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# Students' and Instructors' Perspectives regarding E-Assessment: A Case Study in Introductory Digital Systems*

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Higher education institutions are increasingly offering opportunities for online learning, yet the issues of identifying students and verifying the authorship of their work limit the adoption of online assessment. Furthermore, little is known about the instructors' and students' background and confidence in e-assessment. This study analyzes students' and instructors' experiences, trust, and expectations regarding the use of an e-authentication system for e-assessment purposes. A total of 154 students and 12 instructors were surveyed, and two group interviews conducted, within the context of a pilot for a European project. The pilot consisted of testing several security mechanisms through diverse e-assessment activities in an online university course in digital systems. The results showed that participants had little experience with courses where all assessments were conducted online. Negative expectations of e-assessment (i.e., workload and time overload) were dispelled while ideas about the expected benefits were realized (i.e., flexibility, mobility and comfort). Attitudes toward e-assessment remained positive despite the technical difficulties that arose during the pilot. The use of security mechanisms was perceived as beneficial and opened up new opportunities for innovative practices in e-assessment but caused some mistrust or sense of invasiveness among participants. This study contributes to advancing the field of technology-enhanced assessment and understanding students' and instructors' perspectives on that matter.

**Keywords:** e-assessment; online education; security mechanisms; students' and teachers' perceptions

## 1. Introduction

Current trends in blended and online higher education are oriented toward combined forms of technology-enhanced assessment. The use of technology for assessing the presentation of activities and recording responses is referred to as "e-assessment" [1], also known as "Computer-Based Assessment" (CBA) or online assessment. Although digital technologies are mainly used to reproduce traditional forms of assessment, they have the potential to enhance the evaluation process through, for example, new possibilities for storing results and conducting statistical analysis [2]. Thus, digital technologies can be used merely to support a process of delivery or test declarative knowledge, or also to evaluate higher-order thinking skills accompanied by complex forms of feedback [3]. The use depends on the purpose of assessment [4], that is, whether it is summative (to measure student achievement by making a judgment at the end of an instructional period) or formative (to monitor student learning during instruction and to provide ongoing feedback for improvement). E-assessment is becoming a suitable solution for assessing and providing feedback to large groups of students without increasing the instructor's workload through, for example, online tests and automatic assessment [5–7].

Summative assessments prevail in higher education [8] and e-assessment systems tend to concentrate on virtualizing exams for testing declarative knowledge [9]. However, online testing is rarely used in summative assessment in higher education [10]. Exams are mostly conducted in paper-based form, which hinders student mobility and makes it hard to provide for special educational needs and disabilities (SEND). The perpetuation of paper-based summative assessments is due to social mistrust of online education and its capacity to verify students' identities and prevent cheating [11–13]. Some mechanisms for authentication (e.g., login and password, digital certificates and biometric recognition) and authorship (e.g., automatic plagiarism detection, forensic linguistic analysis and trust-based analysis) are increasingly being considered key in terms of providing the necessary data to reliably assess students online and help overcome barriers of time and place.

Following this trend, the EU H2020 TeSLA project aims to develop an adaptive trust-based

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system that incorporates security mechanisms for e-assessment purposes. eighteen partners across 13 countries, including seven universities, are participating in this project. It has been divided into three pilots where students from among the seven pilot institutions are taking part: (1) small-scale pilot (over 600 students), (2) medium-scale pilot (over 5000 students) and (3) large-scale pilot (over 7000–14000 students involved in two stages) [14, 15]. This paper focuses on the results of the first pilot run during the fall semester of the 2016/2017 academic year. This pilot aimed to lay the basis of the following pilots in terms of internal protocols, security mechanisms, e-assessment activities, legal/ethical frameworks, and SEND students. At this stage, the system was still being developed and some security mechanisms (authentication and authorship instruments) were tested for validating data collection. There was also significant interest in gathering the opinions and attitudes of the participants toward the use of such instruments for e-assessment. The security mechanisms tested were: face recognition (FR), voice recognition (VR), keystroke dynamics (KD) and plagiarism (PL). FR, VR and KD were used for student authentication through the analysis of captured images, audio and typing while performing e-assessment activities (or checking the delivered assessment activities in the case of FR and VR). PL was used for authorship purposes as it detects similarities among text documents delivered by different students. The authentication instruments required creating a learner model for each student—a biometric model. This model was built using so-called ''enrollment activities'' (activities with a non-grading purpose that served for user registration). The same kind of model was used as a reference for the subsequent e-assessment activities. As the data collected were sensitive, all students that agreed to participate signed a consent form where they were informed about data protection. The technological infrastructure for conducting the first pilot was a Moodle instance, which included a third-party plugin used to record video and audio from students and to capture their keystroke rhythms and texts for plagiarism checking.

In the present paper, we describe the results of data collected through four surveys (students'/instructors' pre-pilot survey and students'/instructors' post-pilot survey,) and two group interviews with students and instructors in the context of the Open University of Catalonia (UOC) during the first pilot. This study analyzes students and instructors' experiences, trust, and expectations toward the use of a system such as TeSLA for e-assessment purposes within a fully online university. The main research questions underpinning this study are:

*RQ1.* What are the students' and instructors' learning and teaching experiences with e-assessment?
*RQ2.* Are the students and instructors satisfied with their e-assessment experience within the pilot?
*RQ3.* Have the expectations about the advantages and disadvantages of e-assessment changed as a result of participation in the pilot?

The paper is structured as follows: section 2 examines related work on e-assessment; section 3 explains the methodology used; section 4 discusses the primary results of the study and section 5 draws concluding remarks and discusses the limitations of the study.

## 2. Related work

A number of researchers have investigated the benefits of e-assessment, e.g., location and time flexibility, instant feedback, improved reliability and saving of time/money [16–20]. Nevertheless, despite these advantages, several concerns and some reticence regarding e-assessment persist. First, the difficulty in identifying online learners and ensuring that the person who takes the assessment is who he or she claims to be (authentication) and in demonstrating that the work produced is original (authorship). Second, the common belief that e-assessment facilitates cheating. Third, the perception regarding the increase in student anxiety associated with the use of computers for assessment purposes. Fourth, the social preconception about the low reputation of online universities and the suspicion about accreditation systems based solely on e-assessment. All these arguments have been refuted. A growing body of literature has explored and recommended the use of security mechanisms to identify students and detect fraud in e-assessment [21–24].

There is a considerable amount of literature on the impact of digital technologies in assessment at the institutional, economic and pedagogical level. However, research into the instructor's perspective has been limited [25] as has research on student perceptions and experiences in e-assessment [11, 26, 27]. Existing research on student and instructor perceptions of e-assessment shows both reluctance as well as positive expectations before experiencing online assessment. From the instructors' point of view, the advantages relate to reductions in time and cost while the disadvantages refer to workload and the use of technology (reliability and technological expertise). As for the students, the encouragement of self-regulation is the main advantage while the disadvantages include increased anxiety, lack of reliability, workspace difficulties and unsatisfactory feedback. A number of studies have found that

although it is fairly usual to encounter issues when implementing e-assessment, both instructors and students believe that the advantages outweigh the disadvantages and prefer it to paper-based assessment [28–30]. For instance, regarding the contrast between prior and later beliefs on e-assessment, the findings of a study conducted by [10] suggest that before the start of the study, students had reservations about the idea of being examined online and at the end they were concerned about technical difficulties and internet connectivity. Conversely, the results of a study carried out by [31] showed that although many students and faculty had limited exposure to computer-based testing, they were optimistic about e-assessment and were only concerned with an increase in stress level. Their views remained positive following implementation.

Previous research on instructors' and students' views after experiencing e-assessment describes a double-sided perspective. On the one hand, the literature contains several examples of positive experiences in e-assessment situations. The most common findings are: (a) the e-assessment tools are experienced as learning and teaching aids, (b) the format is perceived as less stressful and more engaging than alternative methods, (c) the feedback is considered as helpful to reinforce learning, and (d) the systems are recognized as trustworthy. Recent evidence reveals that both instructors and students have a positive view of e-assessment and consider that the benefits (e.g., decrease in workload) outweigh the difficulties (e.g., reliability, intrusion, practical difficulties and technical issues) [32]. On the other hand, some studies report negative feelings in regard to e-assessment. For instance, in [33] findings proved that the mean scores for the online learning mode were lower than those of face-to-face learning in learning effectiveness, motivation and assessment outcome.

