
Academic impact of sudden and unforeseen changes in the learning environment due to the COVID-19 pandemic

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Abstract: This study evaluates the impact of changes in the learning environment due to the COVID-19 restrictions at the university level in Singapore based on the grades and student evaluations of 282 students from two cohorts who in 2020 experienced in-class and online teaching consecutively and compares academic performance in both learning environments considering the existing relationship between student evaluations and teacher-student interaction. Results show differences in academic performance on the final exam between the two modes, however, these differences are not related to the student evaluation of the lecturer nor teacher-student interaction as these remained unalterable despite the transition from in-class to online learning. The conclusion is that it is possible to maintain an optimum quality of education without alterations in student evaluations nor in teacher-student interaction in both online and in-class contexts. However, it is necessary to design a course appropriate assessment strategy consistent with the specific learning environment.

Keywords: in-class learning, education online, e-learning, e-assessment, COVID-19.

Reference to this paper should be made as follows: Fernández-Castro, A.M., Sánchez-Cabrero, R., and Eiadat, Y.H. (2021) 'Academic impact of sudden and unforeseen changes in the learning environment due to the COVID-19 pandemic', *Int. J. of Innovation and Learning*, Vol. X, No. Y, ,

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1 Introduction

Restrictions on mobility and social contact as a result of the Covid-19 pandemic have had a dramatic and unprecedented effect on education (Zhao and Watterston, 2021). The closure of educational institutions in 2020 meant the suspension of activities in the most extreme cases, or a hasty adaptation of courses to a new learning environment based on the use of Internet (Burgess and Sievertsen, 2020). The World Bank (2020) estimates that during the first four months of the pandemic 180 countries closed schools and educational institutions which affected 85% of students worldwide. In its report, the World Bank points out that closing schools not only disrupts learning, but also reduces students' sense of attachment to schools, leads to greater inequality among students, worsening of malnutrition among vulnerable populations, aggravated mental health issues, and, in general, greater vulnerability. The resulting economic crisis also negatively impacts on education due to an increase in absenteeism of the most vulnerable, a decrease in the family budget dedicated to education as well as in national budgets, all of which results in a general decline in the quality of education. According to the same World Bank report (2020) the combination of these closures and the economic crisis will, in the long term, have a negative impact on education, human capital, equality and social welfare, and result in an increase in poverty in general.

Pérez and Hernández (2020) point out that once educational institutions transitioned to the new online environment during lockdown in Spain, the main problem was not lack of equipment, but the lack of training in the use of technological tools on the part of both educators as well as students. While deficiencies in the lack of equipment were resolved by educational institutions and administrations, the deficiencies in terms of training and digital competence were not, thus contributing to increasing inequality. Along these same lines Alharthi (2020) notes that the majority of those who experienced learning online, including those in higher education, consider that receiving specific training about the use of the technology involved in this context is fundamental, and yet this was not possible during lockdown (Sánchez Cabrero et al. 2019). Some even refer to a paradigm shift in the field of education since the outbreak beyond the changes we have already experienced based on a combination of ICT and neuroeducation, far beyond immediate and short-term adjustments (Espino-Díaz et al., 2021).

Bączek et al. (2021) have studied the effects of the sudden and unexpected changes in learning (from in-class to online) during lockdown. Based on the responses from 804 students to the questionnaire the researchers conclude that students perceive both environments as equally valid in terms of facilitating learning and that 73% consider the online context equally as satisfactory as attending in class. Nonetheless, a comparative analysis of in-class and online environments had already been amply studied even before the pandemic. After analysing data from 2,196 students about their experience and preferences regarding in-class vs online learning, Paechtr and Maier (2010) highlight the following key advantages of online learning: clarity and coherence of course materials, self-regulated learning, and the distribution of information, while key positive aspects of in-class learning are communication and interpersonal relationships. Alonso and Blázquez (2009) analyse the function of educators in online and in-class environments based on the study of four aspects (theoretical content, practical content, teacher-student interaction, and the design of learning activities) and conclude that there are no discernibly significant differences specific to the environment in which learning takes place. Johnson et al. (2000) carries out a comparative study of the same course taught both in-class and online. In this case, three aspects of the teaching-learning process, among others, are examined: learning outcomes, student evaluations of teachers, and teacher-student interaction. This study finds a slightly more favourable perception of learning in a classroom setting which could be explained by a greater sense of feeling close to the teacher. Learning outcomes were very similar in both contexts. The results indicate that there is a more positive perception of teacher-student interaction in the in-class environment. Along these same lines, Paul and Jefferson (2019) analyse grades from 548 students studying the same subject over eight consecutive years in both in-class (401) and online (147) environments and conclude that there are no appreciable significant differences between student grades, a finding which coincides with the study presented by Toyne et al. (2019).

