Planning, Communication and Active Methodologies: Online Assessment of the Software Engineering Subject during the COVID-19 Crisis

(Planificación, comunicación y metodologías activas: Evaluación online de la asignatura ingeniería de software durante la crisis del COVID-19)

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Abstract

The coronavirus pandemic has had a high impact worldwide. The health crisis has not only had an impact on people's own health and on health systems, but has also affected other areas. In the educational context, the lockdown measures implemented by different governments have challenged the learning ecosystem. In the case of higher education in Spain, with a strong attendance factor in most public universities, face-to-face classes were interrupted after a month in the second term, ending the academic year in the online mode. This change has meant a great effort on the teachers' side to transform the face-to-face teaching into the online approach, which in many cases has meant quite a comprehensive new design of the subject, changing the evaluation process and the methodologies used. This work presents a success case of online assessment developed in the Software Engineering I subject of the Degree in Computer Engineering at the University of Salamanca. The objective is to show how the previous use of active methodologies and the integration of educational technologies in classroom-based teaching facilitates the transformation of assessment to an online or blended approach while maintaining a high degree of student involvement and satisfaction. After presenting a comparison between the face-to-face approach and the adaptation to the online approach, an analysis is made of the learning results and student satisfaction concerning previous academic years. The results show that the change of approach has not reduced the satisfaction results obtained in previous courses. In terms of learning outcomes, there is an overall increase in the grades obtained by students in all assessment items.

Keywords: computer science; e-Learning; higher education; online assessment; teaching experience; teaching method.

Resumen

La pandemia de coronavirus ha tenido un alto impacto a nivel mundial. La crisis sanitaria no solo ha tenido un impacto en la propia salud de las personas y en los sistemas de salud, sino que ha afectado a otros ámbitos. En el contexto educativo, las medidas de confinamiento implementadas por los diferentes gobiernos han supuesto un reto para el ecosistema de aprendizaje. En el caso de la educación superior en España, con un fuerte componente presencial en la mayoría de las universidades públicas, se interrumpieron las clases presenciales un mes después del inicio del segundo cuatrimestre, finalizando el curso académico en modalidad online. Este cambio ha supuesto un gran esfuerzo por parte de los docentes para transformar la enseñanza presencial al enfoque online, lo que en muchos casos ha supuesto un rediseño casi integral de la asignatura, cambiando el proceso de evaluación y las metodologías utilizadas. El presente trabajo presenta un caso de éxito de evaluación online desarrollado en la asignatura Ingeniería de Software I del Grado en Ingeniería Informática de la Universidad de Salamanca. El objetivo es sustentar cómo el uso previo de metodologías activas y la integración de tecnologías educativas en la docencia presencial facilita la transformación de la evaluación a un enfoque online o mixto, a la par que mantiene un alto grado de implicación y satisfacción por parte de los estudiantes. Para ello, tras presentar una comparativa entre el enfoque presencial y la adaptación al enfoque online, se realiza un análisis de los resultados de aprendizaje y la satisfacción de los estudiantes respecto a los cursos académicos previos. Los resultados muestran que el cambio de enfoque no ha mermado los resultados de satisfacción obtenidos en los cursos anteriores. En cuanto a los resultados de aprendizaje, hay un aumento general de las calificaciones obtenidas por los estudiantes en todos los ítems de evaluación.

Palabras clave: informática; educación superior; eLearning; evaluación online; experiencia pedagógica; método de enseñanza.

The current health crisis caused by the SARS-CoV-2 pandemic has affected all areas of society worldwide. The UN Educational, Scientific and Cultural Organization estimated in April 2020 that 138 countries closed schools nationwide, and several other countries implemented regional or local closures (Van Lancker & Parolin, 2020). In Spain's case, on March 14, 2020, the government declared a state of emergency in the country (Gobierno de España, 2020), which involved, among other measures, the closure of schools and universities (Zubillaga & Gortazar, 2020). It is important to note that under the State of Alarm, this quarantine has been extended every 15 days, so that, during the first month, there was no information about the return to classrooms. Likewise, the University of Salamanca was closed on Thursday, March 12, at midday.

The suspension of classes and the impossibility of accessing the university buildings meant the transformation of teaching in two major phases. The first phase marked by the emergency of giving an almost immediate response, without having time to plan and redesign the subjects (Llorens-Largo, 2020). Institutions took steps to inform, reassure and maintain contact with students, meanwhile they worked in ramping up their ability to teach remotely (Daniel, 2020).

The second phase was marked by the decision to carry out a non-attendance evaluation and to end the distance learning course (Abella García et al., 2020; Fardoun et al., 2020). This decision not only affected face-to-face universities but also had a great impact on universities that offer online higher education degrees since non-attendance evaluation is one of the most complex aspects to manage. In fact, most distance or online universities based their evaluation processes on formats that required the physical presence of those who chose to pass these tests (García-Peñalvo et al., 2020). Furthermore, the COVID-19 crisis has revealed digital inequalities among students (Beaunoyer et al., 2020), so institutions and teachers have also faced problems not directly related to the methodology or the assessment. According to Rodicio-García et al. (2020), one in three students, despite having technology in their home, say they do not have the necessary resources.

On the other hand, the crisis has revealed a lack of innovative methodologies and an assessment based on a continuous approach instead a final objective test (García-Peñalvo & Corell, 2020). Although there are works that present the use of active methodologies in higher education, and particularly in the context of computing engineering (Fonseca & Gómez, 2017; García-Peñalvo et al., 2019; Lacuesta et al., 2009; Martínez et al., 2006), this cannot be generalized to the entire teaching community. Moreover, there are some examples of blended an online approaches, mainly based on flipped classroom (Gren, 2020) and project-based learning (Alfaro et al., 2019; Moreno-Ruiz et al., 2019).

