The Impact of Rapid Adoption of Online Assessment on Students' Performance and Perceptions: Evidence from a Distance Learning University

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Abstract: One of the most sensitive changes faced by universities due to the COVID-19 crisis was the remote assessment of student learning. This research analysed the case of a massive distance learning university that rapidly changed the final assessment (*N*=126,653 undergraduate students in 2020) from face-to-face exams to entirely online exams. The research focused on the influence of online assessment on academic performance and students' perception of the new method. Two data sources were used: the contrast of academic performance indicators (assessment, success and achievement rates, and average marks obtained) between the online examination call and the previous ones with face-to-face examinations; and a questionnaire to a sample of students (*n*=714) on their perception of the online assessment experience. The results show that all the academic performance indicators in the 28 Bachelor Degrees offered at the university increased when the final assessment method turned to online due to the pandemic crisis; and that a majority of students are more favourable to online assessment methods. The discussion places these findings in a context of rapid change, and concludes by identifying the possible implications of online assessment for student retention, organisational challenges, as well as possible further studies.

Keywords: e-learning, distance education, online exams, online assessment, students' performance

1. Introduction

The approach to learning assessment is a key aspect in the pedagogical model of higher education institutions. Therefore, universities are very cautious about moving towards digital assessment methods. Changes are usually made with appropriate timing, allocating the necessary resources and valuing their contribution to the quality of education. But the context for introducing digital innovations in universities was altered by COVID-19 (International Association of Universities, 2020; Naffi, 2020; United Nations, 2020), so at that time the transition from campus-based methods to remote teaching practices took place without having time to plan and evaluate the impact of the changes.

There is much evidence to suggest the influence of using different assessment methods —face-to-face, online or blended— on the learning cycle of higher education students (Gikandi, Morrow and Davis, 2011; Ferrell, 2013; Guerrero-Roldán and Noguera, 2018; Tawafak, et al., 2018). And therefore it is to be expected that a change in assessment format —from a face-to-face to an online method— will have some impact on students' performance.

Considering these reflections, in this paper we analyse the impact on students' performance of introducing an accelerated change in the final assessment of students in the case of a massive distance university, which moved from a face-to-face examination-based system to a fully online mode in June 2020, as a consequence of the pandemic. It is worth to notice that the only change was in the assessment system, as the courses were already taught at a distance before, and during, the pandemic. We aim to answer the following research questions:

- Research question 1 (RQ-1). Has the new online final assessment method had any influence on students' performance?
- Research question 2 (RQ-2). How has the sudden change resulting from COVID-19 influenced students' perceptions towards assessment?

In the first place, we introduce the background to the reasons that make it difficult for universities to implement digital assessment systems. We also explore the literature on the relationship between digital assessment and performance in higher education. This is followed by a case study at the *Universidad Nacional de Educación a Distancia* (National Distance Education University, UNED, Spain), where a final online assessment system was

applied due to the COVID-19. We aim to provide evidence about the impact of the rapid adoption of online assessment that can inform further reflection and decision-making about assessment methods that can be used.

2. Barriers to digital assessment in higher education

Examples of digital assessment include proctored exams, multiple-choice digital tests, virtual reality simulations, standardized tests, video performances, and digital portfolios. There is a lot of research on digital assessment, focusing on the application of some of these variants in different contexts (Vani and Gupta, 2016; Smith, 2017; Daffin and Jones, 2018; Nardi and Ranieri, 2019; Makransky, et al., 2020; Alyahya and Aldausari, 2021). In general, the results point to the integrity of remote assessment processes and a number of associated advantages (Gray and Ferrell, 2013; Timmis, et al., 2015; Okada, 2019): better engagement from students; staff can choose the timing for their assessments; students can choose when and where to undertake assessments; more efficient management of assignment submissions, marking and moderation; better storage and archiving of student attainment records; ability to improve existing "human" or solely paper-based methods of marking. But, in the case of higher education and despite the abundance of evidence, only a few universities have implemented any online assessment system. It has been mainly in the open and distance universities that most pilot tests have been implemented (Conrad, 2013; Chaudhary and Dey, 2013; Guàrdia, Crisp and Alsina, 2017; Gil-Jaurena, Domínguez and Ballesteros, 2020), while face-to-face universities are reluctant to overcome the many obstacles to digital assessment. In any case, a recent study about assessment in mega universities shows that "online assessment is reported to be applied at a 'low' level" in 4 of the 7 analyzed open universities (Karadag and Ozgur, 2020, p. 44).

There are a variety of inhibitors that explain the low presence of digital assessment in universities (Bacow, et al., 2012; ENQA, 2015). On the one hand, there are barriers on the academic side. Digital assessment practices require a very different type of educational organisation from the conventional one (Voogt, et al., 2013). They are part of a digital scheme where the educational agents must use communication tools and procedures for the delivery of learning tasks, which are very different from the usual dynamics in the classroom. There are also doubts about the academic reliability of online assessment tools, which lead to questions about the quality and validity of the assessment as a whole. These doubts have been addressed by different forms of proctored digital assessment, but they depend on sophisticated software which is difficult to implement (Langenfeld, 2020). And finally, there is a concern about the complexity involved in adapting assessment tools that are based on different software, each with its own configurations, and which do not always meet the requirements demanded by teachers to assess different types of skills and knowledge. For example, in the case of experimental science studies (Pilli and Aksu, 2013; Faber, Luyten and Visscher, 2017; Dalby and Swan, 2019), there is a concern about the delivery of tasks with mathematical formulations and which demand different time management than those of assessment tests in the field of humanities or art studies (Cheng, et al., 2013; Soffer, Kahan and Livne, 2017).

On the other hand, a second type of barrier of a regulatory and normative nature, is also mentioned in the literature. It is only recently that quality assurance agencies have paid attention to online evaluation (Appiah and Van Tonder, 2018; Foerster, Gourdin and Huertas, 2019; Quality Assurance Agency for Higher Education, 2020). Without the necessary regulatory support, it has been difficult to advance the use of online assessment methods, as in many cases instructional design is tied to specific standards (Ferrão, 2010; Stödberg, 2012; Charteris, et al., 2016).

3. Academic performance in digital assessment

As universities use more digital assessment tools, there is more research analysing their effects on student performance. The main variable to consider when analyzing performance is the control of exams and tasks that are performed remotely. This is because there are many doubts about the integrity of the online assessment processes, which are beyond the direct —physical— control of the teachers. Doubts about integrity lead to the assumption that students can cheat in exams, and as a result their performance will be higher. However, evidence indicates that, in general, students do not cheat on online tests and exams more than on face-to-face ones (Raines, et al., 2011; Ellis, 2012; Fask, Englander and Wang, 2014; Arnold, 2016; Hylton, Levy and Dringus, 2016; Chen, West and Zilles, 2017).

