Article

COVID-19 Impact: A Case Study at the School of Agricultural Engineering and Environment of the Universitat Politècnica de València

Gabriela Clemente [†], Alberto Garcia-Prats [†] [iD], Purificación Lisón *,[†] [iD], Constanza Rubio [†] [iD], Santiago Vidal-Puig [iD], Beatriz Ricarte, Vicente Estruch-Guitart, Loreto Fenollosa, Juan Manzano, Francisco Rovira-Más [iD], Maria Vargas [iD] and Alberto San Bautista

Escuela Técnica Superior de Ingeniería Agronómica y del Medio Natural (ETSIAMN),
Universitat Politècnica de València (UPV), Camino de Vera s/n, 46022 Valencia, Spain
* Correspondence: plison@ibmcp.upv.es
† These authors contributed equally to this work.

Abstract: To study the first impact of the COVID-19 crisis on the results obtained by students belonging to the School of Agricultural Engineering and Environment at the Universitat Politècnica de València (Spain), the average of the marks corresponding to three academic years (2016–2019) was compared to those obtained in 2019–2020 for a total of four bachelor's degrees and two semesters. Our results suggest a positive effect on the marks obtained during the activation of emergency remote teaching during the spring semester of 2019–2020 in three out of the four degrees, with these differences being significant for the whole study. Moreover, just at the end of that period, instructors and students were surveyed regarding teaching methodologies, evaluation modalities, and difficulties found throughout the process of adapting to distance teaching. Our results allow us to sensibly think about that exceptional situation in order to propose a set of counterweighting measures which could improve the implementation of distance learning in engineering colleges.

Keywords: higher education; distance learning; COVID-19

1. Introduction

To control the spread of the COVID-19 epidemic, a state of alarm was declared in Spain from 14 March to 21 June 2020. During this period, people were confined to their homes and only essential activities were allowed in person. Similar measures were rolled out in many other countries at the same time. In this work, we aim to study the first impact of the COVID-19 crisis on the results obtained by the School of Agricultural Engineering and Environment students at the Universitat Politècnica de València (Spain). Moreover, instructors and students were surveyed on teaching methodologies and evaluation modalities to compile their preferences just at the end of that period, corresponding to the 2019–2020 spring semester.

At that time, educational institutions were temporarily closed by most governments [1]. The traditional face-to-face (hereinafter FtoF) courses offered by universities all over the world all at once had to migrate somehow onto an online (hereinafter OL) version using whichever technology that faculty were familiar with at the time [2]. Preserving educational continuity while maintaining a high level of quality has proven to be a significant issue [3]. Universities had to pass from FtoF to OL education and they were not prepared for such a sudden change at the beginning of the pandemic [4]. In this sense, some authors have pointed out the necessity of distinguishing between learning activities planned and designed to take place online from the start, and the temporary transfer of the type of instructional delivery due to circumstances imposed by COVID-19, dubbed emergency remote teaching (hereinafter ERT) [5].

Teaching requires a certain pedagogical content knowledge as a general rule [6], i.e., the integration of the subject matter knowledge contents with the pedagogical knowledge teaching methodologies and strategies for the purposes of adapting the learning process to the students' interest and ability. According to Rapanta et al. [7], OL teaching would require a specific pedagogical content knowledge different from that of the FtoF, due to the irruption of a new component, information and communication technologies [8], which represented a huge challenge for the higher education community that had almost shifted to ERT overnight. In fact, the concept of "technological pedagogical content knowledge" (known as TPaCK), which comprises different elements including the technological content knowledge, has emerged because of the continued development of innovative technologies and their increased integration in educational practices, gaining importance during the COVID-19 epidemic. Beyond the technical barriers and occasional work overload which faculty had to face (the need to learn new software, transform teaching resources to be used online, balance their new family life and work in the same space, etc.), ERT had a profound impact on the emotional well-being of teachers. In a recent university survey conducted in Italy, Casacchia et al. [9] reported physiological difficulties, such as the discomfort of speaking in the void or the absence of eye contact, which ended up expressing themselves in the form of different emotional disorders, such as depressive symptoms, difficulty concentrating or a loss of energy. Odriozola-González et al. [10] reported anxiety, depression and stress in another university survey on the lockdown period conducted in Spain, those effects being even greater in students than in faculty and staff.

Specific barriers have been profusely described when comparing OL teaching to FtoF instruction delivery. Roddy et al. [8] mark out perceived isolation, work and family commitments, confusion with contents, poor academic performance, technical issues, or lack of motivation as the main barriers. The COVID-19 pandemic lockdown forced both students and faculty to work and learn from home when their broadband connectivity quality, access to appropriate equipment (PC, laptop, etc.), digital literacy skills or home study environment was not adequate for such purposes [11]. As regards the broadband connectivity, in a study carried out in Ireland, Cullinan et al. [11] pointed out that almost 17% of higher education students suffered from poor broadband coverage during spring 2020, with significant differences linked to geographical issues and their socioeconomic level.

Some studies have pointed to a poor performance of OL students compared to their FtoF peers. In an extensive survey carried out at a university in the Southwestern United States, McPartlan et al. [12] used the Eccles expectancy-value theory of motivation [13] to demonstrate that differences in the motivation, behavior, and performance of OL students could be explained by using not only demographic variables (age, race, gender, and socioeconomic status) but also other student needs, such as flexibility, cost, or family and employment obligations. However, those differences were not based on ERT but on a free choice and might not be adequate when ERT is applied. In this regard, Patricia Aguilera-Hermida [14] conducted an exploratory questionnaire collected from 270 students at a public university on the East Coast of the United States with the aim of assessing the acceptance of ERT during the stay-at-home order, concluding that students preferred FtoF instructional delivery, although attitude towards the learning delivery method, motivation, self-efficacy and cognitive engagement were key factors. On a positive note, the study confirmed that students used more online educational tools after ERT than before. Regarding the outcomes, contradictory results can be found when comparing FtoF to ERT. Gonzalez et al. [15] conducted research into student performance, comparing the spring semester of 2020 with the outcomes of previous academic years using three subjects from two different program degrees involving 458 students at a public university in Spain, in which they found a significant positive effect on grades. However, Talsma et al. [16] compared self-efficacy beliefs (how 85 Australian students thought ERT would impact their performance in one subject) to both subject grades at the end of the ERT semester 2020 and to grades of the same group in 2019, concluding that no significant differences

existed. It seems that many factors have influenced students' performance (subject, group, socio-economic characteristics, etc.), thus it is important to study each context separately.

