2022, vol. 9, issue 1, 7-16

RESEARCH ARTICLE https://doi.org/10.5281/zenodo.6794376

Did Covid-19 change students' grade assessments? A study from a business school

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Abstract

COVID-19 gave universities and colleges no choice. They had to switch to digital teaching and introduce home-based exams as a substitute for ordinary school exams. At the same time, the ambitions were to maintain the student's learning outcomes and ensure the exam grade measured the students' knowledge and skills. With data from a Norwegian business school, this paper will analyse if home based exams provide other results than traditional school exams with closed books. The chosen method is to compare achievements before and during the pandemic and link the performance to academic skills in other subjects and from upper secondary school. The results suggest that the measurement of grades changed under COVID-19. This applies to the quantitatively oriented subjects and the non-quantitative oriented subjects. This is useful knowledge since students' grades are used for ranking for further studies and professional careers.

Keywords: COVID-19, Exam design, home-based exam, business students, students' performance

Introduction

Like many other countries, Norway has a nationally standardised grading system. A specific grade, for example B, will measure the same knowledge and academic skills regardless of which university or college the candidate has attended. The grades are important for ranking candidates for further studies and careers in working life.

The practice at bachelor's level is a final closed book exam of 4-6 hours (i.e. in a class-room exam, ICE). It is arranged in separate facilities and with many measures in place to ensure that none of the students is able to cheat. The control function is important. The results of this exam determine the grade in the different subjects. COVID-19 completely changed this scheme. The community was shut down. Much of the teaching moved online, the students could not be on campus and a home-based exam was conducted without any kind of control.

Many students and lecturers are now arguing for retaining streamed lectures and home-based exams (THE). Hence, students no longer need to be physically present at lectures. This provides great flexibility since study can easily be combined with work and family (Parker et al., 2021). But there is also a discussion about whether this is a desired development. It can affect the learning environment and the ranking of students. A well-known professor in mathematics at NTNU (Norwegian University of Science and Technology), Helge Holden, has clear views (UA, 2021a). Traditional exams are the best way to measure knowledge. If there are opportunities for cheating, someone will always find it. Don't be naïve. If the grade is used to measure qualifications, it is important to retain the control function. If not, this will create challenges for society. Imagine, a doctor with good university grades who knows little about the human body or an engineer who has successfully graduated from NTNU who is not

able to build bridges, buildings, and roads. Professor Holden conducted online oral exams in his subject to better capture the actual skills of the candidates during COVID-19.

The research emphasises that subjects and question design are of great importance for how different forms of examination function (Parker et al., 2021). Simple questions of low complexity or questions that are designed to give only one correct answer, will be challenging with home-based exams (Roelle & Berthold, 2017).

Based on an institute at the Norwegian University of Science and Technology (NTNU Business School), we will analyse the impact of COVID-19. Given the heterogeneity of the course subjects, we can explore whether there are differences in THE depending on whether the subjects are quantitative or non-quantitative.

Theory and literature review

The research shows that during the COVID-19 pandemic THE gave different results in measuring the students' knowledge compared to ICE (Eurboonyanun et al., 2021).

This can be caused by the following factors:

1. Different learning methods and teaching style during Covid-19
2. Students' preparation for the exam
3. Use of tools
4. Question design
5. Change in the evaluation level
6. Cheating

1. Different learning methods during Covid-19

During COVID-19, in many courses there was a substantial change in teaching style (Pokhrel & Chhetri, 2021; Siriteerawasu, 2021). Face to face teaching was largely replaced with digital distance learning. The students had limited opportunity to appear on campus and were largely left to themselves in their dorm rooms or with their parents. Different online education tools made it possible to communicate with other students and instructors. Universities varied in the extent to which they succeeded in putting in place good measures at such short notice. The students dealt with this in different ways. Some found this scheme to work well, while others struggled (Aristovnik et al., 2020). In any case, this change had a major influence on the students' performance (Spiegel & Nivette, 2021).