As for the specific studies conducted in the context of different engineering fields (e.g., Computer Science, Information Technology and Applied Sciences), findings demonstrate that students and instructors are familiar with the use of computer systems and the internet, which helps give them a favorable view of e-assessments. Research on e-assessment in such a discipline has focused on replacing paper-based exams with e-exams in proctored or unproctored environments and introducing online quizzes and tests to promote student practice before exams. Recent findings demonstrate that e-assessment does not differ from paper-based assessment (i.e., the format does not have a significant effect on student performance), it is not disadvantageous and it is even perceived as less stressful [34–37]. Other studies have demonstrated positive views from students and instructors after experiencing e-assessment. As for student perceptions, the findings obtained by [38] after using Moodle quizzes demonstrated the students' engagement with these systems and their positive perceptions toward an extended use of e-assessments. The study conducted by [39] compared the views of students from six different faculties (including Engineering) after experiencing e-exams and found no significant differences; students favored the use of e-exams.

Some research also approaches the implementation of e-assessment from the instructors' and students' perspective. In a study conducted by [40], the instructors appreciated the opportunity offered by the e-assessment tools (which were part of the university's own e-learning platform) for improving the course rather than spending time evaluating students. Students, however, felt worried about being evaluated without faculty intervention. More positive results have been found in those cases where the use of security measures has accompanied the design of e-assessments. Such technologies have not created mistrust, quite the opposite; both students and instructors have trusted the system, which has influenced their attitudes toward the acceptance of e-assessment [41, 42].

There are also a few cases where e-assessment is not perceived positively. For instance, the research conducted by [43] demonstrated that, after implementing e-exams, instructors continued to show some resistance due to issues regarding support, time spent, usability and reliability of the system. They preferred not to change their examination habits. In a study conducted by [26] where classroom lessons were accompanied by online sessions (e.g., online lectures, online quizzes, peer evaluations and submission of written assignments), instructors and students showed mixed viewpoints regarding e-assessment. Although they perceived e-assessments as increasing their time and workload, they believed that e-assessments could be used as a supplementary tool. Instructors called for better application and technical support while students showed their apprehensiveness. Similarly, in [44] the authors found that developing online tests was labor intensive for instructors and the restricted feedback offered by the multiple-choice part frustrated students. Nevertheless, their overall impression was positive concerning the long-term training effect.

All these studies shed light on the perspectives of students and instructors when experiencing e-assessment. However, all previous research presented in this section in the field of engineering is set in the contexts of face-to-face or blended learning. Furthermore, the types of assessments proposed are mostly based on exams, quizzes and

tests. According to [4], further research is required in the specific context of fully online assessment and with a range of e-assessments. In this regard, the present paper aims to analyze students' and instructors' experiences with and expectations toward e-assessment in an online context where different types of e-assessment activities are suggested.

## 3. Research method

### *3.1 Setting and participants*

The participants in this study were undergraduate students and instructors from the Computer Engineering and Telecommunications Technology degrees enrolled on an online course entitled "Introduction to Digital Systems" at the UOC. It is a first-year mandatory course with a high ratio of students that are divided into groups of 75. The course aims to enable students to analyze and synthesize digital circuits. It is divided into four learning units (LU): (1) numeral systems, (2) combinational circuits, (3) sequential circuits, and (4) design of finite state machines. The course comprises four e-assessment activities. FR, VR, KD and PL were tested in the last three activities. Activities one and two (LU 1 / LU 2) comprised exercises related to the design of digital systems. Activity three (LU 3) required the analysis and design of a sequential circuit. Activity four (LU 4) required students to design a specification as a state machine and synthesize the corresponding sequential circuit. The last three activities entailed the delivery of a short video that was processed by the FR and VR instruments. The requested video was a complementary task for each of the three activities that involved students responding orally to a question about the activity performed (e.g., to reason the decisions made when designing the sequential circuit). The oral response was recorded with a webcam and lasted from one to two minutes. FR and VR instruments were enabled simultaneously during the recording. Students were also asked to solve some questions in a Moodle quiz where KD and PL instruments were enabled. These questions required students to create a written response.

726 students joined the course during the fall semester of the 2016/2017 academic year. The total sample of students that voluntarily consented to participate in the pilot was 154 (13.73% female, 86.27% male; mean age = 34). Twelve instructors were also involved (8% female, 92% male, and 57% in the age group of 40–50). From these, one had the role of coordinating professor (responsible for course design) and 11 had the role of course instructors (responsible for student support and assessment). The gender differences of the sample are representative of the gender imbalance in STEM fields where women are a minority [45, 46].

### *3.2 Research instruments*

#### *3.2.1 Student and instructor surveys*

The students' and instructors' experiences and expectations regarding e-assessment were collected through four surveys (students' pre-pilot, instructors' pre-pilot, students' post-pilot, instructors' post-pilot) (Appendix 1). The pre-pilot surveys were organized into 3–4 sections, namely: (1) demographic information, (2) learning/teaching experiences, behavior (i.e., cheating) and expectations (including information about disabilities), (3) trust and (4) privacy and ethics. In the post-pilot surveys, the same blocks were repeated and a section referring to information and guidance within the pilot was added. The items in the pre-pilot surveys focused on prior experiences while those in the post-pilot surveys were based on the experience of the pilot. The survey items consisted, mostly, of statements prompting responses on a Likert scale of 1–5 (labeled from "strongly disagree" to "strongly agree"), dropdown, multi-choice and open questions. All surveys comprised, approximately, 40 items that were correlated among surveys and associated with indicators. There were 50 correlation identifiers and 48 indicators divided into 15 categories (e.g., students' perceptions, instructors' expectations, privacy, ethics, intrusiveness and satisfaction). Nevertheless, some items were included in the pre-/post-pilot survey because some information only had to be gathered in one of the surveys (e.g., the opinion about prior learning/teaching experiences).

Bearing in mind the focus of this study, only the items referring to learning and teaching experiences, trust and expectations were considered. Some of these items were adapted from previous studies and literature [34, 16, 10, 29, 40, 47, 48], while some were specifically created for this study. The items revised or created considered the specific technologies used within the pilot (authentication and authorship) and the TeSLA system. As the survey comprised several topics, and an appropriate survey length had to be respected, the items had to be limited and balanced among the different sections. Draft surveys were refined to fit the contexts of the partner institutions.

The pre-pilot surveys were used to respond to the first research question regarding students' and instructors' experiences of e-assessment and the third research question about their expectations. The post-pilot surveys were used to respond to the second research question regarding students' and instructors' perceptions of e-assessment after the

**Table 1.** Survey sections and relationship with research questions (RQ)

| | Prior experience | | Pilot experience | |
|---|---|---|---|---|
| | **Students' pre-pilot survey** | **Instructors' pre-pilot survey** | **Students' post-pilot survey** | **Instructors' post-pilot survey** |
| Sections | | | | |
| Demographic information | x | x | x | x |
| Learning/teaching experiences, behavior & expectations | x | x | x | x |
| Trust | x | x | x | x |
| Privacy & ethics | x | – | x | x |
| Information & guidance | – | – | x | x |
| RQ | | | | |
| RQ1 | x | x | – | – |
| RQ2 | – | – | x | x |
| RQ3 | x | x | x | x |

pilot and to the third research question about their expectations (Table 1).

