically based and validated in a Danish context (Herrmann, Bager-Elsborg, and Parpala 2016). The items are adapted from the Finnish questionnaire LEARN, which were adapted and modified from the validated British survey ETLQ (Experience of Teaching and Learning Questionnaire) (Herrmann, Bager-Elsborg, and Parpala 2016).

Table 1. Items measuring the two indicators of students' approaches to learning

Approaches to learning	Items
Deep approach to learning	I often find the content presented on the programme stimulating, and continue to think about it outside the classroom
	Much of what I have learned seems no more than unrelated bits and pieces in my mind
	I study the topics thoroughly so that I can take a critical view of the work we do on the study programme
	I do my best to connect and create an overview of what I learn in different parts of the study programme
Surface approach to learning	I often find it difficult to remember what I need to learn
	I often find that things are difficult to understand, even though I have tried to learn it over and over again
	I often find it difficult to understand what I need to learn because it is too complicated
	I often find that things are difficult to understand, even though I have tried to learn it over and over again

Student well-being

Well-being was measured by the WHO-5-index (The World Health Organisation- Five Well-being Index)(WHO 1998). WHO-5 is a measure of current mental health and widely used around the world. It is validated in a number of studies

with regard to both clinical and psychometric validity, and it is found to be a useful measure of well-being in both younger and elderly persons (Topp et al. 2015). The WHO-5 index consists of five statements measuring positive experiences during the last two weeks (see table 2) ("WHO-5

Questionnaires" n.d.). The statements are rated on a 6-point scale: 0) At no time; 1) Some of the time, 2) Less than half of the time, 3) More than half of the time, 4) Most of the time, 5) All of the time. The total raw score, ranging from 0-25 when summarising the questions is multiplied by

four to make up the final score. 0 indicates the worst imaginable well-being and 100 indicates the best. In 2020 during the COVID-19 pandemic, the total mean score on the WHO5-index for the Danish population was 62 (Sønderskov, Dinesen, Santini and Østergaard 2020).

Table 2. The items in the WHO-5-index

Student well-being	Items
Over the last two weeks...	I have felt cheerful and in good spirits
	I have felt calm and relaxed
	I have felt active and vigorous
	I woke up feeling fresh and rested
	My daily life has been filled with things that interest me

Students' experience of COVID-19-restrictions

Due to the pandemic and lockdown, new items measuring students' experience of the corona situation were added to the Danish Student Survey in 2020 (see table 3). Only students enrolled in a higher education programme

during springtime received questions about how the lockdown in spring affected them. Only students with a valid score on the COVID scale were included in the analysis, reducing the final sample from 94,717 responders to 57,744 responders.

Table 3. Items measuring students' perceived impact from the corona situation

	Items
COVID-19 impact	The corona situation removes some of the joy of studying
	I had a hard time during the corona lockdown in the spring
	Today, my everyday life in my study program works well despite the corona situation
	The lockdown have not delayed me in my studies

Control variables

Controlling for students background characteristics and other possible influential factors we used several pieces of information from Statistics Denmark. We used the following control variables: sex, age, ethnicity, parents' highest completed education and students' GPA (from before entering higher education), which are shown to be associated with student well-being,

deep and surface approach to learning in previous literature (UFR 2019). Information about students GPA before entering higher education was also in previous analyses associated with both students' well-being and approaches to learning (UFR 2019), therefore we decided to include it in our analysis.

Statistical analyses

We developed a COVID scale based on the student's answer to the four questions regarding students' perception of the corona situation. We divided the scale into three categories based on percentiles. Students with an average score lower than the 25th percentile were classified as 'low impact of COVID-19', while students with an average score higher than 25th and lower than 75th percentile were classified as 'moderate impact of COVID-19'. Students perceiving a 'high impact of COVID-19' had an average score higher than the 75th percentile.

To examine the hypothesis we conducted multiple OLS regression analysis using STATA. The regression analysis was adjusted for control variables. We applied fixed effects at a pseudo faculty level using the combination of department and academic field of study to omit any influence from local level variations. To test whether our findings merely was a consequence of the high number of observations and the high power, we ran the regression 500 times with a random 5% sample. All the regressions met the assumptions of a linear regressions analysis.

