

Facing the COVID-19 Pandemic: Massive Distance Learning and On-Line Exams with Moodle, Collaborate, Smowl, Meet

Marco Bernardo and Edoardo Bontà

Centro Integrato Servizi Didattici ed E-Learning, Università di Urbino, Italy

Abstract. We illustrate our experience at the University of Urbino in tackling the COVID-19 outbreak via massive distance learning and on-line exams in the second half of the academic year 2019/2020. We show that two key factors for achieving resilience are the presence of a teaching and learning center, in charge of coordinating all switchover activities and providing daily assistance to lecturers and students during the pandemic, and the use of a combination of tools each with a specific purpose. These tools include the learning management system Moodle and the integrated webconference tool Blackboard Collaborate, both employed for on-line lectures and oral exams, together with the integrated e-proctoring tool Smowl and the standalone webconference tool Google Meet used on student smartphones, both coming into play in addition to the previous two tools in the case of on-line written exams.

1 Introduction

The COVID-19 pandemic has imposed a deep reorganization of lectures and exams within universities in order not to stop student careers during the second semester of the academic year 2019/2020. In Italy the lockdown period was decreed on March 8, when the second semester had commenced a few weeks before, thus forcing a massive conversion of face-to-face lectures into on-line ones. According to data collected by MUR, the Italian Ministry for University and Research, and Fondazione CRUI, the Conference of the Rectors of the Italian Universities, the reaction of the Italian university system was extremely effective. As reported by all major Italian newspapers, within one month from the beginning of the lockdown, more than 90% of the teaching activities of undergraduate courses (“corsi di laurea”) had been moved on-line.

In mid May several restrictions about interpersonal distance as well as traveling were still active, so that also exams and thesis defenses had to be supported by digital technologies. This opened a passionate debate on how exams, especially written ones, had to take place on-line. Actually, the discussion about massive distance learning had already started in March, with an increasing number of webinars organized by both Fondazione CRUI and CODAU, the Conference of the General Directors of the Italian Universities, in which a few universities presented their experiences and several vendors illustrated their products. Those

webinars were important occasions for all the Italian universities, which participated through their delegates to digital transformation or innovative teaching as well as their technical staff, to share information about digital technologies and teaching methodologies, so as to improve their resilience to the pandemic.

The purpose of this paper is to report on our experience at the University of Urbino in facing the COVID-19 outbreak via massive distance learning and on-line exams. Two key factors for achieving a quick and broad change from face-to-face to on-line didactics have been the presence of a teaching and learning center, in charge of coordinating all switchover activities and providing daily assistance to lecturers and students during the pandemic, and the use of a combination of tools, each one serving a specific purpose. These tools include the learning management system Moodle and the webconference tool Blackboard Collaborate integrated in Moodle, which were employed for on-line lectures and oral exams. In the case of on-line written exams, the e-proctoring tool Smowl integrated in Moodle, together with the standalone webconference tool Google Meet used on student smartphones, were additionally employed.

This paper is organized as follows. We start with some figures about our university and the activities of our teaching and learning center (Sect. 2) along with the organization of our Moodle platforms and the features of our teaching-oriented webconference tool Blackboard Collaborate (Sect. 3), as they are instrumental to understand how we dealt with the pandemic. We then illustrate how we rapidly switched to massive distance learning (Sect. 4), on-line thesis defenses (Sect. 5), and on-line oral exams (Sect. 6) via Moodle and Blackboard Collaborate under the supervision of our teaching and learning center. This is followed by a discussion of the considerations that led us to adopt a combination of e-proctoring on student computers via Smowl and videosurveillance based on student smartphones via Google Meet for managing on-line written exams (Sect. 7). We finally conclude with some remarks about lessons learnt and future challenges (Sect. 8).

2 Our Teaching and Learning Center

The University of Urbino, established in 1506, features in the academic year 2019/2020 a total of 34 undergraduate programmes, divided into 15 “laurea triennale” programmes, 5 “laurea magistrale a ciclo unico” programmes, and 14 “laurea magistrale biennale” programmes, for a total of almost 1,000 courses, plus 4 PhD programmes. All these programmes are conventional, in the sense that they entirely rely on face-to-face teaching, apart from 5 undergraduate programmes offered in blended mode.

The overall number of undergraduate and graduate students slightly exceeds 14,000. The teaching staff is composed of more than 300 professors and researchers and 40 foreign language experts, plus more than 400 external lecturers.