In this context, this work aims to show how the use of active methodologies and the integration of educational technologies in classroom-based teaching, not only enables a

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continuous assessment approach, but also facilitates the transformation to an online or blended assessment approach while maintaining a high degree of student involvement and satisfaction. This work describes a particular case, the adaptation to the online modality of the Software Engineering I subject (taught in the second year of the Degree in Computer Engineering at the University of Salamanca) during the COVID-19 confinement in Spain. This subject focuses on the first phases of the life cycle of information systems; conception, requirements elicitation, and analysis.

The rest of the work has been organised into four other sections. The second section makes a comparative description between the face-to-face mode and the transformation to online. The third section presents the feedback received from the students and the learning results. Finally, the last section contains the discussion and the main conclusions of the work.

MODALITIES COMPARISON

The transformation into the online approach was based on maintaining the same assessment design but adapted to the impossibility to plan face-to-face activities. The Figure 1 summarizes the changes introduced in the subject.

Figure 1
Summary of the transformation from face-to-face to online approach

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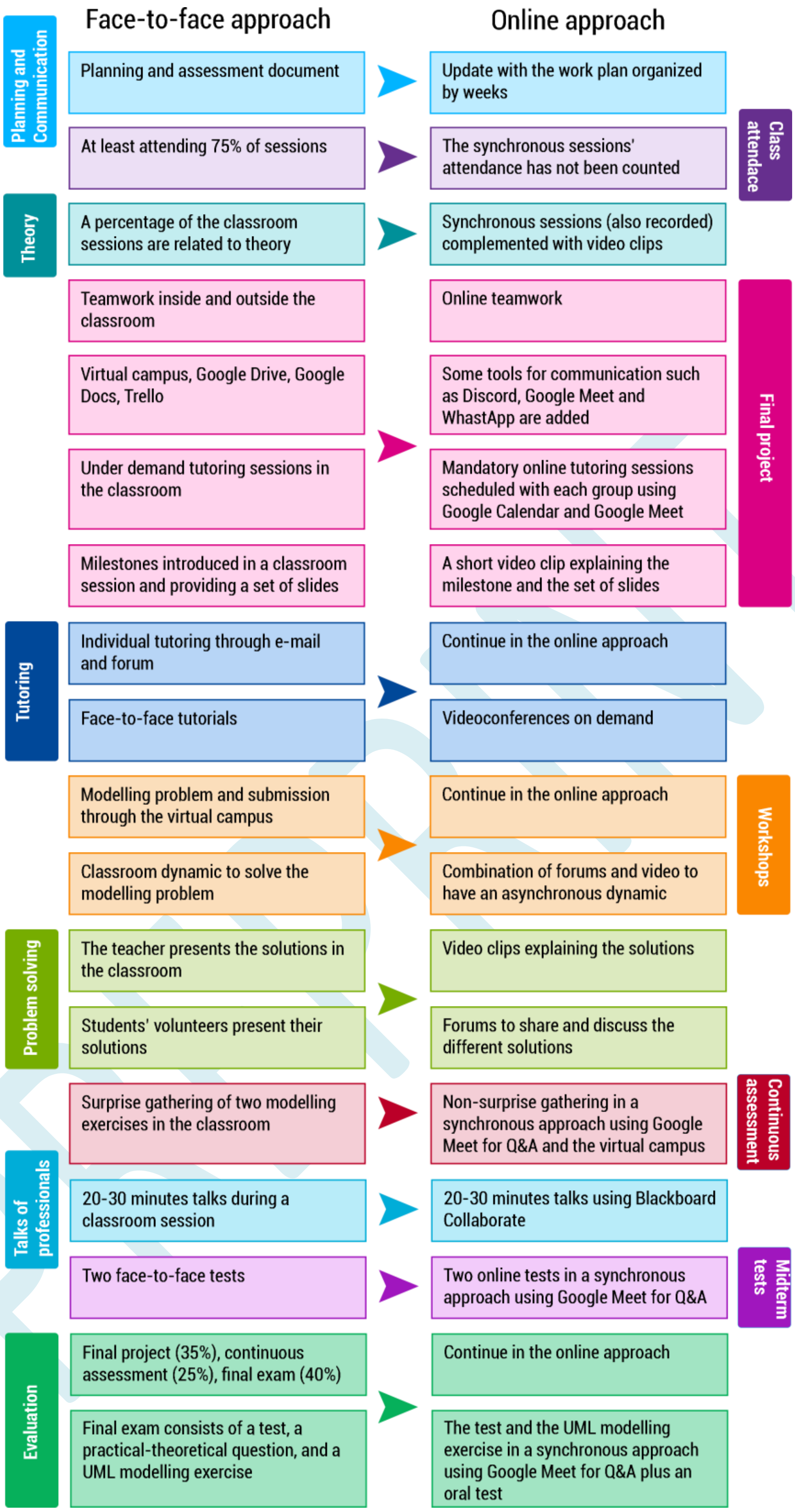

Planning and communication

The subject's adaptation to online mode has been carried out in three phases. The first adaptation was made on March 12 to provide students with an online work plan until the beginning of the non-teaching period of Easter (3-13 April). Then, an update of the planning until the end of the academic year was made. Finally, a third update of the planning was carried

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out to incorporate all the details of the non-attendance evaluation associated with the final exams.

This work plan has been organised by weeks and has been shared comprehensively in an addendum to the programming and assessment document of the subject so that students have had access to it from the very beginning. This document has been complemented with constant communication through the forum of notices and news of the institutional virtual campus, within the space of the subject, so that weekly the students received detailed and extended information for the work of that week. It is also important to mention that the online work plan was presented in a synchronous session on March 13, in which most of the students participated and recorded for later consultation.

Finally, the students' communication has been based on three main pillars: the tools provided by the virtual campus, the coordination with the delegate, and the group tutoring described below.