### *3.2.2 Group interviews*

The students' and instructors' experiences (prior to and after the pilot) and beliefs about e-assessment were also gathered through two group interviews (one with students and staff, and one with instructors and staff). This instrument was helpful for comparing the instructors' and students' views based on discussion. The group interviews were divided into five blocks of questions: (1) pedagogical aspects, (2) trust, (3) cheating and privacy, (4) technological aspects, and (5) expectations (Appendix 2). In line with the purpose of this study, only sections 1, 2 and 5 were analyzed. Two students, two instructors (one coordinating professor and one course instructor), the Pilot Leader (responsible for the planning and execution of the pilot), and the Technical Lead (responsible for the technical planning and execution of the pilot) participated in two 90-minute sessions. Considering the aim of this study, only the views of students and instructors have been analyzed.

## *3.3 Data collection process*

Students and instructors completed the surveys online and anonymously using the Jisc Online Surveys tool. The pre-pilot surveys were given at the beginning of the fall semester of the 2016/2017 academic year. The post-pilot surveys and the group interviews were conducted at the end of the fall semester of the 2016/2017 academic year. The group interviews were launched online in Webex, recorded, and later coded using the Atlas.ti v.7.5 software.

## *3.4 Data analysis*

The three research questions were answered by examining the data from the pre- and post-pilot surveys and the group interviews. A deductive approach was implemented for data analysis. The research questions were used to group the data and detect the main findings. As the surveys and group interviews aimed to collect information from a range of topics, the data presented in this article is based only on those questions referring to teaching and learning experiences, confidence and expectations in relation to e-assessment. Thus, the responses from nine items of each student survey (students' pre, students' post), 10–11 items of each instructor survey (instructors' pre, instructors' post), and a total of 10 questions from the group interviews were analyzed. A thematic analysis was conducted to code and analyze the data from the group interviews. Two families (students and instructors) and 35 codes were created. The ''students'' family contained 20 codes (e.g., reflection on cheating, learning experience, technical problems, prior learning experiences, etc.), and the ''instructors'' family comprised 15 codes (e.g., course design, prior teaching experiences, trust, time, etc.).

The results of the surveys were analyzed based on the number of respondents and presented as a percentage. Responses to open questions were coded. A high percentage of students participating in the pilot answered the pre-pilot survey (84.4%) while the response rate for the post-pilot survey was 36.9%. There was a reasonable response rate of 58.3% of instructors answering the pre-pilot survey and a response rate of 41.6% for the post-pilot survey. The differences in the student response rate between the pre- and the post-pilot survey derive from the typical dropout rate of the ''Introduction to Digital Systems'' course. For many students, this course is the initial contact with online education and the theoretical foundations of engineering education. These two circumstances result in a high dropout rate (about 49%). The results presented below describe the specific case of the students and instructors participating in the pilot and do not aim to be representative of the entire population that comprises the course. Caution is advised as regards the robustness of the

findings due to the small sample size, especially with reference to instructors. Although the sample size of students and instructors is not comparable, the number of respondents represents half the population for each group. For that reason, results from both groups are presented comparatively as they are representative of their population.

## 4. Results

This section presents the results obtained in this study and compares them with existing research. They are classified according to the three research questions: ''What are the students' and instructors' learning and teaching experiences with regard to e-assessment?'' (4.1), ''Are the students and instructors satisfied with their e-assessment experience within the pilot?'' (4.2), and ''Have the expectations about the advantages and disadvantages of e-assessment changed as a result of participation in the pilot?'' (4.3). Quantitative and qualitative data have been merged for the purposes of presentation.

### *4.1 Prior learning and teaching experiences in e-assessment (RQ1)*

Table 2 presents the survey results for items related to e-learning and e-assessment. It can be observed that instructors are slightly more experienced in online courses (85.7%) than students (73.1%) although the majority of participants are used to this mode of teaching delivery. Regarding the e-assessment background, the majority of instructors (71.4%) and half the students (53.8%) do not have experience with courses where all assessment has been conducted online. Nevertheless, almost half the instructors have conducted online examinations (42.9%), in contrast to more than a third of students (33.1%) that claim to have taken online examinations. There may be two reasons for these results. First, thanks to informal conversations with instructors, it was discovered that the majority of students were enrolled for the first time at the UOC and all instructors had some experience conducting courses at our university. As for the students' results, it is not surprising that they had little experience in e-assessment if they were enrolled at the UOC for the first time. Regarding the instructors' findings, it can be deduced that some instructors probably answered based on their prior experiences at other institutions and did not respond in regard to their current situation (i.e., considering that the UOC is a fully online university, all instructors should have affirmed that they had experience in e-assessment). Second, it must be noted that the UOC still has a vast number of courses where in-person exams complement e-assessment activities. For this reason, many instructors may still not have experience conducting exclusively online assessment. Nevertheless, the experience that UOC students and instructors claimed to have in online assessment is significantly higher than the norm for this field. As shown in Section 2, paper-based exams predominate in the engineering field.

Table 3 shows the types of assessment that participants have ever implemented (instructors) and experienced (students). Although the research acknowledges that there are two prominent types of assessment depending on the purpose—summative/formative, in this research, four types were considered taking into account the UOC's educational model and the predominant institutional uses (diagnostic, summative, continuous and formative). In this regard, continuous assessment is considered as a way of assessing students during the course although it might not include giving guidelines for

**Table 2.** Questions about prior learning/teaching experiences (students'/instructors' pre-pilot survey)

| **Students (n=130)** | | | | **Instructors (n = 7)** | | |
|---|---|---|---|---|---|---|
| **Question** | **Yes** | **No** | **Not sure** | **Question** | **Yes** | **No** |
| Have you ever taken an online course? | 95 (73.1%) | 35 (26.9%) | – | Have you ever taught an online course? | 6 (85.7%) | 1 (14.3%) |
| Have you ever taken a course for which all the assessment has been conducted online? | 60 (46.2%) | 70 (53.8%) | – | Have you ever taught a course for which all the assessment has been conducted online? | 2 (28.6%) | 5 (71.4%) |
| Have you ever taken an online examination? | 43 (33.1%) | 87 (66.9%) | – | Have you ever conducted an online examination? | 3 (42.9%) | 4 (57.1%) |
| Have you ever been assessed based on a rubric? | 14 (10.8%) | 58 (44.6%) | 58 (44.6%) | Have you ever designed an assessment rubric?* | 3 (50%) | 3 (50%) |
| | | | | Do you usually provide assessment criteria to students in order to guide them about how they will be assessed for each assessment activity? | 5 (71.4%) | 2 (28.6%) |

* Optional item.

**Table 3.** Questions about the types of assessment experienced (students'/instructors' pre-pilot survey)

| Question | | D* | C | F | S | O |
|---|---|---|---|---|---|---|
| Which types of assessment have you implemented in your courses? | Instructors (n = 7) | 1 (14.3%) | 7 (100%) | 4 (57.1%) | 7 (100%) | – |
| Which types of assessment have you experienced in other courses? | Students (n = 130) | 50 (38.5%) | 90 (69.2%) | 54 (41.5%) | 106 (81.5%) | 7 (5.3%) |

* (D) Diagnostic, (C) Continuous, (F) Formative, (S) Summative, (O) Other.

**Table 4.** Question about assessment criteria (instructors' pre-pilot survey, n = 7)

| Question | Syllabus | Activity statement | Activity solution |
|---|---|---|---|
| When do you provide students with the assessment criteria? | – | 4 (80%) | 1 (20%) |

Optional and multiple-choice item.

improvement. Formative assessment, on the other hand, always aims to help students enhance their learning. Bearing these definitions in mind, as expected, results showed that the summative and continuous types of assessment are the most common. Consistent with the usual pedagogical design used in engineering education, the summative assessment continues to be the most traditional and common form of assessment. In items referring to advanced approaches to assessment, such as rubrics, assessment criteria and feedback, participants demonstrated to have been mainly exposed to traditional forms of assessment. For instance, half the instructors claimed to have designed a rubric at some point, and 10.8% of students declared that they had been assessed based on a rubric (Table 2). However, 71.4% of instructors affirmed that they usually provide assessment criteria (Table 2) that is integrated into the assessment activity statement (80%) or the solution of the activity (20%) (Table 4).