University College London (2020) provides guidelines for designing effective assessment strategies for online learning during Covid-19. When no final exam is required, a variety of assessment methods are suggested including portfolios, learning journals, collaborative learning activities, and interviews. For subjects in which assessment is based on exams proposed assessment strategies include multiple choice tests, in-tray exercises, virtual OSCE (objective structured clinical examination) for the health sciences, essays, and open-book exams as alternative summative and formative forms of assessment. Myrsky and Joutsenvirta (2015) compare open-book exams and traditional exams analysing their preparation, how exams are conducted and learning outcomes. Based on feedback from 110 Finnish students who responded to a survey designed ad hoc they conclude that the time spent planning and preparing is similar in both types of exams from the point of view of the teacher, although for half the students taking the exam and the learning process involved in the case of open-book exams proved to be more time-consuming.

Bengtsson (2019) proposes that the best assessment method at the level of higher education is an online exam because it facilitates constructive learning, allows for reflection and the development of higher-order cognitive skills and, at the same time, turns the evaluation process into a learning process. Bengtsson maintains that these types of exams are not recommended for lower levels due to the evident risk of unethical conduct on the part of students.

Gaytan (2005) studies the elements necessary to ensure effective assessment in an online environment and points to the need for these to take into account various aspects such as technological requirements, teaching style, pedagogical focus and learning outcomes. Gaytan and McEwen (2007) went on to study online assessment strategies and effective techniques. Their work is based on feedback from two surveys sent to 85 teachers and 1,963 students in the USA participating in online classes from whom they obtained 361 responses (29 from instructors and 332 from students). The teachers' survey asked about their perception of whether or not the quality of education was affected by the online context and the effectiveness of their assessment strategies given this environment. The one sent to students was intended to measure their perception of the effectiveness of Internet as a learning environment and which assessment strategies were considered to be the most effective. After analysing the results, the authors conclude that assessment strategies should be based on a wide variety of tasks carried out on a regular basis for which the instructor can provide meaningful feedback. They maintain that effective techniques include projects, portfolios, self-assessment and co-evaluation, weekly tasks and immediate feedback. For Deeley (2018) summative assessment can support the learning process hand in hand with the appropriate technology. This transformation from "assessing" learning to using these tools to "promote" learning should be carried out in environments where there is mutual trust between teachers and students, where both feel comfortable and close. Creating this environment is a gradual process that requires flexibility.

Whenever context allows students' preference over online vs. in-class evaluation should be taken into account (Hewson, 2012). The author examines whether or not this preference conditions the results obtained. She analyses two consecutive cohorts of 33 and 41 students respectively who took the same course with the same instructors. All the students took the same exam but students from cohort 1 were given an in-class exam and those in cohort 2 took the exam online. They found that preferences do not affect the final results, but this does not mean that any reticence towards online exams should be disregarded, especially in the case of students in the social sciences and humanities. During the COVID-19 pandemic a greater disposition towards online assessment could be expected given the priorities and concerns of students regarding personal safety during this period, but this was not considered at the time this study was carried out. Fuller et al. (2020) and Sánchez-Cabrero et al. (2021) propose that the current context provides a key opportunity to expand and improve traditional assessment methods. The recent study by Sánchez-Cabrero et al. (2021) shows how "online evaluation, when proctored, provides the same guarantees as desktop exams, with the added bonus of certain advantages which strongly support their continued use, especially in degrees with many students who may come from many different locations" (p. 1). However, the authors also find that the learning environment (in-class/online) affects how exams are designed which, in turn, affects their level of difficulty. The study reveals that teachers' lack of experience designing online exams resulted in less difficult exams which led to higher marks, although grade distribution for each level remained unaltered, thereby allowing for the conclusion that there are no real differences in terms of assessment strategies, but that fears and expectations on the part

of the teaching staff can affect the final outcome since compensatory measures may be included which can alter findings.

Given this scenario and the unfortunate circumstances brought on by this worldwide pandemic this study proposes taking this unique opportunity to analyse the impact of the transition from one learning environment to another in a university course in Singapore in 2020 due to the restrictions on mobility and social contact imposed by the Covid-19 pandemic. The study is designed with two main objectives in mind. First (1) to compare academic performance of the last cohort to receive all instruction in-class with the first cohort in which instruction was completely online taking into account not only the final global assessment, but also the different components that make up this assessment. Secondly, (2) this study sets out to analyse if the change in learning environment has an effect on student evaluations of the teacher and teacher-student interaction and if any of these factors influence academic performance.

Both research objectives refer to the purely quantitative results of the assessment process despite the fact that academic performance in the learning environment should not be limited to grades but should also include aspects such as motivation, acquired skills, confidence, and attitude (Barrientos et al., 2019). However, this self-imposed limitation allows us to engage in objective comparisons between the two situations and make statistical decisions that reveal existing differences from a quantitative point of view. Moreover, the data were drawn from the standard student evaluation survey designed by the university which only reflects academic results. Given the exceptional situation at the time it was not possible to broaden the scope of our research.

The research design for the study is explained in the following Method section. Next, the results obtained are presented with respect to the two research objectives previously defined in strict order of appearance. This is followed by the Discussion explaining the findings and comparing these to the findings of other similar studies. Finally, the Conclusions section analyses the contributions of this study to the academic field.