During the ERT period, faculty drew upon different learning solutions and innovations for the instruction delivery without a coordinated design plan. Methods of emergency remote teaching differed from college to college, leading to students having varying perceptions of the process and effectiveness of learning [17]. Synchronous/asynchronous online learning or a combination of them (blended learning) along with a wide variety of teaching (projects, case studies, online office hours, etc.) and evaluation (open response exam, multiple choice exam, tasks, etc.) techniques were employed by faculty and the preferences of students and faculty are an issue which deserves attention.

To date, many studies have reported the effect of COVID-19 on academia and students, seeking potential measures which may help alleviate the negative impact of the crisis on higher education and promote future smoother transitions from FtoF to OL teaching (reviewed in [18]). In order to contribute to this search through a case of study at the School of Agricultural Engineering and Environment of the Universitat Politècnica de València, we considered the following research questions (hereinafter RQ):

RQ1. Could the special scenario lived during spring semester lockdown of 2020 have any effect on the students' performance at the School of Agricultural Engineering and Environment located in the third largest city in Spain?

RQ2. In the event of answering yes to RQ1, do those differences depend on the degree program, year, or their interaction?

RQ3. Just at the end of the ERT, did students and faculty express similar preferences on either the teaching or evaluation methodologies developed?

No society is exempt from natural hazards. A global pandemic is a novel situation without precedent in recent times, although more frequent in the not-so-distant past. However, other natural disasters, such as floods, volcanic eruptions, hurricanes, heat, and cold waves, etc. may produce situations that require a new transition to ERT for a short period. A profound understanding of this period and the lessons learned now should lead to colleges being prepared to face new episodes.

2. Materials and Methods

2.1. Context of the Study

The School of Agricultural Engineering and Environment (ETSIAMN) is located in the Universitat Politècnica de València (UPV, Valencia, Spain). For the last two decades, the UPV and, in particular ETSIAMN, have been supporting the incorporation of new information and communication technologies (ICT) in the learning and teaching processes of both bachelor's and master's degrees. However, it has only been now during the COVID-19 pandemic in the second semester of 2020 when distance learning has had to be imposed as the only teaching methodology throughout the University. This has entailed a great deal of effort from the entire university community, both teachers and students and even administration staff.

In UPV, the academic year starts in September and finishes in July. Thus, each academic year covers two calendar years (i.e., academic year 2016–2017 covers from September 2016 until July 2017). The first semester lasts from September to January and the second semester from February to July. Four bachelor's degrees (four academic years) are taught in ETSIAMN: (i) Biotechnology, (ii) Food Science and Technology, (iii) Forestry Engineering, and (iv) Agricultural and Biological Engineering. It is important to note that both Engineering courses meet the requirements of the Accreditation Board for Engineering and Technology (ABET). The student profile differs depending on the degree and academic year; thus, an in-depth analysis is proposed in order to determine the influence of the COVID-19 crisis on student performance (RQ1 and RQ2). On the other hand, three master's degrees (two academic years) are also taught in ETSIAMN: (i) Agricultural Engineering, (ii) Forestry Engineering, and (iii) Oenology. Most of the master's students have not studied bachelor's degrees in ETSIAMN. They come from different national and international universities.

It should be pointed out that the vast majority of teachers in ETSIAMN participate in more than one degree and most of them teach in both the bachelor's and master's programs; thus, their perceptions as regards the teaching methodologies employed during the period in question cannot be distinguished. For that reason, a study into the perceptions of students and faculty in ETSIAMN was developed in order to answer RQ3.

This study has been performed by the Executive Board of the ETSIAMN, including the Director and the Deputy Directors.

2.2. Analysis of Student Performance

In order to answer RQ1 and RQ2, the averages of the marks corresponding to the three academic years preceding the COVID-19 crisis (2016–2017, 2017–2018 and 2018–2019) were compared to those obtained in 2019–2020 (when the lockdown occurred during the second semester) for all the subjects in the four bachelor's degrees and for the two semesters of each academic year. During 2019–2020, OL exams were performed by the students through the PoliformaT platform, which is based on the Sakai environment, and developed at the UPV as a teaching support tool. Although no biometric access control was used to access to the online exams because of protection of image rights, specific identification with ID and password was required to log in the online exams. Moreover, Teams (Office 365) connections during the exam performances were requested so that lecturers could virtually supervise the students' actions by asking them to switch on the cameras at any moment. These measures somehow guarantee the quality of the OL exams.

The anonymous aggregated data corresponding to marks obtained by the total student population were obtained from UPV databases for each course, subject, academic year and bachelor's degree. For each academic year and bachelor's degree, the average mark was obtained from the average mark of all the subjects from each course.

A total of 12,811 marks obtained by the Biotechnology degree students corresponding to three academic years (2016–2017, 2017–2018, and 2018–2019), and 4041 marks corresponding to the COVID-19 2019–2020 academic year were analyzed. In a similar manner, a total of 11,851 marks obtained by the Food Science and Technology degree students, corresponding to the four academic years (2016–2017, 2017–2018, 2018–2019, and the COVID-19 year of 2019–2020) and both semesters were studied. A similar approach was performed for the two engineering degrees offered at ETSIAMN, that is, Forestry Engineering and Agricultural and Biological Engineering. Starting with the first engineering degree, a total of 5331 marks were included in the analysis. As for the Agricultural and Biological Engineering degree, a total of 8514 marks corresponding to the first semester, and 7940 marks obtained by students during the second semester were used to determine frequencies, tests of homogeneities, and to perform an ANOVA analysis.

For each degree course, the statistical analysis of the results was carried out using a chi-square homogeneity test on the grades obtained by the students on a categorical grading scale (No-show, Failed, Pass C, B, A and A+), to conclude whether there was the same distribution of grades in 2016–2019 and 2019–2020, and it was carried out in both semesters separately to detect the effect of COVID-19. To complete the analysis, an ANOVA was also performed, in which the response variable considered was the average mark (quantitative variable) obtained by the students in each subject and, as explanatory factors, the course level, the semester and the academic year of the subjects in order to study the effect of and the interactions between these factors on the response. It should be noted that the interaction of semester and academic year provides a good test to study the effect of COVID-19 on grades.

2.3. Analysis of Student and Faculty Preferences

For the purpose of answering RQ3, an anonymous survey was designed in order to obtain and analyze the opinion of students and faculty regarding the teaching and evaluation methodologies during the COVID-19 pandemic, just at the end of the 2019–2020 spring semester.

