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Brouwer-Zupancic, N.; Heck, A.J.P.; Smit, G.L.H.

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CASE STUDY

Proctoring to improve teaching practice

Natasa Brouwer, University of Amsterdam, Faculty of Science, Amsterdam, Netherlands. Email: natasa.brouwer@uva.nl
André Heck, University of Amsterdam, Faculty of Science, Amsterdam, Netherlands. Email: A.J.P.Heck@uva.nl
Guusje Smit, University of Amsterdam, Faculty of Science, Amsterdam, Netherlands. Email: G.L.H.Smit@uva.nl

Abstract

Universities organise digital summative assessments in special assessment computer rooms and they conduct strong restrictions on the resources. This policy assures safety and security of assessments but obstructs authentic problem solving where open resources are needed. A digital assessment room is also not a proper solution when students for some reason cannot attend the assessment on campus. We present three scenarios from the science and mathematics teaching practice at the University of Amsterdam in which we have used proctoring to create the flexibility of online exams that was needed. Online remote proctoring of computer screens on the campus and/or students at home enabled (1) more authentic exams by allowing open resources, (2) use of own laptops (BYOD) in a regular lecture room, (3) off campus online exams as a part of an online programme, for example, at home anywhere in the world. We have shown that proctoring is not just a different way to control students using computers, but that it enabled improvement of the quality of learning processes in which summative assessments are an integral part.

Keywords: e-assessment, online remote proctoring, summative assessment, higher education.

1. Introduction

Assessment is an indispensable part of any education. It is widely accepted that assessment in a course should be aligned with intended learning outcomes and with the learning process (Biggs, 1996) and that assessment should be adapted when the learning process changes. E-assessment, also called Computer-Assisted Assessment (CAA) enables frequent testing of knowledge and understanding of students. This also raises fundamental questions about the role of the assessment in the education process as a whole (Conole and Warburton, 2005). E-Assessment for learning or online formative assessment is used in courses to support students in self-regulated learning and constructing understanding. In this case, the pedagogical role of assessment shifts from a teacher-centred instructive role to a student-centred supportive role and in the technology perspective shifts assessment from a rigid time and space setting toward a fully flexible one. Heck and Brouwer (2015) studied performance of students using online examples-based mathematics formative assessments through which students regulated their own learning process. The authors found a large impact on academic performance of students in the Numerical Recipes Project course in which ninety percent of the students passed the exam after examples-based and assessment-driven teaching and learning. In higher education usually at the end of the course or at several pre-defined moments within a course a summative test is taken to assess whether students have reached the desired learning outcomes. When digital formative assessment is used in a course it is natural to also take the exam online in a similar design as during the course. When students use computers for problem solving, computer skills need to be assessed as well. In the course Business and Enterprise (Cornock, 2016) the assessment was entirely through coursework tasks.

In any summative assessment security is very important. Online examinations at the universities are taken in specially designed and secured digital examination rooms. Apampa, Will and Argles (2009) defined security goals that are specific for e-assessments. They showed that besides confidentiality, integrity, and availability, the electronic presence security has to be seen as one of the security goals. Specific cheating problems in e-assessment and counteractions have been listed by Rowe (2004). One of the cheating problems is unauthorised help during the e-assessment. In digital examination rooms, students cannot communicate via the computers. All internet connections through which students could reach unauthorised help outside the room or social media are blocked. The websites that are allowed or the computer software need to be whitelisted. In courses in which students work on open problems and use computer software of their own choice, whitelisting of resources is almost impossible.

For many students, online courses create new possibilities for personal development or for a career switch. Students can combine work and study, and they can live far away from the university campus. Coming to the campus to take an exam can be extremely time-consuming and expensive. But taking off campus online exams worries faculties because of the risk of cheating. Fask, Englander and Wang (2014) designed an experiment to assess the difference in student performance between students taking a traditional exam in an examination room and those taking an unproctored exam online. They found no significant difference between online and class exam scores. They found evidence that disadvantages of online assessment offset opportunities for unproctored students to cheat.

2. Three cases of proctoring

In this paper we describe three different educational settings in which a digital examination room was not a suitable place to take a digital summative assessment. Online remote proctoring was used to assure security of these assessments.

We have used two commercial applications, namely ProctorExam Pro and ProctorExam Light (www.proctorexam.com). ProctorExam Pro is an application where a student is observed by a live remote proctor via the webcam of the laptop and a smartphone put behind the student. The computer screen of the student was observed, too (figure 1). All three sources were video recorded, which made it possible to double check suspected fraud marked by the proctor.