2. Students' preparation for the exam

The change in the form of assessment may have affected the students' behaviour. Students probably made more effort for the closed-book exam compared to open-book exams where more tools are available, so the undergraduates do not need to do so much preparation (Agarwal & Roediger, 2011). Many students think they handle THE much better than ICE. This can create false confidence. The candidates decide to study less and take exam preparations much less seriously (Parker et al., 2021). Empirical studies confirm students spend less time in exam preparation in THE compared to ICE (Gharib et al., 2012).

3. Use of tools

Home-based assessments make many tools available compared to traditional assessments. Besides open book and personal notes, the students have access to hardware and software programs and not least the internet. This offers unprecedented opportunities. Hence, students perform under completely different framework conditions than in ICE. The students will handle this in different ways (Parker et al., 2021). The extent to which the individual student can benefit from this tool varies. With limited time, the candidates must consider what the expected benefit is from using the various possible aspects. Some students may spend too much time searching for information and answer using websites rather than making their own response.

4. Question design

Questions suited for closed-book assessments might not be suitable for open-book assessments. There is no point in asking simple or basic questions where one can easily find the answers in the textbook (Parker et al., 2021). The questions should require a higher level of analysis and thinking. Therefore, it can be challenging for the instructor to create questions that capture this goal. Traditionally, multiple-choice questions can be difficult to apply in home-based exams. Due to the risk of cheating, calculation tasks or questions where there is only one correct answer which can be expressed in a few words may also be challenging. As a result, instructors in many subjects have changed the exam design. The questions in THE have normally been changed to make them more demanding and more difficult to answer than in ICE. Due to THE giving access to books, notes and internet, the instructor can develop higher order thinking (Tam, 2021). Some authors argue THE will increase the focus on deeper understanding rather than memorising content (Hagström & Scheja, 2014).

5. Changer in the evaluation level

Normally home exams result in increased difficulty. The instructors are aware of the tools available to students and adjust the grade level based on the expected changes in the quality of answers. More is required to achieve the same grade compared to ICE (Tam, 2021). In principle, the choice of exam design should not affect the mean average grade.

6. Cheating

The presentation of the assessments must be based on independent individual achievements. To collaborate with peer students or others is considered unacceptable behaviour. Tao and Li (2012) suggest cheating is the biggest challenge in arranging home-based exams. The possibility of dishonesty is not easy to deal with and can result in a failure to objectively measure the students' abilities and knowledge in the different subjects (Parker et al., 2021). This is especially true if there are no or limited control systems. The extent of dishonesty can be reduced by setting a time limit (Tam, 2021) and testing for plagiarism and collusion (Cleophas et al., 2021).

Methodology

The methodological approach is used to analyse the results of a survey among the students at NTNU Business School and to study the exam results from the bachelor's programme in recent years. The courses are divided into 3 groups:

1. Non-quantitative subjects (NQS)
2. Medium quantitative subjects (MQS)
3. Quantitative subjects (QS)

Based on the literature review, it is expected that it is easier to achieve good results in QS in comparison to NQS in THE. By looking at correlation and additionally regression models, these topics will be studied more closely. The sample consists of an online survey; 342 students responded. This represents about 25 per cent of the students at NTNU Business School. This was a general survey and only a few of the questions are relevant to this analysis. In addition, we gained access to administrative data for the period 2017-2020 for all bachelor's subjects. The data also contained GPA (Grade Point Average) from upper secondary school (HSGPA), mathematics background, age, and gender. Students can choose between theoretical or practical mathematics in upper secondary school. There is great competition to get a place at NTNU Business School. Therefore, students must have a high score on HSGPA. The correlation analysis looks at whether there is a different correlation before and during COVID-19. We searched for differences and changing links depending on subjects.