The data used in the study come from two anonymous surveys carried out in July 2020 on the ETSIAMN teaching staff and students. Those surveys were performed telematically with the help of the formerly mentioned PoliformaT platform. The PoliformaT learning platform allows teachers and students to share information about subjects and uses various management tools: repository of resources, tasks, content, online exams, news, calendars, chat, internal mail, discussion forums, wiki spaces and staff for students. In particular, the PoliformaT exam tool is highly functional and configurable, allowing the creation of a test with survey-type questions and anonymous correction where, in addition, the answers can be accessed at any time. After the survey is finished, you provide your statistics: firstly, a general statistic, the number of participants, followed by more detailed information per question.

The survey was voluntary for both students and teachers. During July 2020, the students did not physically attend the UPV. As regards the teachers, most of them were teleworking during this period. Nevertheless, it was possible to collect 114 teachers' surveys and 274 from students. Assuming an alpha = 5%, for a sample size of 274 students out of a finite population of 1660 students the margin of error was 7.32%. In the case of lecturers, with a sample of 114 out of a finite population of 312 the margin of error was 5.41%.

The survey was designed to be short and compact in order to facilitate participation.

The second part of the survey was very similar for both students and teachers. It included questions on preferences regarding several aspects of distance learning, including teaching methodologies, evaluation modalities and exam configurations.

The statistical analysis of the results was developed by using averages of a chi-square test of homogeneity.

3. Results

3.1. RQ1: Global Impact of COVID-19 on the Students' Performance in ETSIAMN

The first impact of the COVID-19 crisis on the results obtained by ETSIAMN students was studied by comparing the average of the marks corresponding to three academic years (2016–2017, 2017–2018, and 2018–2019) with students' performance during 2019–2020 for a total of four bachelor's degrees and two semesters (see Materials and Methods section). Particularly, an ANOVA was performed using more than 50,000 marks obtained by all the students belonging to ETSIAMN. As Table S1 (Supplementary Materials) shows, a statistically significant year–semester interaction (BC), with a *p*-value of 0.0007, was observed, indicating that the activation of the ERT caused an impact on the marks obtained by students at ETSIAMN. This effect is illustrated in Figure 1.
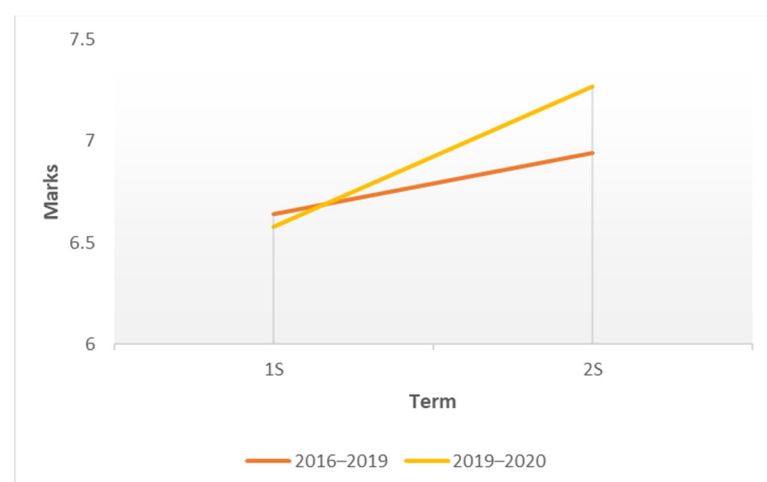

Figure 1. Interaction plot for marks showing the effect between academic year and semester for ETSIAMN students. Marks are ranked from 1 to 10, corresponding 0–4.99 to failed, 5–6.99 to C, 7–8.99 to B, 9–9.99 to A and 10 to A+.

In general terms, our results appear to indicate that the activation of the ERT during the COVID-19 pandemic in the academic year 2019–2020 had a significant impact on students' marks.

3.2. RQ2: Specific Impact of COVID-19 on the Marks in ETSIAMN

To analyze these results by independently considering the four bachelor's degrees offered at ETSIAMN, because both their organization and the students' expectations differ from degree to degree. To that purpose, we analyzed the frequencies for the students' marks in terms of percentages (Table 1) or in absolute terms (Supplementary Material) corresponding to the four degrees, during both semesters (first and second), and for different academic years (2016–2019 and 2019–2020).

Table 1. Frequency table (%) for the grades obtained by students belonging to the four degrees during both the first and the second semesters.

Degree	Term	Year	No-Show	Failed	Pass C	B	A	A+
Biotechnology	1st	2016–2019	0.71	1.77	16.42	56.08	21.39	3.64
		2019–2020	1.13	1.92	18.73	53.52	21.64	3.06
	2nd	2016–2019	1.35	1.65	15.31	55.23	21.78	4.68
		2019–2020	1.04	0.84	10.88	53.68	29.27	4.27
Food technology	1st	2016–2019	1.59	8.77	44.07	40.11	4.03	1.44
		2019–2020	1.41	8.26	44.70	41.24	2.97	1.41
	2nd	2016–2019	2.23	4.46	39.49	42.57	9.25	2.00
		2019–2020	1.72	1.65	32.62	52.29	9.94	1.79
Forestry Engineering	1st	2016–2019	6.95	20.34	43.08	26.39	2.17	1.08
		2019–2020	10.10	20.20	41.04	27.04	1.14	0.49
	2nd	2016–2019	10.27	12.54	36.92	31.71	6.02	2.53
		2019–2020	8.80	11.09	39.58	32.70	6.69	1.15
Agricultural Biological Engineering	1st	2016–2019	4.50	19.16	48.94	23.30	3.14	0.96
		2019–2020	7.37	21.61	50.90	15.62	3.43	1.08
	2nd	2016–2019	7.35	14.48	44.71	28.29	3.40	1.77
		2019–2020	5.41	6.78	36.63	43.47	5.58	2.13

As far as the Biotechnology degree is concerned, the frequency table dealing with the results of students during the first semester (Tables 1 and S2A) showed a minor decrease in the percentage of students obtaining a B grade in 2019–2020 (53.52) when compared to those obtained during the three preceding years (56.08), which was accompanied by a slight increase in the percentage of the Pass C grade (18.73 vs. 16.42). In contrast, during the second semester (Tables 1 and S3A) the tendency was the opposite, with an increase in the percentage of students obtaining an A grade (29.27 vs. 21.78) during 2019–2020 and a decrease in the B (53.68 vs. 55.23) and Pass C (10.88 vs. 15.31) percentages. Moreover, it was observed that those who passed contributed more significantly to the X_i (21.07) grades than those who obtained an A (36.55).

