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UNIVERSITY STUDENTS GRADING BEFORE AND DURING COVID-19 CRISIS

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ABSTRACT

The paper analyses the grades assigned by the professors of the University of Milan to their students at the end of written exams, comparing what happened in academic year 2018-19 and in academic year 2020-21, i.e., before and during the crisis caused by the Covid-19 pandemic.
In March 2020, the lockdown closed the classrooms, stopping face-to-face interactions among professors and students: it became then necessary to identify possible scenarios for carrying on written exams online, suitably monitoring student behaviors, and to propose them to the University professors.
Main purpose of the analysis reported in this paper is a preliminary evaluation of the effectiveness of these scenarios, through comparison of the grades the professors assigned to their students.

KEYWORDS

Written Exams, Online Student Monitoring, Exam Sessions, Grades Assigned to Students.

1. INTRODUCTION

As already presented in recent e-learning conferences (Haus et al. 2020, Haus et al. 2021, Scarabottolo 2022) the lockdown imposed by the Covid-19 pandemic around the end of February 2020 forced the Italian Universities to transfer suddenly online all the teaching activities normally carried on with students physically present in classrooms.

To understand better the context and the dimensions of the problem, it is worth noticing the presence at the University of Milan of 67 bachelor degrees (3 years, 180 ECTS – European Credit Transfer System – credits) 64 master degrees (2 years after bachelor, 120 ECTS credits) and 9 single-cycle master degrees (5 or 6 years, 300 or 360 ECTS credits). According to the rules of the Italian University system, these degrees are allocated to different groups of professors, belonging to entities called (for historical reasons) faculties or schools.

In our University, we have eight faculties: Agricultural and Food Sciences, Humanities, Law, Medicine, Pharmacy, Political, Economic and Social Sciences, Science and Technology, Veterinary Medicine, and two schools: Exercise and Sport Sciences, Language Mediation & Intercultural Communication. They group 2179 staff professors and almost 2000 contract professors (supported by 1960 technical and administrative staff units) teach every year more than 3000 courses.

Despite the dimensions of the University, classroom lectures were transferred online without dramatic effort, by asking professor to adopt streaming and recording in equipped rooms as well as using their own personal computers. The support offered by the university personnel mainly consisted in a set of instructions published on the web portal, helping professors in using streaming and recording facilities and in publishing didactical materials on the proprietary LMS (Learning Management System). Similar approach has been followed to allow the thesis discussion of graduating students: the web conference platforms used for lectures have been adopted also to connect these students from home with the committee of professors evaluating their final exam.

Exams at the end of single courses were initially converted in oral form, allowing interaction between professors and single students by web conferencing supports (e.g., Teams, Zoom, Skype). However, several courses in our university are followed by huge numbers of students, making impractical to examine in oral form each of them. Moreover, in an oral exam, it is hard to ask students to solve problems requiring (even a short) autonomous work, and it is not easy to find a set of equally difficult questions to pose to several students.

To overcome the above limits, a group of experts (including the author of this paper) was asked to identify monitoring scenarios and tools allowing remote control of student behavior (to avoid usage of unauthorized supports and cheating) during written exams performed at home. After several tests and analyses of tools offered by the market, we proposed two scenarios for online student monitoring during written exams to the professors of the University of Milan, depending on the number of students registered to the same exam session. In particular, it has been decided the threshold of 100 students as the discrimination between SMALL and LARGE exam session. In fact, it is proper considering that:

- a reasonable student number that can be monitored by a single person is in the range 20-30;
- it is not worth to ask professors to split students in more than 4 to 5 groups, to be monitored in parallel (with the help of some collaborators) or one after each other.

Figure 1. Direct monitoring of student during a written exam

1.1 Direct Monitoring

For SMALL exam sessions, the envisioned exam scenario, deeply described in (Haus et al. 2020) requires that each group of 20÷30 students is monitored using a web conference platform (e.g., Microsoft Teams, Zoom, etc.) established between the computer of the professor and the smartphone of each student, placed behind her/him to allow a very effective proctoring. In fact, the professor can control that no forbidden material (e.g., books, written notes, etc.) is used by the student during the exam; moreover, by zooming on each student window in the web conference, the professor can look at the desktop and see if the student is operating correctly (i.e., using only the allowed applications). Figure 1 gives an example of such a monitoring scenario.