The selected linear regression model is:

$$Y_i = a_0 + a_1 \mathrm{X1}_i + a_2 \mathrm{X2}_i + a_3 \mathrm{X3}_i + a_4 \mathrm{X4}_i + \varepsilon_i$$

where:

Y = Performance in the subject for student i

(0: F, 1: E, 2: D, 3: C, 4: B, 5: A)

α_0 = constant

X_1 = Student's age (1: 18–21, 2: 22, 3: 23, 4: 24, 5: 25–26, 6: 27–30, 7:31–60)

X_2 = gender (0: F, 1: M)

X_2 = upper secondary school GPA (HSGPA), mean score for all subjects (1: Fail, 6: Top grade)

X_3 = GPA (Grade Point Average) 1st year Bachelor Business Administration (0: F, 1: E, 2: D, 3: C, 4: B, 5: A)

X_4 = dummy variable for theoretical mathematics (T-maths) (0: did not take T-maths, 1: took T-maths)

ε = stochastic error.

The following subjects are selected as dependent variables:

1. Investment and Financial Analysis (IFA)
2. Organisational Psychology (OP)
3. Quantitative and Qualitative Methods (QQM)

They are all 4th and 5th semester subjects (Table 5). IFA is a quantitative oriented course, OP has a non-quantitative approach, while QQM has a mix of the two styles. Since they are the 4th and 5th courses, we can compare the results with the first year (GPA) of the same exam before 2020 , and against THE in 2020 (but no change in exam forms in the first year). Table 6 presents the data used in the regression models. Due to the skewed age distribution, this was divided into intervals.

Findings

The students are divided in their opinions of digital teaching, but the majority prefers physical lectures rather than streaming through Panopto (Table 1). On the other hand, the students are not allowed to be on campus. More than 75 per cent miss contact with their fellow students.

Students report that they were less nervous in THE (Table 2). Otherwise, more than half believe that motivation and learning outcomes are greater in ICE. In addition, the majority report that it is more difficult to cheat, and the grades are fairer.

Table 1. Students' attitudes towards digital teaching, students' attitudes, N= 342, in percentages

	Compl e-tely disagr ee	Dis-agr ee	Nei - the r/ Nor	Agr ee	Complet ely agree
I don't like not being able to meet student friends during digital lectures	5.9	5.0	13. 3	25. 4	50.4
Learning outcomes are greater in physical lectures than when streaming lectures via Panopto	13.6	13. 3	32. 7	18. 8	21.6
I prefer physical lectures to streaming lectures via Panopto	18.0	12. 1	23. 5	21. 7	24.8
The academic quality is better in physical lectures than when streaming lectures via Panopto	11.5	13. 4	42. 9	17. 7	14.6

Table 2. Students' attitudes towards home-based exams. N= 342, in percentages

	Compl e-tely	Dis-agre	Nei -	Agr ee	Compl e-tely

	disagree		ther/Nor		agree
I am very pleased with my home exam	10.9	15.6	17.4	29.8	26.3
Home exam gives as fair grades as the school exam	23.8	28.8	15.6	15.3	16.5
Home exam leads to greater motivation in the subject than in school exams	16.5	28.2	29.4	11.5	14.4
School exam leads to a better learning outcome than in home exams	15.3	22.6	26.2	23.5	12.4
Home exams make me less anxious than school exams	15.3	22.6	26.2	23.5	12.4
Home exams mean that the threshold for cheating is lower than in school exams	11.2	13.2	24.4	29.1	22.1
I prefer school exams to home exams	21.2	18.5	25.3	2.,2	13.8

Table 3. Correlation 1st semester

		HSGPA		MEA(QS)		OM (NQS)	
		2017-19	2020	2017-19	2020	2017-19	2020
		ICE	THE	ICE	THE	ICE	THE
MEA (QS) (Managerial Economics and Accounting)	Corr.	.193	.149				
	Sig.	.000	.002				
	N	916	434				
OM (NQS) (Organisations and Management)	Corr.	.284	.191	.510	.314		
	Sig.	.000	.000	.000	.000		
	N	804	419	845	443		
MBC (NQS) (Marketing Basic Course)	Corr.	.237	.065	.467	.280	.544	.313
	Sig.	.000	.183	.000	.000	.000	.000
	N	818	417	864	439	820	435