Active methodologies

Since the 2016-2017 academic year, the Software Engineering I subject has implemented a set of active methodologies. In particular, it has been implemented through autonomous learning, collaborative learning with some cooperative learning techniques on specific issues, flip teaching approach for the theoretical part of the subject, and project-based learning (PBL) (Daun et al., 2016; Estruch & Silva, 2006; Macias, 2012). The design of the subject is based on a software engineering project that students develop in groups across the whole semester. This has an impact on improving learning outcomes in comparison to previous courses (García-Holgado et al., 2018; García-Holgado et al., 2019; Vázquez-Ingelmo et al., 2019).

This methodological change is based on the technological ecosystem (García-Peñalvo, 2018) provided by the University of Salamanca. In particular, the institutional virtual campus, based on Moodle 3.1, combined with institutional accounts that allow the use of Google Drive (García-Holgado et al., 2019).

The use of the above active methodologies with strong integration with educational technologies has allowed adaptation to the online format to follow an approach similar to the already planned approach for its development in face-to-face classes. The main activities and evaluation milestones and how they have been adapted to the online modality are detailed below. Also, Figure 1 summarizes each element to provide an overview of the design of the subject.

1) Class attendance and participation

Participation in the classroom sessions is one of the key elements of the course since a large part of the sessions are devoted to problem-solving and the development of the final project, so attendance at these sessions positively impacts learning outcomes. Thus, the active approach proposed implies attending at least 75% of the sessions and participating in them.

On the other hand, in the online period, the synchronous sessions' attendance has not been counted. However, the greater weight has been given within the continuous assessment of the participation in the different activities planned asynchronously.

2) Theory

Although the sessions dedicated purely to theory have been reduced to give way to more active approaches, the subject has a high theoretical load, and there are still many contents that are worked on during synchronous sessions. Although most of the basic concepts were seen during the face-to-face period, two synchronous sessions have been held using the Blackboard Collaborate tool integrated into the institutional virtual campus. The sessions have been recorded so that they can be viewed at any time.

Also, the synchronous sessions have been complemented with a set of video clips, mainly focused on concepts needed to develop the last milestone of the final project.

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3) Final project

The final project guides the development of the whole course, so that theory and practice are organised around the different deliveries that are made throughout the course. In particular, the final project is divided into three milestones, each of which is evaluated, giving feedback to the students and allowing the project's continuous improvement, as if it were a real project. The project is carried out in teams of 3 people and consists of developing a software engineering analysis model on a specific topic.

All the necessary materials to develop each of the milestones are available on the institutional virtual campus. Besides, Google Drive is used as a workspace, so that each group has a shared folder in which they must upload the materials and prepare the technical report in a shared Google Docs document, which allows them to track the work of each team member. Using the shared document also facilitates feedback from the teaching team, using suggestions and comments to evaluate each of the milestones.

As part of the teaching innovation project financed by the University of Salamanca and developed during the 2019-2020 academic year (ID2019/011), the Trello tool was added to the technological ecosystem of the course, so that each workgroup could manage the organisation and planning of the tasks associated with the final work through this online tool.

Most of the sessions are dedicated to teamwork in the classroom so that the teaching team attends to each group's doubts in a personalised way and guides the development of the project. Moreover, the first sessions in this modality apply a cooperative learning technique to carry out a brainstorming to define each final project's particular objectives.

From the technological point of view, the adaptation to online mode has not meant significant changes, since Google Drive and Trello allow for distance work. A set of video clips on Google Meet has been provided for video conferences and integration of UML modelling applications with Google Drive to instruct students in teleworking. These clips are available in a playlist on the GRIAL Research Group's YouTube channel (https://www.youtube.com/c/grialusal).

Regarding teamwork sessions in the classroom, synchronous group tutoring have been replaced through Google Meet. These tutoring, with a weekly frequency and a duration of 15 minutes per group, have made it possible to maintain personalised follow-up, giving better results than the face-to-face sessions carried out in previous courses. The tutorials were included in the work plan. A Google calendar was also used; each of the tutoring was created with the corresponding link to Google Meet and the personalised invitation to the group members.

The tutoring dynamic is focused on solving doubts and making recommendations regarding the work done so that each group develops the work at its own pace. Access to shared documents on Google Drive has facilitated this task.

Finally, each milestone's beginning has been accompanied by an explanatory video where the tasks to be carried out are presented, and a set of recommendations are given.

4) Tutoring

The group tutoring, aimed at the final project, have been complemented with individual tutoring, mainly through e-mail and the forum of doubts set up in the virtual campus since the beginning of the course. Regarding traditional face-to-face tutoring, they have been replaced by videoconferences on demand.

5) Workshops

Workshops are sessions focused on problem-solving. Students actively participate in reaching the correct solution, specifically, the modelling in UML of a previously posed statement (García-Peñalvo & Moreno, 2004). The modelling problem is made available to students through the virtual campus one week before the face-to-face session. Each group of practices (the same as for the final project) must propose their solution and submit it through the campus before the session.

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During the session, a group goes out to the blackboard to draw their proposal. This group is randomly chosen from all those who volunteer. Once the initial solution is presented, the rest of the groups indicate which parts they have solved differently or ask questions about the discussed solutions. In this way, the teacher guides the process until the correct solution or solutions are reached.

The adaptation of this dynamic to the online mode is one of the most significant changes compared to the face-to-face approach. The first part of the workshop remains the same; the statement and delivery of each group's solution are made through the virtual campus. Concerning the classroom dynamic, it is replaced by a forum on the virtual campus where the volunteer team presents its solution through a video recorded by all group members. Then, a discussion period is opened (2-3 days) in which other groups comment and share specific parts of their solutions. Once the discussion period is over, one of the teaching team members makes a video explaining the correct solution. This video starts with the volunteer team's solution, drawn on sheets of paper or a whiteboard. Subsequently, the different proposals from the rest of the groups are presented, explaining the correct solution.

As for the volunteer team, once the workshop's delivery period is over, a survey is set up in the virtual campus for the groups to volunteer. The survey is available for 24 hours. Once this period has ended, a random draw is made online, and the chosen group has two days to make the explanation video.

