Aiming to improve higher education testing

Introduction

The case for e-exams

In its research question this thesis ask about how to imporve upon centralized e-exams. This implies in the first place that e-exams in general are superior to paper based exams. There is good reason for this implication. It is a good idea to take a look at these reasons before moving on.

Why move from paper based to electronic exams in the first place?

Paper based exams are still the way to go, when it comes to assessments in German higher education [cite]. There is a strong case to be made by many scholars that e-exams yield benefits over traditional exams. Especially in the efficiency of the assessment process, e-exams show their potential. Leveraging these protentials must not come at the cost of other bereiche. E-exams must at least reach the level of a PB-exam, in their respective field.

When talking about e-exams we will focus on bring your own device (BYOD) exams. As I will later talk about decentralized exams which are in any way conducted at home using the examinees own device, it is unnessasary to think about techincal infrastructure that would be needed to conduct e-exams with univesity computers. Despite BOYD exams are no novelty, they are talked about in many papers and talks. For example the univesity of Blurbington relies on BOYD exams.

Exams as a logistics problem

First, lets think of an exam only as a logistics problem. To illustrate this we use the examination process at the KIT as an example. Although some things may differ, the gist remains. At the Kit exams must be securely printed at one location. Most exams are not single page, they must be stapled by hand. Exam taking students are numerous, it is common for exams to take place at many different sites. Therefore, on the test day must be carried out to the test site. For security reasons this is seldom done by one person only. On test site, exams must be distributed to students. After the exam is written, exam are collected and counted. They are then carried back to a central location, where they remain until correction. For checking answers, correctors come together, again at a central location, where they then are able to correct the exam. After correction a grade for students is published via internet. Some time after the exams have to be brought to revision at another location for the students to review their results. Lastly the exams are brought to archive to be stored there until they are free to be shredded.

Looking at e-exams the logistics overhead is way smaller. All data can be stored at a central database. There is no printing, exams are directly transferred to the

students device the moment the exam begins and can automatically be retrieved after the exam is over. Because the exam answers are digitally available some can be automatically evaluated. The correction of the remaining answers is no longer bound to a certain site but can be done remotely. Despite the test result also the solved exam can be shared via internet. Students can review their exam from wherever they want. Only these students who have specific questions about their exam need to come into revision. The digital exam data can then be archived and in time deleted.

This comparison illustrates the advantage of e-exams with regard to logistics. Not only is there less movement of employees but more importantly there is no movement of physical paper.

- [ ] Datensicherheit.
- [ ] Redundante Datenspeicherung.

The hassel of handwriting

Checking an exam for correctness is one of the most time-consuming process in conducting an exam. Moving away from paper can reduce this time drastically making use of two things. First, some question types, such as multiple choice, true/false and Zuordungsfragen can be automatically checked. This is an immediate improvement over correcting these questions by hand. Secondly must be considered that any exam data exists in digital form. Whereas in PB-exams the answers are only available in sometimes cryptic handwriting, in e-exams the answers are available as digital text. One study shows that reading text is 10000 times as fast. If the text liegt vor in digital form, further unterstützung can be used to make reading free text answers even faster. It is thinkable to highlight special keywords in order to make answers even more readable. In any way the digital presents of exam date leads to a major improvement in the speed an exam can be checked.

Statistics on the fly

Thinking of the digital nature of exam data another vorteil emerges. In PB-exams it is relatively hard to gain detailed information about the exam statistics. Everything that is of interest must be digitized by hand. This is a process prone to errors and more importantly time-consuming. In e-exams it is fairly easy to create statistics. Time that has been used to digitize data now can be used to find intersting information not only about the general exam but about specific questions or question types. These statistics can be very helpful in order to nachvollziehen the performance of students but also the quality of exams and the lecture respectively.

Drinks at the pool

One of the most time-consuming aspects of exam creation is the zusammenstellung of exam questions. It may seem that e-exams do not provide an immediate advantage to PB-exams as questions are in any way conceptualized on a computer. The advantage of e-exams lays in standardization and sharing capabilities. As the Zurich University has proposed a general Format for e-exams, these exam questions are now easily shared among colleges and other universities. These questions can then be collected in so named question pools. At the point where a question pool is large enough, exams can be randomly generated using the exams already present in the pool. Instead of conceptualizing new exam questions, only the question pool must be taken care of.

Some scholars such as Book Author have concerns about filling such a questio pool. If this had to be done by one examiner alone this would really be a serious task but in times of wide spread social media sharing questions or entire pools is worth consideration. As a other way of filling question pools, questions could be thought out by students as exam preperation. Filling the question pool may seem like a daunting task, but making utility of crow thinking and past experiences can dramatically help this endavour. Having created a big enough question pool does not only help in exam creation, it also prevents students from knowing the exam beforhand. Often exam questions are treated as secreds as they are used again and again. This secrecy can not relyably be enforced. It is genral procdure that students collaborate to create in depth Gedächnisprotokolle, which are then uploaded for public access. Having a large question pool, makes it almost impossible for a student to prepare all questions beforehand, creating a more sound depiction of the students skillset.

- [ ] scale economy
- [ ] network effects

A fair depiction of skill

As Handke said in his book, we should not look at exams mearly as a service. Exams should improve

Thinking about skillsets reveals a nother problem of PB-exams. As many have stated, exams often fail to depict real life problems. In contrast to exams real life almost never asks soley for fakts, it asks for a brought application of knowledge. It asks for problem solutions no matter the resource. In this way open book exams may come closest to depicting a real life problem situation. On the other hand some fact knowledge is of utmost importance. Consider a doctor, who needs his cheat sheet, in order to conduct open heart surgery. Or an accountant who has to look up the meaning of working capital, every time it shows up. To make later reasoning more obvious, it is useful to think about why these two examples are considered a no go. The fact knowledge should be there, because it is needed immediately. A doctor who does not know his facts may loose lives, an accountant who does not know his vokaulary is nearly useless in any kind of

verhandlung. The constraining factor in both cases being time. If no real world problem whould have time relevance, it could be argued that fact knowledge is fairly useless. Especially in times, where this knoledge is easier accessible than ever. Sadly time almost always plays a major role in many problems, so there must be some way of checking for fact knowledge. PB-exams in now way allow for a marriage of fact questions and those who ask for transfer whith no restrictions to resources.