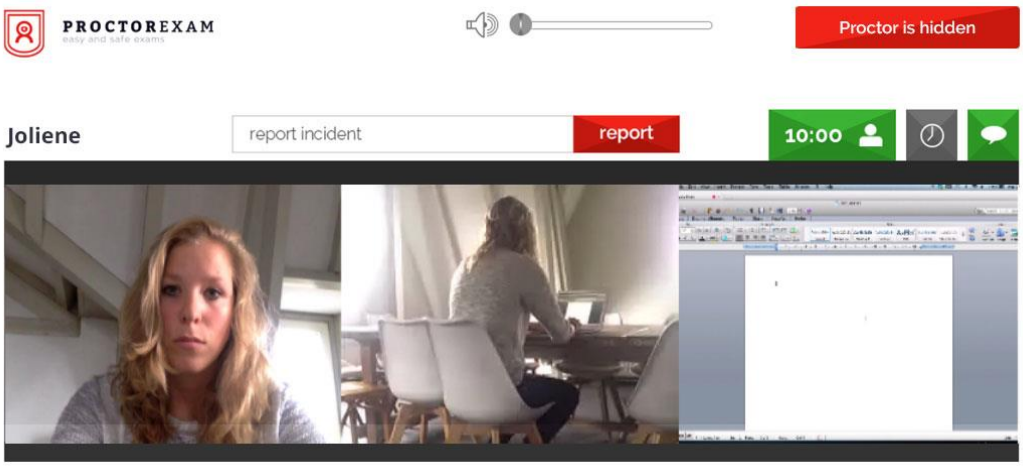

Figure 1. Proctor's view of a student taking an exam using ProctorExam Pro (image from instructional material). *Left*: laptop webcam, *Centre*: smartphone camera image, *Right*: computer screen recording.

ProctorExam Light was used to only observe the computer screen of the students. After the examination, the screen recording was checked at higher speed in order to detect any unauthorised actions.

Back office we monitored on a dashboard (figure 2) when students connected to the proctor online application and registered if the connection was lost during the examination.

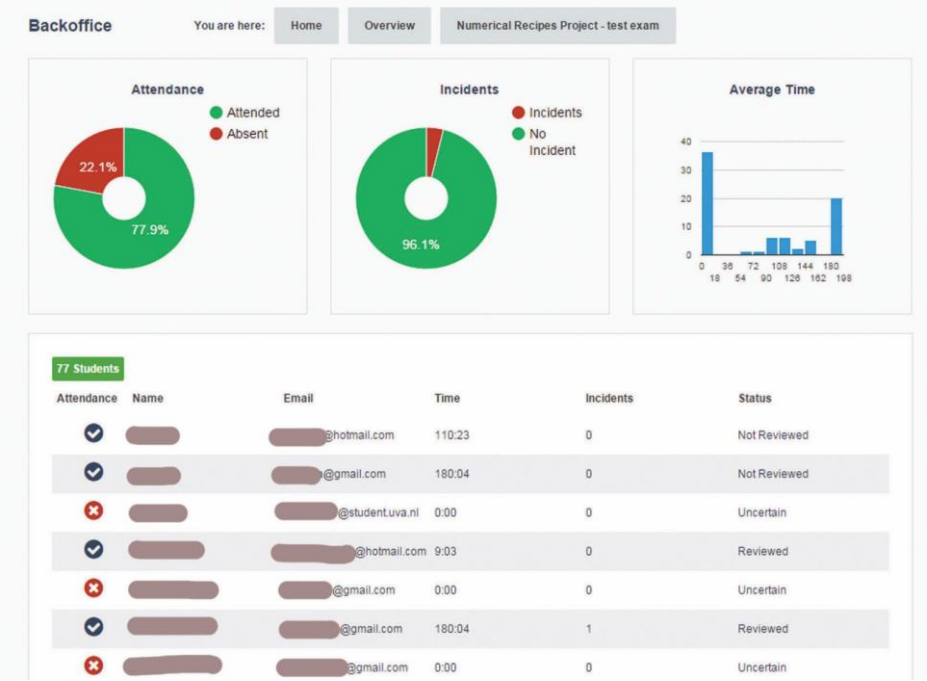

Figure 2. ProctorExam dashboard: report of an exam

Suspected fraud incidents were marked in the proctoring report and the videos of all students' assessments could be watched herein as well (figure 2). An incident was not always a case of cheating: it could also be an innocent deviation in the behaviour of a student or a technical issue from a small disturbance in the internet connection. The lecturer had to evaluate whether an incident was fraud or not. In our cases, no incident indicated cheating.