6) Problem solving in the classroom

Workshops are complemented by face-to-face sessions in which UML modelling exercises are solved. The dynamics vary between sessions but usually combine presentations of a solution by the teacher and students' volunteers who present their solution to the rest of the class.

These sessions are the basis of several evaluation tests, both continuous and final, so their adaptation to the online format will significantly impact learning outcomes. Thus, instead of conducting synchronous sessions where the teacher would solve the exercises, nine video clips of between 5-10 minutes were recorded so that each pill corresponds to a modelling statement whose solution is available as a study material. The clips' aim is to explain the modelling decisions, the possible mistakes that can be made, and the correct use of the UML notation.

Besides, students' active participation in the resolution of these exercises has been replaced by four forums on the virtual campus, each forum associated with a UML modelling problem, so that individually and as part of continuous assessment, students could pose their solutions. The forums remained open for ten days.

Once the period ended, a video was made commenting on the main errors detected in the proposals made and explaining the correct solution.

7) Continuous assessment exercises

In addition to the participation in the classroom, as part of the continuous assessment attendance and completion of workshops, two exercises are collected (without notice of the specific day) throughout the course, so that during a classroom session a modelling problem in UML is delivered, similar to those previously worked. Each student must resolve it individually before the end of the session.

The peculiarity of this type of modelling exercises is that it is improbable that two students will come up with the same solution using the same words to name the different concepts. For this reason, the adaptation to the online format has mainly consisted of eliminating the "surprise" factor.

Each exercise collected has had a date and time of completion. At the time indicated, the statement and a task to deliver the solution were automatically visible on the virtual campus. Each student had to develop their solution individually and deliver it within 1 hour. During this period, the teaching team was connected in a Google Meet session to solve doubts or possible technical problems during the delivery.

Each exercise collected was corrected by a single teacher, so that he or she could detect a copy. Unlike the face-to-face mode, the correction of each exercise was made available to the students to avoid a large number of individual tutoring sessions and as part of the learning process.

8) Talks of professionals

Beyond the methodological change, the course stands out for its incorporation of the gender perspective as a way of making the lack of women in the technology sector visible and promoting diversity in software development (García-Holgado et al., 2020). In addition to the gender and diversity approach applied to all elements of the subject mentioned above, since the 2018-2019 academic year, a series of talks given by professionals lasting 20-30 minutes is being held on software engineering topics in real environments. In addition, to bringing reality closer to students, the people chosen to give the talks have very different profiles, allowing them to show the diversity in the technological field.

In the 2019-2020 academic year, three talks have been organised; all of them focused on teleworking in technology companies. Two talks were held in a face-to-face format, focusing on teleworking in international companies and another on using tools to organise teamwork. The third talk was conducted in an online format through Blackboard Collaborate and focused on teleworking during confinement.

9) Midterm tests

Finally, two midterm tests focused on the theory of the subject are applied throughout the course, so that those who have an average of more than 4 in these tests do not have to take this part in the final exam. These two tests are composed of simple selection questions with four options.

The midterm tests have been kept in the online mode, although an e-proctoring system has not been used (González-González et al., 2020). However, a dynamic similar to the continuous assessment exercises has been followed. The tests were implemented with the virtual campus questionnaire tool. The questionnaire was available automatically at a specific day and time, and students had a single opportunity to take it, with the possibility of moving forward and backwards. The time available for these tests was 20 minutes for 14 questions.

As for the measures to avoid copying, a battery of questions classified by concepts has been elaborated, so that each questionnaire has been generated randomly, avoiding that the students receive the same test. However, the global complexity of each test is similar. The questions are reflective, so it is not possible to find them literally in the notes and materials available.

Evaluation

According to García-Peñalvo et al. (2020), online assessment requires redesigning the subject evaluation system, i.e., the best approach is not to try to replicate traditional tests in the online ecosystem.

In the context of Software Engineering I, the evaluation of the subject gives high weight to the final work or project (35%) and continuous assessment (25%). Evaluation in the form of an exam accounts for 40% of the final grade. The adaptation to the online format during the confinement period has made it possible to maintain all the evaluation percentages and tests.

The main change has been made in the final exam, which corresponds to 40% of the grade, and 50% of which can be passed through the midterm tests previously described. In particular, this exam consists of a test, a practical-theoretical question, and a UML modelling exercise. In the non-attendance evaluation, the test was kept in the same conditions as the midterm tests. The modelling exercise was carried out following the same guidelines as continuous assessment exercises. However, an oral test through Blackboard Collaborate was incorporated. It consists of two questions, one about the solution posed in the modelling exercise to detect copies and plagiarism; and a general question about the main concepts worked on in the

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subject. This oral test was the only one recorded on video as evidence of possible complaints in detecting copy or plagiarism of an exercise or discrepancies in the grade received.

METHODOLOGY

Instrument

The Quality Evaluation Unit of the University of Salamanca collects student satisfaction in each of their subjects every two academic years. These surveys follow a standard model for all subjects, so they do not measure specific elements or methodological changes in particular. Likewise, in the academic year 2019-2020, the Degree in Computer Engineering has not been evaluated.

To have feedback from the students regarding the change of methodological approach implemented in the subject since the 2016-2017 academic year, the teaching team applies annually a questionnaire focused on obtaining the students' satisfaction with the particular actions carried out in the subject. This instrument is an adaptation of the satisfaction questionnaire published as an appendix in González-Rogado's doctoral thesis (González Rogado, 2012; González-Rogado et al., 2014). Each academic year, those items reflecting the novelties in the subject are incorporated.

The questionnaire is divided into four sections:

- Sociodemographic items (gender, highest course enrolled, the order of career choice, grade point average in the file, number of times enrolled in the subject, previous studies).
- General satisfaction on the degree.
- Satisfaction on the subject.
- Hours of work invested in the subject.
- Open answer questions to collect the positive aspects, the negative aspects, and suggestions for improvement.