Since the academic year 2004/2005, a very limited number of undergraduate programmes is offering on-line activities at the University of Urbino. However, only at the beginning of 2015/2016 a big investment was made to create a

teaching and learning center. CISDEL – *Centro Integrato Servizi Didattici ed E-Learning* <https://www.uniurb.it/cisdel/> coordinates and provides support for a number of activities dedicated to undergraduate and graduate students as well as all lecturers and collaborators, both face-to-face and on-line.

The aforementioned activities consist of courses and seminars about teaching and learning strategies, paper writing, bibliographic search, content-and-language integrated learning, and intercultural laboratories. In addition to that, CISDEL maintains three on-premise Moodle platforms, which are accessible in single sign-on by all lecturers and students of the University of Urbino.

At the beginning of every academic semester, CISDEL organizes seminars to instruct lecturers about how to configure and use Moodle resources and activities. Moreover, it maintains the web page <https://www.uniurb.it/blended> where plenty of short textual notes and videotutorials can be found, whose purpose is to help lecturers and students using Moodle.

3 Moodle Platforms and Blackboard Collaborate Chats

From the academic year 2004/2005 to the academic year 2013/2014 several different learning management systems were used in different contexts at the University of Urbino, including Land of Learning [1,2], ItsLearning [3], and Moodle [4]. With the advent of CISDEL, after one year of experimentation all the distance learning activities were moved to three Moodle platforms, each one having a different purpose, hosted by our server farm.

The platform *Moodle blended* <https://blended.uniurb.it/moodle/> is structured by automatically importing the whole undergraduate offer from the software system U-Gov Didattica [5] via the Moodle plug-in Course Fisher [6]. It provides a virtual room for each course of any of the 34 undergraduate programmes of the current academic year. The room is accessible only by the lecturer teaching that course, who has to register via Course Fisher, and all students enrolled on that course, who have to register via the Moodle plug-in AutoEnrol [7] based on data extracted from the student career management system Esse3 [5]. Moreover, it is automatically equipped with a link to the web page of the course and a forum for the lecturer and the students. In each of the past 4 academic years, more than 80% of the aforementioned virtual rooms have been used for discussions on the forum, sharing teaching material in the form of lecture notes, slides, and multimedia resources, or organizing activities in which the students can assess their preparation before taking the exam.

The platform *Moodle elearning* <https://elearning.uniurb.it/moodle/> is structured in the same way as the previous one, but is devoted to the 5 undergraduate programmes that in the current academic year offer part of their lectures on-line. Distance learning takes place via Blackboard Collaborate [8], a webconference tool integrated in Moodle through a suitable plug-in, which allows lecturers to plan and give their audiovisual lectures directly inside Moodle and students to find the recordings again inside Moodle. In addition to features available in most webconferencing tools like a textual chat, document presenta-

tion, and screen sharing, Blackboard Collaborate provides a button for raising a hand, an integrated whiteboard, a polling mechanism, and dynamic role and permission management, all of which are quite effective in a teaching context.

The platform *Moodle education* <https://education.uniurb.it/moodle/> contains virtual rooms for all the other teaching activities like CISDEL services, foreign language courses, contamination labs, summer/winter schools, postgraduate masters, PhD programmes, and lifelong learning for university personnel, school teachers, professionals, and companies, including courses on safety in work places as well as personal data protection regulations.

After using textual chats like the very rich one of Land of Learning [1,2], which we subsequently implemented in Moodle [9], and making some experimentation with BigBlueButton [10], at the beginning of the academic year 2016/2017 we decided to adopt Blackboard Collaborate [8] for distance learning within our Moodle platforms. Till February 2020, it was used only inside the Moodle elearning platform for the audiovisual lectures of the few undergraduate programmes offering part of their teaching activities on-line.

It was then necessary to revisit our decision in the light of the extraordinary development of webconference tools that we have observed during the first half of 2020. This is witnessed by the success of Zoom [11], the enhancement of Cisco Webex [12] and Adobe Connect [13], and the transition – so to speak – from Skype to Microsoft Teams [14] and from Google Hangouts to Google Meet [15].

All these tools have been empowered in general terms, for instance by supporting higher numbers of simultaneous participants most of whom visible in a grid layout, but not in specific terms for distance learning. Being adequate in a teaching context means satisfying requirements ranging from integrability with the major learning management systems – for a distance learning experience as complete as possible – to ease of use in the most widespread operating systems and browsers – as the audience is wide and variegated – and presence of functionalities typical of a teaching environment – distinction of roles and permissions, integrated whiteboard, button for raising a hand, polling mechanism, etc.