For open answer tests, the exam is carried on using the exam.net platform (Exam.net 2020) implemented by the Swedish company Teachiq AB, characterized by:

- the adoption of SEB – Secure Exam Browser (SEB 2020) – that turns any computer temporarily into a secure workstation, forbidding usage of other programs and resources during an exam;

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- a very easy professor interface, greatly facilitating creation and test of exams;
- real time monitoring of student work, since the professor can browse among students and see what each of them already wrote;
- a chat support, allowing the professor to interact with every student without disturbing the overall group.

An example of what this platform allows is given in Figure 2: on the left information regarding the exam, on the right real time monitoring of the exam of a single student.

For closed answer quizzes, not easy to implement with exam.net, direct integration of SEB with the Moodle LMS hosting the quizzes has been adopted.

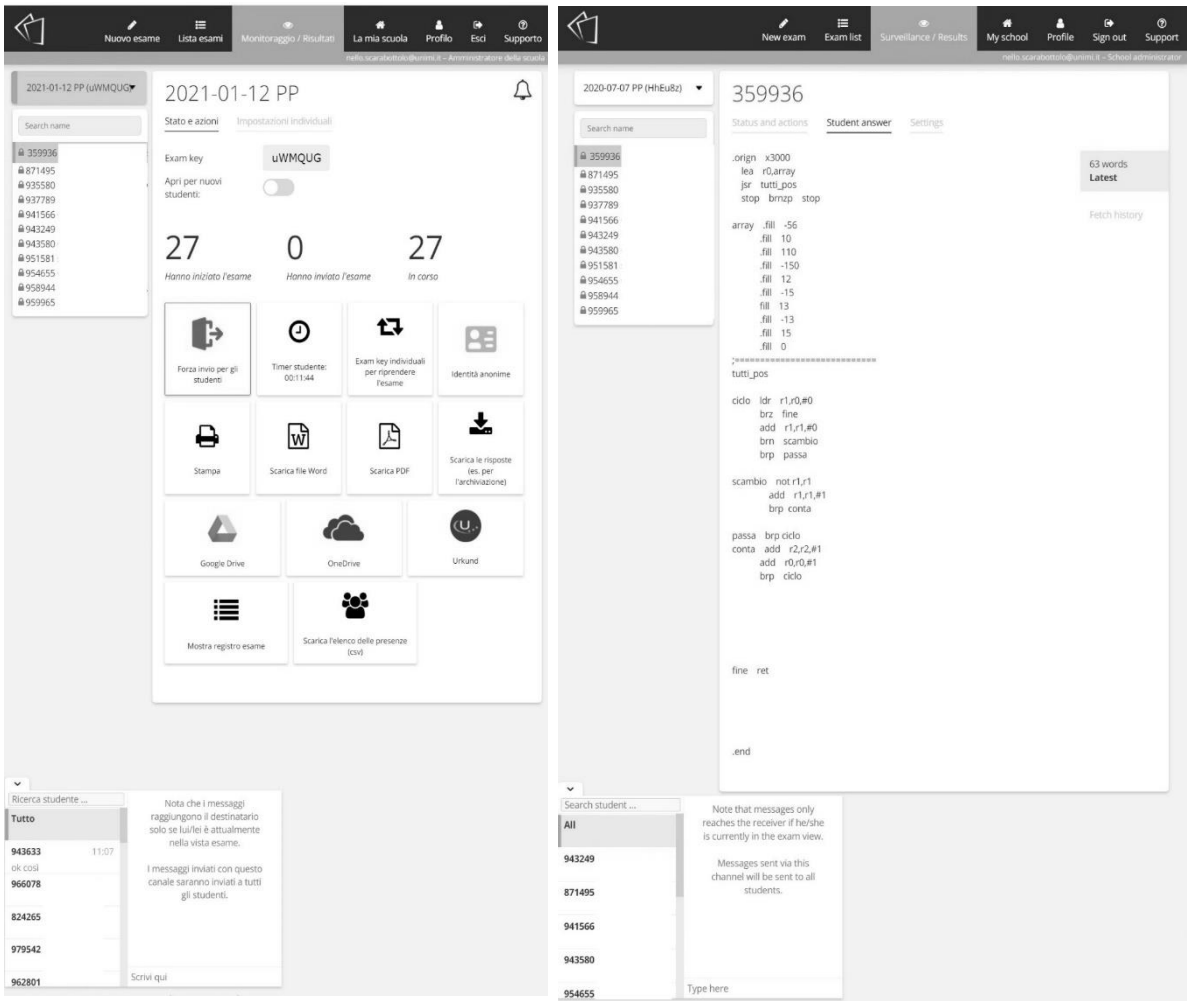

Figure 2. Characteristics of the exam.net platform

1.2 Software Supported Proctoring

For LARGE sessions, where direct monitoring would require too many professors/collaborators, we decided to use a proctoring tool available on the market, designed to record the behaviour of each student during the exam through the webcam of her/his computer. After the end of the exam, all recordings are processed by suitable Artificial Intelligence algorithms, that mark “suspect” behaviours of each student (e.g., eyes or head movements, noises, appearance of other people, etc.) to allow the professor to analyse them and decide accordingly how to manage student evaluation.

After some tests, we adopted Proctorio (Proctorio 2020) mainly for these reasons:

- Proctorio uses a simple add-on for browsers like Chrome that creates a secure exam environment by restricting internet navigation and computer functionality, thus facilitating student computer setup;
- student behaviour monitoring is very accurate, since Proctorio records the webcam stream and also the desktop of the student computer;