The general satisfaction on the Computer Engineering degree is measured with ten Likert items (1=not satisfied, 5=total satisfied), among which the "Adaptation of the career during the crisis of COVID-19" has been included.

The satisfaction on the subject is measured with items organized in different dimensions (first column in Table 1). Each dimension has a set of items from different types. These items were adapted to take into account the online modality. In particular, those satisfaction items that referred to the face-to-face classes have been split into two items, one on the part that was developed face-to-face and another on the online part. Table 1 summarize only those items that were included for measure the satisfaction on the online modality of the subject.

Table 1
Dimensions and items modified or added to account for the online modality

Dimension	Original	Added/Modified
G1: Overall Degree rating (5-point Likert)		G1.10: Degree adaptation during the COVID-19 crisis
A1: Personal work methodology (5-point Likert)	A1.5: Face-to-face lectures help to understand the contents	A1.6: Online lectures help to understand the contents
A2: Depth degree in the study (Multiple choice)	A2.2: I have read all the material	A2.3: I have seen every video resource
	A2.4: I have reviewed the solved exercises	A2.5: I have reviewed the solved exercises videos
A3: Perception of the experimental methodology (5-point Likert)		
A4: General satisfaction (5-point Likert)		A4.4: I was satisfied with the adaptation of the course to online mode

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A5: Usefulness for the subjects' study (5-point Likert)	A5.2: Virtual Campus during the attendance period	A5.3: Virtual Campus during the online period
	A5.5: Face-to-face tutoring	A5.7: Online group tutoring
		A5.9: Class diagram resolution video clips
		A5.10: Sequence diagrams video clips
		A5.11: Final project video clips
A6: Subject rating (5-point Likert)	A6.2: Learning through public presentations	A6.2 ADAPTED: Learning through public presentations (carrying out the class diagram exercises in the forum)
	A6.3: Learning through face-to-face workshops	A6.4: Learning through online workshops

Data collection

Throughout the course, 25 evaluation items related to the evaluation criteria are collected. These items are used to the continuous assessment, the participation of the students, the project-based learning results and the objective tests. Concerning satisfaction, the instrument was applied once the activities of the course had been completed, from 2 to June 24, 2020, the day on which the grades of the first call were communicated.

No control group was applied due to two reasons. First, the successful learning results using the course design based on active methodologies was validated in previous works against the learning results obtained before changing the methodology with the same teaching team (Vázquez-Ingelmo et al., 2019). Second, the aim of this work is to illustrate how a validated approach based on active methodologies enables a successful transformation to an online or blended approach maintaining positive learning results.

Sample

In the Computer Engineering Degree, students are organised into two groups, A and B. The population of the study is made up of group A. There are 70 students, 9 are women (12.86%) and 61 men (87.14%). There are also 57 first-enrolment students (81.43%), 11 second-enrolment students (15.71%), one third-enrolment student (1.43%), and one fifth-enrolment student that never participated in the assessment processes (1.43%).

Regarding the collected sample, 30 students answered the satisfaction questionnaire anonymously, 6 women (20%), 23 men (76.7%), and 1 chose not to say (3.3%). Regarding the number of times that they had taken the subject, 29 responses were for the first time (96.7%). Finally, regarding the average number of grades obtained since the beginning of the degree studies, 20 had grades between 5-6 (66.7%), 9 between 7-8 (30%), and 1 between 9-10 (3.3%).

RESULTS

Grades

Table 2 shows a summary of the average grades obtained in the main evaluation items collected throughout the course. In particular, it shows the values obtained in the last four academic years in which an active approach has been applied (Vázquez-Ingelmo et al., 2019). These grades provide a quantitative overview of the learning results in previous academic years in order to compare with the results applying the transformation into an online assessment.

Table 2
Grades of the main evaluation items in the last four courses

Item	2016-2017 (N=72)		2017-2018 (N=57)		2018-2019 (N=59)		2019-2020 (N=70)	
	N	Avg	N	Avg	N	Avg	N	Avg

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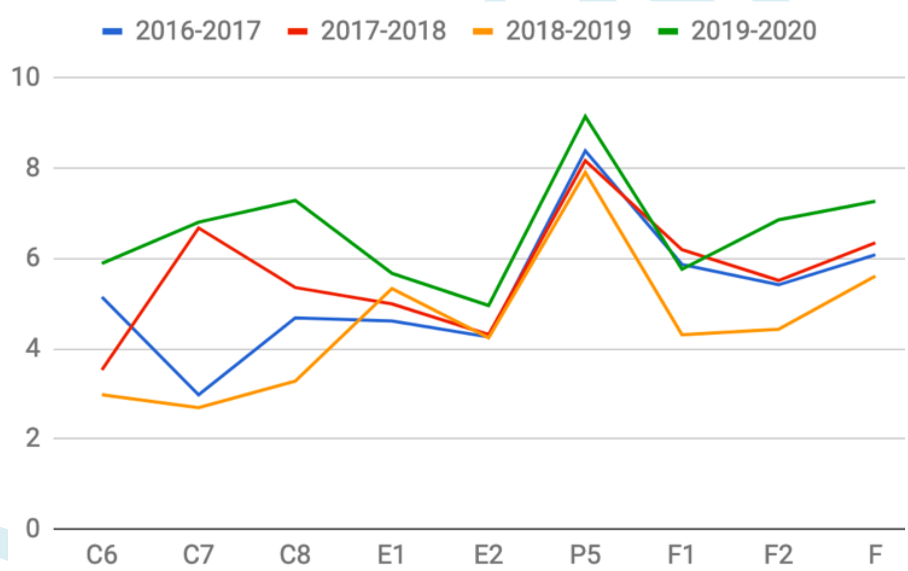
C6[a]	55	5.1454	44	3.5284	46	2.9782	59	5.8898
C7[b]	62	2.9758	45	6.677	47	2.6914	61	6.8049
C8[c]	63	4.6817	50	5.3558	49	3.2818	61	7.2877
E1[d]	67	4.6125	51	4.9925	55	5.3336	65	5.67
E2[e]	52	4.26	47	4.3123	51	4.2417	65	4.9561
P5[f]	62	8.3875	47	8.1708	57	7.91	55	9.15
F1[g]	68	5.8674	50	6.1954	47	4.3098	56	5.7615
F2[h]	30	5.4172	22	5.5138	22	4.4301	25	6.8572
F[i]	69	6.0833	50	6.3463	55	5.6087	66	7.2690