Table 5 indicates the types of feedback that instructors usually provide and that students usually receive. For students, the most common feedback is whole-class feedback (74.6%) and marks (61.5%), while, for instructors, the most usual is the solution of activities (85.7%) and giving marks (85.7%). Such results contrast with previous studies where students defend the usefulness of and need for more immediate and personalized feedback in e-assessment situations for reinforcing their learning [35, 49, 26]. Following this demand, the UOC is motivating instructors to move toward formative assessment practices and to provide more personalized feedback. In the specific case of the "Introduction to Digital Systems" course, instructors use the Rubric Analytics tool which is a management system for providing personalized feedback [50]. Thanks to the use of this tool, the amount of personalized feedback given to students in this course is greater than the use of this feedback in other engineering courses where it is fairly common to provide students with the solution to activities and marks. Nevertheless, consistent with previous research [26], the ratio of students per classroom and the instructors' workload hinders the proliferation of formative feedback. Consequently, according to [4], it is obvious that current forms of implementing formative e-assessments are not truly exploiting their potential for enhancing learning through technology.

To conclude, it can be deduced that instructors and students have prior experience in online courses and, in a lesser proportion, have all experienced online assessment. Participants are used to summative and continuous assessment while the use of formative approaches has been scarce.

### *4.2 Satisfaction with e-assessment experience within the pilot (RQ2)*

Figures 1 and 2 show respondents' satisfaction after the pilot regarding their teaching and learning experience. Both instructors (100%) and students

**Table 5.** Question about feedback (students'/instructors' pre-pilot survey)

| Question | | Whole class | Solution of activities | Mark | Personalized |
|---|---|---|---|---|---|
| Which types of feedback do you usually provide your students with? | Instructors (n = 7) | 3 (42.8%) | 6 (85.7%) | 6 (85.7%) | 4 (57.1%) |
| Which types of feedback do you usually receive from instructors? | Students (n = 130) | 97 (74.6%) | 65 (50%) | 80 (61.5%) | 50 (38.4%) |

Multiple-choice item.

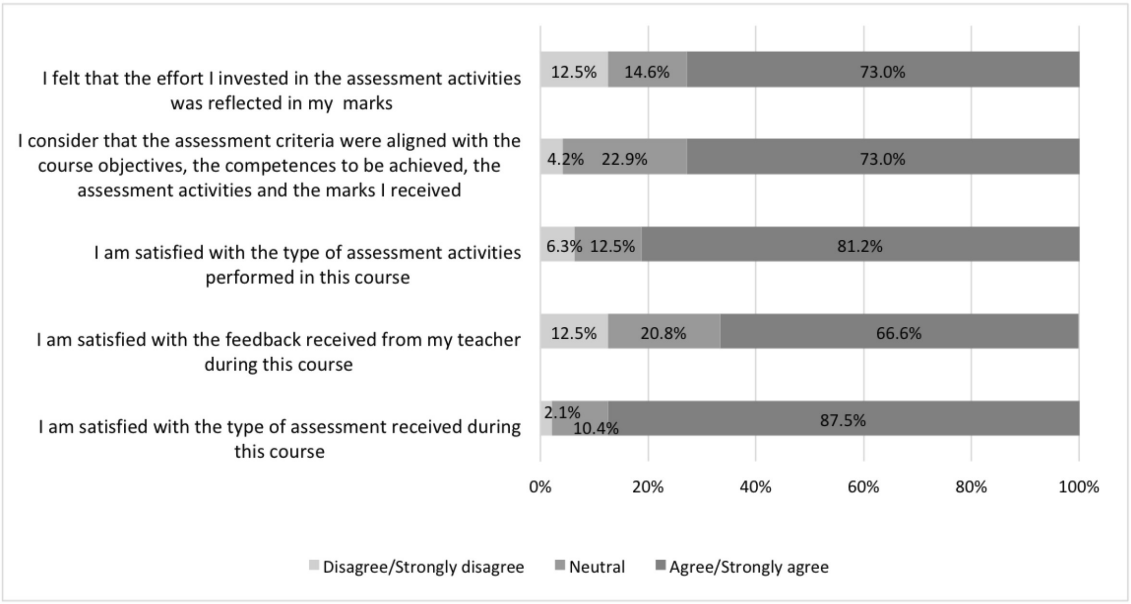


**Fig. 1.** Student satisfaction with the learning experience after the pilot. Post-pilot survey, n = 48.

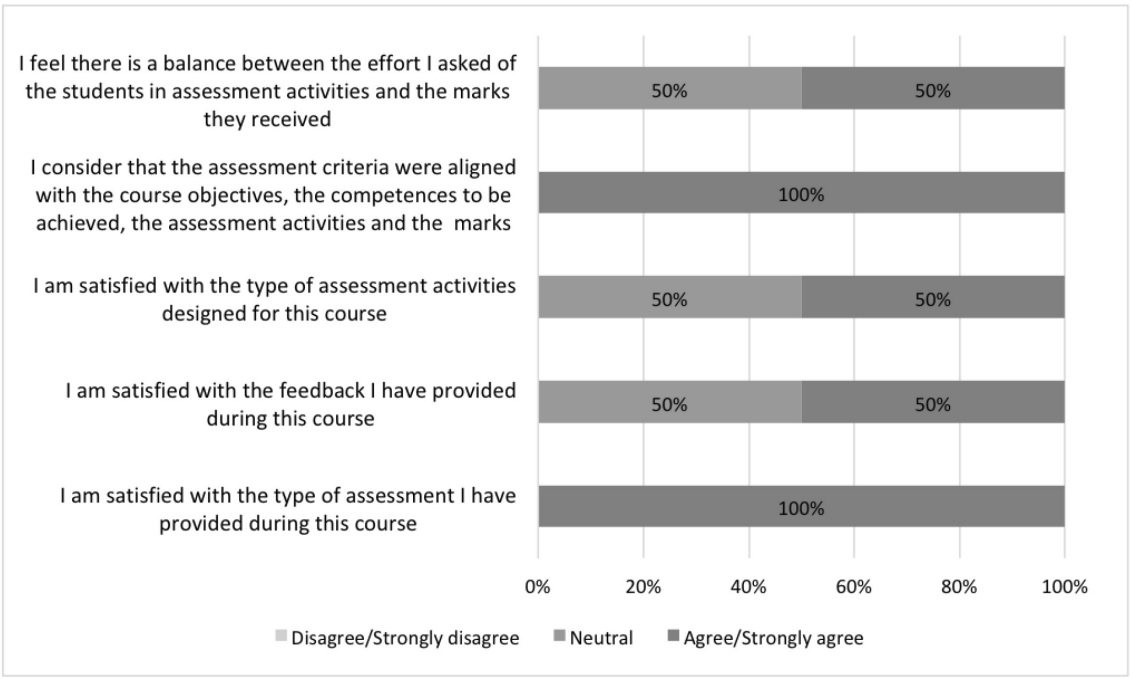


**Fig. 2.** Instructor's satisfaction with the teaching experience after the pilot. Post-pilot survey, n = 5.

(87.5%) are satisfied with the type of assessment designed for the pilot course. This result can be explained considering that, in fact, participating in the pilot did not entail changes in the type of assessment; some activities were simply adapted to fit with the instruments. Concerning feedback, students are more satisfied (66.6%) than instructors (50%), and this is also the case for the type of assessment activities where students are highly satisfied (81.2%) while just half the instructors are satisfied (50%). Conversely, all instructors are satisfied with curriculum alignment compared to 73% of students. Surprisingly, although 73% of the students considered that the effort invested in the assessment activities was reflected in their marks, just half the instructors agreed with this observation. Two reasons may explain the difference between students' and instructors' views. First, the instructors' self-imposed standards. Second, based on the typical responses received in the UOC satisfaction surveys

issued periodically, it could be deduced that the workload described by some students is probably related to the course itself and not to the fact that this course was included in the pilot.

In general terms, it appears that the e-assessment experience was quite satisfying, both for instructors and students. The results of student satisfaction are consistent with those observed in previous research [26, 29, 30, 34–41, 44, 49, 51] where it was demonstrated that students, even before or after experiencing e-assessment, have positive attitudes toward the use of digital technologies for assessment purposes and prefer it to paper-based assessment.

