ONLINE PROCTORED EXAMS
Testing Integrity and Proctoring at the Technical University of Munich (TUM)

Presentation at the EADL Members Conference
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TECHNICAL UNIVERSITY OF MUNICH
Paper & Pencil Exams in the Lecture Hall

(Source: https://www.forschung-und-lehre.de/lehre/was-macht-eine-gute-pruefung-aus-517/)

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Electronic Exams in the Computer Room

TUM PC lab in Weihenstephan Science Center

(Source: tum.de)
The Project „Fernprüfungen“ (Remote Exams)

**Start:** Sept. 2018  
**Duration:** 4 years

**Goal of the project**

1. **Fill the gap** between entire online courses and „on campus“ exams
2. **Find existing tools and scenarios** for online exams in Europe and worldwide
3. **Develop concepts and solutions** for the TUM
4. **Roll out** of an appropriate tool for online courses

**What I did in 2018/2019:**

1. Literature Review,
2. Series of Interviews,
3. Demonstration of the tools,
4. Pilot Exams
Exams in Times of Corona
Paper & Pencil Exams in the Lecture Hall

(Source: https://www.forschung-und-lehre.de/lehre/was-macht-eine-gute-pruefung-aus-517/)
Electronic Exams in the Computer Room

TUM PC lab in Weihenstephan Science Center

(Source: tum.de)
Our question in the pandemic situation:

How would it be if especially the proctored exams no longer had to take place in the lecture hall?
Sounds like a great idea... ;-) 

But how to manage and scale online proctored exams in practice?
Agenda

1. The Technical University of Munich
2. Electronic Exams at the TUM
3. The Exam Process
4. Exam Course Templates for Online Proctored Exams
5. What our Students say…
6. Critical Aspects to consider
Technical University of Munich (TUM)

- 45,356 Students
- 15 TUM Schools and Departments
- 612 Professors
- 11,269 Staff members
- International students: 34%
- 1 offshore campus: TUM Asia in Singapore
- 5 other international offices: Beijing, Brussels, São Paul, Mumbai, San Francisco

(Images: tum.de)
## Overview of the E-Exam Formats

<table>
<thead>
<tr>
<th>UNPROCTORED</th>
<th>PROCTORED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upload Exam</td>
<td>Online Proctored Paper and Pencil Exam (Zoom)</td>
</tr>
<tr>
<td>E-Exam</td>
<td>Online Proctored Exam (Proctorio)</td>
</tr>
</tbody>
</table>

### Upload Exam
- Small to medium cohorts
- Open Book
- Internet connection requirement: **Low**

### E-Exam
- Small to large cohorts
- Open Book
- Internet connection requirement: **Low**

### Oral Remote Exam
- Small cohorts
- Closed Book
- Internet connection requirement: **High**

### Online Proctored Exam (Proctorio)
- Small to large cohorts
- Closed Book
- Internet connection requirement: **Medium-High**

### Online Proctored Paper and Pencil Exam (Zoom)
- Small to medium cohorts
- Open Book
- Internet connection requirement: **High**
Overview of the E-Exam Formats

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</table>

- **Upload Exam**
  - Small to medium cohorts
  - Open Book
  - Internet connection requirement: Low

- **E-Exam**
  - Small to large cohorts
  - Open Book
  - Internet connection requirement: Low

- **Oral Remote Exam**
  - Small cohorts
  - Closed Book
  - Internet connection requirement: High

- **Online Proctored Exam (Proctorio)**
  - Small to large cohorts
  - Closed Book
  - Internet connection requirement: Medium-High

- **Online Proctored Paper and Pencil Exam (Zoom)**
  - Small to medium cohorts
  - Open Book
  - Internet connection requirement: High
## Comparison SoSe 2020 with WiSe 2020/21