[a] Exercise 1 of continuous assessment, [b] Exercise 2 of continuous assessment, [c] Total continuous assessment, [d] First midterm test of theory, [e] Second midterm test of theory, [f] Final project, [g] Final grade first call, [h] Final grade second call, [i] Final grade

According to the data collected during the four academic years (Figure 2), an improvement in the final project (P5) can be seen throughout the courses, as well as the final grades obtained (F1, F2, F). On the other hand, the grades for the main items of continuous assessment (C6, C7, C8) vary significantly from one academic year to another.

Figure 2
Comparison of averages from the 2016-2017 academic year to the current academic year



Finally, we performed a mean difference test in order to find out if the differences found in the grades were significant at a statistical level. Firstly, we checked the normalcy of the distribution of the scores in the nine indicators by calculating the Shapiro-Wilk test. The results indicated that four of the nine items (E1, E2, F1 and F2) had normal distributions while the other five did not adjust to normalcy.

Consequently, we employed ANOVA to conduct the mean difference test for items E1, E2, F1 and F2 and Kruskal-Wallis for the rest. The results of the test (Table 3) indicated significant differences (s.l. .05) in the 9 indicators.

Table 3
Hours of work invested in the subject

	P
C6	<.001
C7	<.001
C8	<.001
E1	.003
E2	.004

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P5	<.001
F1	<.001
F2	<.001
F	<.001

Hours of work

As for numbers of hours of work invested in the subject, the students manifested to have dedicated less ours of work than in previous years with an average of 79.2 hours. This reduction is especially significant in comparison with the courses 2016-2017 and 2017-2018 although it is worth considering the difference in the sample size.

It is also interesting to highlight that the standard deviation is also noticeably smaller, which indicates a higher homogeneity between the students.

Table 4
Hours of work invested in the subject

	Avg	Std	N
2016-2017	83.67	45.42	43
2017-2018	90	33.33	9
2018-2019	90.21	40.81	14
2019-2020	79.2	26.22	30

Students' satisfaction

After conducting the data gathering process, we performed a descriptive analysis of the answers provided by the students. As we can see in table 5 the students manifest a generally high degree of satisfaction with the subject with mean scores above 4 in the majority of the items except items A5.1, A5.4 and A5.5. This contrast with the low level of satisfaction both with the degree and the general adaptation of the degree COVID-19 crisis. Following, we present a more detailed analysis of the frequencies of the items grouped by dimension.

Table 5
Results of the descriptive analysis

	Avg	**Std**	**Med**	**Valid**
G1	3.467	0.973	4.000	30
G1.10	2.552	1.298	3.000	29
A4.1	4.433	0.568	4.000	30
A4.2	4.500	0.682	5.000	30
A4.3	4.667	0.547	5.000	30
A4.4	4.733	0.583	5.000	30
A5.1	3.567	1.040	3.500	30
A5.2	4.167	0.791	4.000	30
A5.3	4.567	0.568	5.000	30
A5.4	2.267	0.868	2.000	30
A5.5	3.733	1.143	3.500	30
A5.6	4.833	0.461	5.000	30
A5.7	4.600	0.621	5.000	30
A5.8	4.433	0.728	5.000	30
A5.9	4.833	0.379	5.000	30
A5.10	4.500	0.900	5.000	30
A5.11	4.633	0.615	5.000	30

Firstly, two items should be analysed about the general satisfaction in adapting the subject during the confinement period. Regarding the general satisfaction on the adaptation of the

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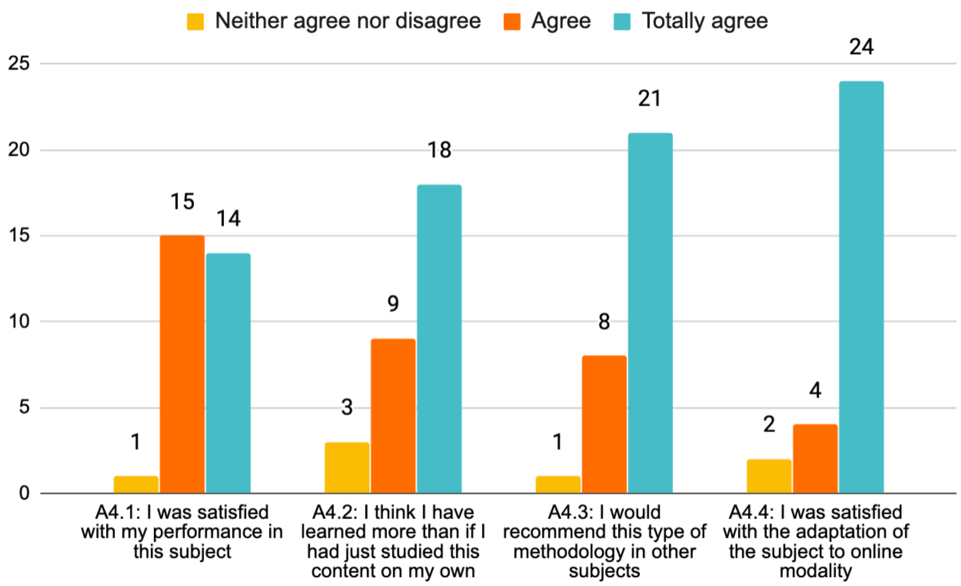
course during the COVID-19 crisis (G1.10), being N=29, 14 students show little or no satisfaction (48.28%), nine are neither satisfied nor dissatisfied (31.03%) and 6 are satisfied or delighted (20.69%). On the other hand, regarding the adaptation to the online modality of the Software Engineering I subject (A4.4), for N=30, two students are indifferent (6.67%). At the same time, 28 say they are satisfied with the subject's adaptation (93.33%).