Notes: 0: F, 1: E, 2: D, 3: C, 4: B, 5: A,

Table 4. Correlation 2nd and 3rd semester

		HSGPAME (QS)		ME(QS)		CAB(MQS)	
		2017-19	2020	2017-19	2020	2017-19	2020
		ICE	THE	ICE	THE	ICE	THE
ME (QS) (Micro Economics)	Corr.	.226	.189				
	Sig.	.000	.000				
	N	676	342				
CAB (MQS) (Cost Accounting and Budgeting)	Corr.	.217	.196	.666	.517		
	Sig.	.000	.001	.000	.000		
	N	498	265	520	274		
BS (NQS) (Business Strategy)	Corr.	.180	.114	.526	.437	.364	.483
	Sig.	.000	.053	.000	.000	.000	.000
	N	602	291	633	302	504	267

Notes: 0: F, 1: E, 2: D, 3: C, 4: B, 5: A.

Tables 3-5 document significant links between the subjects and HSGPA. In many cases, the correlation coefficient is around 0.5. The relationship between performance at NTNU Business School and HSGPA decreases when switching from ICE to THE for most subjects. But it is a mixed picture. For some subjects, the connection is quite constant (ME and CAB), while it rises for others (IFA). ME and IFA are typical quantitative subjects. The same pattern relates to the correlation between the different subjects at the business school. For some courses, there is a considerable fall in the correlation

Table 5. Correlation 4th and 5th semester

		HSGPA (MQS)		IFA(QS)		OP(NQS)	
		2017-19	2020	2017-19	2020	2017-19	2020
		ICE	THE	ICE	THE	ICE	THE
IFA (QS) (Investment and Financial Analysis)	Corr.	.204	.338				
	Sig.	.000	.000				
	N	515	186				
OP (NQS) (Organisational Psychology)	Corr.	.285	.148	.324	.241		
	Sig.	.000	.062	.000	.002		
	N	377	159	394	168		
QQM (MQS) (Quantitative and Qualitative Methods)	Corr.	.280	.177	.507	.449	.466	.356
	Sig.	.000	.024	.000	.000	.000	.000
	N	406	163	427	171	361	151

Notes: 0: F, 1: E, 2: D, 3: C, 4: B, 5: A.

coefficient (see OM and MEA, Table 3). Although there is an example where the link strengthens (for instance between BS and CAB, Table 4). However, there is no marked difference depending on whether the subjects apply a quantitative or non-quantitative approach.

Table 6. Descriptive statistics. Variables applied in the regression models

	Mean	St. Dev	Skewness	Kurtosis
QQM (Quantitative and Qualitative Methods) (0: F, 1: E, 2: D, 3: C, 4: B, 5: A)	3.95	.71	-1.43	3.38
IFA (QS) (Investment and Financial Analysis) (0: F, 1: E, 2: D, 3: C, 4: B, 5: A)	3.66	1.08	-.96	1.04
OP (Organisational Psychology) (0: F, 1: E, 2: D, 3: C, 4: B, 5: A)	2,97	.94	-.34	.11
HSGPA (upper secondary school) (1 to 6)	4.73	.31	-.11	,49
GPA 1st year: (0: F, 1: E, 2: D, 3: C, 4: B, 5: A)	3,32	.97	-.75	-.10
Theoretical Maths (Upper Secondary School)	.73	.45	-1.02	-.96
Gender (F: 0, M: 1)	.53	.50	-.14	-1.99
Age	23.50	2.10	2.42	11,38

The regression models (Tables 7- 9) show that the performance in the 4th and 5th semesters is significantly positively correlated with GPA in the first year. The value is lower for OP than for the other two subjects. When introducing THE during COVID-19, all three courses show a marked decline in standardised B with the biggest fall for IFA. The other variables generally do not have a significant impact on the result.