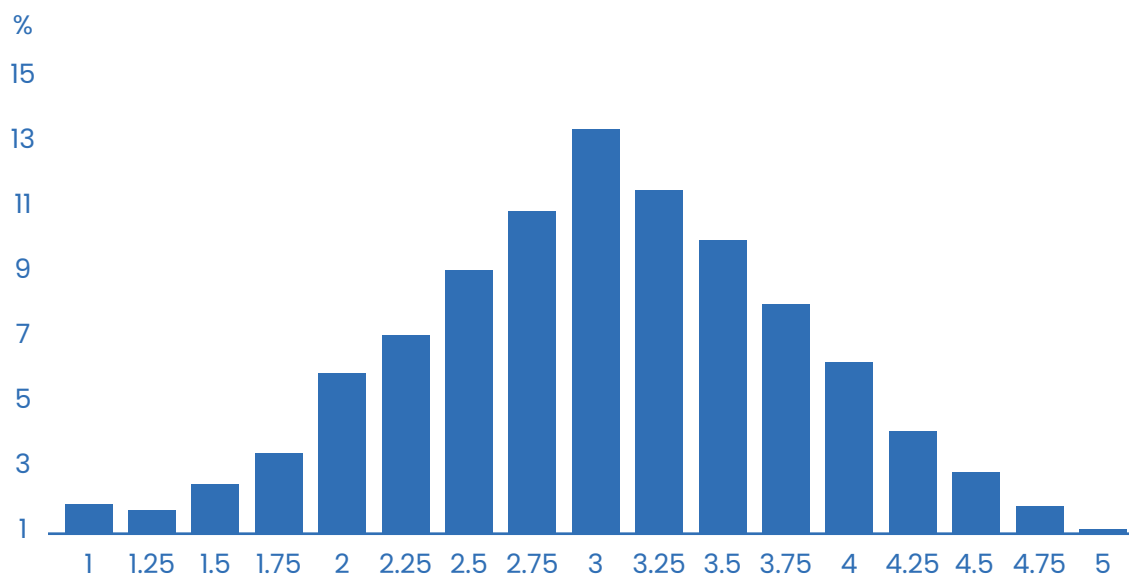
Results

All the scales showed an acceptable or strong internal reliability. The well-being index (WHO-5 scale) showed the highest Cronbach's alpha level (0.86), while the COVID scale showed a Cronbach's alpha level at 0.65. The scales for deep and surface approach to learning resulted in a Cronbach's alpha at 0.73 and 0.77 respectively. Thus, the COVID scale was the only scale scoring marginally under the convention at 0.7 (Sharkness and DeAngelo 2011).

Differences in the perceived impact of COVID-19 restrictions.

The score on the COVID scale almost showed a normal distribution (see figure 2) indicating that the perception of the COVID-19 restrictions differed among students. A high score on the scale indicates a high impact from COVID-19 restrictions, while a low score means that students were less or not affected by the COVID-restrictions. The total mean on the scale was 3.02 (see table 3). 31% of the students felt a low impact from COVID-restrictions, while 45% and 24% respectively, experienced a moderate and were highly affected by the COVID-restrictions.

Figure 2: The distribution of students score on the COVID-scale



Descriptive statistics

Students highly affected by COVID-19 restrictions had a lower score on the well-being index (M=47.36) compared to students perceiving a moderate (M=57.30) and low impact (M=62.31) from COVID-19 restrictions. According to students' approaches to learning, students highly

affected by the COVID-19 restrictions had a lower score on deep approach to learning (M=3.79) and a higher score on surface approach to learning (M=2.88) compared to students with a low impact from COVID-19 (deep: M=3.92) and (surface: M=2.43) respectively.

Table 4. Well-being, deep and surface approach to learning divided by different level of impact from COVID-19

		COVID-scale			Well-being		Deep approach to learning		Surface approach to learning	
Numbers					57,744		40,333		40,519	
		Mean (pct.)			Mean (CI 95%)					
COVID scale (categorised)	Low	2.04 (30.9)	[2.03;2.05]	62.31	[62.03;62.59]	3.92	[3.91;3.93]	2.43	[2.42;2.44]	
	Moderate	3.11 (45.4)	[3.11;3.12]	57.3	[57.07;57.53]	3.85	[3.84;3.85]	2.65	[2.64;2.66]	
	High	4.11 (23.7)	[4.11;4.12]	47.36	[47.02;47.70]	3.79	[3.78;3.81]	2.88	[2.86;2.89]	
Total (mean)		3.02	[3.01;3.02]	56.50	[56.34;56.66]	3.86	[3.85;3.86]	2.63	[2.62;2.64]	

Multiple regression analyses:

The relationship between COVID-19 impact and student well-being

According to our hypothesis (h1), we expect that students highly affected by the COVID-restrictions have a lower level of well-being. Table 5 presents results from the regression analysis. Model 1 is the unadjusted relation between COVID-19 impact and well-being, while model 2 is adjusted for relevant control variables, described in the previous section (see methods).