From there, another dimension analysed is whether control over examinations and assessment tests has any impact on student performance. Most research focuses on proctored online examinations, which are the most common way of controlling the assessment process in digitally mediated situations. But the results are

inconclusive: there is ample evidence indicating better assessment results when online exams are not proctored than when they are proctored (Milone, Cortese, et al., 2017; Alessio, et al., 2018; Daffin and Jones, 2018); while other research (Eyal, 2012; Stack, 2015; Hylton, Levy, and Dringus, 2016) indicates a high dependence on the academic conditions in which the exams are administered. Also, proctored —versus non-proctored— exams are perceived by students as more difficult and anxiety-generating, especially in the case of webcam-controlled exams (Kolski and Weible, 2018).

In addition to process control, various other uncontrolled factors that can influence student performance in digital assessment have also been analysed. For example, the influence of attitudinal (Elmehdi and Ibrahem, 2019) and anxiety-related issues (Stowell and Bennett, 2010), the impact of the exam environment (Hollister and Berenson, 2009), student procrastination (Levy and Ramim, 2012) or engagement (Bertheussen and Myrland, 2016) have been analysed.

Research results are inconclusive on whether online examinations are determinative in one way or another of student performance. Eventually, a review of the literature suggests that performance depends on classic academic variables, such as the context in which the examinations are held, the configuration of the assessment tests and how they fit into the learning design. The fact that assessment exercises are proctored does not seem to influence the grade obtained either, with results indicating different levels of performance depending also on academic variables.

4. Methodology

4.1 Research context

The main objective of the research is to determine the influence on students' performance of the change in the final assessment system at UNED, from a face-to-face to an entirely online examination system. To better understand the impact of this change on students, the research also aims to understand the influence of the speed of change, since the online assessment system was suddenly introduced as a result of the COVID-19 crisis.

Normally, the final assessment at the UNED was based on face-to-face examinations held in the study centres located in Spain (65 centres) and abroad (19 centres). The change in assessment method meant that teachers had to convert their final face-to-face examination into a digital web-based examination. To this end, the UNED offered two digital assessment systems. One of these was applied mainly to courses with a low number of students enrolled, and consisted of using the assessment facilities available in the university's learning management systems (LMS). This solution involved adapting a digital infrastructure that was already in use. The second option was a new digital assessment system on which we focused on this work. This is a proctored testing platform created by UNED in order to scale up the large number of tests that had to be taken online due to the pandemic. The number of online exams that took place in the new e-assessment proctored platform was about 188,000. Table 1 presents the characteristics of the final assessment methods before and during the pandemic. We remind that the only change was in the assessment system, as the courses were already delivered at a distance mode before the pandemic.

Table 1: Final assessment methods at UNED before and during the COVID-19 crisis

Key issues	Usual scenario	COVID scenario
Delivery of the courses.	Distance mode.	Distance mode.
Final assessment system.	Face-to-face exams. Teachers prepare exams that students take in the UNED regional centres.	Proctored online exams. A cloud-based application was designed with user access via the web. Teachers prepare exams, and students take them online from anywhere.
Type of exams.	Different types of exams can be prepared (MCQ, essay or open-ended questions, or mixed).	Different types of exams can be configured (MCQ, essay or open-ended questions, or mixed).
Time to complete exams.	The examinations were conducted synchronously. Limited response time control (maximum 2 hours, minimum 1 hour).	The examinations were conducted synchronously. Limited response time control (maximum 2 hours, average 1 hour).

Resources allowed in the exams.	Normally students cannot introduce or use any material (books, class notes) in the exam classroom.	Some teachers designed open-book online exams.
Integrity of the assessment process.	The integrity of the process was guaranteed by the exams being invigilated (by teachers and support staff from the regional centres). No electronic devices are permitted.	Integrity was ensured through control procedures that prevented students from cheating: camera shots during the exam, no copy and paste in the application, reduced time to complete the exam compared to the time available in the face-to-face mode.

To clarify and monitor (for quality assurance purposes) the academic aspects associated with the transition from an analogical to a digital assessment system on a mass scale, the university designed a protocol that included guidance for the teaching staff. The university's premise for its professors was to apply the same academic criteria established in the study guide for each course, making the least number of changes to the structure of the assessment, even though it was now online: i.e., if the original classroom exam was a multiple-choice questionnaire (MCQ) to be completed in one hour, the online assessment should be similar; if the classroom exam included a MCQ section and an essay section to be completed in 2 hours, the online exam should have the same scheme.

The transition from one system to another did not cause any organisational difficulties, although the context of the COVID-19 led to a consensus among the teaching staff that the design of the new online exams would not lead to increased difficulty. The aim was to avoid greater stress for students, considering the difficult situation associated with the pandemic.

In terms of the availability of technological infrastructures and the digital skills of students, teachers and support staff, the context of a distance university means that these needs are essentially covered. During the enrolment process, students are asked about the need for connectivity to access online learning. Similarly, teachers and support staff are trained to operate in fully online contexts.

4.2 Participants

The final online assessment system was implemented mainly at the undergraduate level —at UNED, Master's Degree studies are mostly based on continuous online assessment—, so research is focused on Bachelor's Degree students at UNED.

According to university statistics, in 2019-2020 the number of students enrolled in undergraduate studies was 126,653. In 2019-2020 UNED had a total of 158,782 students enrolled (see Table 2).

Table 2: UNED students enrolled in Bachelor Degrees and the total set (Source: UNED data centre)

Year	Undergraduate students	Total students at university
2015	143,255	190,019
2016	142,807	185,194
2017	136,791	172,319
2018	128,867	162,720
2019	129,124	163,481
2020	126,653	158,782

UNED offers 28 Bachelor Degrees, listed in Table A-B in the Appendix and also shown in figures 2, 5, 6 and 7. The number of students enrolled in each program varies, ranging from 27,510 students in the Bachelor Degree in Psychology to 477 in the Bachelor Degree in Engineering Information Technology.

4.3 Data collection methods

Two sources were used to obtain the data that meet the research questions:

1. Information from the university's Data Management Office. To respond to RQ-1, information was collected from the UNED data centre on student performance in the last six-year cycle. All data refer to

the June evaluation call, which corresponds to the second semester. The data collected were grouped according to a set of key indicators related to the academic performance of students (see Table 3).

Table 3: Key indicators of students' academic performance

Indicator	Description
1. Assessment rate (AR).	How many students took the course final assessment examinations. Increased student participation in assessment tests is positive in determining performance.
2. Success rate (SR).	How many students (of those who were assessed) passed the course. If the number of students taking the subject and passing it is high, it is positive in determining performance in that subject.
3. Achievement rate (Ar).	How many students passed the course, on total enrolment. If the number of students who pass the course (in this case in aggregate, considering all those enrolled) is high, it is positive for determining performance in that course.
4. Average mark in the course (AM).	Including the final exam and other required activities. The mark can range from 0 to 10, being 5 the pass score. A high average mark in the course indicates better performance.