Despite the positive views presented above, the instructors affirmed that they have experienced an increased workload due to the pilot. All of them refer to the correction process and 40% to the creation of activities—implementation in the Learning Management System (LMS) (Table 6). These results coincide with previous studies where instructors experienced increased demands on their time and workloads in e-assessments [26, 43] and contrast with previous research where it has been demonstrated that, although e-assessment is time-consuming during the design period, it helps to save time in terms of marking, which contributes to instructors having more time for supporting the students in the learning process [40, 38]. None of the respondents have experienced an increased workload due to the type of assessment when generating new resources or in learning new technologies. This last result is interesting in comparison to data collected on expected disadvantages (section 4.3) where almost half the instructors foresaw that learning new technologies could be one of the main disadvantages. Based on the observation, it was evident that using the Moodle instance (which is not the UOC LMS) for testing the instruments incremented the instructors' workload. It required additional steps for accessing the delivered e-assessment activities, and it involved more effort in creating and adapting the course. We consider that this workload will decrease as the project progresses, given that the system is expected to work in the background, integrated into the UOC LMS, and will be a more user-friendly system.

When comparing and contrasting the responses from the post-pilot surveys with the group interviews, it is revealed that participation in the pilot had no major impact on course design, neither for instructors nor students. Students did not allocate more time to completing the activities and did not change their usual procedure for completing the activities (i.e., they first created an outline or a script on a paper and then transformed it into the delivery format as usual). Similar results have been observed by [29] in a study where students affirmed that computer-based assessment did not take longer than paper-based assessments. For instructors, the pilot slightly impacted on their definition of time spent on activities and represented a positive impact as it helped to rethink and improve the course. Some examples of quotations taken from the group interviews are as follows:

> "It is not forced at all, it depends on your time and depends on external things, the format you use to do the activities doesn't matter. I think it is even better to do it in this format [video]. One of the questions had to be answered orally and it was a lot more comfortable for me." (Student)

> "It costs relatively little to integrate these questions that go beyond the traditional written format into voice or audio format. We had to look for questions mostly oriented toward theoretical knowledge, rather than practical knowledge. They must be short questions that can be answered in a few sentences." (Instructor)

> "It has given us a chance to squeeze our brains and think about what types of meaningful activities we could propose that would be useful for you [students] and which we could collect data from." (Instructor)

As for the advanced forms of assessment, after the pilot, all instructors claimed to have provided assessment criteria (in contrast to 71.4% who claimed to usually provide assessment criteria in the pre-pilot survey), and less than half (40%) confirmed having used a rubric (consistent with the pre-pilot survey where 50% of instructors declared to have designed a rubric at some point) (Table 7).

Figure 3 shows instructor and student confidence in online assessment after participation in the pilot. In line with [29, 40, 41], findings showed that student confidence in e-assessment increased after experiencing it, especially if security instruments were implemented. In our research, 39.6% of the students and 60% of the instructors affirmed that their trust in online assessment had increased due to involvement

**Table 6.** Question about workload (instructors' post-pilot survey, n = 5)

| Question | Course design | Define activities | Create activities | Support students | Correct activities |
|---|---|---|---|---|---|
| Select the actions (if any) where you have experienced an increased workload due to your participation in the pilot | 1 (20%) | 1 (20%) | 2 (40%) | 1 (20%) | 5 (100%) |

Multiple-choice item.

**Table 7.** Questions about assessment (instructors' post-pilot survey, n = 5)

| Question | Yes | No |
|---|---|---|
| I provided students with assessment criteria | 5 (100%) | – |
| I provided students with a rubric | 2 (40%) | 3 (60%) |

in the pilot. This can be explained because the UOC already uses security mechanisms (e.g., antiplagiarism tools) and such instruments probably make e-assessment trustworthy enough for students. It is possible that one of the main advantages that the students see in the system is that it provides a way of avoiding final in-person examinations. Such results are consistent with the fact that 87.5% of the students considered, after participating in the pilot, that it is possible to be assessed fully virtually (Fig. 4).

Instructors, on the other hand, considered that their opinion and confidence in online assessment had not changed as a result of participating in the pilot (60% of instructors agree or strongly agree, and 40% disagree or strongly disagree) (Fig. 3). In our opinion, this skepticism is clearly related to the fact that during the pilot instructors did not receive any information about students' behavior (i.e., the tool for providing information about instrument results was not ready for the first pilot, so no data was reported to instructors about cheating or plagiarism).

Overall, considering the findings obtained through the post-pilot surveys and the group interviews, it appears that participating in the pilot did not have a significant incidence on teaching and learning experiences. The biggest effort was adapting the activities to the instruments. Although instructors experienced some increase in workload during the creation and correction of activities,

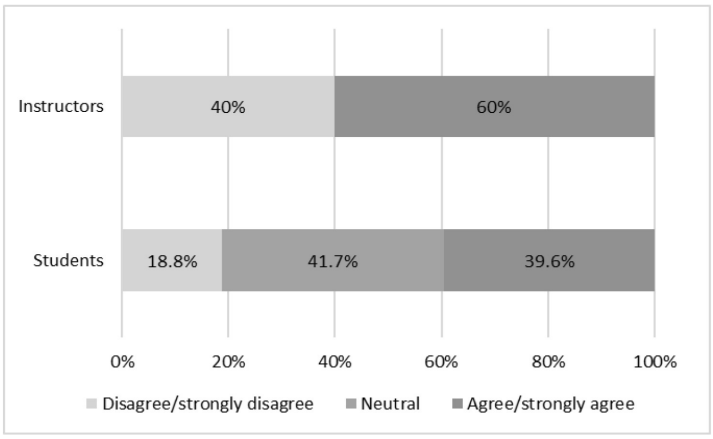


**Fig. 3.** Students' and instructors' degree of acceptance with the statement "My opinion and confidence about online assessment increased due to participation in the pilot." Post-pilot survey, students n = 48, instructors n = 5.

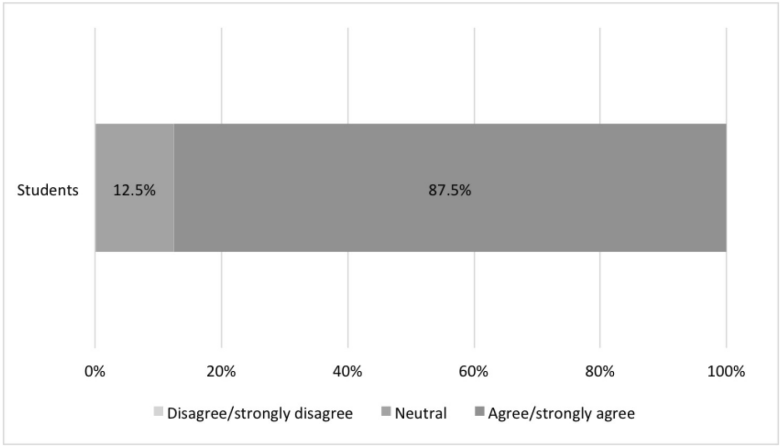


**Fig. 4.** Students' degree of acceptance with the statement "After participating in the pilot, I consider that it is possible to be assessed fully virtually." Students' post-pilot survey, n = 48.