Model 2 showed a high and significant association between impact from COVID-19 restrictions and students' scores on well-being, when adjusting for students' background characteristics. Students highly affected by the COVID-19 restrictions had a lower score on the well-being index compared to students moderately and less affected by COVID-19 restrictions. The findings were supported when rerunning the regression 500 times on a randomly drawn 5% subsample.

Table 5. Multiple linear regression analysis with students' well-being as outcome, fixed effect

	Model 1: Well-being		Model 2: Well-being^a	
	b/95% CI		b/95% CI	
Low COVID-19	(Ref.)		(Ref.)	
Moderate COVID-19	-4.771***	[-5.17,-4.37]	-4.745***	[-5.14,-4.35]
High COVID-19	-14.898***	[-15.37,-14.42]	-14.658***	[-15.13,-14.18]
Constant	62.551***	[62.24,62.86]	68.912***	[56.65,82.18]
Obs.	45,890		45,890	
R-sqr	0.078		0.105	

Note: ^a Model 2 are adjusted for gender, age, ethnicity, students GPA before entering higher education, parents highest completed education and fixed effects at faculty level.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The relationship between COVID-19 impact and students' approaches to learning mediated by well-being

To test hypothesis 2a and 2b we used regression analysis with students' deep approach to learning (table 6) and surface approach to learning (table 7) as the dependent variable. Table 6 and 7 include three models. Model 1 shows the unadjusted effect, while we adjusted for control variables in model 2. In model 3, we tested hypotheses 3a and 3b and added well-being to the model to test for mediation.

In the first regression analysis (table 6), we investigated how COVID-19 restrictions affect students deep approach to learning. In model 1, only COVID-restrictions were added to the model and both high and moderate impact of COVID-restrictions were significant associated

with students' deep approach to learning. In model 2, we adjusted for student's background characteristics, GPA and fixed-effects, leading to a reduction in the COVID coefficients. In model 3, well-being was included in the model and only moderate level of COVID-restriction remained significant. The coefficient dropped remarkable and the association between COVID-restrictions and deep approach to learning nearly disappeared. After rerunning model 3 on a 5% randomly drawn subsample, we found no significant association between either student's impact from a moderate (b: -0.02, SD=0.036, $p=0.448$) or a high level of COVID-restrictions (b: -0.01, SD=0.045, $p=0.488$) on students' deep approach to learning. This indicates that well-being reduced the effect of COVID-impact on students' deep approach to learning.

Table 6. Multiple linear regression analysis with students' deep approach to learning as outcome, fixed effect

	Model 1: Deep approach		Model 2: Deep approach (adjusted)^a		Model 3: Deep approach (adjusted)^a	
	b/95% CI		b/95% CI		b/95% CI	
Low COVID-19	(Ref.)		(Ref.)		(Ref.)	
Moderate COVID-19	-0.067***	[-0.082,-0.052]	-0.052***	[-0.07,-0.04]	-0.022**	[-0.037,-0.007]
High COVID-19	-0.121***	[-0.139,-0.103]	-0.099***	[-0.12,-0.08]	-0.008	[-0.027,0.010]
WHO5-score					0.006***	[0.006,0.006]
Constant	3.885***	[3.873,3.897]	3.647***	[3.27,4.03]	3.219***	[2.845,3.593]
Obs.	31.138		31.138		31,138	
R-sqr	0.006		0.040		0.077	

Note: ^a Model 3 is adjusted for gender, age, ethnicity, students GPA before entering higher education, parents' highest completed education and fixed effects at faculty level.
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In table 7, students' surface approach to learning was the dependent variable. First, we estimated a model only between COVID-restrictions and surface approach to learning. We found a high and significant association between the two variables. In model 2, we adjusted for relevant control variables and fixed-effects. COVID-restrictions remained significant related to students surface approach to learning. In model 3, well-being was also included in the model and

both well-being and COVID-restrictions were significantly associated with COVID-19 impact. However, the effect size of both moderate- and high impact from COVID-19 dropped. Hereby, well-being mediated the relationship between COVID-19 impact and surface approach to learning. The overall regression model for surface approach to learning (model 3) was significant. After rerunning the regression on smaller randomly drawn samples, model 3 remained significant.