2 Method

Participants

Taking the university population of Singapore as a reference point a cluster sampling was used to carry out this research. The sample consists of 282 undergraduate university students in two different cohorts of 125 and 157 respectively ranging in age from 18 to 21. All the participants were enrolled in the same module in both cohorts, and they have completed the university's standard evaluation form. Both cohorts are characterised by a high level of cultural diversity and there are no detectable significant differences in terms of gender. The specific distribution of male and female participants and ages are not known because of data protection restrictions imposed by the university in order to guarantee student anonymity. However, equitable and random distribution in terms of gender and the limited age range (18-21) guarantees that these variables are controlled and do not interfere with the final results.

Singapore's educational system provides the framework for the instruction given and which is the subject of this analysis although the degree offered is recognised as part of The European Higher Education Area. The degree (180 ECTS) offered is a branch of the social sciences. The programme is divided into semesters allowing students to begin the course at two different times of the academic year which means that there are two cohorts during each natural year.

Instruction in the case of the first cohort (125 students) was in-class, while for the second cohort (157 students) instruction was online which replaced in-class learning with synchronous online sessions. Figure 1 shows final grades and continuous assessment components for all 282 students, while the analysis of the teacher and student-teacher interaction is based on feedback from 114 survey responses.

The research was conducted at the beginning of the lockdown in Singapore, and students were enthusiastic about and supportive of the new learning environment. It's possible that if the study had taken place later, after a longer period of confinement under lockdown, their attitude and response to the new methodology might have changed by then which could have impacted the final outcome.

Figure 1. Sample distribution according to participation in the different assessment components

Instruments used to obtain data and variables to be analysed

The main variables studied are described below:

1. Learning environment: This is the main variable in this study. Nominal value at two levels: in-class learning environment and online learning environment. This consists of two cohorts attending the same course during the same academic year.
2. Academic performance: A continuous quantitative variable consisting of student grades for each of the assessment components: Course Project, Final Exam and Final Overall Grade.
3. Student evaluations: The analysis of student evaluations is based on students' responses to official questionnaires including nine items on the 5-Point Likert Scale.
4. Teacher-student interaction: Analysis of teacher-student interaction is based on student's response to three items on the 5-point Likert Scale.

Two assessment instruments are used. On the one hand, to evaluate academic performance students' final grades are analysed as well as the grades achieved for each of the components that make up the Final Overall Grade (project work and a final written exam online). On the other, to evaluate the teacher's performance and teacher-student interaction the results from official student evaluations completed by students using a 5-point Likert scale are examined.

The data were collected from the standard evaluation survey previously designed by the university, so students did not know that they were part of any specific research, and consequently no Hawthorne effects were expected. Standard university protocol was always used both in the case of assessment via final exam as well as student evaluation surveys. This process requires students to evaluate student-teacher interaction before final assessment so that this is not a factor that can affect their final assessment. These standard procedures ensure objectivity, and that the university complies with the student confidentiality and anonymity requirements established by law.

Design and Procedures

The proposed study has an *ex post facto* design and is descriptive given that it is based on data on the different grades students have received and their feedback from the questionnaires. This study is correlational as it analyses the correlation among variables such as students' grades and their evaluations of the teacher, and longitudinal as it examines two consecutive cohorts taking the same course. At the same time, the analysis is also multivariate as it considers cohorts, grades and evaluations.

A correlational analysis of grade distribution in the two cohorts is carried out using Spearman's Rho as the test statistic and applying inferential statistics using the independent-samples t-test and the Student's t-test as test statistic. The relevant data for both cohorts and all the grades were statistically analysed using SPSS statistical software (version 24). Likewise, the results obtained from student evaluations of teaching from the two different cohorts will also be compared. To analyse teacher-student interaction student evaluations completed by the second cohort on the three aspects of the new online environment are revised and compiled.

3 Results

With regard to the comparative evaluation of the data on academic performance, Table 1 shows the results of the descriptive analysis of both cohorts using Arithmetic Mean and Standard Deviation. Students in the in-class cohort (N=125) received instruction in-class during the first semester, while the online cohort (N=157) received instruction online throughout the second semester of the academic year. The university uses a letter grade scale in which D is the minimum passing grade and A+ is the highest. The Mark to Grade conversion scale converts grades on a scale from 0-12 (from 0=fail to 12 = A+). The

final grade is based on the grade obtained for a completed project (40%) and the final written exam (60%).

Table 1: Descriptive Statistics

In table 1 we can clearly observe that there are significant differences between both groups in terms of the Final Exam Grade and Final Overall Grade, while there are considerably fewer differences in terms of Project Grades. The visual analysis of the results shown in Figure 2 may help explain these differences.