Table 7. Dependent variable: IFA (Investment and Financial Analysis) (QS)				
	2019(ICE)		2020(THE)	
	Standardised B	Sig.	Standardised B	Sig.
Age	-.025	.751	-.174	.043
Gender	.048	.548	-.005	.953
HSGPA	-.086	.320	.021	.821
GPA (first year)	.696	.000 ***	.465	.000 ***
Theoretical Maths (Upper Secondary School	.125	.083 *	-.048	.538
	N=108 , Adj. R^s=.463		N= 140, Adj. R^s= .272	

Notes: *** p<0.01, ** P<0.05, * p< 0.1

Table 8. Dependent variable: OP (Organisational Psychology) (NQS)				
	2019 (ICE)		2020 (THE)	
	Standardised B	Sig.	Standardised B	Sig.
Age	.025	.786	-.014	.875
Gender	-.114	.223	-.043	.610
HSGPA	.008	.940	.004	.969
GPA (first year)	.508	.000 ***	.469	.000 ***
Theoretical Maths (upper secondary School	-.120	.165	-.106	.195
	N=113 , Adj. R^s=.250		N= 133, Adj. R^s= .200	

Notes: *** p<0.01, ** P<0.05, * p< 0.1

Table 9. Dependent variable: QQM (Quantitative and Qualitative Methods) (MQS)				
	2019 (ICE)		2020 (THE)	
	Standardised B	Sig.	Standardised B	Sig.
Age	-.053	.481	-.066	.442
Gender	.073	.325	-.121	.108
HSGPA	-.032	.692	-.089	.337
GPA (first year)	.632	.000 ***	.552	.000 ***
Theoretical Maths (Upper Secondary School	.073	.306	.010	,899
	N=132 , Adj. R^s=.403		N= 142, Adj. R^s= .290	

Notes: *** p<0.01, ** P<0.05, * p< 0.1

Discussion

It is well known in the literature that HSGPA is a good predictor of success in undergraduate courses (Al Hazaa et al., 2021; Perkins, 2021; Sulphey et al., 2018). Other studies suggest the cumulative GPA is an even stronger indicator of good grades (Abdelfattah, Tatar & Düştegör, 2020). The finding in this research is in line with that. The focus of this study is to compare ICE and THE introduced during

COVID-19 in 2020. Unsurprisingly, the connection between success in the first year and the 4th and 5th semesters weakens using the regression models (Tables 7-9), but the change is not considerable. Still, the value of the coefficient B is around 0.5 and strongly significant. Even though the decline is greatest for the IFA course, the difference between the different courses is nevertheless small. The decline is about the same in the non-quantitative subject (Organisational Psychology) as in a more quantitative subject (Quantitative and Qualitative Methods).

The use of bivariate correlation coefficients provides partly the same pattern. Switching to THE during COVID-19 resulted in a notably weaker link between HSGPA and successes in the various subjects for the undergraduates in business studies. Academically skilled students from upper secondary school achieved less success in business studies. Hence, students with weaker grades from upper secondary school can perform better. The biggest drop in the relationship to HSGPA is in the non-quantitative subject Marketing Basis Course. For the quantitative subjects (Microeconomics, Managerial Economics and Accounting), the decline is minimal. For the third quantitative subject (IFA), there is, surprisingly, an increase in the value. Based on the theoretical review, it was expected to have the least impact for the non-quantitative subjects with long answer questions that require reflection and individual answers. According to the theory, THE may be a suitable exam form for these subjects. Therefore, the instructors made minimal changes in those courses when changing to THE.