Despite the recent advances, we believe that the choice we made a few years ago to adopt Blackboard Collaborate is still fully adequate today for the needs of lecturers and students, as to the best of our knowledge Blackboard Collaborate is the only webconference tool possessing all the following features together:

- settings, roles, and permissions:
 - usable on the operating systems Linux/MacOS/Windows/Android/IOS via the browsers Firefox/Chrome/Safari without having to install any additional software component in the user device;
 - supporting up to 500 participants in normal mode and 1,000+ participants in webinar mode;
 - establishing audiovisual connection subject to prior consent to share microphone and webcam on the user device;
 - multiple roles (moderator, speaker, participant);
 - multiple permissions (audio, video, messages, drawings);
 - dynamic management of roles and permissions;

- functionalities:
 - visibility of the full list of participants and their status in textual format;
 - possibility to record audiovisual chats;
 - immediately accessible buttons for activating/deactivating microphone and webcam;
 - immediately accessible button for raising a hand;
 - integrated textual chat equipped with emoji;
 - integrated whiteboard usable in a shared way;
 - sharing the entire screen;
 - sharing an application in a single window;
 - sharing a document;
 - sharing a further webcam;
 - polling mechanism;
 - breakout groups;
- integration in Moodle:
 - planning and joining audiovisual chats within Moodle;
 - guest link for the participation of those who have no Moodle account;
 - finding audiovisual chat recordings within Moodle;
 - keeping user identity when moving from Moodle to an audiovisual chat;
 - coordination between Moodle roles (lecturer, collaborator, student) and audiovisual chat roles and permissions.

4 Switching to Massive Distance Learning

The province of Pesaro-Urbino, in the northern part of Marche region, was one of the most affected by the COVID-19 pandemic in the central part of Italy. All schools in the province and the University of Urbino had to stop their on-site teaching activities already on March 2, i.e., one week in advance with respect to the national lockdown.

On February 28, two Rector's notes respectively informed lecturers and students that all face-to-face lectures would have been replaced by on-line ones from March 2 till the end of May, taking place on the Moodle blended platform via the integrated webconference tool Blackboard Collaborate. On-line lectures would have followed the same timetable as face-to-face activities and would have been recorded for students not able to connect.

We were ready for this quick and broad switchover for two reasons. The former was the presence of a teaching and learning center – CISDEL – that periodically trains users and to which users are accustomed to ask for assistance. The latter was the availability of a learning management system for all the undergraduate programmes – the Moodle blended platform – with which the vast majority of lecturers and students were familiar since the end of 2015.

The aforementioned switchover had to be accompanied by a number of additional measures. Firstly, CISDEL assistance, mostly taking place via e-mail, was enhanced by introducing a phone help desk responding Monday to Friday from 9

am to 6 pm. Secondly, the web page <https://www.uniurb.it/blended> was enriched by CISDEL with additional information and videotutorials. In particular, a new section devoted to distance learning was added because only a few lecturers and students – those of 5 undergraduate programmes out of 34 – were used to meet via Blackboard Collaborate. Thirdly, a higher number of computational resources had to be reserved in our server farm to the Moodle blended platform to satisfy the increased workload. Its architecture was optimized in terms of caching and parallelism and entirely revisited by decoupling the application from its database for achieving better performance.

From the beginning of March to the beginning of May, we were able to support every workday around 10,000 users accessing our Moodle blended platform and using Blackboard Collaborate, with peaks of 3,000 users in the same hour, especially in the morning. By the end of March, more than 90% of our almost 1,000 courses within the 34 undergraduate programmes were delivered on-line. A positive side effect was that all the 4 PhD programmes started using Moodle systematically, with on-line lectures taking place with Blackboard Collaborate.

5 On-Line Thesis Defenses

It is worth mentioning that even the undergraduate thesis defenses scheduled on March, and the PhD thesis defenses scheduled shortly thereafter, were moved on-line. This was the case also with undergraduate thesis defenses between the end of June and the beginning of July.

All of them took place by having the candidates and the committee connected through Blackboard Collaborate, with the candidate under examination presenting slides in the speaker role. These events were broadcast via the web channel <https://www.uniurb.it/live> to allow parents, relatives, and friends of graduating students to attend.