As the homogeneity tests show, there were significant differences between the distribution of the observed frequencies of the marks corresponding to the COVID-19 year (2019–2020) and those corresponding to the rest of the years (2016–2019), both for the first and second semesters, with a greater contribution to the X_i during the second semester (66.7 vs. 11.9) (Tables S2B and S3B).

In the analysis of variance (ANOVA; Table S4), the year–semester interaction (BC) was almost significant (*p*-value 0.0528) showing that the effect on the average marks when moving from the first to the second semester was significantly higher in the year 2019–2020 when compared to the marks for the previous years. This result is consistent with the obtained in the homogeneity test, which revealed a significant COVID-19 effect on the

distribution of the observed frequencies in both the first and second semesters, this effect being more marked in the second semester, with a greater contribution to the Xi.

Different behavior was observed in the Food Science and Technology degree. During the first semester, there were hardly any differences in between the frequency of the marks obtained in the COVID-19 academic year 2019–2020 and those obtained during the three preceding years (Tables 1 and S5A). However, during the second semester, the distribution of frequencies was clearly different, with an increase in the number of students obtaining a B grade during the COVID-19 2019–2020 academic year (52.29) when compared with the rest of the years (42.57), and a decrease in the percentage of fails (1.65 vs. 4.46); the contributions of both marks to the Xi were 22.36 and 22.22, respectively (Tables 1 and S6A).

In addition, the homogeneity tests showed that the difference between the distribution of the observed frequencies of the marks in the COVID-19 year (2019–2020) and the rest of the years (2016–2019) was only significant in the second semester, when the COVID-19 crisis and the activation of the ERT took place (Tables S5B and S6B).

As the ANOVA shows (Table S7), the year–semester interaction (BC) was almost significant (*p*-value 0.0667), this result being consistent with that obtained in the homogeneity test, which revealed a significant COVID-19 effect on the distribution of the observed frequencies in the second semester, with a greater contribution to the Xi (59.961). These results were similar to those analyzed in the Biotechnology degree. Furthermore, a significant AB interaction (semester–course level) was observed for both degrees, with a *p*-value which was ten times lower in the Food Science and Technology degree when compared with that obtained in Biotechnology (0.0005 vs. 0.0054).

As far as the mark frequencies of the Forestry Engineering degree are concerned, a significant effect was observed during the first semester (Table S8B), mainly due to a higher percentage of students who did not attend the exams, which increased from 6.95 during 2016–2019 to 10.10 for 2019–2020 (Tables 1 and S8A). On the contrary, unlike science degrees, no statistically significant differences were observed during the second semester, displaying a very similar distribution of marks during 2016–2019 and 2019–2020 (Tables 1 and S9A,B). In accordance with the aforementioned results, the ANOVA showed no significant year–semester interaction (Table S10; *p*-value 0.5808); the rest of the interactions were not significant either.

Regarding the Agricultural and Biological Engineering degree, as Tables 1 and S11A show, the percentage of students not attending the exams increased during the first semester of the 2019–2020 academic year (7.37) when compared to the three previous years (4.50), concomitantly with a decrease in the percentage of B grades (15.62 vs. 23.30), with contributions to the Xi of 24.16 and 41.29, respectively. In contrast, during the second semester (Tables 1 and S12A) the tendency was the opposite, the percentage of students obtaining a B rising sharply from 28.29 during 2016–2019 to 43.47 during the activation of ERT, and the percentage of students failing clearly dropping (6.78 vs. 14.48).

Despite the fact that the observed tendency was similar to the one described for the Biotechnology degree, the tests of homogeneity revealed a greater significance for both semesters in the Agricultural and Biological Engineering degree (Tables S11B and S12B). According to this, the ANOVA showed a statistically significant year–semester interaction (BC), with a *p*-value of 0.0031; the rest of the interactions were not significant (Table S13).

In Figure 2, the interaction plots for the marks, of the four bachelor's degrees are represented, considering the semester and academic year.
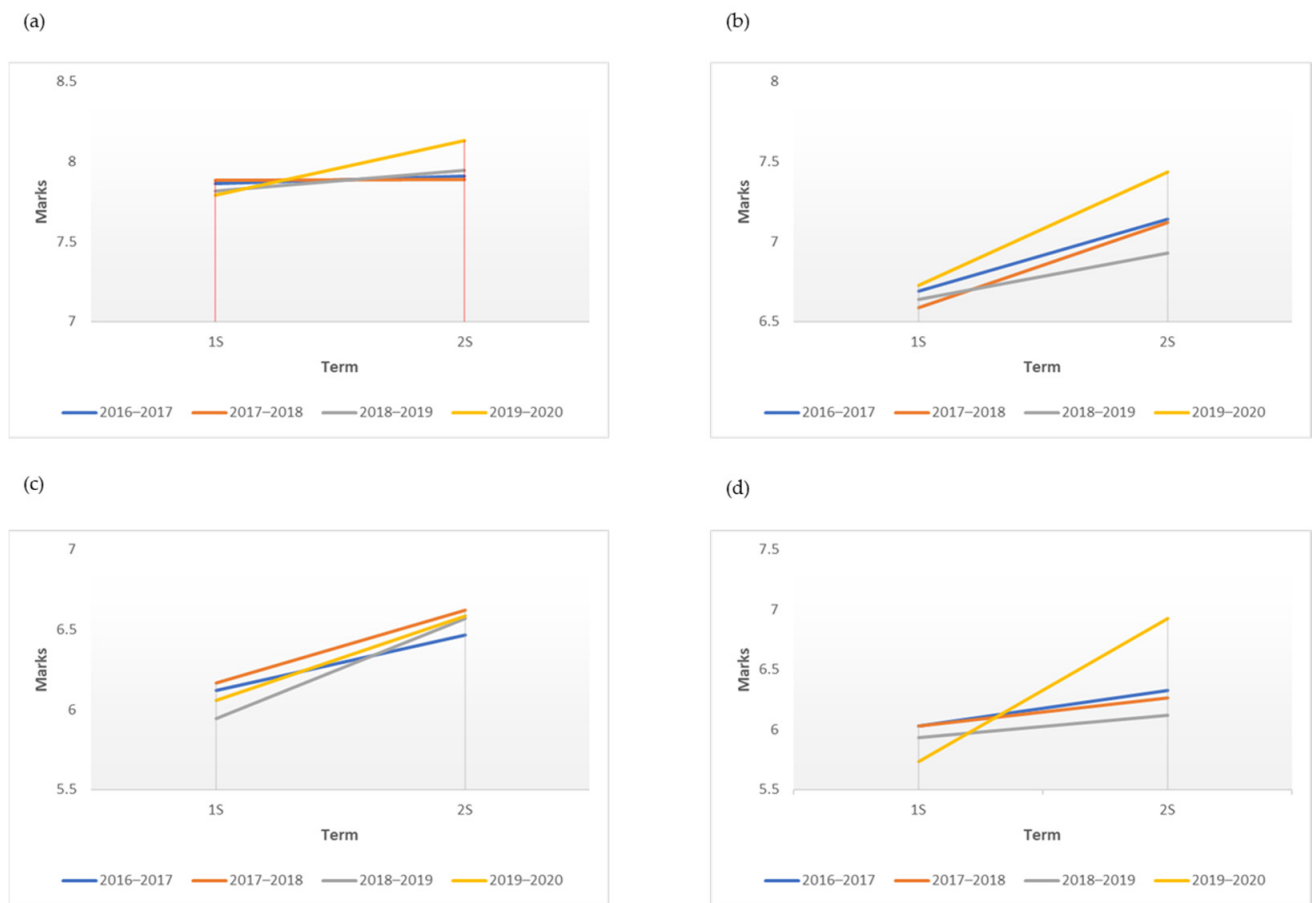
Figure 2. Interaction plots for marks showing the effect between academic year and semester. (**a**) Biotechnology degree. (**b**) Food Science and Technology degree. (**c**) Forestry Engineering degree. (**d**) Agricultural and Biological Engineering degree. Marks are ranked from 1 to 10, corresponding 0–4.99 to failed, 5–6.99 to C, 7–8.99 to B, 9–9.99 to A and 10 to A+.