For the quantitative subjects, the situation was different. The traditional design of the assignments was not suitable for THE. This was clearly demonstrated in another department at NTNU that employed unchanged multiple-choice exams when switching to THE. The result was no students failed, compared with normally 20 percent. 40 per cent achieved A against usually 20 per cent (UA, 2021b). Since all instructors were forced to apply THE in 2020, many chose to switch to pass or fail grades (Mathematics, Statistics, Macroeconomics and more). In the quantitative subjects with grades, one changed the scheme by making the exam more complicated with other types of questions and increased the workload. With a 4-hours limit, this would reduce the ability to read books, search online or collaborate with others. Students were given different assignments than they expected. Higher requirements were set for achieving a specific grade than before.

So what can explain the major impact on the non-quantitative subjects? Even with the same type of assignments, there has been a change in the ranking of the students and a weaker connection to GPA from the upper secondary school. The explanation probably lies in changes in students' behaviour. The students themselves state that COVID-19 has led to them becoming more lonely. Home-exams could also provide less motivation and poorer preparation for the exam. It can vary to what extent one could positively benefit from open book and internet access within a 4-hour exam. As Parker et al. (2021) pointed out, it can also quickly result in ineffective use of the time. This might explain why Rummer et al. (2019) report students perform better with closed-book than open-book exams by allowing half of the students to have access to books while the other half did not have this option. Other students can take advantages of THE. In line with other research, some candidates become less stressed in THE and therefore perform better compared to ICE (Mokdad & Aljunaidi, 2021).

Another important factor is if someone takes the opportunity to cheat while others are honest and follow the instructions (Hill et al., 2021; Meccawy et al., 2021). This will affect the ranking of students where the honest students can be at a disadvantage and get weaker grades. The students at NTNU Business School know that the threshold for cheating is much lower with home-based assignments (Table 2). A survey at the Mathematical Institute, NTNU suggests that 30 percent of the students admitted having cheated (collaborating with peer students, etc.). This is justified by the fact that the grade means so much for further studies and job opportunities due to the strong competition, therefore one can be tempted since there is almost no control. There is so much to gain by being dishonest. Such factors may explain why most students at NTNU Business School believe that the grading in THE is more unfair than in ICE (Table 2).

According to Roelle and Berthold (2017), the benefit of open book exams is limited with complex questions. This presupposes that there is no dishonest behaviour. Even with complicated questions,

it is possible to cheat. Others can solve the assignment for the actual candidate. There is no control. According to inspector Andrey Chesnokov NTNU, a global network of PHD candidates offers to solve and translate assignments into Norwegian for a fee (for example 60 to 100 USD) (UA, 2021).

There are many more factors that can affect the grades of THE compared to ICE. The scope may vary from subject to subject. The students might take advantage of the possibilities in different ways and in the different subjects in home-based exams. Hence, a logical consequence is less association between the performance students achieve in the different subjects in the same semesters. The findings in Tables 3-5 might confirm this assumption.

This study shows that the transition from ICE to THE will affect the performance and ranking of students. There will be less predictable results based on past performance.

The analysis here does not provide a clear answer to the extent of this nor the reasons for the differences, which can be caused by several factors. Surprisingly, there was not the difference between quantitative and non-quantitative subjects that one might expect.

Conclusion and further research

Data from a business school in Norway indicate that coronavirus has created challenges for students' learning outcomes and measurement of their knowledge and skills. There is limited access to data on changes in students' behaviour. However, the study of students' performance and grades before and during COVID-19 suggests that switching from traditional closed textbook school-based exams to home-based open-book exams and access to various aids leads to a change in the composition of students who succeed in different subjects. The achievements are less related to GPA from high school and success in other subjects at the business school. There is no clear difference between assignments with short questions with one correct answer and long answer questions. This study suggests home-based exams do not favour skilled students. This has an impact on further studies and job applications.

An idea for further research is to study how different exam forms affect the behaviour of students. This can explain more in details the findings of this article, and particularly why the switch from traditional school exam to home-based exam greatly will influence the ranking of students also in non-quantitative oriented subjects.

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