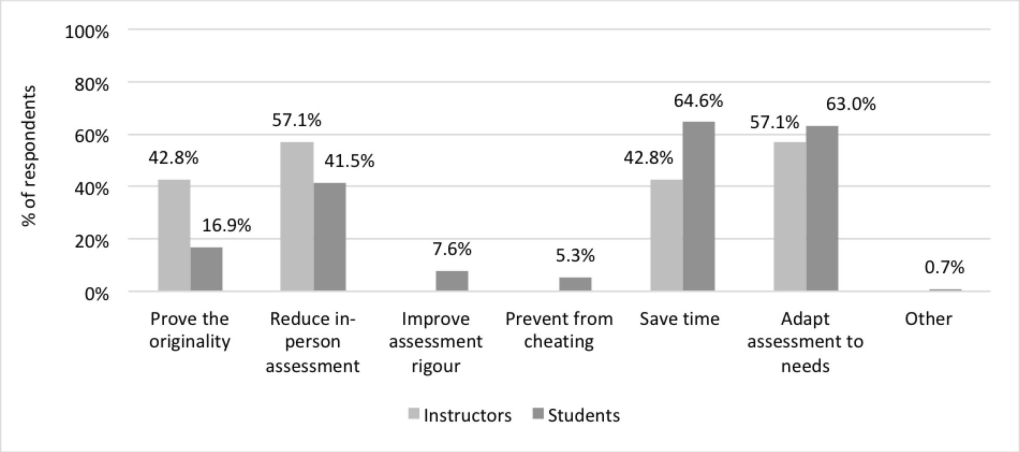


**Fig. 5.** Instructors' and students' responses about the advantages of online assessment. Pre-pilot survey, students n = 130, instructors n = 7. Multiple-choice item.

students did not feel the consequences. In fact, it seems that participating in the pilot had a positive impact on course design (e.g., assessment criteria were incorporated into the course) as instructors took advantage of the work they had to do for the pilot and incorporated some improvements on pedagogical aspects (e.g., inclusion of tasks in form of oral presentations and written questions in quizzes). On the other hand, as the system was not yet developed and only some instruments were implemented (i.e., FR, VR, KD and PL), the participants' confidence in e-assessment did not significantly change as a result of the pilot.

### *4.3 Changes in the expected advantages and disadvantages of e-assessment (RQ3)*

Figure 5 indicates the list of benefits of online assessment that instructors and students anticipated in the pre-pilot survey. In consonance with the results obtained by [10] where students highlighted adaptation to needs and reduced travel time and expense as the main benefits of e-assessment, in our research, both instructors and students considered that the main advantages related to flexibility and physical aspects. In relation to flexibility, 57.1% of instructors and 63% of students selected "adapt assessment to needs" as the main advantage. Regarding physical aspects, 57.1% of instructors and 41.5% of students chose "reduce in-person assessment" and 42.8% of instructors and 64.6% of students selected "save time" in surveilling/commuting as clear benefits. Respondents also highlighted authorship and authentication aspects (42.8% of instructors and 16.9% of students selected "prove the originality" and 5.3% of students chose "prevent from cheating"). Just 7.6% of students stressed the positive influence on pedagogical aspects ("improve the assessment rigor").

Some advantages cited in the pre-pilot survey relating to flexibility (e.g., adaptation to needs), physical mobility (e.g., to avoid commuting), pedagogy (e.g., improving online assessment) and authentication and authorship (e.g., verification of authors) have also been repeated in the post-pilot survey. In addition, students and instructors have emphasized other benefits such as the physical and psychological comfort of being at home to take exams (e.g., stress reduction), confidence (e.g., increased student confidence in the course), financial (e.g., saving money on transport), ecology (e.g., reduced paper usage in exams), technology (e.g., ease of being assessed online), and efficiency (e.g., improved efficiency when taking exams) (Table 8). These results are consistent with previous research where flexibility [10, 38], stress reduction and comfort [49, 10] and saving paper [28] are considered as key benefits for students after experiencing e-assessment. In general terms, taking into account the responses to pre- and post-pilot surveys, respondents in both cases indicated that the main benefits were flexibility (i.e., adaptation to needs and time-saving) and avoiding in-person assessment. The issue of comfort appears as a major advantage in the post-pilot survey and dealing with authentication and authorship is still considered one of the benefits of online assessment.

In accordance with such findings, during the group interviews, flexibility was considered one of the leading advantages of e-assessment. For students, the instruments tested could improve user experience, especially for those students who have mobility issues or physical difficulties. By offering a range of instruments, assessment can be better adapted to the needs of each student. The students claimed that audio and video tools would be largely accepted in Computer Engineering degrees, where there is a need to reinforce communicative and teamwork competencies. Instructors highlighted

**Table 8.** Advantages (students'/instructors' post-pilot survey). Open question

| Advantages | Examples |
|---|---|
| Comfort | Increase (T/S)<br>Stress reduction when taking exams (S)<br>Better concentration (S)<br>Develop feeling of responsibility (S) |
| Flexibility | Increase (T)<br>Delivery (S)<br>Adaptation to personal needs/schedules (S)<br>Adaptation to disabled students (S) |
| Physical | Facilitate logistics & avoid commuting (S/T)<br>Ubiquity and geographical flexibility (S)<br>Avoid reservation of spaces & proctoring staff (T) |
| Confidence | Increase (university-students, students-course) (T/S) |
| Pedagogical | Improve instructor support (interaction, feedback) (S)<br>Assess student aptitude (S)<br>Experience all assessment online (T/S)<br>Closeness to face-to-face education (S) |
| Financial | Saving money on transport (S) |
| Authentication | Identification & verification of authors (S) |
| Ecology | Reduce paper usage (S) |
| Technological | Easy access to assessment tools & resources (S) |
| Efficiency | In exams (S) |

(S) Students' responses (T) Instructors' responses.

that every case and need should be analyzed and an adapted solution given although the video and audio tools are a good solution for physically-impaired students. Sample comments taken from the group interviews are as follows:

> "One of the things that the university offers me is flexibility. I was traveling when I had to do the e-assessment activities. I had to do them in a hotel, and in different places." (Student)

> "We use some software that can be more complicated for them [disabled students]. Somehow, if there is a complementary assessment method, such as an oral method using voice recording, it can be helpful for these people or even for us, to make assessment simpler." (Student)

> "I believe that we should look for a personalized solution for each case. That is, if any student has any problem or needs anything special, we would have to analyze it independently. Not all solutions would work for all students." (Instructor)

In contrast to the results of the study conducted by [10] where the least liked aspects of online assessment for students were being observed and facial recognition, in our group interviews, students argued that using video tools did not increment their anxiety; students appreciated the method and it felt comfortable. Some examples of quotations taken from the group interviews are as follows:

> "An examination is something stressful in itself, at least for me. And I think for everyone. So, first, it is stressful and, second, I have not felt more stressed." (Student)

> "I felt quite comfortable. It is true that expressing yourself can be a bit difficult. However, I think that for assessment purposes it will be much better because it will be easier for instructors." (Student)

On the whole, after participating in the pilot, the main benefits perceived (i.e., flexibility, avoiding in-person exams, increasing comfort and dealing with authentication and authorship issues) remained unchanged although more advantages were recognized (e.g., ecological, trust-related and financial). These opinions suggest that people expect an e-assessment system to be flexible enough to support students' needs (disability, special needs and time organization) and to maintain the comfort that students anticipate. Instructors also assume that any e-assessment activity (not just exams) could be conducted online. They also expect an e-assessment system to provide reliable information regarding student behavior.

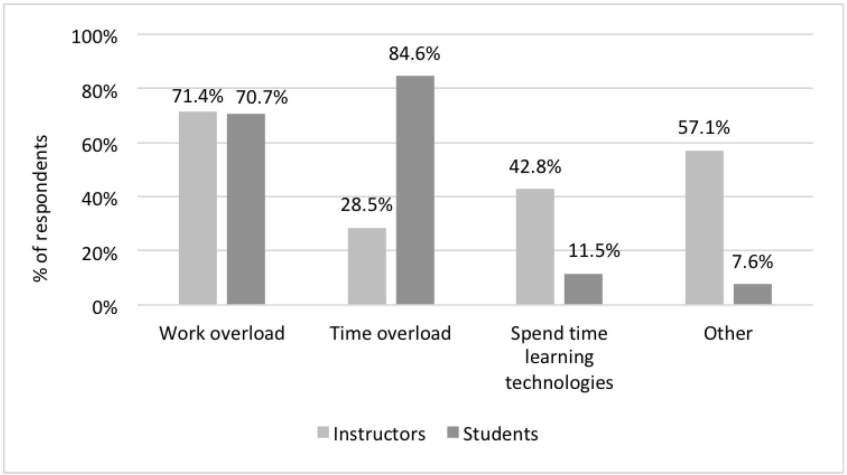


**Fig. 6.** Instructors' and students' responses about the disadvantages of online assessment. Pre-pilot survey, students n = 130, instructors n = 7.

