An Experiment in Automated Proctoring

Thomas STAUBITZ, Ralf TEUSNER, Jan RENZ & Christoph MEINEL

Hasso Plattner Institute,
{thomas.staubitz, ralf.teusner, jan.renz, christoph.meinel}@hpi.de

Abstract

Credibility is a central feature for every certified training. The same applies for MOOCs. Individual supervision of participants in study centers reaches its limits when having thousands of students. Thus online proctoring as a means to handle the amount of participants in MOOCs seems to be a suitable way to increase certificate valuation. We compare various flavors of online proctoring and the current practices of current MOOC platforms. Furthermore, we present the results of several user surveys, dealing with the importance of the certificates to our users. Finally, we inform about an experiment with a rather new flavor of online proctoring, which instead of relying on human eyes is using an automated comparison by means of a mathematical model of the face, to identify a participant.

Keywords

Assessment, Identity, Exams, Proctoring, Online

1 Introduction

When completing a MOOC, students take several things with them. In best cases, they made some new contacts, acquired new knowledge and qualified for a certificate issued by the course instructors to prove their newly developed skills. Currently, MOOCs are shifting from the experimenting phase towards enterprise usage for additional on the job trainings. Recent addition of showcase functionalities in professional networks such as LinkedIn or Xing, further outlines the necessity for reliability and trust in virtual certificates. Most often, this trust issue is addressed by several measures known from bank notes in order to counter forgery. Since the certificates are usually printed by the participants, watermarks and logos are the only viable ways to prevent digital changes towards the scores. One step further, and luckily also de-facto standard today, is the approach to embed a link or QR-code in the document, which allows third parties to validate whether the certificate was indeed issued by the respective MOOC platform and whether the results and scores are correct. The validity of the document is however void, if the assessment itself was flawed. Every platform is unable to determine whether an exam was solved by the intended participant or probably by a skilled relative. The connection between the person solving an exam and the issued certificate therefore has to be validated. Despite the identity of the registered participant can not be guaranteed to 100%, the following approach helps to fortify the trust: The participant willing to be "proctored", signs up for an enhanced version of the respective assessment. She registers with the proctoring platform and takes some portrait photos (usually 2-5) to validate against via her webcam and thereby ensures that all technical requirements are met. Afterwards, she starts the assessment just like normal. The webcam is active during this time and shows her the captured scene. The whole stream or only parts of it (for example one photo each minute) is persisted and processed for anomalies. In order to close the chain of trust, a photo taken during the assignment is also embedded into the final certificate. Managing this identity problem is not a core business of an (academic) MOOC platform, leaving the field open for third party service providers. Nonetheless, the platform operators vouch for the quality of this check with their current reputation. At openHPI, we therefore tested such a system in order to ensure a baseline quality before further offering this feature to the public.

2 Valuation of MOOC Certificates

2.1 User Surveys

We started our research one and a half years ago in 2013. At that time, we asked the users of our platform how important certificates are for them and how they use their certificates in a job application process. A total of 774 of our users participated in this survey. A third of the participants stated that they are only marginally interested in the certificates. About a quarter of the participants opted for optional, very few for obligatory proctored exams. Another result of the survey was that only few users would be willing to pay for a more trusted certificate. 45.3% of the participants would add their certificates to their job application papers, another 17.5% would even add a confirmation of participation. 10.59% would only add a more trusted certificate to their application papers. One and a half years later, in 2015, we asked the questions again in a condensed form. Still, the majority of users is either not interested in a more trusted certificate at all or would not accept the privacy intrusion of a proctoring solution. Only very few would pay more than 50 Euros for such a certificate form (see also Figure 3–Right). In several meetings with different companies, however, proper identification of the users that are taking the exams were specified as a requirement, e.g. for using our platform for in-house trainings. Furthermore, this would be a self-posed requirement for us to offer ECTS points for a MOOC. At this point, we also need to state that the majority of our user base are not students but professionals with some experience in their job. ECTS points are no longer that relevant for them. So the survey results probably are biased to a certain extent. The question is not necessarily if our current user base is interested in certificates with an added value, but if we can expand our current user base by offering such certificates.