- the browser add-on sends only some video frames instead of a continuous streaming, thus significantly reducing the network bandwidth requirements (and facilitating monitoring of students with poor internet connections);
- the final AI algorithm can be tuned by the professor in terms of sensitivity to the different kinds of suspected behaviours after receiving the recorded exams; this allows the professor to emphasize the aspects considered most dangerous and/or more common.

2. EXAM SESSIONS BEFORE AND DURING PANDEMIC

A first analysis is the comparison between a normal academic year (2018-19, before Covid-19 pandemic) and the academic year 2020-21, when all exams have been carried on online due to the various limitations imposed by the lockdown rules.

Table 1 shows the numbers of SMALL and LARGE written exam sessions per month in 2018-19 and 2020-21 (August has been omitted, since almost no exams take place during the traditional Italian vacation month).

It is interesting to note that almost in every month the number of SMALL sessions decreased during pandemic, with the exception of May. The most likely explanation for that is the delay in defining the scenarios recalled above, that forced professors to postpone exams during the first pandemic months (March-April 2020).

Table 1. SMALL and LARGE exam sessions in 2018-19 and 2020-21 per month

Month	**SMALL exam sessions**			**LARGE exam sessions**		
	2018-19	**2020-21**	***delta***	**2018-19**	**2020-21**	***delta***
January	1˙150	992	*-158*	51	29	*-22*
February	1˙238	1˙232	*-6*	32	35	*3*
March	306	319	*13*	10	21	*11*
April	516	433	*-83*	18	7	*-11*
May	534	650	*116*	11	16	*5*
June	1˙323	1˙111	*-212*	51	30	*-21*
July	1˙780	1˙461	*-319*	27	39	*12*
September	1˙537	1˙357	*-180*	16	7	*-9*
October	284	252	*-32*	1	0	*-1*
November	529	411	*-118*	4	8	*4*
December	506	461	*-45*	39	31	*-8*
Total	**9˙703**	**8˙679**	***-1˙024***	**260**	**223**	***-37***

Table 2 shows the same data of Table 1 over the various faculties. The numbers of written exam sessions decrease everywhere with the exception of the Humanities faculty. A possible explanation for that is the huge numbers of enrolled students (14˙878 in 2018-19, almost twice the 8˙450 students enrolled in the second faculty, Science and Technology) suggesting adoption of software supported proctoring for managing the largest exam sessions.