Table 7. Multiple linear regression analysis with students' surface approach to learning as outcome, fixed effects

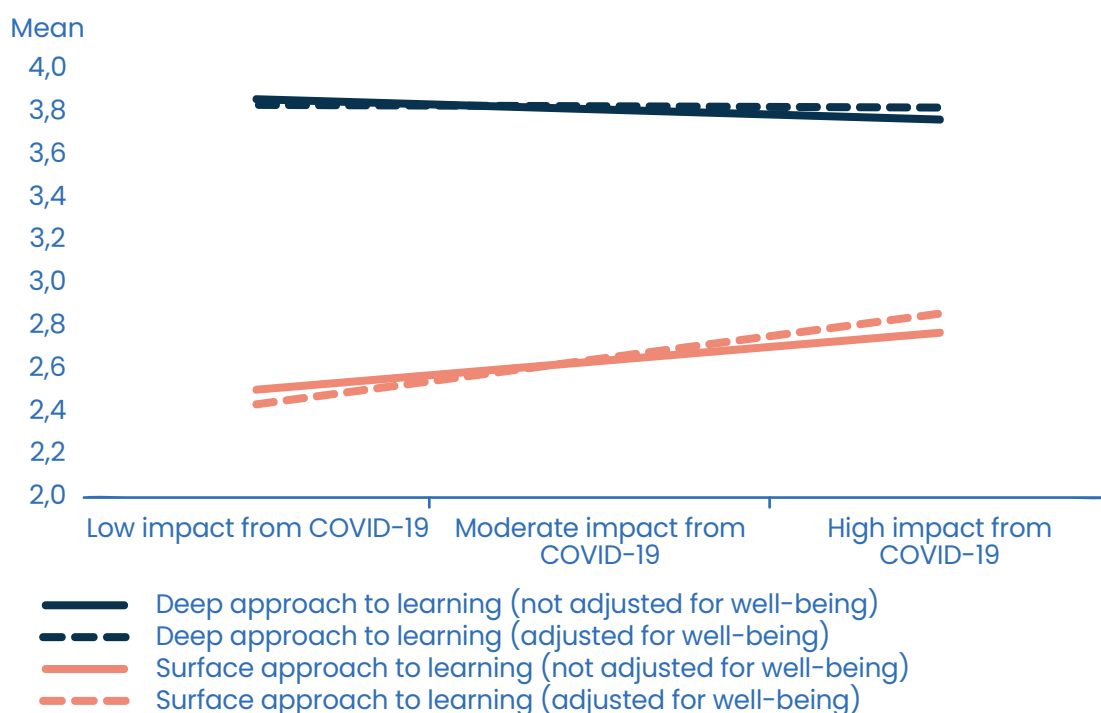
	Model 1: Surface approach		Model 2: Surface approach (adjusted)^a		Model 3: Surface approach (adjusted)^a	
	b/95% CI		b/95% CI		b/95% CI	
Low COVID-19	(Ref.)		(Ref.)		(Ref.)	
Moderate COVID-19	0.218***	[0.200,0.237]	0.208***	[0.19,0.23]	0.160***	[0.142,0.178]
High COVID-19	0.446***	[0.424,0.469]	0.420***	[0.40,0.44]	0.275***	[0.252,0.297]
WHO5-score					-0.010***	[-0.010,-0.009]
Constant	2.433***	[2.418,2.447]	2.586***	[2.12,3.05]	3.273***	[2.820,3.725]
Obs.	31,380		31,380		31,380	
R-sqr	0.047		0.102		0.162	

Note: ^a Model 3 is adjusted for gender, age, ethnicity, students GPA before entering higher education, parents' highest completed education and fixed effects at faculty level.
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The predicted values of COVID impact on students' deep- and surface approach to learning before (model 2) and after adjusting for well-being (model 3) are shown in figure 3. The figure shows that the relationship between COVID-19 impact and students' deep and surface approach to learning gets weaker when controlling for student well-being. Therefore, some of the effect of COVID-19 on students'

approaches to learning are explained by well-being. The less affected the students are by the COVID-19 pandemic the more they tend to adopt a deep approach to learning. However, this finding does not exist, when considering student well-being. In contradiction, students highly affected by the COVID-19 pandemic to a higher extent adopt a surface approach to learning, also when adjusting for student well-being.