<table>
<thead>
<tr>
<th>Category</th>
<th>SoSe 2020</th>
<th>WiSe 2020/21 (preliminary)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of centrally administered distance examinations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e-exams (unproctored)</td>
<td>182</td>
<td>272</td>
</tr>
<tr>
<td>upload exams</td>
<td>49</td>
<td>55</td>
</tr>
<tr>
<td>ZOOM-supervised exams</td>
<td>70</td>
<td>25</td>
</tr>
<tr>
<td>proctored exams</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>165</td>
</tr>
<tr>
<td>Participants</td>
<td>ca. 17.000 Ps</td>
<td>ca. 30.000 Ps</td>
</tr>
<tr>
<td>Biggest e-exam unproctored</td>
<td>1.139 Ps</td>
<td>ca. 1.200 Ps</td>
</tr>
<tr>
<td>Biggest e-exam proctored (with Proctorio)</td>
<td>1.060 Ps</td>
<td>938 Ps</td>
</tr>
</tbody>
</table>
Overview of centrally managed E-Exams at TUM

Preliminary status as of 03/22/2021.
30,439 students in 260 online exams supported by Moodle.

Numbers of students in e-exams (WS 20/21)

Distribution of the exam variants (WS 20/21)

Status: 22.03.2021, ProLehre examination team.
Data set: Preliminary data from the lecturers' exam registrations. These are exclusively written distance or online exams organized with Moodle and supported by ProLehre with an exam course. Final results after the examination phase.
How can online proctored exams be implemented in practice?
Online Proctored Exams and Alternative Exam

Exam scenario for European universities

1. Online Proctored Exam with monitoring of the examinee and the computer
   - Can be done outside of the lecture hall e.g. at home
   - Requires tools to monitor the participant, e.g. face recognition, eye tracking
   - Requires the consent of the examinee to provide his or her sensitive personal data

2. Alternative exam "on campus" only with computer monitoring
   - Is held in a lecture hall, seminar room or a computer room of the university
   - Only tools to secure the computer and to document the exam content are used
   - No further consent is required, as consent for the use of basic personal data is usually given at the beginning of studies
### Overview of the TUM Exam Process

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Preparation of the entire test scenario</td>
</tr>
<tr>
<td></td>
<td>• Decide the form of examination</td>
</tr>
<tr>
<td></td>
<td>• Prepare the exam topics</td>
</tr>
<tr>
<td></td>
<td>• Get familiar with the proctoring tools in the LMS</td>
</tr>
<tr>
<td></td>
<td>• Plan the most important dates</td>
</tr>
<tr>
<td></td>
<td>• Prepare the information on data protection for the participants</td>
</tr>
<tr>
<td>2</td>
<td>Administration of a demo exam</td>
</tr>
<tr>
<td></td>
<td>• Determine the required proctoring tools</td>
</tr>
<tr>
<td></td>
<td>• Clarify, if an alternative test is needed</td>
</tr>
<tr>
<td></td>
<td>• Implement a demo exam with the necessary exam variants and the most important question types</td>
</tr>
<tr>
<td>3</td>
<td>Preparation of the test questions and the real exam</td>
</tr>
<tr>
<td></td>
<td>• Clarify the question types and the content for the real exam</td>
</tr>
<tr>
<td></td>
<td>• Define the general conditions for the exam (time, etc.)</td>
</tr>
<tr>
<td></td>
<td>• Try out the real exam scenario with different users directly on the LMS</td>
</tr>
<tr>
<td>4</td>
<td>Administration of the real exam</td>
</tr>
<tr>
<td></td>
<td>• Activate the real exam</td>
</tr>
<tr>
<td></td>
<td>• Check if the participants can handle the questions</td>
</tr>
<tr>
<td></td>
<td>• Create a first impression of fraud immediately after the end of the first tests</td>
</tr>
<tr>
<td>5</td>
<td>Follow-up of the exam</td>
</tr>
<tr>
<td></td>
<td>• Evaluate the real exam</td>
</tr>
<tr>
<td></td>
<td>• Provide the exam grades</td>
</tr>
<tr>
<td></td>
<td>• Interpret the answered questionnaires</td>
</tr>
<tr>
<td></td>
<td>• Review the proctoring evaluations = identify fraud</td>
</tr>
<tr>
<td>6</td>
<td>Closing</td>
</tr>
<tr>
<td></td>
<td>• Delete the proctoring data</td>
</tr>
<tr>
<td></td>
<td>• Archive the test and the results</td>
</tr>
</tbody>
</table>