Figure 2: Final Grade Distribution

In Figure 2 we can see the percentage of failing grades in both cases (less than 2%). However, the distribution of passing grades shows a greater concentration of lower grades (between D- and C+) for cohort 2 (57%) which is online and higher grades (between B- and A-) for cohort 1 (77%) in which case learning takes place in-class. Grade distribution for cohort 2 (online) is very similar to the grade distribution of all the courses in the department and shows a more normalised distribution than cohort 1 (in-class).

Figures 3 and 4 show the grade distribution for the two components that make up the Final Overall Grade.

Figure 3: Distribution of Project Grades

The graph in Figure 3 shows that in the case of the Project, grade distribution for both cohorts is very similar.

Figure 4: Grade Distribution for Final Exam

In terms of the distribution of Final Exam Grades we can see there are important differences between the two cohorts. For online cohort 2 the percentage of failures is much higher while for in-class cohort 1 there is a greater number of high grades (between B- and A-).

The visual analysis of the results seems to indicate that the difference between the two cohorts could be due to the differences in the distribution of Final Exam grades as we can see in Figure 4 so that an analysis using inferential statistics seems pertinent in order to determine if the differences between the two groups are significant.

First, in order to evaluate if the differences between the two cohorts are significant the independent-samples t-test is employed using the student's T-test as the contrast statistic. The results obtained are shown in Table 2.

Table 2. Independent samples t-test

Table 2 shows that when we look at Final Exam and Final Overall grades the differences are statistically significant, but there are no significant differences in the case of Project grades. Keeping in mind that the Final Overall Grade is based on both grades we can conclude that it is the Final Exam Grade that generates the differences between the two groups.

Finally, the correlations between the different grades are analysed in order to examine the existing covariance among the grades using Spearman's Rho as the contrast statistic which allows for the inclusion of ordinal variables. In this way the comparison may also include the cohort variable converted into an ordinal scale as we can see in Table 3.

Table 3: Spearman's rank-order correlation

The analysis of the correlations in Table 3 indicates that all the correlations between the grades are significant which shows a high intrasubject coherence (that is, grades depend greatly on the effort and

talent of the individual student which is desirable). Nonetheless, it is possible to observe that, as occurs with the comparison of means, the strongest association is between Final Overall Grades and Final Exam Grades and the only non-significant association is that between the Cohort and Final Project Grade.

Eighty-four out of 125 students from in-class cohort 1 responded to the questionnaire and 30 out of 157 students from online Cohort 2 responded. Table 4 shows the mean values of the responses on a 5-point Likert scale for each cohort for the 9 items:

Table 4: Results of Student Evaluation Questionnaire

Table 4 shows there are very few differences between cohorts in the case of student evaluations of the instructor; consequently, we can conclude that the shift in the learning environment was not a factor that affected this variable and that the differences in academic performance between the cohorts were not likely due to any differences as far as the teacher's performance is concerned. Below, figure 5 visually shows these results providing more information on which to base our final conclusions:

Figure 5: Means of Course Evaluations

As in Table 4, Figure 5 shows a high consistency in student evaluations of the teacher's performance which reinforces the impression that the differences between cohorts are not due to any differences as far as teaching is concerned. Unfortunately, as this questionnaire is external to this study, it is not possible to determine if there is a significant difference with inferential statistics which would have helped to determine the statistical significance of these impressions.

The information from teacher-student evaluations completed by students taking the course online is also used to evaluate teacher-student interaction. Compared to the teacher-student evaluations of students who attended the course in-class, there are three additional questions related to the learning environment. A total of 30 out of 157 students from online cohort two responded. Table 5 shows the mean value of the responses on the 5-point Linkert scale:

Table 5: Results of Teacher-Student Evaluations

In Table 5 we can see that the results from the students' questionnaire on teacher-student interaction in the online environment indicate that the differences in academic performance between the two cohorts are also not related to this issue since the evaluations are equally as positive as the evaluations of the teacher. In fact, they are slightly higher so that we can conclude that the learning environment was not a factor that affected this variable. Figure 6 below visually shows these results, integrating the results of the three questions about the learning environment with the general questionnaire providing more information on which to base our final conclusions:

Figure 6: Mean Values of General Questions and Questions about the Online Environment

As occurs in Table 5, Figure 6 shows a high consistency in student evaluations of teacher-student interaction within the online learning environment on the part of students which reinforces the impression that the differences between the cohorts are not the result of a different approach to teacher-student interaction. Unfortunately, as this questionnaire is external to this study it is not possible to determine if there is a significant difference through the use of inferential statistics which would have helped to determine the statistical difference between the impressions.

4 Discussion

With respect to the first objective of this research which focuses on the comparison of academic performance of the last cohort to receive all instruction in-class and the first cohort to receive all

instruction completely online taking into account not only the final overall grade, but also the different assessment components on which this is based, the data shows a greater concentration of high grades in the case of the first cohort despite the fact that the success rate is around 98% for both cohorts. Using the grade distribution for all the modules offered by the same department as the reference point we find that in this case grade distribution deviates from the expected normal distribution. It is reasonable to assume there is a certain anomaly with regards to the distribution of these grades. After considering different factors that could explain this difference, everything points to the exceptionality of the final exam which can be interpreted as an indication that this component was inadequately adapted to the learning environment. As previously noted, instruction in this course was carried out in-class although a national lockdown was instituted shortly before the examination date so that the final exam could not take place in the classroom.