2.2 Anti-forgery measures

The first step to improve the quality of our certificates was to provide a mechanism that allowed employers to check whether a user had forged the document. An URL and a

QR code were added to the certificate[1], which allows the employer to make sure that e.g. the user's results have not been forged.

This, naturally, is not a sufficient measure to guarantee that the person who is stated as the participant on the certificate is actually the person who took the course and especially the exams.

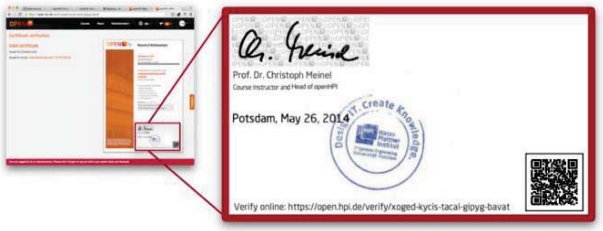

Figure 1: openHPI certificate validation page

3 Proctoring vs. Identity Check

3.1 Definition of Terms

Whereas identity-control only attempts to make sure that the participant who took the exam is the one that is stated on the certificate, proctoring goes a step further in attempting to make sure that the participant does not cheat during the exam by using forbidden devices such as books, the internet or the help of other persons. In this context, we also need to speak about open vs. closed book exams. In an experiment, Gharib, Phillips and Mathew found out that results generally are better in open book exams while anxiety is significantly lower. Good students performed good in both types, bad students did not. The most significant finding of their study is, however, that the retention rate was the same for both exam types (GHARIB, PHILLIPS & MATHEW, 2012). Identity-controlled exams correspond to open book exams while proctored exams, depending on the predefined settings, correspond to closed book exams. We decided that open book exams are sufficient for our use case. In cases where learning by heart is still considered to be key, restrictive time constraints during exams have been proven to be a sufficient solution during our In-Memory Database (IMDB) courses. (TEUSNER et al., 2015)

[1] Back in March 2014 when we rolled out the new version of our platform

3.2 Current Solutions and Best Practices

Naturally, openHPI is not alone with this problem, so we examined how other MOOC providers tackle it. Coursera, Udacity, and edX have been selected, as they are the major players in the MOOC market. Iversity and mooin have been selected as they are fellow platforms on the German market. We have not included imoox as to our knowledge it currently does not offer some sort of identity check.

3.2.1 Tracks

What all of the platforms have in common is that certificates with different kinds of validity are offered for paying customers next to the basic free tracks. Iversity offers an *ECTS Track* and a *Certificate Track*. Coursera offers a *Signature Track*, edX a *Verified Track*. The identity check is similar on all platforms. Users register with a photo of themselves and a photo of their ID-card. Certificates in these tracks are enhanced with a verification URL similar to our solution. Only participants who have opted for one of the non-free tracks are allowed to access a final proctored exam. For online proctoring all of the platforms cooperate with third party providers. EdX and Iversity employ SoftwareSecure, Coursera and Udacity employ ProctorU (IVERSITY, 2015; COURSERA, 2015; PROCTORU, 2015; EDX, 2015; UDACITY, 2015).

3.2.2 Online proctoring solutions

ProctorU, a company that has evolved from an academic background runs a couple of online assessment centers. Course participants have to register for a certain date when they will take their exam a couple of days upfront. A real person will then watch what the participant is doing while she takes the assessment. The course providers can speci-

fy upfront which devices are allowed, e.g. certain books and some hand-written notes but no internet[2]. SoftwareSecure's solution differs from ProctorU as the participants are recorded during the exam and several people evaluate these recordings afterwards[3]. Naturally, the list of these providers is not exhaustive. There are others, such as Kryterion[4], or iSQI[5], where iSQI takes the role of a re-seller, bundling SoftwareSecure's proctoring solution with a quiz system[6]. SMOWL, a Spanish company, offers an identity check rather than a full-fledged proctoring. A user registers with SMOWL by taking three pictures. During the exams, at a predefined time interval plus a random time component, a picture is taken. These pictures are compared to the pictures that have been taken during the registration process. This is done by a machine using biometric verification technologies (LABAYEN et al., 2014).