Table 2. SMALL and LARGE exam sessions in 2018-19 and 2020-21 per faculty

Faculty/School	**SMALL exam sessions**			**LARGE exam sessions**		
	2018-19	**2020-21**	***delta***	**2018-19**	**2020-21**	***delta***
Agricultural and Food Sciences	893	613	*-280*	7	2	*-5*
Exercise and Sport Sciences	168	69	*-99*	14	9	*-5*
Humanities	532	687	*155*	53	40	*-13*
Language Mediation & Intercultural Communication	590	416	*-174*	32	25	*-7*
Law	147	124	*-23*	7	3	*-4*
Medicine	1˙814	1˙489	*-325*	2	1	*-1*
Pharmacy	701	622	*-79*	8	3	*-5*
Political, Economic and Social Sciences	2˙003	1˙869	*-134*	84	89	*5*
Science and Technology	2˙372	2˙295	*-77*	42	47	*5*
Veterinary Medicine	483	495	*12*	11	4	*-7*
Total	**9˙703**	**8˙679**	***-1˙024***	**260**	**223**	***-37***

3. GRADES OBTAINED BY STUDENTS

In (Weiner & Hurtz 2017) a comparison between online and onsite proctored exams is reported, showing that there are no significant differences in final grades: this allows authors of that paper to state that the effectiveness of student proctoring can be satisfactory both online and onsite.

To evaluate what happened at the University of Milan, Table 3 reports the average grades (ranging from 18/30 to 30/30) obtained by students of the various faculties in written exams after and during pandemic, for SMALL and for LARGE exam sessions. It is easy to see that data confirm the correctness of the (Weiner & Hurtz 2017) conclusions: the largest difference between the two years is the 0.6/30 increase in grades obtained in LARGE sessions by students of the Political, Economic and Social Sciences faculty.

Table 3. Average grades obtained by students in 2018-19 and 2020-21 per faculty

Faculty/School	**SMALL exam sessions**			**LARGE exam sessions**		
	2018-19	**2020-21**	***delta***	**2018-19**	**2020-21**	***delta***
Agricultural and Food Sciences	24.4	24.3	*-0.1*	23.9	23.4	*-0.4*
Exercise and Sport Sciences	26.0	25.7	*-0.3*	26.9	26.4	*-0.5*
Humanities	25.7	25.5	*-0.2*	24.5	24.9	*0.4*
Language Mediation & Intercultural Communication	25.0	25.2	*0.3*	25.4	25.3	*-0.1*
Law	24.2	24.6	*0.4*	26.8	na	*na*
Medicine	25.6	25.7	*0.1*	28.5	26.9	*-1.6*
Pharmacy	24.3	24.6	*0.3*	24.3	23.9	*-0.4*
Political, Economic and Social Sciences	24.8	25.2	*0.5*	24.9	25.5	*0.6*
Science and Technology	25.2	25.4	*0.2*	25.0	23.6	*-1.5*
Veterinary Medicine	24.9	25.2	*0.3*	24.5	24.4	*-0.1*
Total	**25.0**	**25.3**	***0.2***	**25.2**	**25.2**	***0.0***

Table 4. Standard deviations of grades obtained by students in 2018-19 and 2020-21 per faculty

Faculty/School	**SMALL exam sessions**			**LARGE exam sessions**		
	2018-19	**2020-21**	***delta***	**2018-19**	**2020-21**	***delta***
Agricultural and Food Sciences	3.9	4.1	0.2	3.7	3.3	-0.3
Exercise and Sport Sciences	3.5	3.6	0.1	3.1	3.3	0.2
Humanities	3.8	3.9	0.1	4.1	4.3	0.2
Language Mediation & Intercultural Communication	3.9	4.0	0.1	3.9	3.4	-0.4
Law	4.6	4.4	-0.2	3.7	na	*na*
Medicine	3.5	3.6	0.2	3.4	1.6	-1.8
Pharmacy	4.1	4.5	0.4	3.8	6.5	2.7
Political. Economic and Social Sciences	4.1	4.1	0.0	4.0	4.1	0.1
Science and Technology	4.0	4.4	0.4	4.3	5.5	1.3
Veterinary Medicine	3.7	3.6	-0.1	3.5	3.6	0.1
Total	**3.9**	**4.1**	**0.2**	**4.0**	**4.2**	**0.2**

Even if considering the standard deviations of grades obtained, the picture – reported in Table 4 – does not indicate significant differences after and during pandemic. The highest differences for SMALL sessions – both equal to 0.4 – regard the two faculties of Pharmacy and Science and Technology, whose professors evidently used materials produced in online exams to better differentiate final grades. Definitely higher differences are present for LARGE sessions, but they refer to faculties (Medicine and Pharmacy) where the very limited numbers of this kind of sessions does not allow significant statistical evaluations.