2. Data from a survey addressed to enrolled students, about their perception of the rapid change in assessment methods at the university. To respond to the RQ-2, we designed a survey for the students, most of whom had participated in the final online assessment of the UNED Bachelor Degree courses, in the June call, during COVID-19. The survey included questions about previous experience with online exams, the conditions under which they took the exams, perception of the time for completing the exam, difficulty, anxiety, control/invigilation, and preferences about assessment modalities. The survey included closed questions, Likert-type questions, and an open-ended question for additional observations the students would like to express. The survey was announced in the digital spaces of the courses once the exams had finished, during the second half of June 2020. And it was also distributed in the social networks of the research team and collaborating professors. The data collected was screened for reliability: repeated answers or replies sent several times were eliminated, as well as rare cases (such as the selection of the same answer in all the questions or answers inconsistent with the questions asked). It resulted in the number of valid responses of n=714 (from 725 original replies). The sample includes students from 20 Bachelor Degrees, with a higher representation of students in the Social Sciences area. Only 4 of these respondents had not participated in the final online assessment.

5. Results

The results derive from the analysis of data from the two research data sources. Firstly, data on student performance over the past six years measure the impact of the change in assessment method during COVID-19. As described below, the analysis of these data in response to RQ-1 takes two forms: aggregating all Bachelor's Degrees and measuring the variability of performance indicators in the last six years; and disaggregating each Bachelor's Degree and performance indicators into these degrees.

The second analytical framework concerns data from the survey of Bachelor Degree students who participated in the new online assessment. In response to RQ-2, only the items referred to students' perceptions of the sudden change in the final assessment method because of the COVID-19 have been considered.

5.1 Overview: general evolution of academic performance indicators

The information in Figure 1 provides an overview of the evolution of four academic performance indicators in the cycle over the last 6 years, aggregated for all UNED Bachelor Degree courses. The data for the year 2020 correspond to the online assessment method, whereas the usual face-to-face examinations at UNED were used in the previous 5 years, from 2015 to 2019. In 2020 the academic performance of students increased in all 4 indicators by between 10% and 15%.

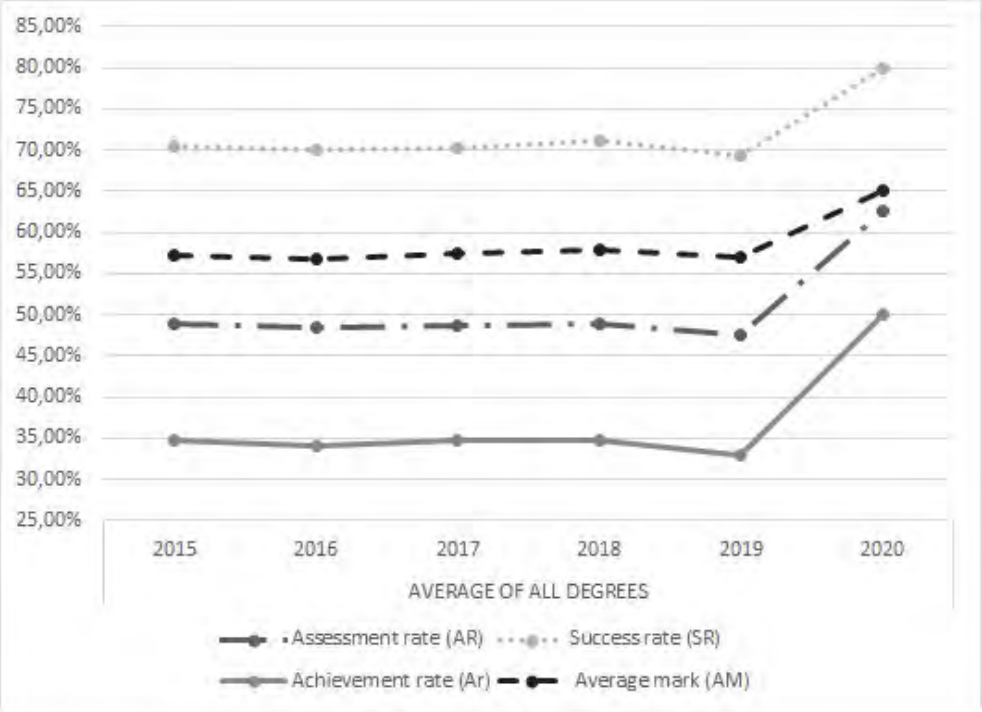

Figure 1: Evolution of academic performance indicators in UNED students. Aggregated data from all Bachelor Degree courses between 2015 and 2020 (Source: UNED Data Management Office)*

* To include all the indicators in the same figure, the value of the Average Mark (AM) has been weighted to 100% based on the information provided in table 3. So here a score of 0 points is equivalent to 0%, and a score of 10 points to 100%.

The following sections present the results by breaking down the data from the two sources mentioned. For a better understanding, the information is grouped around each performance indicator. Figures 2, 5, 6 and 7 have a similar structure: they show, for each Bachelor Degree, a line that represents the increase in each indicator, being the origin of the line on the left the average of the indicator score in years 2015 to 2019, and the end of the line on the right the indicator score in 2020. The figures highlighted in each figure reflect the increase (the difference between the two values, also available in Table A-B in the Appendix). We also performed one-way ANOVA tests on each undergraduate degree, marking with an asterisk in the corresponding figures (2, 5, 6 and 7) those degrees that show statistical significance (p<0.05) and where the null hypothesis –that there is no difference between means– is rejected.

5.2 Assessment rate (AR) results

The AR is a very relevant indicator to be considered in this study due to its relation with students' engagement in the courses. From a stable rate below 50% in the previous 5 years, in June 2020 this indicator has increased up to almost 65% (see Figure 1, and the details in Table A-B in the Appendix).

To deepen the analysis, the comparison between the value of the AR indicator during the cycle of the last 5 years in each degree —the reference value is an average of these 5 years—, when the final assessment was the face-to-face one, and the value corresponding to the same indicator in 2020, when the final assessment was online, is shown in a disaggregated way in Figure 2.

The students who have increased their assessment rate the most (24.09%) are from the Bachelor Degree in Criminology. In contrast, those who had the lowest increase in the AR are from the Bachelor Degree in Physics (8.58%). The average increase in AR for all Bachelor degrees was 14.42% (SD=4.02).

Coinciding with the online exams, all Bachelor Degrees experienced an increase in the student assessment rate in 2020 compared to the average of the previous 5 years. The increase was significant in 24 out of 28 degrees (85.7%). The mean increase in AR for all Bachelor Degrees was 14.42% (SD=4.02). The AR increased the most in

the Bachelor Degree in Criminology (24.09%; p=0.00 significant), while it increased the least in the Bachelor Degree in Physics (8.58%; p=0.39 non-significant).