Given the protocols in place at the university regarding final exams (exams must be approved by the department and an external examiner from another university) there was not enough time to redesign and revise all the final exams for all the courses in all the degree programmes in order to adapt these to the online environment. Faced with this situation, the faculty decided to maintain the exams designed for in-class assessment despite the transition to the online environment and focus all efforts on guaranteeing that all students would be able to take the exams from their homes. In the second semester, both instructions as well as assessment activities were designed for the online environment. The faculty informed students of this decision well in advance indicating that this decision was final, regardless of the confinement stage in effect at the time the exam was scheduled. In this case, students took an open-book exam where students were allowed to access as many sources of information as they had at their disposal. Given the nature of this type of exam students were given 5 hours to complete the exam instead of the usual two hours allowed for in-class exams which is in line with proposals by Myyry and Joutsenvirta (2015).

To confirm if the anomalous academic results from in-class cohort 1 were due to the final exam taken, all we need to do is look at the grade distribution obtained in each cohort for each of the components: the Project Grade (Figure 3) and the Final Exam Grade (Figure 4). The significant similarity in the distribution of the Project Grades evidences that the origin of the deviation is, in fact, the Final Exam. The similarity in the distribution of Project grades confirms the statistical analysis presented in Table 2. Using the t-test for equality of means demonstrates that the two means are indeed equal (here significance = 0.905), but this is not true for the Final Exam and Final Overall grade (significance = 0).

The relatively high percentage of students who do not pass the Final Exam in the second cohort is consistent with results on record for this exam. The reason is that students already know the Project grades by the time the Final Exam is scheduled and given that these are usually high, some students tend to adapt the amount of effort spent preparing for the final exam to ensure a final passing grade (university regulations do not allow establishing minimum grades for the different assessment components that make up the final grade). As shown in Table 3 the result is a relatively low correlation between Project Grades and Final Exam grades (0.209) which is much lower than the existing correlation between Final Overall Grades and Final Exam Grades (0.930), but also considerably lower than between Final Overall Grades and Project grades.

Keeping in mind the parity between success rates in the two cohorts and the anomaly in terms of the final grade explained above, the results obtained are coherent with the conclusions by Johnson et al. (2000), Paul and Jefferson (2019) and Toyne et al. (2019), who found no significant differences between student grades in online and in-class learning environments. However, there were significant differences in terms of final exam grades but as Sánchez-Cabrero et al. (2021) found, these differences in academic performance are attributable to final exam design and teacher expectations about assessment due to the special circumstances, and may have affected the final outcome (different duration of time allowed for the exam, not adapting the type of exam to the specific learning environment, compensatory measures given the special circumstances under which assessment took place).

The second objective of this research is to assess if the shift in learning environment has an effect on students' evaluations of teaching and student-teacher interaction and whether or not these factors have an impact on academic performance. As far as this point is concerned the first thing that draws our attention is the survey response rate. In in-class Cohort 1 this was 67% (84 out of 125), while for online cohort 2 this was only 19% (30 out of 157). However, there is a simple explanation. In the in-class learning

environment questionnaires are completed during the penultimate session (teacher not present), consequently all the students in class at the time complete the questionnaire. This is not an option in the online environment.

The data obtained on both cohorts was very similar (Figure 5) and clearly show that the students' perception about the quality of the course and the teacher barely varied. For two of the questions the average rating was the same; for 6 questions the difference between the two cohorts was just 0.1; and for one question the difference was 0.2. The average rating was the same (4.0). These values indicate that the students did not perceive a decline in quality in the new learning environment.

When comparing these results with those obtained by Johnson et al. (2000) we can appreciate a subtle difference since they found a slightly more favourable perception of the teacher in the in-class environment. In our case, the evaluation of the teacher is the same in both learning environments which implies an increase in the evaluation of the teacher in the online learning environment compared to what could be expected based on the above research. The exceptional context in effect (a lockdown due to the pandemic) in which the teaching-learning process takes place in cohort 2 could serve as an explanation for this since students were positively predisposed towards the new learning environment from the beginning. Students showed a high degree of empathy and accepted the proposed transition as the best alternative which is consistent with the conclusions drawn by Bączek et al. (2021).

The information obtained from the students' survey on teacher-student interaction in the online environment is not especially relevant given the small size of the sample as it includes only three questions. Despite this, the results obtained (an average rating of 4.1) are consistent with those for the rest of the questionnaire (an average of 4.0). This means that the three aspects analysed in the new online environment were evaluated in a similar way as the other items included in the questionnaire (Figure 6) so the overall rating in each case is not significantly altered, which is consistent with the conclusions drawn by Alonso and Blázquez (2009).