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Lecture with Online Proctored Exam

**Start planning lecture with OPE**

**Start of the semester**
- Assemble the Information for the students
- Clarify the Student mood regarding an Online Proctored Exam
- Decide if an alternative exam is needed

**Preparation of the demo exam**
- Create the test questions
- Specify the proctoring tools
- Try out the necessary demo exam types on the LMS

**Preparation or the real exam with online proctoring**
- Create the exam questions, time frame, ...
- Try out the real exam scenario directly on the LMS

**Evaluation Proctoring + consequences**
- Review the possible fraud cases
- Include of the Audit Committee, if applicable

**Inspection of grades**
- Set the inspection date or period
- Unlock the grades and exam results for the students

**Closing**
- Delete the proctoring data as soon as the legal situation requires it
- Archive the screencasts, logs and evaluations

**Preliminary planning**
- Consider if proctoring makes sense in your exam scenario
- Clarify costs and financing for the tools
- Gain experience with a proctoring demo exam
- Create a schedule
- Select the exam topics
- Think about appropriate question types
- Remember alternative exam

**Room and hardware planning**
- Clarify rental computers for the proctoring exam and / or alternative exam on campus
- Clarify the performance of the WLAN for the test rooms

**Administration of the demo exam**
- Activate the demo exam for the students
- During the activation time of the demo exam:
  - Check the first results
  - Check the tools
  - Check the answers of the pre-questionnaire
  - Check the ratio between “on campus” and “at home” exams

**Administration of the real exam**
- Get the consent of the examinees
- Bring supplementary computers on site or use a computer room
- Support the examinees with technical issues

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Online Proctored Exam without Lecture

**Preliminary planning**
- Consider if proctoring makes sense in your exam scenario
- Clarify costs and financing for the tools
- Gain experience with a proctoring demo exam
- Create a schedule
- Select the exam topics
- Think about appropriate question types
- Remember alternative exam

**Preparation of the demo test**
- Create the test questions
- Specify the proctoring tools
- Try out the necessary demo exam types on the LMS

**Administration of the demo exam AND the real exam**
- Activate the demo exam AND the real exam for the students
- During the activation time of the exams:
  - Clarify if all students did the demo exam(s) before the real exam
  - Get the consent of the examinees
  - Bring supplementary computers on site or use a computer room with human proctoring
  - Support the examinees with technical issues if the timeframe allows it

**Evaluation Proctoring + consequences**
- Review fraud cases
- Include the audit committee, if applicable

**Closing**
- Delete the proctoring data as soon as the legal situation requires it
- Archive the screencasts, logs and evaluations

**Room and hardware planning**
- Clarify rental computers for the proctoring exam and / or alternative exam on campus
- Clarify the performance of the WLAN for the test rooms

**Start planning OPE without lecture**

**GO LIVE**
How to scale Online Proctored Exams?
Requirements for the RollOut of E-Exams

Organization of distance exams
• *Distance exam calendar* with key dates of the exam, link to the exam course and contact person
• *Central registration* and overview of planned and implemented remote exams

(Partial) automation of the entire examination process
• Course templates for test and exam courses
• Reply modules for support requests

Self-learning materials
• Wide range of information for different user groups:
  • Lecturers Background information and help with implementation
  • Students Information about data protection and handling of an exam
  • Framework information + How-To for practical implementation

IT support
• Support with ticket system
• Live chat / telephone contact during the exam
RollOut Aspects

1. Initial information and advice
   - Website
   - Distance learning info course(s)
   - Demo videos
   - FAQ with content and legal questions
   - Test courses on demand
   - Individual online consulting

2. Application
   - Online application form for TUM lecturers only.
   - Categories for quick classification of exam courses
   - More information about previous experience, faculty, size