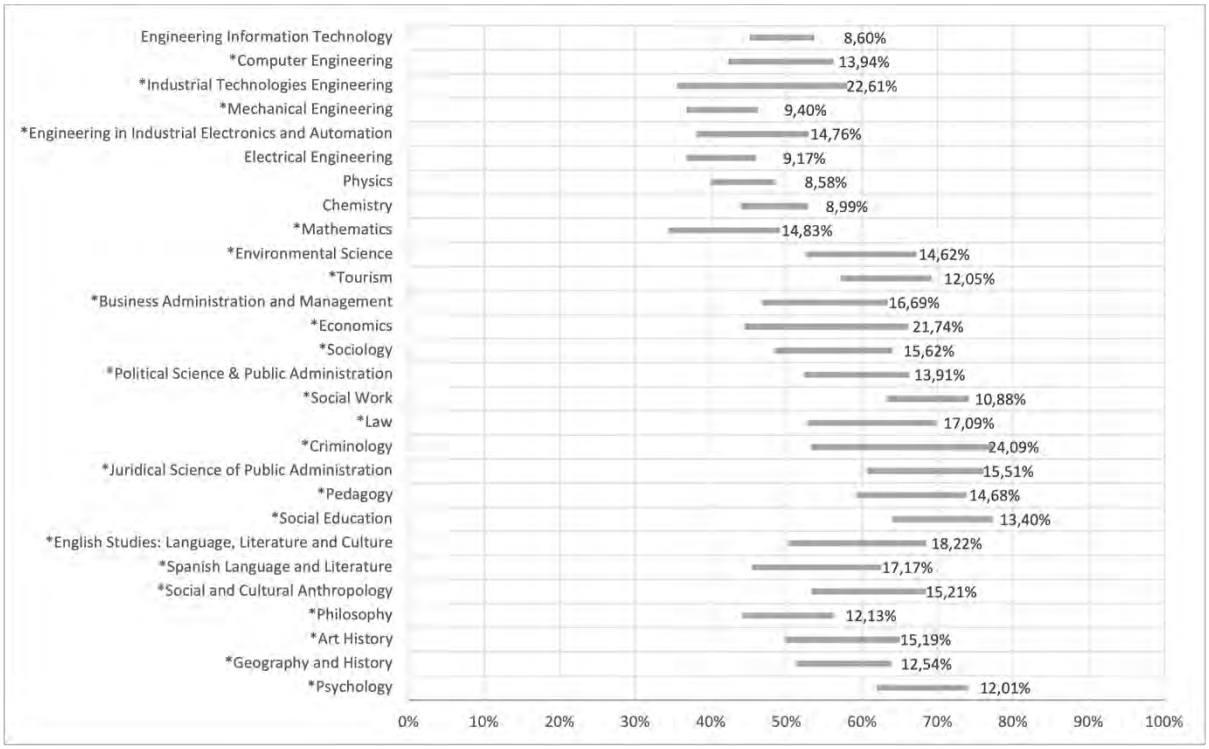

Figure 2: Assessment Rate: Average score from previous years with face-to-face exams *versus* score with online exams (Source: UNED Data Management Office)

* The difference is statistically significant (p<0.05 in one-way ANOVA)

The data from the survey on students' perceptions provide a complementary view related to the RA. Students were asked what influence the fact that the method used was online had on their decision to participate in the final assessment (Figure 3). A majority of students said it had no influence at all (64.8%), followed by those who felt encouraged to participate (24.0%), and a minority felt discouraged (11.2%). This is directly related to students' perception of online assessment, with a positive impression (predominantly "no influence" or "positive influence" responses). Eventually, this could explain in academic terms the higher participation rate in the exams. However, the possible projection of these results to other domains should consider the context of the research, as well as the possible biases of a sample composed mainly of students who took the exams and excluding those who did not, who may also have been discouraged by the new online exam format.

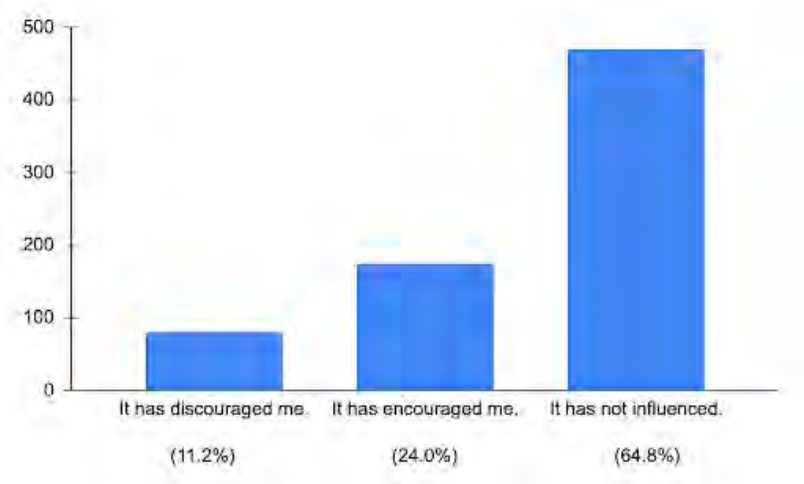

Figure 3: Data from the item: Has the fact that the exams are online influenced your decision to take them?

Figure 4 also shows the data from the survey items on students' preference between online and face-to-face exams. The majority of UNED students prefer online exams (54.3%) to face-to-face exams (39.9%), with a small percentage expressing other preferences (5.8%). Although this is significant, it should be noted that the context is that of a distance university, where there is a clear preference for digital methodologies.

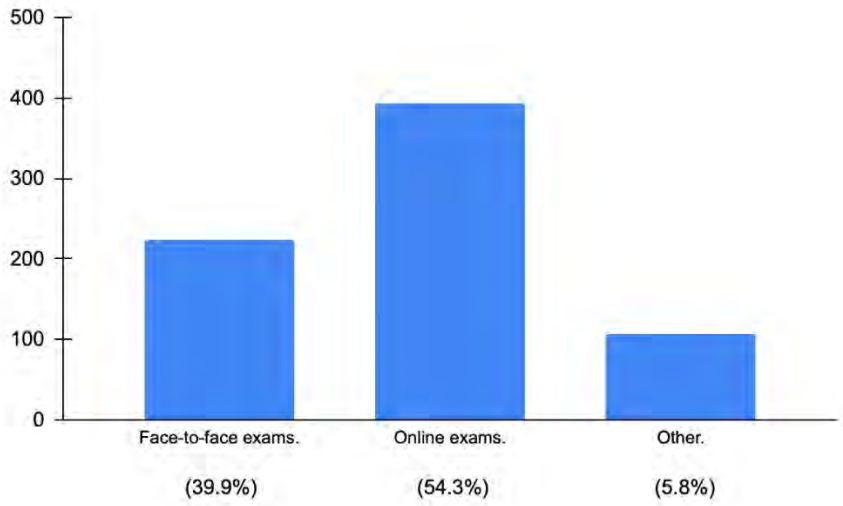

Figure 4: Data from the item: What assessment method do you prefer for taking the final exams?

5.3 Success Rate (SR) results

The SR indicator also increased with the new online assessment method (see Figure 5). The average increase in the success rate was 10.12% (*SD*=2.76). The increase was statistically significant in 10 out from the 28 Bachelor Degrees. This means that the percentage of students who passed the courses among those that were assessed was significantly higher in 35.7% of the Degrees. The Bachelor Degree with the highest increase in SR was Criminology (19.33%; *p*=0.00 significant), and the one with the lowest increase was Political Science & Public Administration (6.91%; *p*=0.30 non-significant).