Given the limited nature of the data provided by the feedback on the questions posed in the questionnaire regarding teacher-student interaction in the new learning environment, it could be useful to obtain more information through further research at the institutional level. In contrast to previously published data, in this case the information is not drawn directly from the students in the course in question. Here the information is drawn from a study carried out by the educational institution at the end of the first semester in which the course was offered online in order to improve the quality of the learning experience in which both students as well as instructors participate. This study finds an excessive use of emails to answer questions or address concerns on the part of students as opposed to participation in online tutoring sessions which were scarcely used. Students stated that it was important to them that the lecturer clearly defined the means of communication to be used in the course showing no preference for either email or the use of the Virtual Classroom. Likewise, students rated the use of the poll feature -a tool available through the Virtual Classroom- during class time positively as this promoted participation and helped avoid distractions. Teachers responded along the same lines and pointed out that there was a high participation in the online chat sessions (so much so that these sometimes became unmanageable) in contrast to low oral participation. The information presented in this initial study can be useful in designing more effective teaching and learning processes in the online environment as well as in developing future lines of research.

5 Conclusions

The shift to online learning brought about by the COVID-19 pandemic did not have a significant impact on the academic performance in the case presented, although the distortion in academic performance observed in Final Exam Grades for in-class cohort 1 demonstrates the importance of adapting all the elements in the teaching-learning process to the environment in which it takes place, including assessment instruments and strategies. The quality of the learning experience, as measured by student evaluations of the instructor and the course based on feedback from questionnaires, was not affected by the transition online, nor was teacher-student interaction perceived to be more negative in the

virtual context in comparison to in-class contexts. Still, it is important to note the variety of means of communication offered by the online environment (email, messages, chats, forums, tutoring sessions via video) and the simultaneous availability of several options may generate confusion among students and alienate them from the process.

As discussed in the Introduction this study is limited to a particular case: a single course offered within a specific academic and social context. The aim of the research was to provide insight into the issue without seeking generalisable conclusions for all cases in every educational setting. Moreover, this study attempts to establish a point of departure for further research in order to obtain contrastable data on which to base generalisable conclusions. This study is incidental and not all possible methodological variations between environments are included or under this author's control. No demographic information regarding age or gender is available, and the means at our disposal compiled from students' responses does not allow for relevant inferential statistical analysis.

As a result of these limitations at some point in the future the study could be extended to include more variables pertaining to each environment deliberately selecting and controlling these from the onset.

It may be of interest to extend the research by incorporating the results of future cohorts taking the original course online and analysing the extent to which the initial transition from in-class to online learning affects the teaching-learning process upon the return to classroom sessions. In the same way, the analysis of results in other courses within the same degree programme could further support and reinforce the conclusions obtained in this study.

As a final conclusion it is worth noting that our findings contribute to the comparative analysis of online and classroom-based assessment from both a theoretical and practical perspective. On the one hand, in terms of theory the study confirms that the same level of learning and development of competences can be achieved in both online and in-class contexts. This also holds true in terms of the quality of student-teacher interaction. On the other, from a practical standpoint the findings highlight the fact that adapting assessment strategies to the environment in which learning takes place is the key to avoiding variations in outcomes. The main risk as far as assessment is concerned is not contingent on the learning environment itself, but on the decisions taken by teachers which may lead to biased results due to underlying expectations and concerns regarding different assessment strategies.

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7 Tables, figure captions and figures

Figure 1. Sample distribution according to participation in the different assessment components

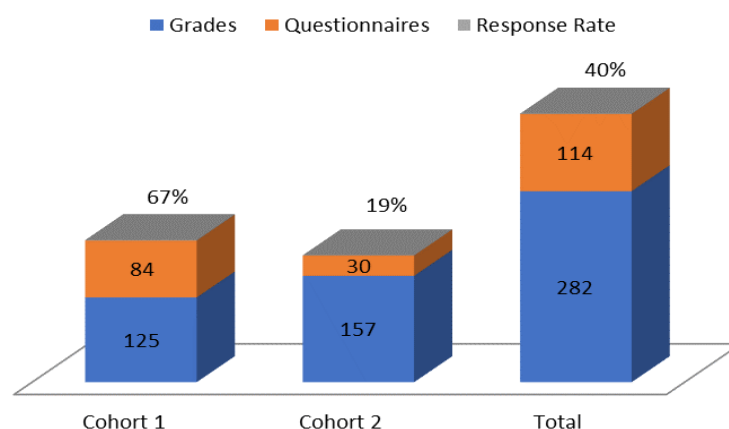
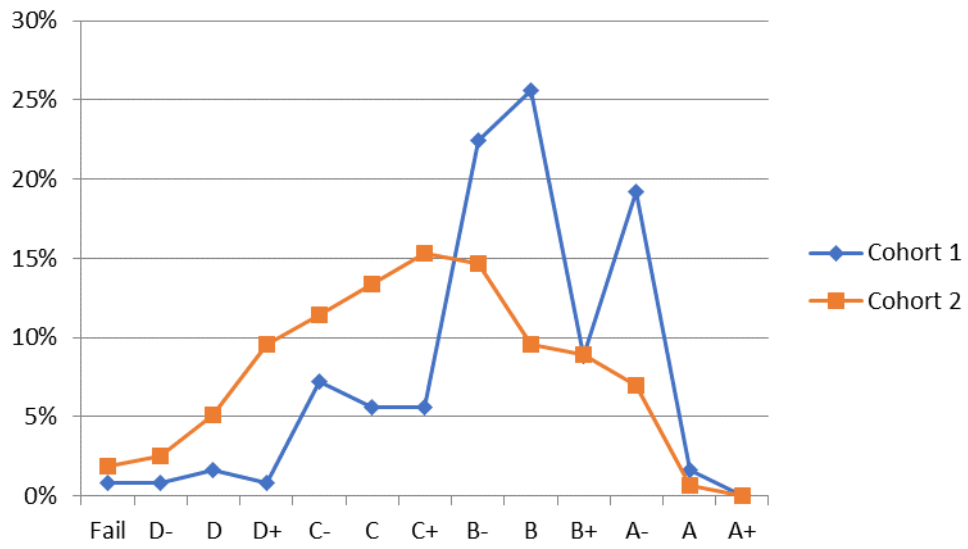