Recently, ANECA[7] has approved two online master's degree programs by Universidad Rey Juan Carlos (URJC). These programs are no longer required to include a final offline exam that has to be attended by the students in person. Instead, a broader selection of learning activities and assignments throughout the course's runtime is monitored by SMOWL (SMOWL, 2015).

3.2.3 Offline exams

Offline exams are an alternative to online proctoring solutions. However, they do not scale easily. mooin currently offers one course where the final exam has to be physically attended (MOOIN, 2015). Udacity cooperates with Pearson VUE to offer offline exams in testing centers all over the world (UDACITY, 2012; PEARSON, 2015).

[2] Telephone Conference with ProctorU. July 22, 2014

[3] Telephone Conference with SoftwareSecure. July 17, 2014

[4] http://www.kryteriononline.com/

[5] https://www.isqi.org/

[6] Meeting with iSQI. July 22, 2014

[7] ANECA is the official entity, which certifies the university degrees in Spain, and a member of the European Association for Quality Assurance in Higher Education (ENQA).

At openHPI we have also conducted a (failed) offline exam experiment. Three out of ~10,000 course participants registered for an offline exam on our campus in Potsdam, two of them did not show up.

4 First Experiments with SMOWL

4.1 Why SMOWL?

After several in-depth calls with some of the previously mentioned proctoring providers, we decided to go for SMOWL. One of our reasons was the price tag. We had decided early on, that, if we offer proctored courses, we want all assignments in these courses to be proctored, not only the final exam. That accounts for a maximum of 8 hours proctoring per course and student. According to our surveys, only very few students are willing to pay more than 50€. SMOWL was the only provider that offered a solution in this price range with the trade off of only supporting open book exams. Furthermore, SMOWL employs HTML 5 video technology, which fits better in our technology landscape than the solutions of the other providers. Finally, even though ProctorU and SoftwareSecure support the SafeHarbor[8] framework for data protection, they're still located in the US, which freaks out many of our users in terms of privacy issues.

Table 1: Comparison of proctoring providers' key features

	Technology	Platform Support
ProctorU	Java	Windows, Mac
SoftwareSecure	Special Browser/Flash	Windows, Mac
SMOWL	HTML 5/Flash fall-back	Windows, Mac, Linux

[8] http://www.export.gov/safeharbor/

4.2 Test Setup

Up to now we ran two tests (alpha and beta), a third one is currently being set up. In this section, we will describe the settings of the completed tests. The alpha test was run on our staging platform with internal users only. Members of the openHPI team, colleagues from other projects of the chair, students, and a member of the openSAP team, volunteered as users. Overall we had about 20 participants in this first test. The following beta test was public. During the *Web Technologies 2015* course on openHPI we conducted a survey to ask who would be willing to test our new identity check feature. Out of about 10,000 course participants, 1826 answered the survey. 186 out of these were interested in testing our new feature. For those participants who volunteered to be proctored, we enabled the proctoring feature in one of the quizzes. Finally, 49 learners participated in the beta test.

Figure 2: Integration of the SMOWL Proctoring Solution within the openHPI quiz system. Left – Adjusting the camera before the quiz is started. Right – Proctoring during the quiz.