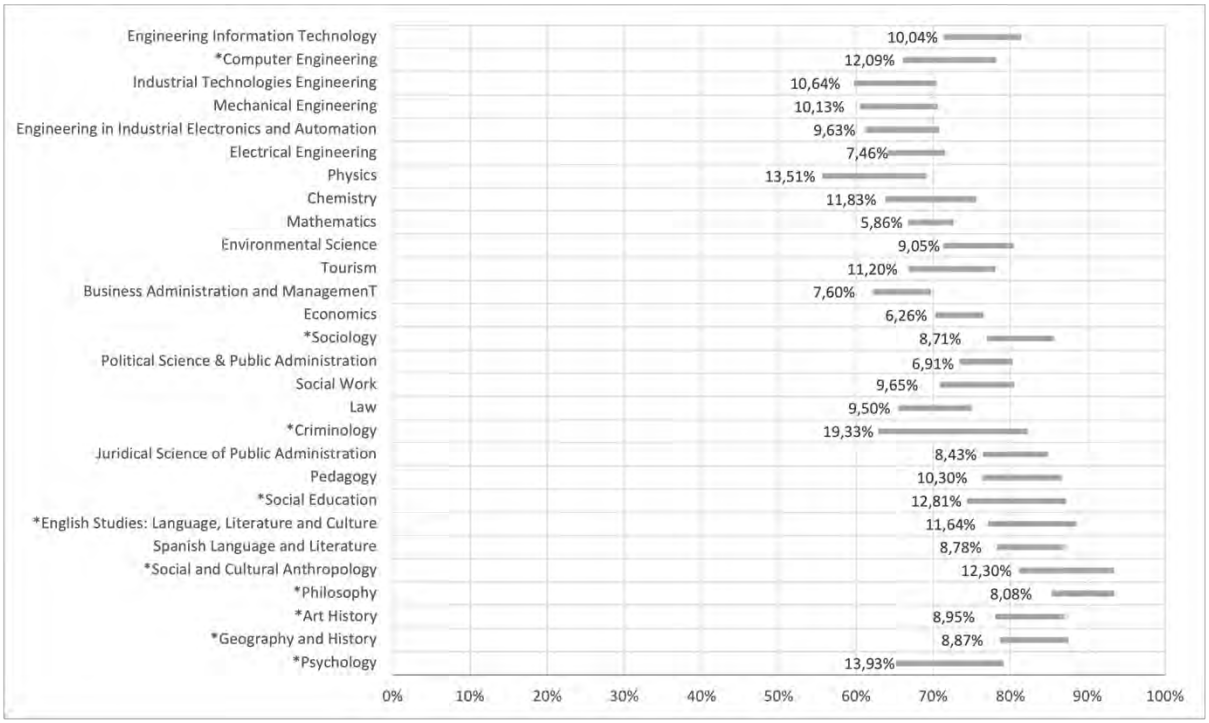

Figure 5: Success Rate: Average score from previous years with face-to-face exams *versus* score with online exams (Source: UNED Data Management Office).

* The difference is statistically significant (p<0.05 in one-way ANOVA)

5.4 Achievement Rate (Ar) results

The Ar, which derives from the previous two indicators (assessment rate and success rate), has consequently increased, as well (see Figure 6). The increase was statistically significant in 24 out from the 28 Bachelor Degrees (85.7%), and the detailed data indicate maximum increases of 30.62% (p=0.00 significant) in the Bachelor Degree in Criminology, although the highest figure is in the Bachelor Degree in Social Education with 67.54%. The lowest increases are those of the Bachelor in Engineering Information Technology with 8.40% (p=0.55 non-significant), with the Ar in that Degree in June 2020 below 50%. The average rise in Ar for all the Degrees was 16.01% (*SD*=5.67).

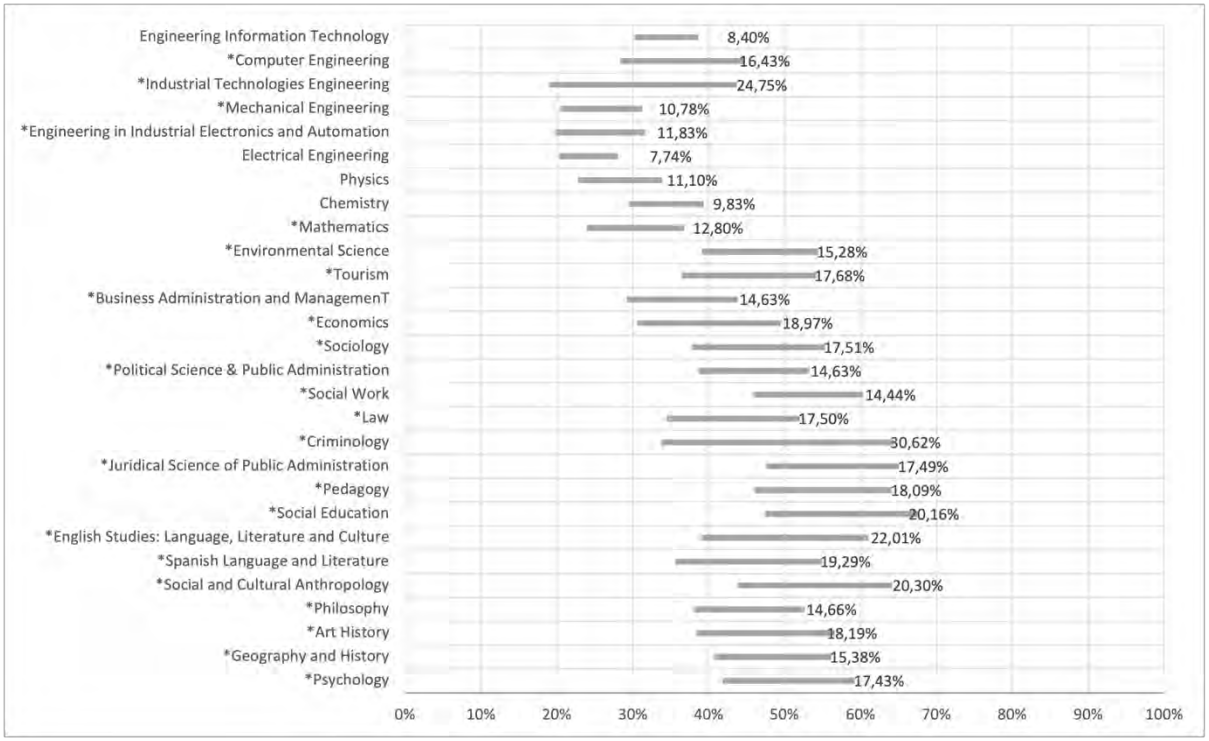

Figure 6: Achievement Rate: Average score from previous years with face-to-face exams *versus* score with online exams (Source: UNED Data Management Office)

* The difference is statistically significant (p<0.05 in one-way ANOVA)

5.5 Average Mark (AM) results

The impact of the online assessment on AM was also high (see Figure 7). The increase was statistically significant in 50% of the degrees (14 out of 28 degrees), with the highest increase in Criminology (1.51 points; p=0.00 significant), and the lowest in Electrical Engineering (0.14 points; p=0.92 non-significant). The average increase in all the Degrees was 0.8 points (*SD*=0.28). In all the cases, the Average Mark is over the pass score (5 points), which was not the case in previous years in two of the 28 Bachelor Degrees, in the Engineering area.