Table 1: Descriptive Statistics

	Cohort	N	Mean	St. Dev.
Project Grade	In-class	125	8.50	2.395
	Online	157	8.53	2.171
Final Exam Grade	In-class	125	6.82	2.821
	Online	157	4.13	3.061
Final Overall Grade	In-class	125	7.47	2.131
	Online	157	5.82	2.492

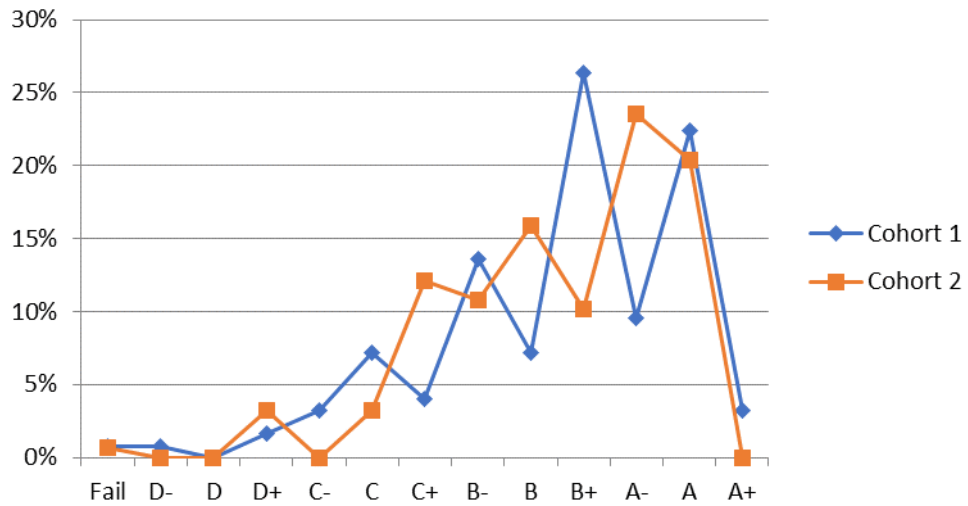
Source: Prepared by the Author

Figure 2: Final Grade Distribution



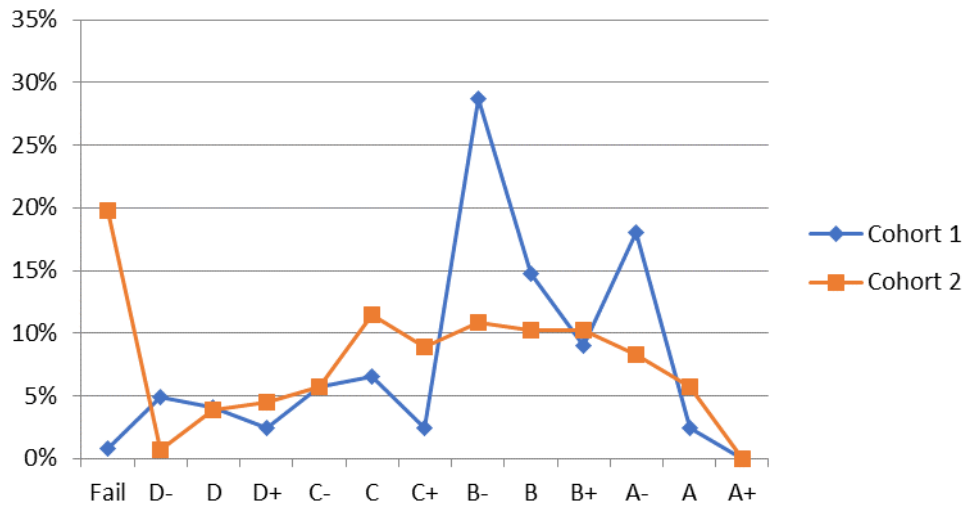
Source: Prepared by the Author

Figure 3: Distribution of Project Grades



Source: Prepared by the Author

Figure 4: Grade Distribution for Final Exam



Source: Prepared by the author

Table 2. Independent samples t-test

Variable	<i>t</i>	Level of Significance
Project Grade	-0.120	0.905
Final Exam Grade	7.656	0.000
Final Overall Grade	5.991	0.000