Figure 3. Predicted means for deep and surface approach to learning divided by students' impact of the COVID-restrictions, with/without well-being as a mediator



Discussion

Main results

The aim of the study was to investigate how COVID-19 restrictions affected students in higher education in general and what impact the pandemic had on students' well-being and approaches to learning. We found that students overall have been affected to a varied degrees. Perceived impact of COVID-19 restrictions were significantly associated with both well-being and students' surface-approach to learning. Deep approach to learning only showed a very weak association to COVID-restrictions. In other words, being highly affected by COVID-restrictions were associated with a lower well-being and higher tendency to adopt a surface approach to learning. We also found that well-being mediated the effect of both

deep and surface approach to learning. Well-being partially mediated the relationship between impact from COVID-19 restrictions and students' surface approach to learning. For deep approach to learning, the link to COVID-restrictions were no longer present, when adjusting for student well-being.

Comparison to other studies

Our findings are in line with previous studies investigating the effect of COVID-19 on student well-being (Belghith et al. 2020; Varga et al. 2021; Hoffmann et al. 2021; Mseleku 2020). The constantly changing circumstances during the pandemic challenged students in how to navigate and react to the high demands and expectations regarding how to meet friends and peers (Danish Counselling service 2020).

At the same time, the uncertainty regarding when returning to school and when the society will get back to normal, also affected student well-being. On the other hand, COVID-19 did not affect all students negatively. Many factors contribute to how young people were affected during the pandemic. Foulkes et al. (2021) examined the individual differences in adolescent mental health during COVID-19 and the importance of peer relationship quality. Young people with a high-quality peer relationship can either benefit from a change to a social platform to cope with the social restrictions. Others might experience a large frustration and loneliness caused by lack of social interaction (Foulkes and Blakemore 2021). Thus, some students might have struggled more during the pandemic, while others might have found the shift to online learning beneficial. Virtual learning can remove the anxiety of asking questions in front of peers but also contribute to a better flexibility and a greater participation in courses (Burns, Dagnall, and Holt 2020).

In our study, we found a significant association between perceived impact of COVID-19 restrictions and students' surface approach to learning. We also found that well-being mediates the relationship between COVID-19 and students' approaches to learning. A high impact of COVID-19 was associated with a lower level of well-being and a higher score on the surface approach to learning. The link between student well-being and surface approach to learning is supported in previous studies (Stoliker and Lafreniere 2015; Heikkilä et al. 2012). The impact of COVID-19 and the transition to online teaching can reduce study motivation, interaction with peers and communication with lecturers (Haslam, Madsen, and Nielsen 2021; Mahdy 2020), which can be either direct or indirect related to students' approaches to learning (Parpala, Lindblom-Ylänne, and Entwistle 2013). Changes in the teaching and learning environment and new virtual circumstances due to the institutional lockdown challenged students' motivation and learning interest. In Denmark, almost 80% of the students perceived a lower academic achievement due to the online teaching compared to normal face-to-face learning (UCN 2021). The lack of interactive teaching, less

effective communication and a limited contact to students and lecturers can make it harder for students to reach out when having trouble in their studies. Lack of sufficient technical skills among lectures and bad internet connection can also affect student learning and result in poor online teaching (Mseleku 2020). However, the transition to online teaching during COVID-19 also showed some advantages. It can increase flexibility, be less time consuming and increase the opportunity to spend time on other activities and for some provide more opportunities for self-studies (Mahdy 2020). The lockdown forced educational institutions to develop and implement more digital solutions and innovative ways to deliver teaching (Mseleku 2020). Taking all this together, it is plausible that a rapid shift to online teaching both can have a positive and negative impact on student well-being and learning.

A remarkable finding is the rather poor relationship between COVID-19 impact and deep approach to learning compared to the effect of the surface approach. Deep approach and surface approach to learning are often interpreted as opposite ends of the same continuum, which is not the case in The Danish Student Survey. The wording of the indicator deep learning focused on the individual ambition to study in a certain way, that very well can go unaffected by the transition to online teaching. On the contrary, surface approach to learning focus more on outcomes, such as not being able to remember or make sense of the things presented online. Students might feel limited in engaging with peers and teachers in the virtual classroom during COVID-19 lockdown, which may increase the probability of adopting a surface approach to learning.