6 On-Line Oral Exams

Starting from mid April, oral exams took place – like distance lectures – within every course room in the Moodle blended platform via Blackboard Collaborate. Obviously, before starting each exam, the lecturer has to make sure of the student identity. Moreover, the lecturer has to verify – via the student webcam – that no other person is in the student room and that no teaching material is near the student computer – except for the case of a student with special needs – with the verification being repeatable at any time during the exam.

The precise protocol to be followed was established by a Rector's decree in mid April and the web page <https://www.uniurb.it/blended> was then updated accordingly by CISDEL. The protocol allows all students enrolled on a course to attend the on-line exam of that course, but only the student under examination will have microphone and webcam active in Blackboard Collaborate. The student career management system Esse3 was extended by CINECA with the possibility of uploading digital copies of student identification documents.

This saved students from sending their identification documents via email at every exam and lecturers from remembering to eliminate the received documents as soon as the identity verification is completed.

7 On-Line Written Exams: Proctoring + Videosurveillance

The organization of on-line written exams was more complex because of the simultaneous presence of several students taking the exam. Many lecturers decided to convert their written exams into oral ones during the emergency period. However, there are disciplines like Sciences, Economics, and Foreign Languages for which this is not always appropriate or feasible.

Similar to traditional written exams, on-line ones can be computer based or take place by pen and paper. In the former case, the Moodle activities quiz and assignment naturally lend themselves to be used for setting up a written exam, provided that the lecturer can monitor the correct behavior on each student computer. In the latter case, Moodle can still be useful for delivering the text of the exam to all students, with the lecturer checking what is going on via the webcam of every student. In both cases, a webconference tool is necessary to establish a communication channel between the lecturer and the students throughout the exam, so that students can pose questions and the lecturer can answer them or warn students in case of misbehavior.

From March there was a big debate within the Italian university institutions about how to guarantee the correctness of on-line written exams. One option is to adopt an e-proctoring system, which is a mechanism for controlling what is happening on student computers. These systems range from lockdown browsers, which prevent students from launching programs different from the allowed ones, to applications performing facial recognition and monitoring all computer activities, which let students free to use any program.

A different option is to set up a videosurveillance system for environmental monitoring by taking advantage on the lecturer side of the grid or carousel view available in many webconference tools like Zoom, Google Meet, and Microsoft Teams. Every position in the grid corresponds to a student smartphone, located in the student room in such a way that the lecturer can see both the student and the student computer or the paper on which the student is writing.

The debate was motivated by the fact that e-proctoring systems seem to be more effective – even in the case of pen-and-paper exams as students may cheat by looking for answers on computers – but they are more expensive, usually require students to install software components on their computers, and should guarantee a full compliance with regulations about student privacy. On the other hand, the videosurveillance option does not incur the aforementioned problems, but is less effective as it does not really permit to observe what is happening on student computers, especially when there are many students taking the exam.

While most universities considered the two options as being alternative to each other, we viewed them as complementary, so that our choice at the University of Urbino was to combine an e-proctoring system with videosurveillance.

As for e-proctoring, we avoided resorting to lockdown browsers. While they are well adequate for computer-based exams taking place on-site, in the case of on-line written exams they may not be able to detect (and close) programs opened before starting the exam, thus a student may keep sharing the computer screen with a third party who may suggest the right answers. Among the remaining systems, we focussed on European solutions, for a higher confidence in privacy regulation adherence, that could be used within learning management systems.

We finally adopted the GDPR-compliant, Moodle-integrated, e-proctoring tool Smowl [16], also because from May to September it was offered at a discounted price, with the total cost depending only on the number of students using it instead of the number of exams taken by those students. Smowl performs facial recognition by taking one picture per minute on average via the student webcam – to make sure that the student does not go away and no other person replaces or gets close to the student during the exam – and, through the Smowl CM component, monitors all applications that are open on the student computer – including those launched before the exam, possibly automatically by the operating system – by periodically taking screenshots. Videosurveillance was instead realized via Google Meet [15] on student smartphones with the grid view active on the lecturer computer, given the free educational license of the Google suite currently available at our university for all lecturers and students.

Similar to oral exams, also in the case of written exams the precise protocol to be followed was established by a Rector’s decree, dating back to mid May. The web page <https://www.uniurb.it/blended> was further updated accordingly by CISDEL and specific instructions about subtleties of the tools to be used were provided to students through an additional Moodle page. More than 100 courses used the combination of Smowl and Google Meet from mid May to the end of September, with almost 4,000 students involved in on-line written exams.