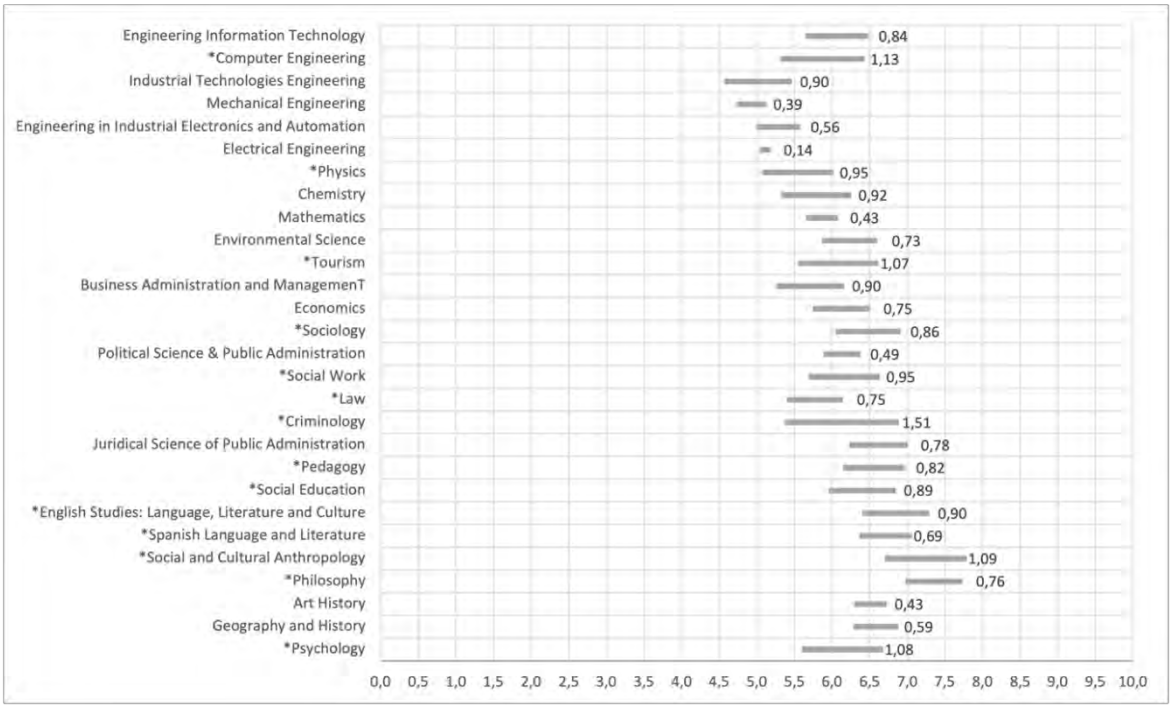

Figure 7: Average Mark: Average score from previous years with face-to-face exams *versus* score with online exams (Source: UNED Data Management Office).

* The difference is statistically significant (p<0.05 in one-way ANOVA)

The improvement in grades is paralleled by students' perception of the online assessment method as difficult. This would be adding value to the improvement in scores, in terms of the reliability of the examination system. The data from the Likert scale in Figure 8 show that a majority of students consider online assessment to be no easier than face-to-face assessment (39.5% strongly disagree; 24.3% disagree), with 25.7% thinking it is the same. In addition, the effect of a possible use of the survey by students to condition the difficulty of exams in the future could also be considered.

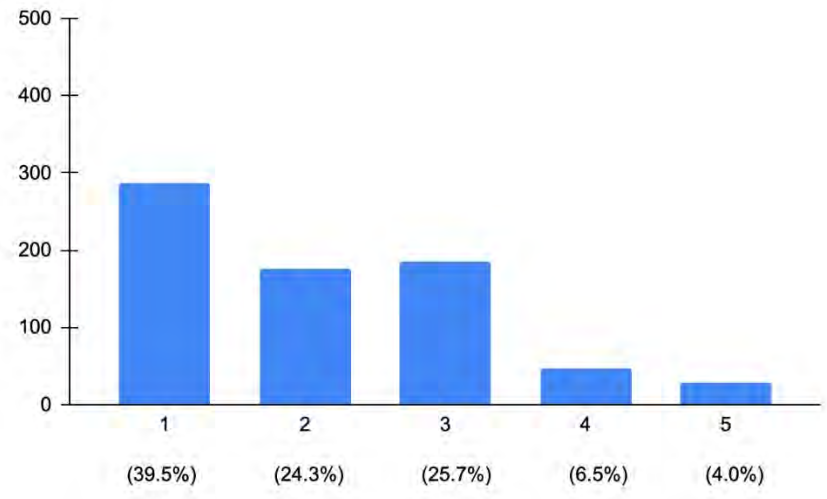

Figure 8: Data from the item: Are online exams easier than face-to-face ones?*

* (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Strongly agree.

Also, the time variable is one of the most mentioned in the scientific literature on the integrity of proctored exams. It is also stressed that more time in exams does not improve student performance in terms of higher scores (Portolese, Krause and Bonner, 2016). On this occasion, Figure 9 shows a clear majority of students who

stated that the time available was short (60.2%), followed by those who had sufficient time (31.1%) and, residually, those who claimed to have more time than necessary. These results indicate that the high-performance scores were achieved under conditions of time constraints.

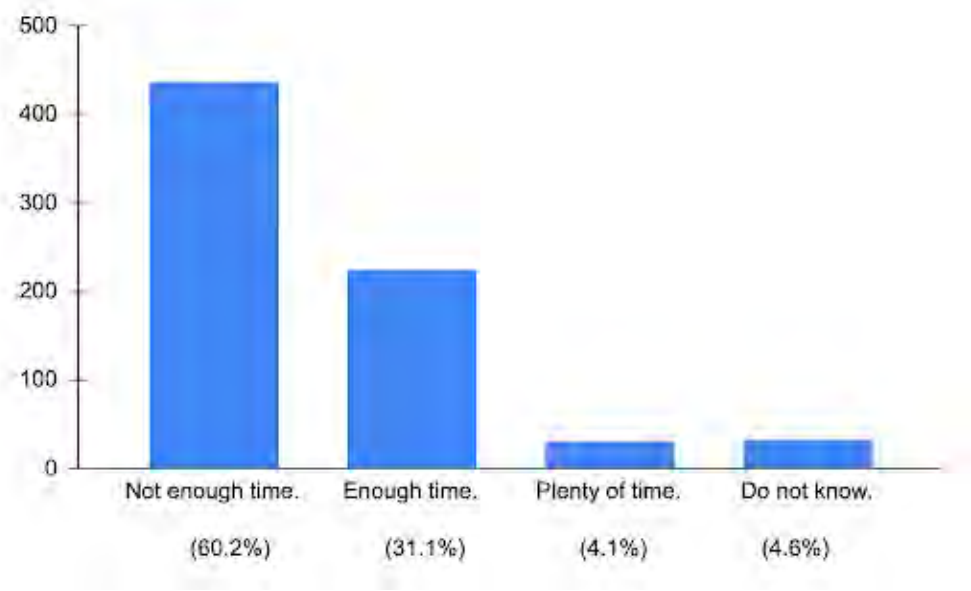

Figure 9: Data from the item: Have you had enough time to take the exam?