The students who took a digital assessment with online remote proctoring followed a three step model (figure 3). First, they had to sign a privacy agreement about sharing personal data. Next they had to install a ProctorExam browser add-on on their computers and pass a technical test to assure the required technical standard of their equipment (laptop, webcam, audio, smart phone and internet connection) met the security conditions for the examination. The technical test was taken several weeks before the examination to give students enough time to fix the equipment if necessary. A student could not take part in the examination until the technical requirements were satisfied. In step 2 (figure 3) the online exam was mimicked. A dummy assessment was used to experience the online examination as realistically as possible. This diminished unnecessary stress during the examination. Students who had already taken an off campus online exam could skip step 2. According to Dutch law regarding protection of personal data students could refuse online remote proctoring for personal reasons. Thus we have always arranged a possibility to take the exam on the campus. Some students chose for a pencil and paper exam and others preferred an extra invigilator to be present and observe their computer screen from behind during the whole exam.

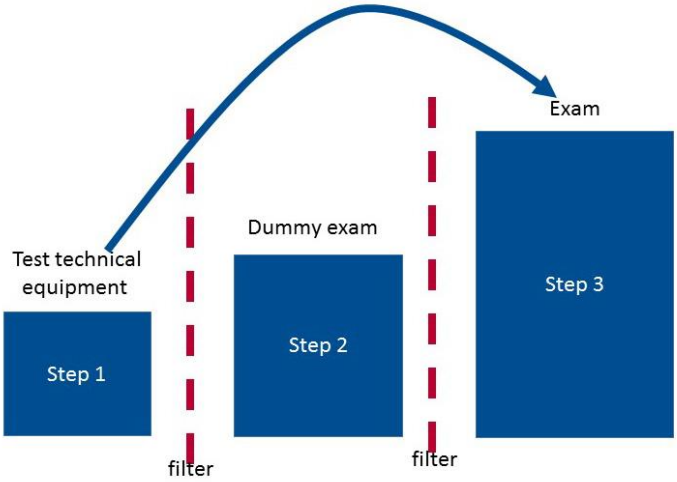

Figure 3. Three step model of digital assessment with online remote proctoring

2.1. Case 1: digital exam with open resources

Title of the course: Operating Systems.
Student population: 137 first-year students in the Computer Science bachelor.
Course design features: problem solving, authentic problems, open resources. Students could use any resources they wanted, including search engines such as Google.

The lecturer designed an open resources exam with problem solving questions. This kind of exam could not be organised in digital examination rooms on the university campus for the following reasons:

- whitelisting of all possible resources that students could use was impossible;
- even if a whitelist were possible, allowing wide access to resources while preventing contact with each other or people outside the class via the internet was impossible;
- observing individual screens by invigilators in the room was not feasible. A privacy protecting foil (fraud prevention) prevented reading the computer screen from an angle. This also prevented the invigilators to notice any unauthorised actions like using chat boxes or social media;
- software for online remote proctoring was not available in digital examination rooms.

As a workaround the lecturer organised the digital exam in a regular computer room at the faculty and he used online remote proctoring of computer screens during the whole exam (figure 4).

The lecturer monitored the digital exam in the lecture room on his laptop using ProctorExam back office tool. This way he could see which students logged in to the digital assessment and if all of these students were connected to the online remote proctoring app. No additional invigilators or other support staff was needed during this exam.

This situation had also several drawbacks. The exam had to be scheduled in several sequential groups because the room was too small for the whole group. On the computer screens there was no privacy foil. The students had to be seated further away from each other. To prevent cheating in the room each student got a different set of questions, which costed the lecturer more time to prepare the assessment.