Figure 6 shows the main disadvantages of online assessment that instructors and students considered during the pre-pilot survey. The main disadvantages that students anticipated were time (84.6%) and work (70.7%) overload. In the "other" option, many students predicted technical problems (e.g., loss of internet connection, electricity outage, computer issues, continuous updating of software and downloads).

In the pre-pilot surveys, instructors' responses differed from students' responses. Although work overload was also the main disadvantage for instructors (71.4%), time overload was not perceived as a disadvantage (28.5%). Instructors considered it worse to spend time on learning to use new technologies (42.8%). Similar results have been observed by [26, 43] where workload and time dedication were the main adverse beliefs instructors and students held in relation to e-assessment. In addition to those main disadvantages, in the "other" response, instructors expected issues concerning the configuration of software and hardware (as students detected in the post-pilot survey) in relation to the security and reliability of the information offered by the system. This lack of trust can be associated with the common social perspective that gives more credibility (in terms of security and reliability) to face-to-face education than to online education.

After participating in the pilot (Table 9), students continued to highlight some of the technical disadvantages that they had predicted in the pre-pilot survey and added new ones (e.g., compatibility with operating systems and browsers). As occurred in previous studies [10, 32], despite students being satisfied with the experience, they were dissatisfied with the technical difficulties. Furthermore, time was still a significant disadvantage (e.g., self-organization) although work overload disappeared from the list of disadvantages. This result is coherent with previous research where it has been demonstrated that e-assessment reduces workload [32, 43]. However, some new disadvantages appeared in the students' post-pilot survey. While comfort was considered an advantage, some students considered that not being at the university to take an exam could result in it being carried out in an inappropriate environment. Similar opinions were collected in research conducted by [10, 32] where students acknowledged having had difficulties with the workspace and complained about the lack of access to private and quiet spaces for online examination. Furthermore, respondents considered the lack of physical interaction (e.g., complexity for communicating with instructors) and authorship (e.g., the possibility of cheating) as the main disadvantages. The lack of contact with instructors (even if due to the virtualization or automatization of assessment) has also been observed in other studies [10, 40]. The disadvantages relating to pedagogical aspects (e.g., little transparency when assessing) and security issues, have been less cited although students reflected more about cheating and security issues in the post-pilot survey than in the pre-pilot survey. They considered that there is no absolute control in online assessment and, thus, cheating and plagiarism is possible. They argued that more tools to confirm identity are needed because mistakes can be made in verifying identity.

In general, cheating, technical issues and lack of physical interaction are the main disadvantages for students. Similarly, considering the instructors' responses to the post-pilot survey, the main disadvantage is monitoring cheating and plagiarism, followed by technical issues and impersonalization. These results contrast with previous research [28, 31, 32, 35, 51, 52] where it was found that from the instructors' and students' perspective, cheating is not incremented in e-assessment, on the contrary, it is easier to prevent or is even reduced.

Work overload has disappeared from the disadvantages reported by respondents while technical issues, authorship and authentication issues, and issues related to the lack of physical contact were raised. On the one hand, concerns about the lack of physical contact seem to be more related to the lack of experience in online education and do not appear

**Table 9.** Disadvantages (students'/instructors' post-pilot survey). Open question

| Disadvantages | Examples |
|---|---|
| Comfort | Lack of appropriate environment (S)<br>Less stress, more mistakes (S) |
| Non-physical interaction | Loss of interaction (instructors-students)<br>More complexity & waiting time for resolving queries (S)<br>No face-to-face practice (S)<br>More impersonal (T) |
| Pedagogical | Little transparency when assessing (S)<br>Poor evaluation due to factors not taken into account (S) |
| Authentication and authorship | Cheating & plagiarism (T/S)<br>Validation failure (S/T) |
| Technological | Specific software mandatory usage (S)<br>Technology/Internet/computer dependence (S)<br>Connection, electrical, computer or internet failure (S/T)<br>Compatibility with operating systems & browsers (S)<br>Required devices (microphone, webcam) (S)<br>Increased complexity (S) |
| Security | Security issues (S) |
| Time | Time lost recording videos (S)<br>Self-organization is more demanding (S) |

(S) Students' responses (T) Instructors' responses.

to be specifically related to e-assessment or the pilot. Again, the social prejudices regarding online education can affect the growth of e-assessment. For instance, during the group interviews, one student pointed out the complexity entailed in oral presentations regarding communicative competence and one instructor commented that not all students could accept e-assessment. On the other hand, being dependent on technologies can make people feel stressed or suspicious, and can make them have less confidence in online assessment. However, as demonstrated by [31], after experiencing e-assessment, students do not feel stressed or feel less stressed than expected. Regarding cheating, participants also recognized that although the tools can help prevent cheating, there will always be ways of doing it. Sample statements taken from the group interviews are as follows:

> "It is important to consider what an oral presentation would entail, because of the speed and ease at which someone responds, which are also indicative of how hard a person is working on the course. You can't be as comprehensive orally as in written form." (Student)

> "It is positive, it opens up a new possibility. Oral presentations have always existed. It means that oral presentations can be made when students are not at the university. We gain in flexibility. However, it does not mean that all exams must be carried out like this. This will be just another tool to be used depending on the course.' (Instructor)

> "It is not the panacea that will solve the way students are evaluated at online universities. I think most students will not want that change or it will take many years to change how we evaluate students." (Instructor)

> "I believe that some people are going to plagiarize, and there will always be plagiarism, even in face-to-face situations. In online learning, this will also happen." (Student)

> "There will always be someone who will try to do whatever they can to cheat. I am concerned with achieving the maximum security possible." (Instructor)

Broadly speaking, the expectations did not change significantly during the pilot, although after participating in the pilot there was a greater diversity of expected advantages and disadvantages. Before the pilot, participants expected more flexibility and to avoid in-person exams. After the pilot, these advantages were maintained and advantages related to dealing with authentication and authorship issues and increasing comfort were raised. As for the disadvantages, work overload and technical issues were the main common disadvantages predicted by respondents in the pre-pilot survey although time spent was also a major issue. After the pilot, time overload and technical issues remained while work overload disappeared and the issues of comfort, physical interaction and authorship were raised. By participating in the pilot, participants were better informed about and more experienced with e-assessment and able to reflect on its advantages and disadvantages.

## 5. Discussion

Previous results demonstrate that although the learning context where the pilot was conducted was fully online, prior experiences show that exclusive e-assessment is still not a usual practice. The types of e-assessment experienced were quite traditional and were combined with in-person examinations. This is coherent with the examples presented in Section 2 describing current practices in the field of engineering. The introduction of several instruments for online assessment opens up the possibility of designing new types of e-assessment activities. The instructors who participated in the pilot merely adapted the instruments to the existing activities although they took the opportunity to introduce some small innovations. Several authors have demonstrated the low communicative competence of engineering students [53–55]. This is particularly problematic when it comes to online education where the opportunities for oral communication are limited. In this sense, introducing the use of webcams to record oral presentations and adding open questions to quizzes that require written responses is rather innovative in the field of online engineering education. First, it contributes to promoting the acquisition of oral and written communicative competence. Second, it helps to overcome the e-assessment trend in the field of engineering, which consists of virtualizing exams by expanding the range of e-assessment activities. According to [4], such findings have significant implications for research, as they highlight the need for in-depth research into successful e-assessment practices in e-learning in engineering education that truly use the full potential of technologies and help improve assessment instead of continuing to support restricted and traditional types of assessment.