To sum up, our results indicate that the COVID-19 crisis had an impact on students' marks in three out of four degrees at ETSIAMN, with the interaction between academic year and semester (BC) being statistically significant for one of them (Table S13).

To compare the students' performance in the four bachelor's degrees the averages of the total marks from all the years and semesters were calculated. As Figure 3 shows, the marks obtained by students belonging to engineering degrees were significantly lower than those obtained by the students on science degrees, the average of the Biotechnology students being the highest, which is in accordance with the cut-off note of this degree. The clear differences in the average of the marks of engineering and science degrees are very important and should be considered in order to correct the score the students have to obtain when applying for grants. In this sense, the relative scoring position in the promotion appears to be a better parameter to take into account when evaluating the applications, rather than the absolute value of the mark.

3.3. RQ3: Distance Learning Preferences of Students and Lecturers

To analyze instructors and students' preferences just at the end of the spring semester of 2019–2020, different dimensions such as teaching methodologies, evaluation modalities, and difficulties found throughout the process of adapting to distance teaching were considered for an original survey design, adapted to the ETSIAMN-UPV context. Regarding teaching methodologies, several real possibilities, including live streaming, recorded lessons or a combination of both of them were considered. As far as the evaluation modalities is concerned, case-based projects, exams with free access to documentation, oral exams,

numerical problems, open questions of multiple choices were listed. Furthermore, different configurations for the OL were considered, including time limitation or the possibility to go back. Finally, several difficulties during the ERT were considered, including lack of motivation, excess of information, accessibility to the material or technical difficulties.
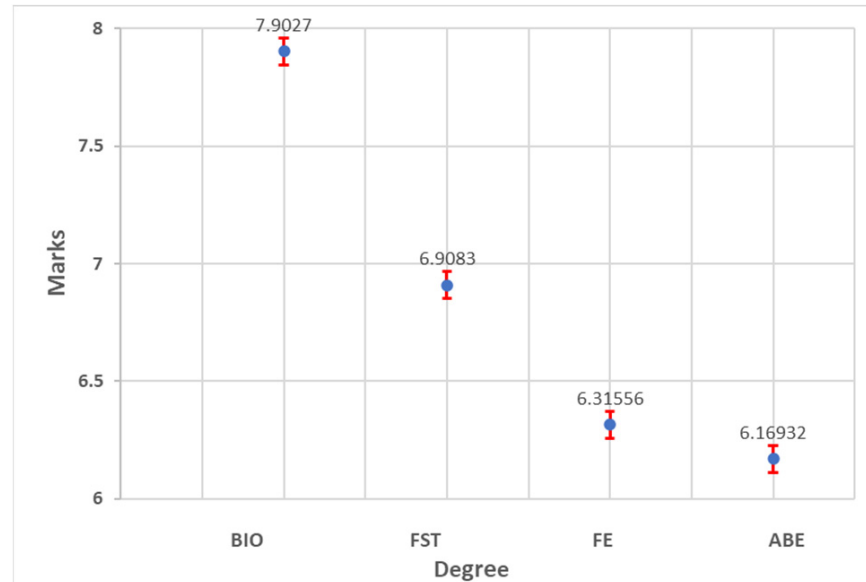
Figure 3. Average of the marks obtained at ETSIAMN in the four bachelor's degrees: (BIO) Biotechnology, (FST) Food Science and Technology, (FE) Forestry Engineering, and (ABE) Agricultural and Biological Engineering. Marks are ranked from 1 to 10, corresponding 0–4.99 to failed, 5–6.99 to C, 7–8.99 to B, 9–9.99 to A and 10 to A+.

As Figure 4 shows, although no clear preferences were identified as regards the teaching methodology favored by students and lecturers, the combination of live streaming during the regular course schedule together with the use of recorded material was the preferred method, chosen by 37.86% of the students and 34.47% of the lecturers. Live streaming during the regular course schedule was the second most desirable methodology for both students and lecturers. The preferences of both students and lecturers were compared, and a chi-square test of homogeneity with a *p*-value of 0.456 confirmed that there were no significant differences between students' and lecturers' preferences as regards methodology.
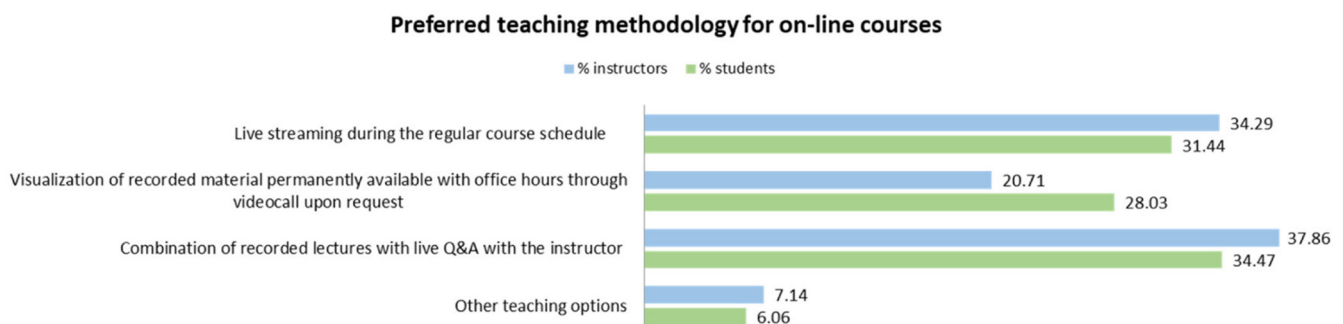
Figure 4. Distance learning teaching methodology: preferences of students and lecturers.