Figure 3 shows the different items related to the subject's general satisfaction, where a positive opinion about the learning within the subject can be seen.

Figure 3
Overall satisfaction with the subject (A4 dimension) (N=30)



Regarding the materials provided in both the face-to-face and the online period (Figure 4), it should be noted that 96.67% of the students who answered the instrument indicated that they had reviewed the exercises solved on video, i.e., the video clips that were developed as material to replace the face-to-face sessions in which exercises were solved on the blackboard. It is also important to emphasise that not only have they used these videos, but they consider them very useful according to the results shown in Figure 5 (A5.9 and A5.10).

Figure 4
Depth degree in the study of the contents (A2 dimension)

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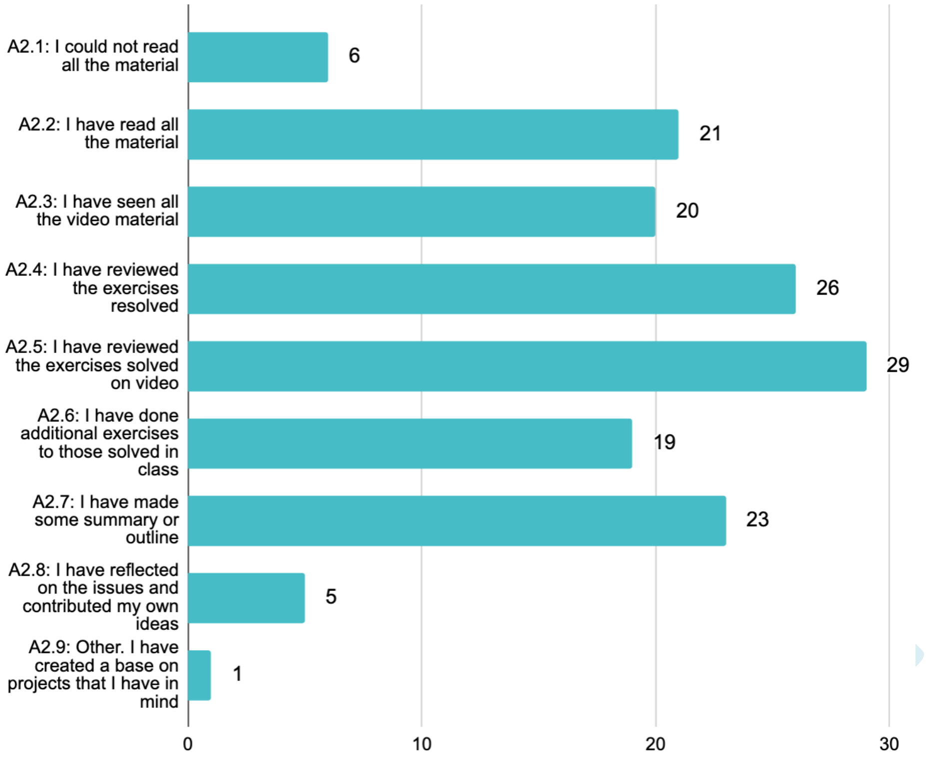
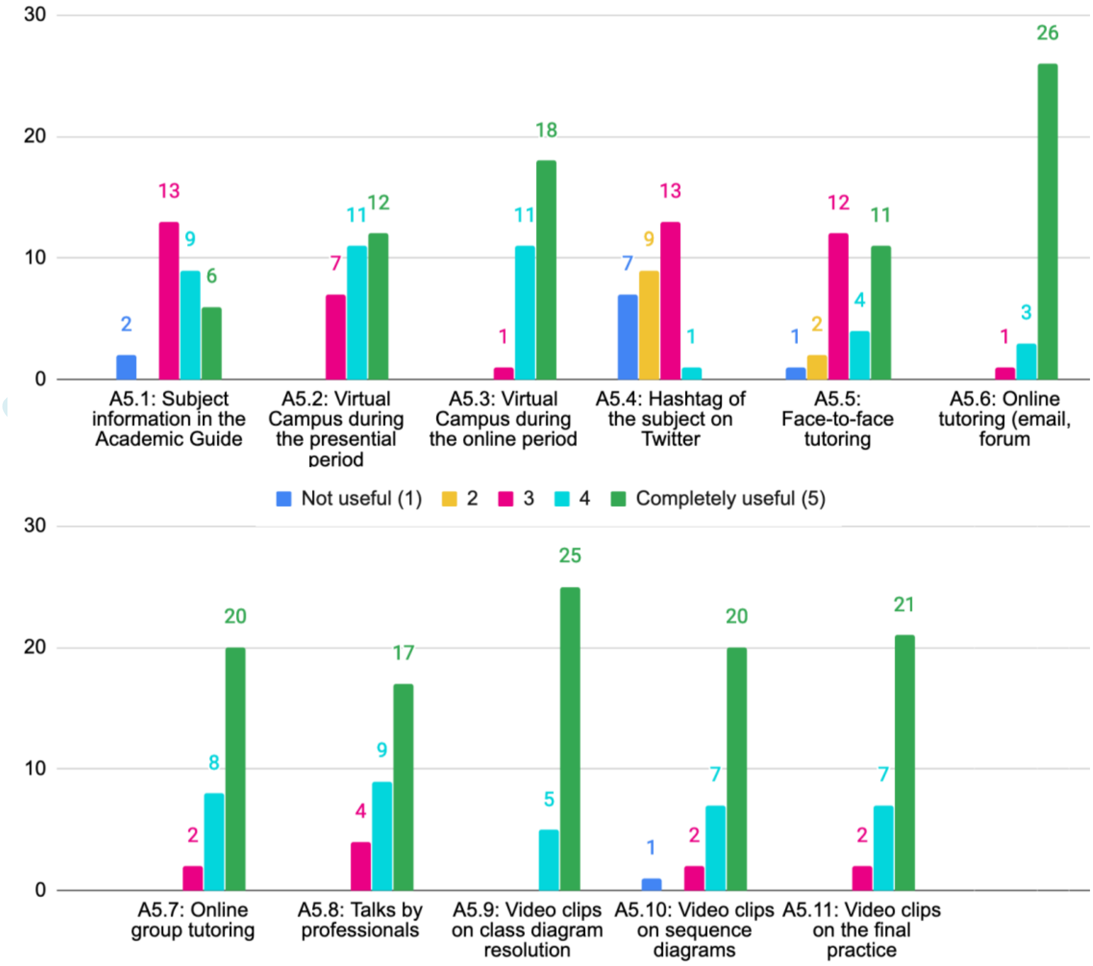