Another interesting analysis is the behavior of students in the different types of university degrees, namely: bachelor degree (BD: 3 years) master degree (MD: 2 years after bachelor) single cycle master degree (SC: 5 or 6 year). As shown in Table 5, grades reported in master degree are always higher than in bachelor degrees, since master students already obtained a bachelor, they decided to continue studying, they are for sure well acquainted with university exams.

Even the single cycle master degree of the Medicine faculty (Medicine and Surgery) shows an average grade in line with the other master degrees of the same faculty, since less than one fourth of perspective students can enroll to this single cycle degree, after passing a very hard admission test. On the contrary, then single cycle master degrees of the Pharmacy faculty (Pharmacy and Pharmaceutical Chemistry and Technology) show average grades in line with the bachelor degrees of that faculty, probably because the admission tests to these single cycle degrees are far less crowded.

Note that two faculties – Law and Veterinary Medicine – are not present in Table 5. This is because both bachelor and master students of these faculties can follow the same courses. Thus, no distinction in final grades is possible.

Again, standard deviations – given in Table 6 – do not show significant differences after and during pandemic.

Table 5. Average grades obtained by students in the various types of degrees per faculty

Faculty/School	**2018-19**			**2020-21**		
Type of degree	**BD**	**MD**	**SC**	**BD**	**MD**	**SC**
Agricultural and Food Sciences	24.0	26.2		24.2	27.3	
Exercise and Sport Sciences	26.1	26.6		26.1	26.0	
Humanities	25.2	26.1		25.2	27.1	
Language Mediation & Intercultural Communication	25.1	25.8		24.9	26.6	
Medicine	25.0	26.6	27.0	25.3	27.0	27.0
Pharmacy	23.6	28.3	24.3	23.3	27.2	24.5
Political, Economic and Social Sciences	24.5	26.1		25.0	26.4	
Science and Technology	24.9	26.7		24.9	27.2	
Total	**24.8**	**26.3**	**25.8**	**25.0**	**26.8**	**25.7**

Table 6. Standard deviations of grades obtained by students in the various types of degrees per faculty

Faculty/School	**2018-19**			**2020-21**		
Type of degree	**BD**	**MD**	**SC**	**BD**	**MD**	**SC**
Agricultural and Food Sciences	3.9	3.4		4.1	3.4	
Exercise and Sport Sciences	3.4	3.3		3.4	3.5	
Humanities	4.0	3.6		4.1	3.3	
Language Mediation & Intercultural Communication	3.9	3.7		3.6	3.7	
Medicine	3.5	3.3	3.5	3.6	3.1	3.6
Pharmacy	4.0	3.9	4.0	4.3	3.6	4.6
Political, Economic and Social Sciences	4.1	3.9		4.1	3.8	
Science and Technology	4.0	3.6		4.5	3.6	
Total	**3.9**	**3.7**	**4.0**	**4.1**	**3.7**	**4.3**

Similar considerations can be made by examining average grades obtained by students in the various years of their curricula, whenever such information is available (again, some faculties leave to students the freedom to follow a course in different years). Tables 7 and 8 show these average grades, for academic year 2028-19 and 2020-21 respectively. As it can be easily noted, grades usually increase when passing from each study year to the following one, since students become more and more acquainted with university studies.

Standard deviations – given in Tables 9 and 10 – confirm the above.