Limitations

Some limitations should be considered regarding the interpretation of the results. The use of cross-sectional data limits the causal inference drawn from the results. Well-being, students' approaches to learning and perceived impact of COVID-restrictions were all measured at the same time. Therefore, the causal inferences are unclear. It is uncertain whether students well-being has changed due to the high impact from COVID-19 restrictions or if students with pre-pandemic

disorders are more affected by the pandemic (Hoffmann et al. 2021; Varga et al. 2021). To understand the causal link, future studies should use a longitudinal design, thus clarifying the temporal link between the outcome and exposure.

In our study well-being, approaches to learning and impact from COVID-19 were all measured using an online self-reported questionnaire. In general, self-reported questionnaires are prone to various types of response bias (Donaldson and Grant-Vallone 2002). The use of a self-reported questionnaire may have increased both the risk of selection bias and social desirability bias in this study.

Regarding the COVID scale, we were only able to estimate a score among students enrolled in a higher education institution during spring 2020. Hereby, students in their first semester were not included in the analysis, which might increase the risk of selection bias. First-semester students might be highly affected by the COVID-19 pandemic in regard to being lonely and not having the opportunity to meet fellow students (EVA 2021a; 2021b). It is possible, that the exclusion of first semester students have caused an underestimation of the effect, that COVID-restrictions have had on student well-being and students' approaches to learning.

Social desirability bias is common when measuring psychological well-being due the stigmatisation in the mental health area (Caputo 2017). People tend to under-report behaviour seen as inappropriate or stigmatised, while they tend to over-report behaviour seen as appropriate (Donaldson and Grant-Vallone 2002). In our study, social desirability bias can result in under-reporting of student well-being causing misclassification. If students with bad well-being instead are categorised as having a great well-being it might induce an underestimation of the real effect. However, the survey was collected anonymously, which might reduce the risk of social desirability bias.

Statistical models

Another limitation is the low R-squared value in our regression models, which indicate that our models only explain a little variation of the dependent variables. However, in social science a low R-squared value often exist in studies explaining human behaviour. The purpose was not to examine predictors of student well-being and approaches to learning, but simply to analyse if an association exists between perceived impact from COVID-19 and the dependent variables. It is plausible that many other factors, such as pre-existing illness, might affect students' well-being. We did not ask students about disorders prior to the pandemic in the survey, but we recommend that future studies include information about student's history of illness.

The high number of observations in our models also returned very low p-values in our regression models. A large sample and high power is beneficial when doing complex analysis, but the pitfall of a large sample is "the p-value problem" (Lin, Lucas, and Shmueli 2013). Even minuscule effects might be statistically significant. Relying solely on p-values and effect-sizes in large samples can cause wrong statistical inferences. To explore if our findings were driven by the large power, we reran our regression models on a 5% subsample 500 times. This method was also used in other studies, to test robustness, when analysing large sample sizes (Yao, Dresner, and Palmer 2009). Further, we used CI 95% in our models, which is more reliable for models with a high power (Lin, Lucas, and Shmueli 2013).

Implications and future research needs

Our findings indicate that student well-being and students' approaches to learning have been affected to varied degrees by the COVID-19 restrictions. Students highly affected by the COVID-19 restrictions scored significantly lower on well-being and higher on surface approach to learning, compared to students perceiving a low impact. However, longitudinal studies are needed to clarify the causal inference between impact of COVID-19 restrictions on students' well-being and

approaches to learning. Our findings revealed that well-being plays a role in the relationship between COVID-19 impact and student approaches to learning. An investment in the study environment such as improving the social environment and increasing the amount of social activities might have a positive impact on both student motivation, well-being and students' interest in learning. Increasing the opportunity to meet peers and lecturers might re-establish the sense of belonging many students have lost during the pandemic. A beneficial learning environment also affect that students adopt a more convenient learning approach. However, not all students suffered from learning loss and mental health problems during the pandemic. Some students actually benefitted from the new online standards. Today online teaching has become a new and integrated part of the higher education sector. Higher education institutions should rethink in new and innovative teaching forms giving the opportunity for students to stay connected with peers in the online classroom. New interventions should not be broad and holistic targeting at all students, but must instead be targeted, so they meet the need of different student groups.

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About EUROSTUDENT

The EUROSTUDENT project collates comparable student survey data on the social dimension of European higher education, collecting data on a wide range of topics, e.g. the socio-economic background, living conditions, and temporary international mobility of students. The project strives to provide reliable and insightful cross-country comparisons.

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