Source: Prepared by the Author

Table 3: Spearman's rank-order correlation

		Project Grade	Final Ex. Grade	Fin. Overall. Grade	Cohort
Project Gr.	Correl. Coef.	1	0.209**	0.504**	-0.007
	Sig. (bilateral)	.	0	0	0.902
	N	282	282	282	282
Fin. Ex. Gr.	Correl. Coef.	0.209**	1	0.930**	-0.424**
	Sig. (bilateral)	0	.	0	0
	N	282	282	282	282
Fin. Overall Gr.	Correl. Coef.	0.504**	0.930**	1	-0.344**
	Sig. (bilateral)	0	0	.	0
	N	282	282	282	282
Cohort	Correl. Coef.	-0.007	-0.424**	-0.344**	1

	Sig. (bilateral)	0.902	0	0	.
	N	282	282	282	282

**Significant correlation at the 0.01 level (bilateral).

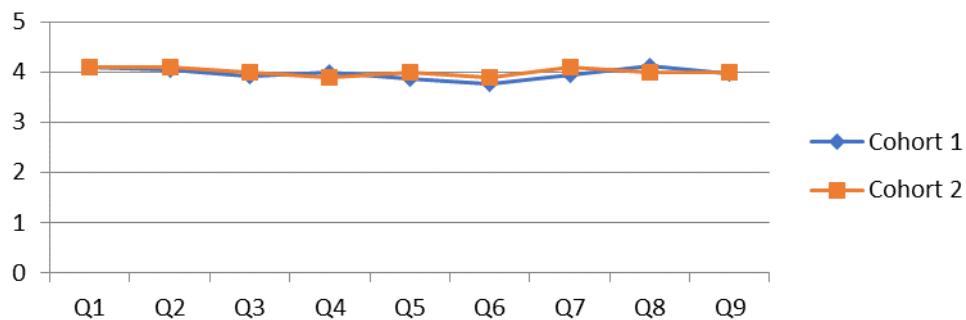
Source: Prepared by the Author

Table 4: Results of Student Evaluation Questionnaire

Question	Cohort 1	Cohort2
1. The course guide clearly establishes the objectives, learning outcomes and content of the module.	4.1	4.1
2. The requirements for the Project and grading criteria were clearly explained.	4.0	4.1
3. The project increased my interest in the course.	3.9	4.0
4. I understood the level of work expected in this course.	4.0	3.9
5. The lecturer stimulated my interest in the course.	3.9	4.0
6. The teaching methods used made the course more interesting.	3.8	3.9
7. Classes were well-organised.	3.9	4.1
8. The teacher encouraged participation through debates and other exercises.	4.1	4.0
9. The course content was intellectually challenging.	4.0	4.0
Mean	4.0	4.0

Source: Prepared by the Author

Figure 5: Means of Course Evaluations



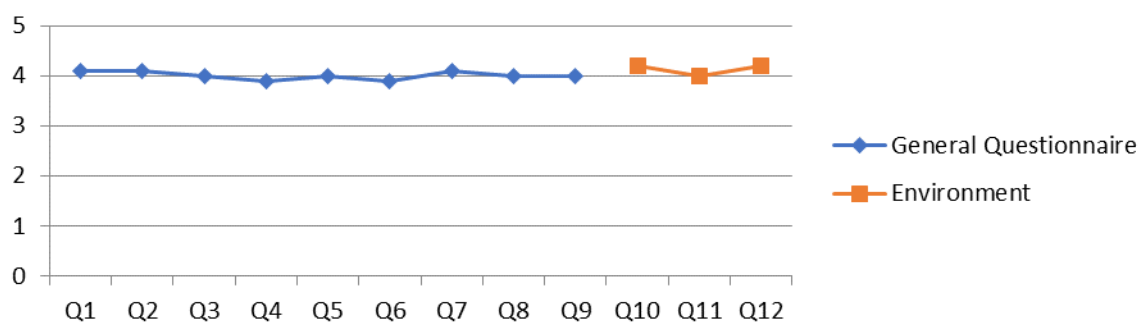
Source: Prepared by the Author

Table 5: Results of Teacher-Student Evaluations

Question	Cohort 2
10. The course guide provides clear instructions on how to access classes online via Virtual Classroom.	4.2
11. Online classes helped facilitate my learning.	4.0
12. The use of the Virtual Classroom was simple.	4.2
Mean	4.1

Source: Prepared by the Author

Figure 6: Mean Values of General Questions and Questions about the Online Environment



Source: Prepared by the Author