6. Discussion

Digital learning assessment methods have proved to be useful in improving teaching, mainly because of their flexibility and ability to adapt to individual student situations (Timmis, et al., 2015; Pauli and Ferrell, 2020). However, studies on its impact on academic performance have been inconclusive, and the only common element in the scientific literature is the strong link between performance and the academic conditions that frame online assessment —i.e., rapid organisational change, prior training of students in assessment, circumstances in which exams are held, etc.—. In the study presented here, the positive effect of online assessment on student performance is clear. And eventually, analysis of the findings must also consider the impact of academic conditions on outcomes.

The main evidence found is in response to RQ-1, since the results indicate a direct relationship between the use of an online assessment method and the performance improvement in all the indicators. So it is in the response to RQ-2 where the aspects related to the academic scheme of online assessment should be considered.

In the case of UNED, the academic issues that conditioned the online assessment revolved around the emergence of change as a consequence of the COVID-19. In addition, the speed of change also affected the type of technology and the assessment process in each case.

The results show that the improvement in performance indicators coincides with a high appreciation of online assessment by students; there are a residual number of students discouraged from taking exams when the system changed from face-to-face to online (Figure 3). The research suggests two factors that may explain the improvements, and these are provided below.

- The online assessment under analysis took place in June 2020 during the COVID-19 crisis that, in the case of Spain, led to a situation of population confinement. In this context, many distance students may have taken advantage of the slowdown in socio-economic activity to spend more time on academic activities. This situation may have altered the results, making it necessary to further study the impact of online assessment under “normal” circumstances.
- Another circumstance that can explain the positive results in performance is the protocol applied to design the exams. Due to the rapid change, teachers simply replicated the face-to-face exams in the online format, and tried to avoid extra difficulties for the students. It is possible that the online exams that were finally designed were less difficult than the original face-to-face version. Again, this possible

bias calls for alternative research on successive cohorts of students and also adding analysis of the process of test design by teachers.

The fact that research is contextualised in a distance university also has an impact on the acceptance of online assessment, as students eventually appreciate the ease of not having to travel to the examination centres. In this sense, the results are consistent with previous studies that highlight the preference of university students for online exams (Attia, 2014; Matthíasdóttir and Arnalds, 2016; Böhmer, Feldmann and Ibsen, 2018; Pagram, et al., 2018; Butler-Henderson and Crawford, 2020), and specifically in the context of distance learning universities (Gaytan and McEwen, 2007; Kim, Smith and Maeng, 2008; Yang, et al., 2017).

Another topic of discussion is the influence of online exam time on performance. According to the results of previous studies, this research also points out that students attach great importance to the time available. Here their perception is that examination time has been low (Figure 8), although, contrary to the results of other studies (Portolese, Krause and Bonner, 2016), the scores (average mark, see Figure 7) have been higher than in face-to-face exams with the same time available. Previous research relates time available to anxiety levels, and indicates that perceived negative factors about the dynamics of an online exam decrease after students have tried the system (Kumar, 2014; Kolski and Weible, 2018). While this study does not address the anxiety variable, it does reinforce students' concerns about the apparent lack of time to take exams and the difficulty that comes with it.

Another issue of interest concerns differences in performance in the various undergraduate degrees at the university. There is not enough evidence to establish sets of Bachelor Degrees with different performance values, since in all cases the scores on the indicators increased and in a majority of them (85.7%) the increase in assessment (AR) and achievement (Ar) rates were statistically significant. The lowest increase is the indicator Average Mark (0.14) in the Bachelor Degree in Electrical Engineering, and that is a degree where the average scores are usually very low (5.04). This reinforces the conclusion that the increase in the set of indicators in all cases is due to the general academic context —in the variables already analysed, and other potentials not covered in this research— and also to the accelerated change in the assessment method in a more specific way.

Finally, it is worth discussing the role of cheating in research results. The scientific literature highlights doubts in the integrity of online assessment due to the possibility of cheating, among other factors. In the study, this weakness attempted to be controlled by looking at the different control mechanisms (technological, time, question focus, process monitoring, etc.) that were applied in the UNED online exams. Table 1 shows the control technologies employed, and evidence was also collected on the difficulty of limiting the time available to take the exams (see Figure 9), which affects the intentionality to cheat in online performance situations (Capraro, 2017; Kubesch, Lankes and Maurer, 2019; Van der Cruyssen, et al., 2020).

7. Conclusions

The aim of the research is to take a broader view than the purely technical one of the consequences on academic performance of changing the assessment format —use of an online versus a face-to-face system—, incorporating academic factors —organizational context and students' perception of rapid change— which, according to the literature review, are also decisive in explaining student performance. To this end, data were collected from the first cohort of students using an online assessment system at the UNED.

The first research question focuses on the influence of the new online examination system on student performance. The study concludes that there is an increase in the academic performance of students who have taken the online exams in all the indicators analysed, and that the differences are statistically significant, specially in Assessment and Achievement rates (in 24 out from 28 Bachelor Degrees in each rate). Success rate and Average mark have also increased with the online assessment that was in place in 2020, but the differences were statistically significant in 50% (AM) and 35.7% (SR) of the Bachelor Degrees. The second research question focused on the possible change in students' perceptions of online examinations after experiencing the new method. And the research concludes that improvement in academic performance also coincides with a better perception by UNED students of online assessment as opposed to face-to-face assessment. In addition, the online format encouraged them to take the exams, although they did not perceive the online version to be easier and found the short time available a particular difficulty.

The contribution of the study to the issue of the integrity of the online assessment process is limited. However, the results of the survey on students' perceptions of online assessment point to a more difficult, time-sensitive and generally more complex system than face-to-face examinations. In this sense, the data indicate that students do not perceive online assessment as easy, with lower quality and less control. And in the specific case of distance learning universities, the most relevant academic aspect resulting from students' acceptance of the online method is the increase in Ar, considering that in distance learning higher education the number of students enrolled who pass the course is usually lower than in face-to-face universities.

There are also limitations when it comes to attributing a motivational capacity to online exams. In the research, students expressed a favourable tendency towards online exams, insofar as they had no influence or minimal incentive to take them (Figure 3) and are preferred over face-to-face exams (Figure 4). However, this effect seems to be more related to the context of a distance learning university —where students are more likely to opt for any non-face-to-face alternative— than for online exams *per se*. So, based on the data from this research, a conclusion on this aspect would require further inquiry in conventional face-to-face learning situations.