3. Template courses
   - DE and ENG
   - Trial courses to try out
   - With and without on-site testing
   - Detailed information on testing, legal framework and technical issues

4. Consulting and support during preparation
   - Demo videos on the Moodle test and Proctorio tools
   - Concrete tool suggestions
   - Ticket system and response templates
   - Individual online consulting

5. Administration and support
   - Proctorio support for technical problems directly at Proctorio
   - Live support for students by TUM via "emergency link" and/or telephone contact in the exam

6. Conclusion
   - Templates for deleting the proctoring data
   - Archiving of the proctoring and results

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Exam Course Template
Exam Course in LMS (I): Start

Welcome to the Exam Course "Demo Course for Proctorio Video Lectures"

If you haven't taken a Proctorio exam yet, you might want to watch the demo video. There you will learn how a Proctorio exam works and what you need to know to make sure everything goes well.
Exam Course in LMS (II): Information

**IMPORTANT INFORMATION for Examinees: Please read!**

Here you will find important information about Proctorio exams and practical use.

Please read through the information at your leisure so that you are well prepared for the exam! 😊

- [INFO PAGE: Online Proctoring and Proctorio](#)
- [INFO PAGE: Your exam options](#)
- [INFO PAGE on the voluntary nature of this online test](#)
- [INFO PAGE on data protection](#)
- [INFO PAGE and FAQ: What to do in case of technical problems?](#)
Exam Course in LMS (III): Demo Exam

**DEMO EXAMS to try out**

Here you can try out the exam with a few demo questions and check your technical equipment.

*Please make sure you take the demo exam, otherwise you will not be able to see and take the "real" exam!*

This online check can ONLY be performed with the Chrome browser and a browser extension from Proctorio. As operating systems you can use current versions of *Windows, MacOS and Linux* (no Android and iOS/iPadOS). More detailed information about the requirements of Proctorio can be found at: [https://proctorio.com/system-requirements](https://proctorio.com/system-requirements)

If you do not want to use your own device, or if the device does not meet the requirements, you can rent a laptop. *Here you will find the corresponding rental information.*

- DEMO EXAM - Computer Protection only (Fernbeaufsichtigt)
- DEMO EXAM - with Video Proctoring (Fernbeaufsichtigt)
- Forum TECHNICAL support for the DEMO exams
Exam Course in LMS (IV): Exam Options

SELECT you EXAM OPTION

Here you can decide which examination variant you would like to take (online with automatic video supervision or at the university in classroom form).
If you make NO selection, you will NOT see any exam!

Select your exam option here
Exam Course in LMS (V): „Real“ Exam

Here the information about the time and place of the exam will appear as soon as you have completed the preparations (demo exam, exam selection).

As long as you see a warning message, you have not completed all preparations and therefore cannot take the exam!

Timetable for the exam today [Insert Date]
Room for the exam ON CAMPUS: [Insert Room]

[Insert Time]: Prepare at home and log in
[Insert Time]: Prepare in the room on campus
[Insert Time]: BEGINNING of the exam

If you don’t see an exam despite all preparations - PLEASE UPDATE the page

HOTLINE in case of any uncertainties regarding the content: XXXX
HOTLINE for technical problems: XXXX

Restricted: Not available unless: You belong to any group (hidden otherwise)

Exam - Computer Protection only (Fernbeaufsichtigt)

Restricted: Not available unless:
• You achieve a required score in DEMO EXAM - Computer Protection only (Fernbeaufsichtigt) (hidden otherwise)
• You belong to Group 1: Computer Protection only ▶ Exam in the lecture room (hidden otherwise)

Exam - with Video Proctoring (Fernbeaufsichtigt)

Restricted: Not available unless:
• You achieve a required score in DEMO EXAM - with Video Proctoring (Fernbeaufsichtigt) (hidden otherwise)
• You belong to Group 2: With video proctoring ▶ Exam outside the lecture room (hidden otherwise)

YOU HAVE NOT TAKEN THE DEMO EXAM AND THEREFORE YOU DO NOT SEE THE EXAM!