Depending on the subject, course and degree, different evaluation techniques were applied during the lockdown period. For that reason, different dimensions of the evaluation preferences of students and lecturers were explored, including the evaluation method and the configuration of the online exam (Figures 5 and 6). Exam configuration includes the options of time limitation and/or going back to previous pages. Unlike the methodology

preferences, clear differences were observed between students' and lecturers' preferences as regards the modalities of evaluation and the configuration of exams. In both cases, the homogeneity test was statistically significant, with a *p*-value of 0.000.
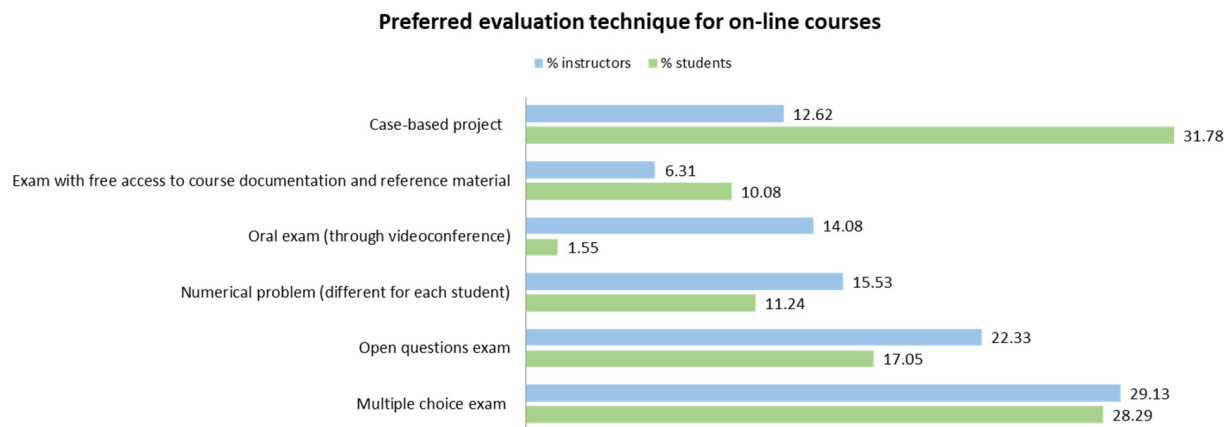
Figure 5. Modalities of evaluation in distance learning: preferences of students and lecturers.
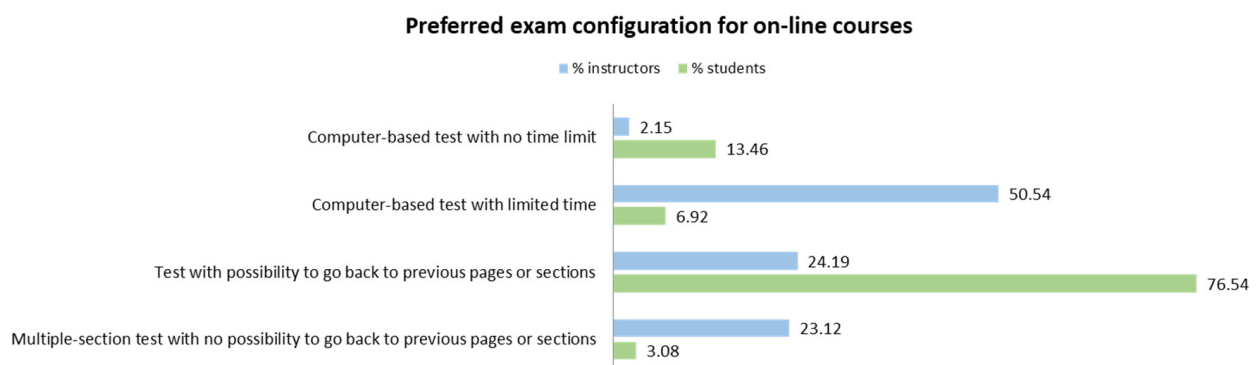
Figure 6. Exam configurations in distance learning: preferences of students and lecturers.

The students considered the most objective evaluation methods to be case-based projects and multiple-choice exams, with these two options representing 60.07% of the answers. In contrast, the lecturers considered multiple-choice exams to be the best evaluation method in distance learning, representing 28.29% of the preferences. Interestingly, oral examinations were the least liked by the students, only accounting for 1.55% of the answers, which contrasts with the lecturers, 14.08% of whom chose this method (Figure 5).

As regards the online exam configuration, while no clear inclination for time limitation was shown by students, what could be seen was that lecturers very clearly prefer to limit the time permitted for the test, with 50.54% of them choosing this modality. In contrast, a test that offers the possibility to go back to previous pages or sections was chosen by 76.54% of the students, whereas the lecturers showed no special preferences for the go back configuration (Figure 6).

Finally, the students were asked for possible difficulties, if any, which emerged during the ERT. As Figure 7 shows, 47 students declared finding no difficulties, representing around 20 of those surveyed. Among the difficulties listed, a lack of motivation or technical difficulties were the ones most selected by ETSIAMN undergraduates, with more than 100 students choosing them. Another important aspect is the availability of the information necessary to follow the courses, with both a lack and an excess of information identified as being equal contributors to the difficulty.