A possible implication of the implementation of the online assessment and the increase in academic performance is an expected reduction of dropout in the medium term. The significant increase in the achievement rate (figure 6), which means that a higher percentage of students pass a course, can positively lead to a higher enrolment in the next year. This impact on retention has a great significance in distance education, where dropout has been a permanent challenge (Garrison, 1987; Aretio, 2019).

The findings show that the students' academic performance in all the indicators and all the Bachelor Degrees has improved, and that the general opinion of the students who responded to the survey is good about the online system. The question then is how this experience will inform and drive long-term organizational change. In the case of UNED, the online final assessment system was also implemented in the September 2020 call and throughout the 2020-2021 academic year. But is this still an emergency solution, and will exams be held again face-to-face as long as the pandemic allows? Will online exams continue to be the main final assessment system after the COVID-19 crisis? Will online and face-to-face exams coexist in the future?

On the horizon, organisations are faced with questions about improving the reliability of online examinations, and administrative barriers related to agencies and quality standards. How to overcome these barriers and take advantage of the benefits of digital assessment will be factors to be analysed in the near future.

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Appendix

Table A: UNED students' academic performance indicators (AR, SR). Disaggregated data for all Bachelor Degrees, 2015-2019 and 2020 (Source: UNED Data Management Office).

	Assessment Rate (%)			Success Rate (%)		
Bachelor Degree	**2015-19 Average**	**2020**	**Difference**	**2015-19 Average**	**2020**	**Difference**
Psychology	61.95	73.96	**12.01**	65.16	79.09	**13.93**
Geography and History	51.27	63.81	**12.54**	78.62	87.49	**8.87**
Art History	49.83	65.03	**15.19**	77.98	86.94	**8.95**
Philosophy	44.16	56.29	**12.13**	85.33	93.42	**8.08**
Social and Cultural Anthropology	53.23	68.43	**15.21**	81.07	93.37	**12.30**
Spanish Language and Literature	45.36	62.53	**17.17**	78.18	86.96	**8.78**
English Studies: Language. Literature and Culture	50.26	68.48	**18.22**	77.02	88.67	**11.64**
Social Education	63.93	77.32	**13.40**	74.33	87.14	**12.81**
Pedagogy	59.21	73.89	**14.68**	76.34	86.63	**10.30**
Juridical Science of Public Administration	60.61	76.13	**15.51**	76.40	84.84	**8.43**

	Assessment Rate (%)			Success Rate (%)		
Bachelor Degree	**2015-19 Average**	**2020**	**Difference**	**2015-19 Average**	**2020**	**Difference**
Criminology	53.21	77.29	**24.09**	62.88	82.21	**19.33**
Law	52.71	69.80	**17.09**	65.45	74.95	**9.50**
Social Work	63.23	74.11	**10.88**	70.83	80.48	**9.65**
Political Science & Public Administration	52.33	66.25	**13.91**	73.37	80.28	**6.91**
Sociology	48.41	64.03	**15.62**	76.92	85.63	**8.71**
Economics	44.39	66.13	**21.74**	70.23	76.49	**6.26**
Business Administration and Managemen	46.74	63.43	**16.69**	62.12	69.72	**7.60**
Tourism	57.18	69.23	**12.05**	66.86	78.06	**11.20**
Environmental Science	52.59	67.21	**14.62**	71.32	80.37	**9.05**
Mathematics	34.30	49.13	**14.83**	66.75	72.61	**5.86**
Chemistry	43.91	52.89	**8.99**	63.78	75.61	**11.83**
Physics	39.96	48.54	**8.58**	55.59	69.09	**13.51**
Electrical Engineering	36.82	45.99	**9.17**	64.07	71.53	**7.46**
Engineering in Industrial Electronics and Automation	38.17	52.94	**14.76**	61.16	70.79	**9.63**
Mechanical Engineering	36.82	46.22	**9.40**	60.51	70.64	**10.13**
Industrial Technologies Engineering	35.48	58.09	**22.61**	59.76	70.40	**10.64**
Computer Engineering	42.32	56.26	**13.94**	66.07	78.16	**12.09**
Engineering Information Technology	45.11	53.71	**8.60**	71.33	81.37	**10.04**

Table B: UNED students' academic performance indicators (Ar, AM). Disaggregated data for all Bachelor Degrees, 2015-2019 and 2020 (Source: UNED Data Management Office).

	Achievement Rate (%)			Average Mark (1-10)		
Bachelor Degree	**2015-19 Average**	**2020**	**Difference**	**2015-19 Average**	**2020**	**Difference**
Psychology	41.80	59.23	**17.43**	5.60	6.68	**1.08**
Geography and History	40.76	56.14	**15.38**	6.29	6.88	**0.59**
Art History	38.40	56.60	**18.19**	6.29	6.73	**0.43**
Philosophy	38.02	52.67	**14.66**	6.97	7.73	**0.76**
Social and Cultural Anthropology	43.82	64.13	**20.30**	6.70	7.79	**1.09**
Spanish Language and Literature	35.61	54.90	**19.29**	6.37	7.06	**0.69**
English Studies: Language. Literature and Culture	39.02	61.03	**22.01**	6.40	7.29	**0.90**

	Achievement Rate (%)			Average Mark (1-10)		
Bachelor Degree	**2015-19 Average**	**2020**	**Difference**	**2015-19 Average**	**2020**	**Difference**
Social Education	47.38	67.54	**20.16**	5.95	6.84	**0.89**
Pedagogy	46.07	64.16	**18.09**	6.14	6.97	**0.82**
Juridical Science of Public Administration	47.60	65.09	**17.49**	6.23	7.01	**0.78**
Criminology	33.74	64.36	**30.62**	5.38	6.88	**1.51**
Law	34.46	51.95	**17.50**	5.40	6.14	**0.75**
Social Work	45.90	60.34	**14.44**	5.69	6.63	**0.95**
Political Science & Public Administration	38.62	53.25	**14.63**	5.89	6.38	**0.49**
Sociology	37.79	55.30	**17.51**	6.05	6.91	**0.86**
Economics	30.54	49.51	**18.97**	5.74	6.50	**0.75**
Business Administration and Managemen	29.21	43.84	**14.63**	5.25	6.15	**0.90**
Tourism	36.49	54.17	**17.68**	5.54	6.61	**1.07**
Environmental Science	39.10	54.38	**15.28**	5.87	6.60	**0.73**
Mathematics	23.98	36.78	**12.80**	5.65	6.08	**0.43**
Chemistry	29.52	39.35	**9.83%**	5.33	6.25	**0.92**
Physics	22.79	33.89	**11.10**	5.06	6.02	**0.95**
Electrical Engineering	20.26	28.00	**7.74**	5.04	5.18	**0.14**
Engineering in Industrial Electronics and Automation	19.80	31.63	**11.83**	5.01	5.57	**0.56**
Mechanical Engineering	20.50	31.28	**10.78**	4.73	5.12	**0.39**
Industrial Technologies Engineering	18.92	43.67	**24.75**	4.56	5.46	**0.90**
Computer Engineering	28.32	44.75	**16.43**	5.31	6.43	**1.13**
Engineering Information Technology	30.22	38.62	**8.40**	5.64	6.48	**0.84**