To prevent technical problems and to try the test before, you have to do the DEMO EXAM.

Restricted: Not available unless:
• You do not get certain scores in DEMO EXAM - Computer Protection only (Fernbeaufsichtigt) (hidden otherwise)
• You do not get certain scores in DEMO EXAM - with Video Proctoring (Fernbeaufsichtigt) (hidden otherwise)

YOU HAVE NOT SELECTED AN EXAM OPTION AND THEREFORE YOU DO NOT SEE THE EXAM!
Exam Course in LMS (VI): Additional Material

- SURVEY for the Examination (optional)
- INFO about the course preparation (FOR LECTURERS)
Proctorio Configuration
Proctorio Tools (I)

- **Recording Options**
  - Record Video
  - Record Audio
  - Record Screen
  - Record Web Traffic
  - Record Room

These options determine what information will be recorded during the exam.

- **Lock Down Options**
  - Moderate (15s)
  - Only One Screen
  - No New Tabs
  - Close Open Tabs
  - Disable Printing
  - Disable Clipboard
  - Block Downloads
  - Clear Cache
  - Disable Right Click
  - Prevent Re-entry
Proctorio Tools (II)

Verification Options

- Verify Video
- Verify Audio
- Verify Desktop
- Auto ID Check
- Verify Signature

These options determine what will be verified prior to the exam.

In-Quiz Tools

- Scientific Calculator
- Whiteboard

These options determine what tools the test taker will have access to during the quiz.
Proctorio Evaluation

Der Versuch endete, als der Prüfungsteilnehmer die Prüfung einreichte. Erfahren Sie mehr über diese Warnung.

Computerleistungs-index
(kann auf Grunde fur Computerprobleme hinweisen)

* Internettyp: college
* Der Prüfungsteilnehmer hatte schwache overall Performance
What are our experiences?
Current Experiences with Online Proctored Exams

- As many and well-structured **self-learning materials** as possible are helpful for the preparation of lecturers and students.
- Lecturers and those responsible for examinations must be **picked up where they are** in their preparation.
- **Individual consultation** necessary.
- Relying on the correct participation of examinees is **not enough** in practice and is therefore critical.
- **Demo examination** and selection of the type of examination are imperative.
- **Large remote exams in particular require intensive pre-thinking and pre-testing.**
- Good preparation often shows high voluntary participation in the "at home" variant (> 80-90%).
Evaluation of Online Proctored Exams: PRO

"What advantages do you see in an online proctored exam?"

Answers (summarized)

• Spatial and temporal flexibility
• Easier organization (travel, no traffic jams or breakdown of public transport)
• Less nervousness in case of exam anxiety
• Contemporary, modern form of examination
• Support for special groups (e.g. people with disabilities)
Evaluation of Online Proctored Exams: CONTRA

"What disadvantages do you see in an online proctored exam?"

Answers (summarized)
• Privacy
• Technical problems
• Lack of or insufficient technology at the participants' end
• No personal contact
• Security
• Easier fraud?
How did our students feel about the online proctored exams?
First Impressions from the Exam Evaluation (I)

Exam: Sports and Health Sciences
Participants: 425; n=49

Exam: Business Sciences
Participants: 640; n=85

How was your experience with automated supervision?

Very good

good

totally agree

totally agree

Thanks to the advance information, I was able to manage the exam process without any problems.
First Impressions from the Exam Evaluation (II)

Exam: Sports and Health Sciences
Participants: 425; n=49

Exam: Business Sciences
Participants: 640; n=85

The overall exam process was too complicated.