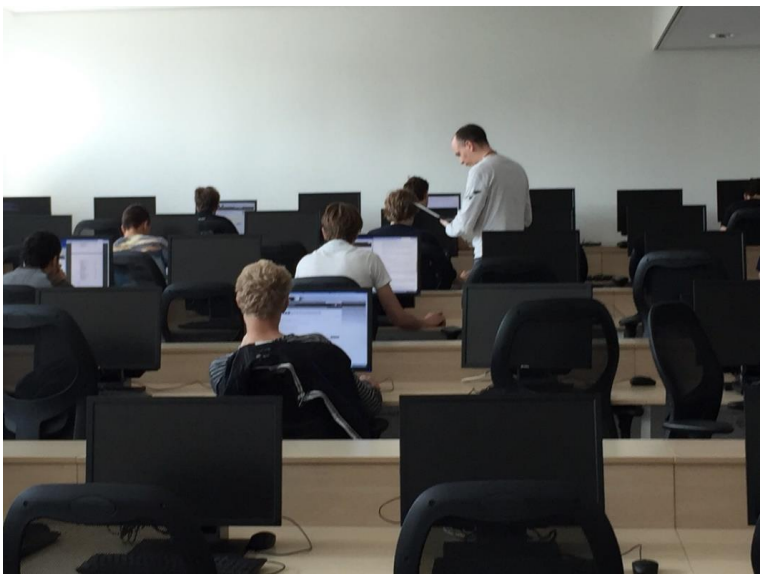

Figure 4. Digital exam using ProctorExam Light. The lecturer is answering a question of a student.

2.2. Case 2: digital exam using Bring Your Own Device (BYOD)

Title of the course: Numerical Recipes Project.
Student population: 77 second-year students in the Computer Science bachelor.
Course design features: learning based on worked-out examples and formative assessments. Students worked on their own laptops (BYOD) in SOWISO, a cloud-based environment for learning, practising, and assessing mathematics (www.sowiso.com). Most of the face-to-face activities were tutorial sessions in parallel groups. Each week students had to pass several assessments. They could take them anywhere, any time within the deadline and as often as they wanted. Every time a different set of questions appeared. Passing the assessments was obligatory to get the final mark for the course but no credits were given. More details about the course design can be found in Heck and Brouwer (2015).

The lecturer designed two summative assessments for a final mark in SOWISO on BYOD, just as students were used to working during the course. This could not be organised in the digital examination rooms of the university for three reasons:

- it was too expensive because the size of the digital examination room did not match the size of the student population taking the exams;
- it was obligatory to use the available computers there;
- there was no WiFi and no sockets for BYOD power supply.

The lecturer organised the summative assessments in the regular lecture rooms where students could use their laptops (figure 5). Online remote proctoring was used and all laptop screens were captured in order to prevent fraud. The students started the assessment at the same moment in several parallel lecture rooms. The students could use pencil and paper to work out the assignments before they filled in their final answers in the SOWISO assessment. The digital exam was automatically marked. The lecturer checked by hand only the erroneous responses to assign partial points if the answers were partly correctly worked out on paper. In practice, the availability of the digital final answers more or less halved the correction work by the teacher and offered students the possibility to compare their answers with the worked-out solutions.

Figure 5. Students taking an e-assessment in SOWISO on their laptops. The lecturer observes the students from the last row.

2.3 Case 3: online pre-master programme

Programme: Pre-master Information Studies, five online courses given three times a year.
Target group of students: students with knowledge deficiencies who wished to start a masters' programme Information Studies. An intake procedure assured that a level of pre-education of applicants was appropriate to start the pre-master programme.
Number of students: about 100 students per year
Programme design features: fully online courses on Blackboard (university virtual learning environment). The course design of four courses was test-based learning using adaptive release of lesson material in Blackboard (figure 6).

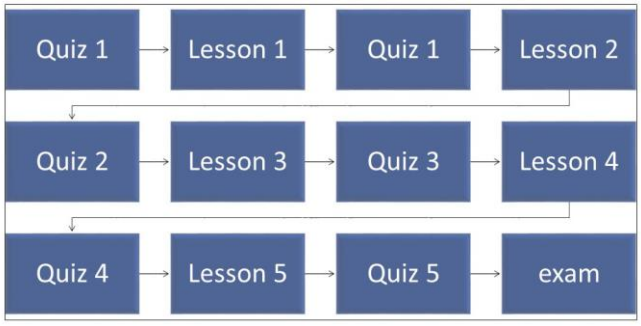

Figure 6. Test-based learning course design of Pre-master Information Studies courses

Students had to pass each quiz with a score of at least 80% before the next lesson would open. A student could repeat a quiz as often as (s)he wanted. Every time a different set of questions was displayed in the quiz. In one course (Academic Skills) the adaptive release was less strictly applied. In each online course there was a moderator who supported students in their learning.

The final exam was taken online in Blackboard. The students could take the exam at home using online remote proctoring (ProctorExam Pro) or come to the university campus. The final exam of the

Pre-master Information Studies courses was not organised in digital examination rooms of the university for two reasons:

- the students were located all over the world. It would be very expensive to come to the campus only to take the exam. Some of the students would first have to arrange an entrance visa before they could come to take the exam;
- also for most Dutch students it was more convenient to take the exam at home. Thus the group of students who preferred to take the exam on campus each time was very small (between 3 and 8 students). One invigilator could assure security of the exam in a small regular computer room on campus.