4.3 Evaluation

Both tests were accompanied by surveys. For the alpha test we only ran a post test survey, basically asking for usability issues with the integration. For the beta test we started with a pre-test survey, asking the users particularly about their attitude towards

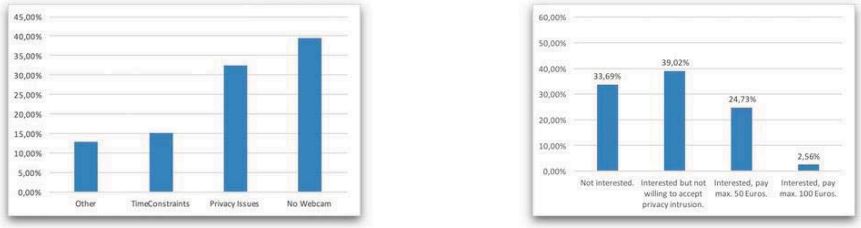

Figure 3: Left – Privacy and missing webcams are the main reasons why users did not want to participate in the test. Right – Request for more valid certificates.

being proctored during an online assignment. An essential amount of participants, had strong objections against being filmed. The major concern was privacy. A surprisingly high amount of participants was unable to upgrade to the proctored track due to the fact that they do not have a camera available, particularly those that are participating at their workplace (see Figure 3–Left). The results of the post survey question are shown in Figure 3–Right. As already discussed in Section 2 the request for "more valid" certificates has not increased amongst our users during the last two years. We had a more detailed discussion with some users that revealed their exact motives for being concerned about their privacy. One big issue was the connection of their image to their name. We have taken this into account by identifying the users towards SMOWL with a cryptographic hash value of their user_id, which disables SMOWL from identifying them. Next to the surveys, we analyzed the results that we received from SMOWL by comparing them to our information about the cheating attempts. For the alpha test we had well-defined plans for each participant's cheating attempts. For the beta test we asked the users to come up with ideas of their own and report them to us. The simplest way to trick the system is to trick the camera with a photo of the "candidate to be certified" (CTBC). Technically more ambitious participants set up a remote desktop session or simply used two monitors and keyboards. The CTBC sits in front of the camera, while someone else is answering the questions. Another variation of this theme is to have a helper in the same room but out of sight of the camera. To prevent these forms

of cheating, it would be required to install additional software—such as special browsers that lock the user in a certain window or tab—or hardware—such as a 360º panorama camera. In theory, it would be possible to integrate such tools with SMOWL.

SMOWL actually does not film the users, photos are taken in a previously defined time interval. There is also no audio surveillance. SMOWL uses HTML5 video as the default technology and also offers a Flash fallback version for devices that do not support HTML5. The HTML5 version gives the user the illusion of being filmed, while the Flash version shows exactly when the photo is going to be taken[9]. The most important finding here is that the automated part of their analysis works rather good. In both tests, the cheating attempts of our users had been detected. The most interesting case was one where we have a detailed description from the user how he cheated holding a photograph of himself in front of the camera[10]. In the report that we had received from SMOWL, the cheating attempt was not listed as such. When they investigated this issue, it turned out that the algorithm had actually detected the cheating attempt. In such cases they have a human controller taking a second look on the data. The controller rejected the cheating attempt and therefore caused the miss. Due to this finding, SMOWL has adjusted this process to prevent such errors[11].

The resulting data does not always give a clear distinction between cheating attempts and normal human behavior. SMOWL allows a variety of settings, which can be specified either as an absolute amount of pictures or as a percentage (see Figure 6 left.) Next to the severe issues, such as *incorrect user* or *cheating attempt* less severe, fuzzier issues are *nobody in front of screen, wrong lighting*, or *other tab*. *Black images* or *webcam discarded* were mostly reported for Linux users, who in turn reported technical problems[12]. Each of these criteria can be activated and a threshold can be set.

A good compromise needs to be found here between too strict and too loose settings.

Several smaller flaws in SMOWL's web interface have been detected during the tests and have been resolved immediately.