I feel that "cheating" is easier with online supervision.
First Impressions from the Exam Evaluation (III)

Exam: Sports and Health Sciences  
Participants: 425; n=49

Exam: Business Sciences  
Participants: 640; n=85

**Overall, which exam scenario would you prefer?**

- e-exam at home
- paper exam on campus

**Would you like to write more online proctored exams?**

- yes
- don’t know
Critical Aspects
What about Cheating in Online Proctored Exams…?
Cheating: „Classical“ Cheating Tactics

Classic cheat sheet (Tweedy 2016)

Cheat sheet on the finger nail (Tweedy 2016)

Cheat sheet in water bottle. (Tweedy 2016)
Chating: Other Ideas

Youtube: 7 Smart Gadgets For Cheating During Exams

Special camera eye glasses (YouFact EN 2017)

Cheating material outside of the camera angle (Binstein 2015)
Cheating: Technical Solutions

VGA splitter and second monitor. (Smith 2016)

ManyCam: Alternative video signal instead of the real video. (Binstein 2015)
# TUM Cheating Contest 2020: Outcomes

<table>
<thead>
<tr>
<th>Cheating Approaches</th>
<th>Exam Process</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handmade crib sheets with small annotations / Cheat Sheet</td>
<td>Exam Section</td>
<td>12</td>
</tr>
<tr>
<td>Tactical body language</td>
<td>Whole Exam Process</td>
<td>12</td>
</tr>
<tr>
<td>Strategic placement of unallowed aids</td>
<td>Whole Exam Process</td>
<td>12</td>
</tr>
<tr>
<td>Unedited script</td>
<td>Exam Section</td>
<td>7</td>
</tr>
<tr>
<td>Phone / Tablet / Beamer / Second Computer to store information</td>
<td>Exam Section</td>
<td>4</td>
</tr>
<tr>
<td>Modifying the computer settings</td>
<td>Between Pre – Check and Exam Section</td>
<td>4</td>
</tr>
<tr>
<td>Collaboration with friend through the phone</td>
<td>Exam Section</td>
<td>3</td>
</tr>
<tr>
<td>Virtual Machine</td>
<td>Whole Exam Process</td>
<td>2</td>
</tr>
<tr>
<td>Headphones</td>
<td>Exam Section</td>
<td>2</td>
</tr>
<tr>
<td>Search Engines / Internet</td>
<td>Exam Section</td>
<td>1</td>
</tr>
<tr>
<td>Fake network error</td>
<td>Exam Section</td>
<td>1</td>
</tr>
<tr>
<td>Screen sharing</td>
<td>Whole Exam Process</td>
<td>1</td>
</tr>
</tbody>
</table>

n = 12
What is there to consider legally?
Online Proctored Exams in Europe

Legal Foundations (Exam Law and GDPR)

- **Authentication** when registering for the examination electronically and when taking the examination.
- Ensuring **equal opportunities** for all of the examinees
- Sufficient **practice opportunities** for students with the electronic exam
- **Supervision of examinations by humans or specific software** and electronic recording of the exam contents.
- Ensuring **access** to electronic examinations + **archiving** of examination
Most important legal aspect

1. Students have the **free decision** whether to provide personal data or not
2. The decision **must not have negative consequences**

In almost every examination scenario at the TUM there were some students who are **not willing to provide their personal data** for an Online Proctored Exam.
Legal Conditions: Aspects to clarify

Form of examination "Online Proctored Exam"
• What legal framework (examination regulations) must be observed?

Involvement of an external company in the examination process
• What data is transferred?
• Is the storage of sensitive personal data on (European) servers necessary?

Equal opportunities with BYOD
• What equipment do participants have?
• Do participants with inappropriate devices need an exam computer?

Voluntariness of consent
• Are participants free in their decision to take part in a proctored exam?

Dealing with suspected behavior
• How are suspected cases in the "gray zone" handled?
Summary

- Online Proctored Exams have been in use worldwide for years and are used at many educational institutions.
- In Europe, there are specific legal frameworks that need to be taken into account.
- The implementation of proctored exams - especially large examinations - requires good planning, preparation and communication of all parties involved.
- The reliable preparation of the examinees is an important factor for the successful and smooth implementation of a distance examination.
Thank you very much for your attention and your time!

QUESTIONS?
Sources (I)


Sources (II)