E-exams on the other hand can provide a mixture of both. Consider an exam where in principle every resource could be used. In such an open book exam especially transfer knowledge can easily be tested. As we discussed fact knowledge is also essential part of the examination process. As this fact knowledge, in a real world application must be available in seconds it is only a reasonable thing to just enforce a time restriction to any fact questions.

In this way e-exams can achive a hybrid testing form. It allowes examiners to more reallistically einschätzen a students real capabilities. Moving the education closer to real world problems. This also helps to steuer against the trend of Bullemie lernen. As studendts find themselves forced to wiedergeben sometimes hundereds of pages of scripts, this short term memory is reinforced.

- [ ] Question types

Change and scale

Some scolars express concerns about the infrastructural scalability of e-exam systems. In their eyes, exams only provide utility with X students or more being part of the exam. This argument ignores the scaleable nature of the an exam system. Moving to e-exams must not be a decision of one course or one Lehrstuhl alone.

- [ ] Größe von e-exams

Cheating and randomization

Cheating may be the biggest concernt when it comes to moving from paper to e-exams is probably cheating. Although academic dishonesty is not vermeidbar there must be made measures to prevent it.

As [cite] found in his paper there are two main categories when it comes to cheating. Planned and spontaineous cheating. Spontainous cheating accures in stress situations where the student feels overwehlmed. It may include looking at other students worksheets or even going to the toilet to look something up on the internet. Planned cheating on the other hand is intended by the stundet beforhand. The student deposits a cheat sheet in the bathroom, or directly to the exam. Even if the Folgen of cheating are in most cases a failure of the exam, cheating is still common among students. A study of ... found that measures against cheating had almost no effect.

We must keep this in mind when thinking about e-exams. Against spontaious cheating, some measure can easily be enforced. As tests can be highly randomized looking at a neighbours screen may lead to no new information.

Otherwise, as in a this first step we just replaced paper with a computer there are basically the same eforcements possible. Software such as the open source safe exam browser of the ETH Zürich (link) can be used to make other programs on the device inaccessible during the exam. So in theory e-exams can be just as safe as paper based exams.

As I discussed earlyer cheating may not be the biggest problem if examiners rely on (partial) open book exams. As open book exams do not rely on restriction of resources. In such a case not even software to restrict students device capabilities is needed. This has also the benefit, that such a system has less parts that must be maintained, thus being less prone to errors.

Problems

Many have pointed at problems that may arise from switchig from paper based exams to e-exams. Some of these problems are not of any concern as techincal advancements have made them obsolete.

The providing of technical infrastructure in form of a computer for every testtaker may seem daunting. Nowadays it is more than common for students to have access to a webbrowser. And really thats all they need. Although not recommended, exams could really be taken on any smartphone.

Another concern touches upon connection problems. There is no doubt upon e-exam using a client–server structure. Dependant on the implementation, this may make e-exams prone to connection errors. For example if after every question a new question must be fetched from the server having connection errors can quickly ruin the exam for anyone that is taking it. On the other hand there is the possibility to store the exam and the given answers in the local storage of the browser. As long as the browser is not reinstalled or forced to clear its chache the exam information is secure. To prevent fiddelling with the local chache it could be encrypted. Using this method e-exams could be counducted even be conducted offline, only to send in the exams solution and to download the exam questions an internet connection would be needed. Of course such a soulution must be tested firmly to make sure that any way of hacking the exam is prevented.

With regard to the configuration and usage of an e-exam tool, it is clear that a soulution that is easily usable for novice users but yields potential for more advanced users is of utmost importance. Examiners must have the chance to learn the new tool, ideally this is supported by the usage of hight standards of user interface design.

Politics and angst also play into the above problems. As new technologie and software often creates a sense of being overwhelmed there must be a strone

emphasis on showing examiners the advantages an e-examination system could give them. E-exams especially show their potential when being widely adopted. As more usage of e-exams can lead to network effects. Especially inside an institution there must be enforcement of the usage of new systems. The faster a new way of working gets adapedt the faster it can improve. In this way also small exams are very valuable. It is even thinkable to get immediate feedback of the examinees to improve the system or to get a students feelings about the exam. As the examination infrastructure is easily scalable, there is not need for smaller exam groups to move back to paper. Questions and questionpools can be created in the same way as for bigger exams and as a new e-exam does not need more resources there is no need to hold back.

==========

From central to decentral e-exams — moving up the ladder

The previous section was about moving away from paper and its benefits. As we now aim to improve the examination process even further. In order to do this, we must look at the shortcomings our current thought out system still has.

E-Exams as an logistics problem

As seen above, e-exams can be immensely more efficient in terms of logistics, compared to a paper based exam. There are however still some shortcomings. Especially the personel that is needed in order to supervise the examinees seems to be costly. However the personel is only needed to supervise student behavior and enforce exam rules. As we discussed earlier open book exams are realizable quite easily using e-exams. Also through the use of heavy randomization, it is harder for them to collaborate.

- [ ] Copy pasta
- [ ] encryped local storage
- [ ]

Cheating

No system is foolproof.

- [ ] cooperation