The Smowl plug-in for Moodle originates a Smowl block inside Moodle that has different functionalities for lecturers and students. Prior to the first on-line written exam, a lecturer has to activate the Smowl block inside the Moodle room of the course; in this way, the Smowl block becomes available also to all students enrolled on that course. On the other hand, regardless of the specific course, at least 72 hours before the first on-line written exam a student has to register once and for all with Smowl, by following a link available in the Smowl block of the course or of the aforementioned additional Moodle page. Smowl registration is accomplished by taking three facial pictures – for facial recognition at exam time – and installing the Smowl CM component on the computer – for monitoring applications at exam time. So far, the Smowl CM component is available only for Windows and MacOS, and the recommended browsers when using Smowl are Firefox and Chrome.

From the Smowl block of the course, the lecturer sees which students successfully registered to Smowl and decides which quiz or assignment activities should undergo to Smowl monitoring. At the beginning of the exam, the lecturer and the students virtually meet on the Moodle blended platform via Blackboard Collaborate. For each student, the lecturer performs the same verifications mentioned

in the case of on-line oral exams and additionally checks that no HDMI cable is attached to the student computer, so as to avoid hardware connections with nearby people which could not be detected by Smowl. The student is then invited to join Google Meet via the smartphone, to be located in a proper position as described before.

After this initial phase, the on-line written exam can start. When entering the Moodle quiz or assignment, every student is informed that the Smowl monitoring is about to start and is asked consent to proceed. Then the image captured by the student webcam is displayed within Moodle to the student and a small window reminding the student that Smowl CM is active stays open until the end of the on-line written exam. We emphasize that computer monitoring through Smowl CM is in use only during the on-line written exam, with the student being free to install it just before the exam and remove it once the exam is over.

On the other hand, from the Smowl block the lecturer can look up the outcome of Smowl CM monitoring and warn students who are using applications that are not permitted. This means that the screenshots taken by Smowl CM are made available in real time. More precisely, this is what happens for the quiz activity, whereas it is not always the case for the assignment activity, which can be anyhow simulated by a quiz with open-ended questions. In contrast, the outcome of facial recognition is available in 24 hours. This delay can be mitigated thanks to the use of Google Meet, in the sense that environmental monitoring allows the lecturer to see in real time who is taking the exam.

In conclusion, we handled on-line written exams by a combination of tools each serving a specific purpose:

- Moodle for delivering exam questions/exercises and receiving student answers via quiz or assignment activities, as well as for hosting the Blackboard Collaborate activity, the Smowl proctoring, and a url resource for Google Meet monitoring.
- Blackboard Collaborate for the initial phase of the exam and audio monitoring afterwards, with the latter allowing students to pose questions and the lecturer to provide clarifications and warn students in case of misbehavior.
- Smowl for e-proctoring consisting of student facial recognition via student computer webcams and application monitoring on student computers.
- Google Meet for environmental monitoring via student smartphones (with the grid view active on the lecturer computer), which can also be considered a secondary channel to communicate with students during the exam.

8 Conclusions

Our experience in tackling the COVID-19 pandemic emphasizes the importance of a learning management system already in place for all the major teaching activities, as well as of the presence of a teaching and learning center in charge of supervising and supporting the switchover. In case of health, weather, hydrogeological, and seismic emergencies, both factors contribute to reduce enormously the switchover time and increase consequently the institution resilience.

As far as massive distance learning is concerned, our experience shows that it is fundamental to have not only a mature learning management system like Moodle, but also an integrated webconference tool like Blackboard Collaborate that is teaching oriented, i.e., possessing features that are strictly necessary in a teaching context. If we consider instead on-line written exams, it turns out that using an e-proctoring tool like Smowl alone, or exploiting the grid view of a webconference tool like Google Meet alone, is not satisfactory. To set up an effective anti-cheating system, we firmly believe that the right solution is the combination of e-proctoring and videosurveillance.

While the challenge during the second half of the academic year 2019/2020 has been the quick provision of suitable technological support to keep giving lectures and organizing exams, the challenge in the first half of the academic year 2020/2021 is rather different. There is a huge effort going on to resume on-site activities under safety conditions, in a scenario in which part of the students will attend in physical rooms at our university by respecting a specified interpersonal distance, whereas the remaining students will attend remotely via Blackboard Collaborate inside the Moodle blended platform. This requires equipping physical rooms with suitable multimedia technology like touch boards, smart webcams, and room microphones, not to mention the methodological issues arising from teaching to students who are simultaneously on-site and on-line.

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