Table 7. Average grades obtained in 2018-19 by students in the various study years per faculty

Faculty/School	**2018-19**					
Course year	**1**	**2**	**3**	**4**	**5**	**6**
Agricultural and Food Sciences	23.6	24.2	24.5	26.1	26.5	
Exercise and Sport Sciences	26.3		25.3	26.3	28.2	
Humanities		28.2		28.4		
Language Mediation & Intercultural Communication	24.5	25.7	25.0	25.5	26.7	
Medicine	24.7	25.7	26.0	26.9	27.4	29.5
Pharmacy	23.3	24.7	24.0	25.2	24.2	
Political, Economic and Social Sciences	24.2	24.5	25.0	26.0	26.4	
Science and Technology	24.7	24.8	25.2	26.9	26.9	
Total	**24.4**	**24.9**	**25.2**	**26.2**	**26.8**	**29.5**

Table 8. Average grades obtained in 2020-21 by students in the various study years per faculty

Faculty/School	**2020-21**					
Course year	**1**	**2**	**3**	**4**	**5**	**6**
Agricultural and Food Sciences	23.6	24.6	24.9	27.3	26.9	
Exercise and Sport Sciences	27.0	25.5	25.5	26.0		
Humanities	26.2	24.7				
Language Mediation & Intercultural Communication	24.6	25.7	24.9	26.5	27.0	
Medicine	25.2	26.4	26.1	26.7	28.1	27.7
Pharmacy	23.8	24.4	26.0	25.3	25.0	
Political, Economic and Social Sciences	24.9	24.5	26.0	26.2	26.8	
Science and Technology	24.8	24.9	25.7	27.4	28.4	
Total	**24.8**	**25.0**	**25.8**	**26.5**	**27.1**	**27.7**

Table 9. Standard deviation of grades obtained in 2018-19 by students in the various study years per faculty

Faculty/School	**2018-19**					
Course year	**1**	**2**	**3**	**4**	**5**	**6**
Agricultural and Food Sciences	4.1	3.9	3.7	3.6	3.0	
Exercise and Sport Sciences	3.4		3.4	3.1	3.5	
Humanities		3.0		5.2		
Language Mediation & Intercultural Communication	3.8	4.0	3.6	3.8	3.2	
Medicine	3.7	3.4	3.6	3.2	3.3	2.6
Pharmacy	4.3	3.6	3.9	4.1	4.0	
Political, Economic and Social Sciences	4.1	4.0	4.0	3.9	3.8	
Science and Technology	4.1	3.9	3.8	3.2	3.1	
Total	**4.0**	**3.9**	**3.8**	**3.7**	**3.6**	**2.6**

Table 10. Standard deviation of grades obtained in 2020-21 by students in the various study years per faculty

Faculty/School	**2020-21**					
Course year	**1**	**2**	**3**	**4**	**5**	**6**
Agricultural and Food Sciences	4.2	4.0	3.9	3.5	3.2	
Exercise and Sport Sciences	2.6	3.8	2.9	3.5		
Humanities	3.3	3.4				
Language Mediation & Intercultural Communication	3.5	3.7	3.9	3.9	3.0	
Medicine	3.7	3.5	3.5	3.4	3.0	3.6
Pharmacy	4.8	4.9	4.1	4.2	4.0	
Political, Economic and Social Sciences	4.1	4.1	4.0	3.9	3.5	
Science and Technology	4.6	4.2	3.9	3.4	2.9	
Total	**4.2**	**4.1**	**3.9**	**3.8**	**3.5**	**3.6**

4. CONCLUDING REMARKS

In this paper, some preliminary analyses on written exam sessions at the University of Milan have been performed, to assess the efficacy of the monitoring scenarios for online written exams identified during the first lockdown phase of the pandemic.

The results of that analysis are definitely satisfactory. Even during pandemic, lot of written exams have been smoothly carried on thanks to the different scenarios proposed to professors for conducting them. Moreover, grades obtained by students before and during pandemic show very limited differences, confirming what stated in (Weiner & Hurtz 2017) about the significance of online proctored exams. It should be emphasized that up to now we did not receive any complaint about the necessity of reducing the exam difficulties when going online. On the contrary, some problems arose in collecting handwritten diagrams or drawings, requiring a scan and send procedure not so easy to manage.

Another interesting result of the analysis is the progressive increase in grades obtained by students as soon as they proceed in their university careers, becoming more and more acquainted with university studies and exams.

Future work will address in more detail the behavior of each professor, even if this requires surveys and questionnaires whose return rate are usually limited. However, it is already possible to conclude that carrying on online written exams is feasible and satisfactory: this is why we will still use online exams even when our University will reopen, e.g. for particular courses or degrees reserved to older, full-time employed students, definitely preferring online exams to avoid necessity of vacation days to undergo exams.

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