Did you find any difficulty to follow on-line courses during the pandemic?
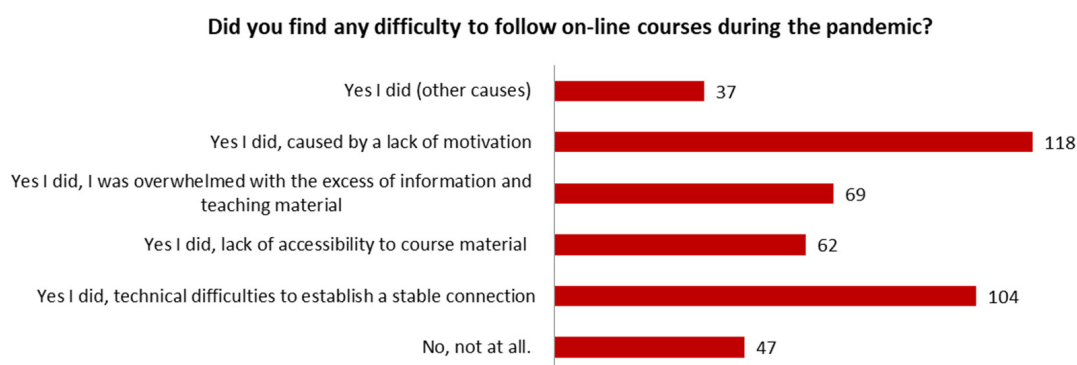
Figure 7. Students' difficulties in distance learning.

4. Discussion

Here we have analyzed the impact of the COVID-19 crisis on the marks obtained by the School of Agricultural Engineering and Environment students (RQ1). To that purpose, we have compared the average of the marks corresponding to three academic years (2016–2019) to that obtained in 2019–2020. This impact has been particularly analyzed uisng results corresponding to four bachelor's degrees and two semesters (RQ2). Finally, instructors and students were surveyed about different dimensions of the ERT just at the end of the ERT period to compile the first impressions (RQ3).

As regards RQ1, our results indicate a positive impact of the ERT activation by COVID-19 on the marks at ETSIAMN, as shown by the interaction plots for marks (Figure 1). Moreover, the interaction between semester and academic year was statistically significant, confirming these results (Table S1). It seems that, regardless of the difficulties lockdown supposed for students during the learning process in general terms, students at ETSIAMN improved their marks. Several possibilities for this positive impact could be considered. First, remote exams could be easier for students, giving them more opportunities to access several sources of information. This could explain the clear lecturer's preference of limiting time through the exam configurations (Figure 6), precisely to control this access. However, studies performed by Gonzalez et al. [15], observing a similar positive effect, indicated that the new assessment process developed during the ERT could not be the reason for the improvement in students' performance, since only subjects which include several tests that had not been modified because of the confinement were chosen for their studies. Therefore, a more optimistic explanation could then be considered, relying the positive effect on the management performed by ETSIAMN-UPV. It is worth noting the effort made by UPV in activating technological tools for all the stakeholders involved in ERT in a very short period. All the ETSIAMN staff adapted to the new situation perfectly, probably because most of them had skills in the development of both online teaching materials and evaluation. Moreover, the students were closely supervised and applied the greater academic effort required by lockdown, therefore coping with the difficulties associated with ERT. This positive effect could be also boosted by the high degree of coordination between the assistant directors of the degrees and the students on the different courses, permitting the difficulties encountered to be solved with great agility and success. Finally, a special sensitivity of lecturers for students' marks given the extraordinary situation they were suffering could be also considered to explain the observed positive effect.

When the analysis was particularly studied for all the programs, years, subjects and students at ETSIAMN (RQ2), our results appear to indicate a clear effect of COVID-19 on the marks obtained by students in three of the four degrees (Figure 2a–d) during the spring semester of 2019–2020, when the ERT was activated. As regards the Agricultural and Biological Engineering degree (Figure 2d), this effect appears to be exacerbated by the statistically significant lower results obtained during the first semester of the same academic year. The differential behavior of the results for the Forestry Engineering degree was mainly due to the absence of the COVID-19 effect during the spring semester of

2019–2020 (Figure 2c). The behavior of these students is particular, and the dropout rate is high. This could explain the differences observed, since the effect exerted by the close supervision and academic effort could be diluted among the low population of students. Specific studies for online engineering education have been previously performed [19]. The results of our study add to those and can help the online instruction of engineering courses to guarantee they meet the rigorous requirements of the program accreditations, such as ABET.

Regarding the preferences of the students and faculty (RQ3), both surveyed just at the end of the ERT period, whilst the lecturers and students agreed as to their preferences for teaching methodologies in distance learning, their perception regarding the most accurate evaluation methodology was different. While the students appeared to be mainly concerned about the evaluation techniques, preferring the case-based project and multiple-choice exams, the teachers were concerned about the quality of the evaluation process, by limiting the time and go back options in the exams. This highlights the fact that although the lecturers and students have the same perception concerning the acquisition of knowledge, it differs as regards to how the knowledge can be evaluated.

Several proposals and policies for improvement the impact of COVID-19 on students and teachers in higher education institutions have been described, including support for students, providing high-quality tools, receiving feedback, investigating efficacy, stating objectives, seeking for policies to mitigate any risks or inequalities, revisiting and rethinking of pedagogical strategies, training staff and students, diversifying methods and broadening accessibility [18]. The experiences in universities have demonstrated some advantages for some situations of OL teaching. As it has been highlighted by [4], the higher education institutions need to adapt the curricula to face the needs of new social and scientific challenges regarding the sustainability of digital education. Universities have the responsibility of preparing the students for the current changing environment. In a recent study [20] a relationship between employability and higher education in EU-28 countries during COVID-19 was found, among other factors, because individuals with higher education were better prepared to adapt to the changes and new challenges during this period. Higher education institutions should continue working in that sense to train well-prepared professionals for unexpected eventualities.

5. Conclusions

A positive impact of the ERT during COVID-19 on the marks at ETSIAMN was detected. It could be explained by some of the advantages that remote exams present to the students. Nevertheless, the high effort made by all the stakeholders could also explain this effect.

The students' performance was not the same for the four bachelor's degrees, with the Forestry Engineering degree being the only degree without any COVID-19 effect during the spring semester of 2019–2020. That could be explained by the high dropout rate of these students which entails a low population. The effect of close supervision and academic effort could be diluted for these students.

Lecturers and students agreed in their preferences for teaching methodologies while their preferences about the most accurate evaluation methodology was different. The difference in preferences about the configuration of the exams was especially interesting, with the limitation of time (highly preferred by teachers) and the possibility of go back in the exams (preferred by students) being the main disagreement in their responses.

Our research covers a very specific moment when we suddenly had to change from FtoF teaching to OL teaching. The results have served to emphasize those aspects that we have detected as important, to identify the deficiencies, and work to solve them.