Figure 5
Usefulness for the subjects' study (A5 dimension)



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Regarding the use of the virtual campus (Figure 5), integrated into the subject's teaching in the face-to-face mode, and as the main channel of coordination and communication during the online period, the results show a proper evaluation by the students (A5.2 and A5.3).

In general terms, most of the items on the usefulness for the study of the subject are well evaluated, except using the hashtag of the subject, whose use by the teaching team was reduced by the workload associated with the health crisis. It is also worth noting some students' opinion on the face-to-face tutoring, mainly carried out as part of the face-to-face sessions where three people (10%) do not consider them useful.

Finally, some of the suggestions for improvement that can be applied in future academic years should be highlighted:

"More short and concise videos to explain the theory part."

"I wish more subjects like this could be brought into the online methodology. It would be good to leave this year's material to next year's students to learn both by going to class and by learning at home and consulting the teachers' explanations without the need for a tutorial".

"Increase the weight of final work, increase class participation with exercise, and less weight on the test."

"The monitoring done through the online tutoring has been very useful to me, because it forced you to work and keep up with the project. [...] That is why I recommend that in the face-to-face work, greater emphasis be placed on having those 10-15 minutes per group as a task during the final practice and not just as an optional resource".

DISCUSSION AND CONCLUSIONS

As shown in Table 2, there is a general increase in the grades obtained by the students in all of the items which may be explained by a combination of different factors.

Firstly, in the case of the exercises related with the continuous assessment (C6 and C7), this may be because the difficulty of the proposed exercises was lower than the exercises in previous years to motivate the students. Although these results influence the total score for continuous assessment (C8), the higher average obtained in this item is also due to a considerable increase in student participation in the asynchronous activities proposed.

Secondly, the grades obtained in the midterm tests (E1 and E2) are significantly higher than in previous courses, although they remain in the range between 5 and 6 over 10. Although the midterm tests were not monitored or supervised, the use of reflection questions has made it possible to reduce mass copying, which can explain the low grades in these items.

As for the final project, the average grades are also higher than in previous courses. The main difference with previous courses has been more considerable personalised attention to each of the working groups, so that continuous improvement has been carried out in almost all the projects.

These results are aligned with some studies have identified improvement in the students' learning performance during the COVID-19 confinement. In particular, according to Gonzalez et al. (2020) students have changed their strategies to a more continuous habit, improving their efficiency. Sanz et al. (2020) also identify more commitment to personal homework during the confinement, but they highlight that it should take into account the differences between teaching in this particular situation and teaching in a most general scenario.

On the other hand, the perception of the students of the amount of time dedicated to the subject is lower to previous years which combined with the increase in their performance indicates that the changes introduced to the subject may have improved the effectiveness of the teaching methodology. The causes of this change in the perception of the students of the time spent working on the subject constitute an interesting topic of research for future studies.

According to Hernández-Ramos and Belmonte (2020), students consider that, in a training system based on the development of competences, educational practices based on an active approach are more appropriate and motivating than the traditional ones. This statement is reflected in the students' satisfaction results in previous academic courses. Regarding the adaptation to online mode during the confinement period, it has not reduced the satisfaction results obtained in previous courses. Also, the items directly related to the online period show

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a high degree of satisfaction on the students' part. Although the answers collected do not represent 100% of the study population, they cover a broad spectrum of students according to the ranges of grades obtained so far in the Degree in Computer Engineering.

The course's adaptation to online format has not meant a redesign of the course or a change in the methodology, as can be seen in the comparison between the face-to-face and online approach. The primary key to this almost transparent process has been the previous use of active methodologies, the weight of the continuous assessment and the final project in the evaluation of the subject, and the integration of the university's technological ecosystem as part of the presential dynamics. The assessment items were adapted to the online approach, but they were not replaced or removed to simplify the assessment due to the pandemic situation. Based on this experience, it is possible to underline that the use of active methodologies and the combination of summative and formative assessment, enable the transformation from a face-to-face assessment into an online assessment. This perception of the teaching team is guaranteed by the learning results obtained and the students' feedback about the adaptation of the course to an online format.

On the other hand, although the use of active learning foster the participation and involvement of the students in the learning process, there were risks that cannot be controlled such as the lack of interest of students or their particular situations during the confinement period.

The study presents some limitations; firstly, it is worth noticing that the data gathering process has been done through self-report which compromises the honesty in the answer of the students. However, the consistency with the results from previous years on which the information was gathered with the same instruments may help to give some perspective and mitigate the effect of the social desirability bias.

Additionally, as has been stated, the size of the sample is small and, although it is representative of the study population, the results cannot be generalised to other contexts. The extension of the methodology to other populations and contexts may also be of interest for future studies.

Finally, the experience has allowed improving the approach of the subject. Among the actions undertaken for subsequent courses, the use of all the digital material created should be highlighted.

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