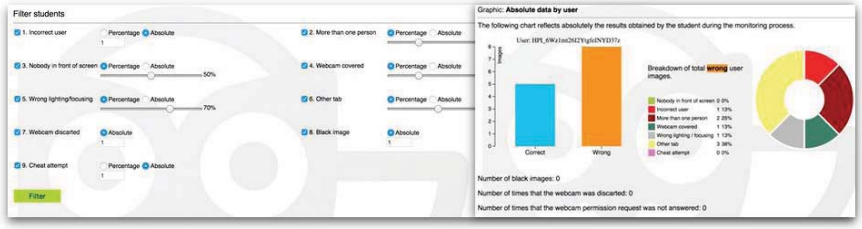

Figure 6: Left – SMOWL settings. Right – SMOWL results page (User)

5 Future Work

We are currently working on a better integration of the identity check with our platform. Particularly in terms of privacy concerns, we have to improve our information policy significantly. A third test is scheduled with, hopefully, significantly more participants.

[9] There is no deeper reason for this. The Flash version is just older than the HTML 5 version. The Flash version is not under active development any longer and its use as a fallback will not be necessary anymore in the near future.

[10] Pieper-Woehrle, R. Private Communication. July 22, 2015

[11] Fraile, M. Private Communication. August 7, 2015

[12] It is currently evaluated if this is a real issue or if it can be solved with different browser settings.

6 Conclusion

Even if more trusted certificates are not a major concern of our current user group, this will become an issue to make the courses more attractive for, currently, underrepresented target groups, such as e.g. students requesting ECTS points. Full-fledged human proctoring is expensive and not very well accepted amongst our users. SMOWL offers an alternative, using biometric face recognition, which has made a good impression during our tests. Naturally, it cannot provide 100% security, but at least it significantly raises the bar for cheaters.

Acknowledgements

We would like to thank SMOWL, particularly, Mikel Labayen, Manu Fraile, and Ricardo Vea for their support during the setup.

References

Coursera (2015). *Earn a Course Certificate*. Retrieved September 23, 2015, from https://www.coursera.org/signature/

EdX (2015). *Verified Certificates of Achievement*. Retrieved September 23, 2015, from https://www.edx.org/verified-certificate

Gharib, A., Phillips, W., & Mathew, N. (2012). *Cheat Sheet or Open-Book? A Comparison of the Effects of Exam Types on Performance, Retention, and Anxiety*. Psychology Research, *2(8)*, 469-478.

Iversity (2015). *Frequently Asked Questions*. Retrieved September 23, 2015, from https://iversity.org/en/pages/support

Labayen, M., Vea, R., Flórez, J., Guillén-Gámez, F., & García-Magariño, I. (2014). *SMOWL: A Tool for Continous Student Validation Based on Face Recognition For Online Learning.* Proceedings EduLearn 2014, 5354-5359. Barcelona.

mooin (2015). *Grundlagen des Marketing*. Retrieved September 23, 2015, from https://mooin.oncampus.de/mod/page/view.php?id=222

Pearson (2015). *Pearson VUE test center network*. Retrieved September 26, 2015, from http://home.pearsonvue.com/Test-Owner/Deliver-your-exam/Pearson-VUE-test-center-network.aspx

ProctorU (2015). *Coursera ProctorU Testing Center*. Retrieved September 23, 2015, from http://www.proctoru.com/portal/coursera

SMOWL (2015). *ANECA approves the use of SMOWL system for online courses*. Retrieved September 26, 2015, from http://www.smowltech.net/Newsletter/NewsletterANECA/ANECASmowlEN_Short.html

Teusner, R., Richly, K., Staubitz, T., & Renz, J. (2015). *Enhancing Content between Iterations of a MOOC – Effects on Key Metrics*. Proceedings EMOOCS 2015, 147-156. Louvain.

Udacity (2012). *Udacity in partnership with Pearson VUE announces testing centers*. Retrieved September 23, 2015, from http://blog.udacity.com/2012/06/udacity-in-partnership-with-pearson-vue.html

Udacity (2015). *Udacity is currently not offering any Proctored Exams*. Retrieved September 23, 2015, from https://www.udacity.com/wiki/proctored-exams