Similar to previous research [26, 29, 30, 38, 39, 44, 49, 51], both instructors and students maintained positive attitudes toward e-assessment even if their experience during the pilot was not completely satisfactory (e.g., technical issues). This means that, both from the research and institutional point of view, our study is consistent with previous results [34–37]; a favorable conclusion is that instructors and students prefer e-assessment to paper-based assessment. Thus, we should exploit this advantage to make e-assessment advance and grow. One of the most controversial consequences of e-assessment is the use of security mechanisms. Although such mechanisms are considered as core instruments for reliably assessing students online,

and they are increasingly being tested with positive results [41, 42], more research is needed to investigate the instructors' and students' perspectives and sense of intrusiveness when using such technologies for e-assessment purposes. We should ensure that the perceived advantages (e.g., flexibility, mobility and comfort) of e-assessment outweigh the disadvantages (e.g., workload and technical issues) and that both instructors and students accept them. In fact, the common belief that e-assessment increases workload and time overload has been partially refuted in our study (regarding students) although the technical issues have certainly become a handicap. Our study is therefore in line with [32] results that found that although students and instructors experienced technical difficulties in e-assessments, they perceived that the benefits outweighed the costs.

From the research point of view, it is plausible that a number of limitations may have influenced the results obtained. First, the sample size and the number of participants in the group interviews limit the possibility of making generalizations based on the study. Further investigations are needed with a larger sample of students and instructors from diverse courses and disciplines to obtain a broader view of e-assessment experiences and expectations. Second, there is self-selection bias resulting from the voluntary participation in the pilot. It should be noted that, in this study, the UOC's ethical standards for research have been followed to guarantee that students did not suffer inequalities (i.e., benefit from the use of security mechanisms for e-assessment purposes) relating to their participation in the pilot. Third, due to selection bias, the students who were more intrinsically motivated were probably those who consented to participate. Nevertheless, as can be observed in the results section, participants expressed both positive and negative attitudes and opinions toward e-assessment, which indicates that their motivation had not tipped the balance in favor of the system. Fourth, as for the survivorship bias, the loss of participants during the pilot is very likely due to the course dropout rate itself and not linked to the design or execution of the pilot. Nevertheless, in future pilots, these students will be given a dropout survey so that they can share their opinions of the e-assessments experienced in the course and their reasons for dropping out. Finally, concerning the construct validity, it should be mentioned that the pilot interacted with other assessment and security tools within the course. However, the research instruments aimed to gather a broad view on e-assessment. Consequently, participants could express their experience with e-assessment within the course regardless of which tools were used.

## 6. Conclusions

The study aimed to investigate the students' and instructors' perspectives regarding the use of an e-authentication system for e-assessment purposes. The results obtained reveal that although participants had little experience with fully online assessment, their attitudes and expectations regarding its use are positive.

Our work showed fruitful results in incorporating the use of technologies (i.e., security mechanisms) for assessment into an online educational context as it opened new opportunities for improving pedagogical aspects in course design. The major challenges the use of security mechanisms for e-assessment poses are, first, the fast detection and resolution of technical issues to minimize its impact on students' evaluation process. Second, the need for institutional decisions and pedagogical strategies to deal with the attitudes toward the acceptance of e-assessment. The sense of intrusiveness that such technologies may involve together with the reticence to the reduction of faculty presence may compromise and determine the success in the implementation of an e-authentication system for e-assessment.

The major implication of this study is that using an e-assessment system could bring about a change in the prestige of online universities. The social perception regarding the accreditation of students could improve as it would be based on reliable assessment. Furthermore, students could feel more comfortable performing e-assessment activities and have more trust in the university. This could, in the medium term, reduce dropout and improve student satisfaction.

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## Appendix 1

Students' and instructors' pre-/post-pilot survey (instructors' items in italics, response options in brackets)

| Items | Pre | Post |
|---|---|---|
| *Prior learning/teaching experiences* | | |
| 1. Have you ever taken an online course? *Have you ever taught an online course?* (Yes/No) | x | |
| 2. Have you ever taken a course for which all the assessment has been conducted online? *Have you ever taught a course for which all the assessment has been conducted online?* (Yes/No) | x | |
| 3. Have you ever taken an online examination? *Have you ever conducted an online examination?* (Yes/No) | x | |
| 4. Have you ever been assessed based on a rubric? *Have you ever designed an assessment rubric?* (Yes/No) | x | |
| 5. *Do you usually provide assessment criteria to students in order to guide them about how they will be assessed for each assessment activity?* (Yes/No) | x | |
| 6. Which types of assessment have you experienced in other courses? *Which types of assessment have you implemented in your courses?* (Diagnostic, Continuous, Formative, Summative, Other) | x | |
| 7. *When do you provide the students with the assessment criteria?* (Syllabus, activity statement, activity solution) | x | |
| 8. Which types of feedback do you usually receive from instructors? *Which types of feedback do you usually provide your students with?* (Whole class, solution of activities, mark, personalized) | x | |
| *Learning/teaching experience in pilot* | | |
| 9. I felt that the effort I invested in the assessment activities was reflected in my marks. *I feel there is a balance between the effort I required from students in assessment activities and the marks they received* (Disagree/Strongly disagree, Neutral, Agree/Strongly agree) | | x |
| 10. I consider that the assessment criteria were aligned with the course objectives, the competencies to be achieved, the assessment activities and the marks I received. *I consider that the assessment criteria were aligned with the course objectives, the competencies to be achieved, the assessment activities and the marks* (Disagree/Strongly disagree, Neutral, Agree/Strongly agree) | | x |
| 11. I am satisfied with the type of assessment activities performed in this course. *I am satisfied with the type of assessment activities designed for this course* (Disagree/Strongly disagree, Neutral, Agree/Strongly agree) | | x |
| 12. I am satisfied with the feedback received from my teacher during this course. *I am satisfied with the feedback I have provided during this course* (Disagree/Strongly disagree, Neutral, Agree/Strongly agree) | | x |
| 13. I am satisfied with the type of assessment received during this course. *I am satisfied with the type of assessment I have provided during this course* (Disagree/Strongly disagree, Neutral, Agree/Strongly agree) | | x |
| 14. *Select the actions (if any) where you have experienced an increased workload due to your participation in the pilot* (Course design, define activities, create activities, support students, correct activities) | | x |
| 15. *I provided students with assessment criteria* (Yes/No) | | x |
| 16. *I provided students with a rubric* (Yes/No) | | x |
| *Trust* | | |
| 17. My opinion and confidence about online assessment increased due to participation in the pilot. *My opinion and confidence about online assessment increased due to participation in the pilot* (Disagree/Strongly disagree, Neutral, Agree/Strongly agree) | | x |
| 18. After participating in the pilot, I consider that it is possible to be assessed fully virtually (Disagree/Strongly disagree, Neutral, Agree/Strongly agree) | | x |

| | | |
|---|---|---|
| *Expectations* | | |
| 19. Which main advantages do you expect from online assessment? *Which main advantages do you expect from online assessment?* (Prove the originality of the work, reduce in-person assessment, improve assessment rigor, prevent cheating, save time, adapt assessment to needs, other) | x | x |
| 20. Which main disadvantages do you expect from online assessment? *Which main disadvantages do you expect from online assessment?* (Work overload, time overload, spend time learning technologies, other) | x | x |

## Appendix 2

Students' and instructors' group interviews

| **Questions** |
|---|
| *Pedagogical aspects* |
| 1. Do you trust that the activities you went through/designed during the pilots have had no adverse impact on teaching/ learning processes? |
| 2. Did authentication add extra time and workload to the assessment process? Do you think this is reasonable? |
| 3. Did your/the students' level of stress or anxiety increase due to the use of the FR and VR instruments? |
| 4. Overall, do you think the pilot activities could introduce more flexibility to learning/assessment design processes? |
| 5. Do you believe that the TeSLA authentication and authoring instruments may enhance the evaluation system? |
| *Trust* |
| 6. Based on the information you received, do you trust the TeSLA system? |
| 7. Do the activities you experienced so far have the potential to create a positive effect on creating a relationship of trust between teachers and students? |
| 8. Do you believe that it is possible to be assessed fully virtually? |
| *Expectations* |
| 9. What do you need and expect from an e-authentication system? |
| 10. What advantages and disadvantages do you anticipate in e-authentication systems? |

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