3. Experiences with online remote proctoring

The experiences of the lecturers with online remote proctoring were positive. They could create flexibility for their summative assessments that would not have been possible otherwise. All lecturers were concerned about the reliability of online remote proctoring to assure security. They found it very important to have full insight in the data of the proctoring. The lecturers would have appreciated to get a more explicit and clearer report about the observed incidents so that they could analyse it more efficiently. In our case, they first had to watch all video fragments to find out what exactly the proctor had marked as incidents before they could decide if it was necessary to start any procedures about cheating.

Five to ten percent of the students per course refused proctoring for personal or privacy reasons and took the exam in a campus computer room having sufficient invigilators (1 invigilator per maximum 5 students). A large majority of students who took an exam with online remote proctoring was very positive about the flexibility this had offered them. Several students who took the assessment at home explained why by statements such as: “I prefer to take the exam at home because at home I can concentrate better”. Several students who took their exam on campus answered the question “Why did you take the exam on campus and not at home?” by “I prefer to take the exam on campus because there is less disturbance than at home and I can concentrate better.”

In practice, no summative assessment can be 100% secure from fraud or cheating. We used online remote proctoring only in case a university digital examination room was not a feasible option for a specific course or group of students. In table 1 (see appendix), a tool is presented to estimate benefit/costs ratio that could help instructors or programmes to make a choice for proctoring online in relation to the assessment setting and the flexibility that can be gained with it.

4. Conclusions

Remote online proctoring makes it possible that summative e-assessments are more flexible in place and time and that open resources can be used. This way a summative assessment can be better constructively aligned with the learning process of the course. Instead of a list of allowed aids for the exam, students are asked to handle according to the academic aptitude. Thus online remote proctoring is not just a different way to control students and to prevent cheating, but it makes it possible to improve the quality of the learning process as a whole in which summative assessment is an integral part.

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We acknowledge the following education innovation projects:
Online Switch (University of Amsterdam, 2013-2014,
http://starfish.innovatievooronderwijs.nl/project/21/),

Surveillance on distance, (SURF, Innovatieregeling Digitaal toetsen voor Onderwijs op maat, 2015-2016, https://www.surf.nl/innovatieprojecten/onderwijs-op-maat/digitaal-toetsen/innovatieregeling-digitaal-toetsen-voor-onderwijs-op-maat-2015-2016/index.html),
Digital Assessment Matched (Faculty of Science, University of Amsterdam 2015-2017, http://starfish.innovatievooronderwijs.nl/project/634/).

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7. Appendix

Table 1. Institution benefit/cost ratio

Benefit/cost ratio: high ***, medium **, low *

Number of students	A resit with a small group of students	An exam with access to the internet	An exam on BYOD	Students are abroad / unable to come to the university location
1 or 2 students	Exam location outside the university (e.g. at home) *ProctorExam Pro* ***	Exam location outside the university (e.g. at home) *ProctorExam Pro* ***	Exam location outside the university (e.g. at home) *ProctorExam Pro* ***	Exam location outside the university (e.g. at student's home) *ProctorExam Pro* ***
	No location costs. No local computer costs.	No location costs. No local computer costs.	No location costs. No local computers costs	No location costs. No local computer costs.
< 50 students	In a lecture room *ProctorExam Light* **	In a university lecture room *ProctorExam Light* **	In a university lecture room *ProctorExam Light* **	Exam location outside the university (e.g. at student's home) *ProctorExam Pro* ***
	Low location costs room invigilators computers in the room	Low location costs, room invigilators computers in the room	Low location costs room invigilators extra computers (safety / privacy)	No location costs. No local computer costs.
50-100 students	n.a.	In a university lecture room *ProctorExam Light* **	In a university lecture room *ProctorExam Light* **	Exam location outside the university (e.g. at student's home) *ProctorExam Pro* **
		Location costs room invigilators computers in the room	Location costs room invigilators extra computers (safety / privacy)	No location costs. No local computer costs. Higer costs per student when group is larger.
> 100 students	n.a.	In a university lecture room *ProctorExam Light* *	In a university lecture room *ProctorExam Light* *	Exam location outside the university (e.g. at student's home) *ProctorExam Pro* **
		Location costs room invigilators big computer rooms or multiple computer rooms	Location costs room invigilators extra computers (safety / privacy)	No location costs. No local computer costs. Higer costs per student when group is larger.