Although it has been shown that it is necessary to have digital competencies, we believe that FtoF teaching is essential for the comprehensive training of students. However, the situation we have experienced has opened our eyes to work on the elimination of the digital gap and to develop additional activities for the better training of our students.

Our case of study at the School of Agricultural Engineering and Environment, which responded satisfactorily to the exceptional situation, could point to the fact that the coordination among the all the stakeholders participating in the ERT—including students, lecturers, and executive board—is an important issue to be considered in the future. This coordination could provide with new measures agreed by all parts. Therefore, our study represents a contribution to the understanding of ERT which will be very helpful if future unforeseen circumstances demand that it be employed once again.

References

1. Education: From Disruption to Recovery. Available online: https://en.unesco.org/covid19/educationresponse (accessed on 15 February 2022).
2. Romero-Ivanova, C.; Shaughnessy, M.; Otto, L.; Taylor, E.; Watson, E. Digital Practices & Applications in a COVID-19 Culture. *High. Educ. Stud.* **2020**, *10*, 80. [CrossRef]
3. Dietrich, N.; Kentheswaran, K.; Ahmadi, A.; Teychené, J.; Bessière, Y.; Alfenore, S.; Laborie, S.; Bastoul, D.; Loubière, K.; Guigui, C.; et al. Attempts, Successes, and Failures of Distance Learning in the Time of COVID-19. *J. Chem. Educ.* **2020**, *97*, 2448–2457. [CrossRef]
4. Sousa, M.J.; Marôco, A.L.; Gonçalves, S.P.; Machado, A.D.B.; Estrada-Guillén, M.; Monferrer, D.; Sousa, M.J.; Lúcia Marôco, A.; Gonçalves, S.P.; De, A.; et al. Digital Learning Is an Educational Format towards Sustainable Education. *Sustainability* **2022**, *14*, 1140. [CrossRef]
5. Hodges, C.B.; Moore, S.; Lockee, B.B.; Trust, T.; Bond, M.A. The Difference Between Emergency Remote Teaching and Online Learning. 2020. Available online: http://hdl.handle.net/10919/104648 (accessed on 27 June 2022).
6. Shulman, L. Knowledge and Teaching:Foundations of the New Reform. *Harv. Educ. Rev.* **1987**, *57*, 1–23. [CrossRef]
7. Rapanta, C.; Botturi, L.; Goodyear, P.; Guàrdia, L.; Koole, M. Online University Teaching During and After the COVID-19 Crisis: Refocusing Teacher Presence and Learning Activity. *Postdigital Sci. Educ.* **2020**, *2*, 923–945. [CrossRef]
8. Roddy, C.; Amiet, D.L.; Chung, J.; Holt, C.; Shaw, L.; McKenzie, S.; Garivaldis, F.; Lodge, J.M.; Mundy, M.E. Applying Best Practice Online Learning, Teaching, and Support to Intensive Online Environments: An Integrative Review. *Front. Educ.* **2017**, *2*, 59. [CrossRef]
9. Casacchia, M.; Cifone, M.G.; Giusti, L.; Fabiani, L.; Gatto, R.; Lancia, L.; Cinque, B.; Petrucci, C.; Giannoni, M.; Ippoliti, R.; et al. Distance education during COVID 19: An Italian survey on the university teachers' perspectives and their emotional conditions. *BMC Med. Educ.* **2021**, *21*, 1–17. [CrossRef] [PubMed]
10. Odriozola-González, P.; Planchuelo-Gómez, Á.; Irurtia, M.J.; de Luis-García, R. Psychological effects of the COVID-19 outbreak and lockdown among students and workers of a Spanish university. *Psychiatry Res.* **2020**, *290*, 113108. [CrossRef] [PubMed]
11. Cullinan, J.; Flannery, D.; Harold, J.; Lyons, S.; Palcic, D. The disconnected: COVID-19 and disparities in access to quality broadband for higher education students. *Int. J. Educ. Technol. High. Educ.* **2021**, *18*, 1–21. [CrossRef] [PubMed]
12. McPartlan, P.; Rutherford, T.; Rodriguez, F.; Shaffer, J.F.; Holton, A. Modality motivation: Selection effects and motivational differences in students who choose to take courses online. *Internet High. Educ.* **2021**, *49*, 100793. [CrossRef]
13. Eccles, J. Expectancies, values and academic behaviors. In *Achievement and Achievement Motives: Psychological and Sociological Approaches*; Spence, J.T., Ed.; Free Man: San Francisco, CA, USA, 1983; pp. 75–146.
14. Patricia Aguilera-Hermida, A. College students' use and acceptance of emergency online learning due to COVID-19. *Int. J. Educ. Res. Open* **2020**, *1*, 100011. [CrossRef] [PubMed]
15. Gonzalez, T.; de la Rubia, M.A.; Hincz, K.P.; Comas-Lopez, M.; Subirats, L.; Fort, S.; Sacha, G.M. Influence of COVID-19 confinement on students' performance in higher education. *PLoS ONE* **2020**, *15*, e0239490. [CrossRef] [PubMed]
16. Talsma, K.; Robertson, K.; Thomas, C.; Norris, K. COVID-19 Beliefs, Self-Efficacy and Academic Performance in First-year University Students: Cohort Comparison and Mediation Analysis. *Front. Psychol.* **2021**, *12*, 2289. [CrossRef] [PubMed]
17. Shim, T.E.; Lee, S.Y. College students' experience of emergency remote teaching due to COVID-19. *Child. Youth Serv. Rev.* **2020**, *119*, 105578. [CrossRef] [PubMed]
18. Abu Talib, M.; Bettayeb, A.M.; Omer, R.I. Analytical study on the impact of technology in higher education during the age of COVID-19: Systematic literature review. *Educ. Inf. Technol.* **2021**, *26*, 6719–6746. [CrossRef] [PubMed]
19. Asgari, S.; Trajkovic, J.; Rahmani, M.; Zhang, W.; Lo, R.C.; Sciortino, A. An observational study of engineering online education during the COVID-19 pandemic. *PLoS ONE* **2021**, *16*, e0250041. [CrossRef] [PubMed]
20. Mariani, M.G.; Volmer, J.; Gavrilut, N.; Grecu, S.-P.; Chiriac, H.C. Sustainability and Employability in the Time of COVID-19. Youth, Education and Entrepreneurship in EU Countries. *Sustainability* **2022**, *14*, 1589. [CrossRef]