Online Exams as Part of the IT-supported Examination Process Chain

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1. EXECUTIVE SUMMARY

In the wake of the Bologna process, examinations are a crucial part of both the academic teaching and learning process and of university's administration procedures as well. IT support of administrative sections of the examination process chain is common today among German universities. Recently, some higher education institutions have started off to switch paper-based examinations into a computer-based environment due to increasing numbers of exams. On-screen exams are supposed to reduce costs, and improve quality and speed of the correction process. However, integrating computer-based tests and assessments in the examination process chain brings about a lot of problems and challenges for both faculty and administrators. Against the background of the IT-supported examination workflow, this contribution focuses on the organisational and technological challenges that have to be met and presents some lessons learnt from recent developments in German higher education.

2. IT SUPPORT OF THE EXAMINATION WORKFLOW

In the wake of the Bologna process, examinations are a crucial part of both the academic teaching and learning process and of university's administration procedures as well. IT support of administrative sections of the examination process chain is common today among German universities. Different software systems are used to support examination processes at universities, i.e. campus management systems (examination administration and course management systems) as well as learning management systems and e-learning testing solutions. While the IT-based administration of examination processes is widespread and well-established at German universities, the switch from paper-based to computer-based examination environments is still in its early stages. Nevertheless, the IT-based rearrangement of examinations is currently becoming more and more popular due to increasing numbers of exams. On-screen exams are supposed to reduce costs, and improve the quality and speed of the correction process. However, integrating computer-based tests and assessments in the examination process chain brings about a lot of problems and challenges for both faculty and administrators.

The shift of examination as well as examination administration procedures from paper-based to IT-based processes necessitates substantial reorganisation processes at universities. Administrative staff, IT support staff, lecturers and examiners as well as students have to adapt to and to familiarise themselves with new examination practices. Against the background of the processes of the electronically processed examination workflow, the novel domain of computer-based examinations will subsequently be depicted with its specific didactical, technical, juridical, resource-related and organisational aspects.

2.1. IT support of administrative sections of the examination process chain

The Bologna process brings about a lot of major changes for the IT management of students' and examination data. The implementation of new study programmes, the new tiered degree structure with Bachelor und Master degrees imply the development of new study and examination guidelines. New trans-sectoral study programmes were partly facilitated with the academic reform. Many of the Bologna-related changes of the basic university structure have consequences on the study and examination management processes and lead to new responsibilities. The introduction of innovative study programmes, tuition fees, student selection processes or new organisational structures, to name but a few recent changes in the university sector, have resulted in new tasks and roles within the university administration as well.

With regard to the administration of examinations, responsibility assignment between the employees of the university administration and the examination administration has changed significantly. An important aspect of the Bologna process is the stringent structuring of studies which also lets lecturers and administrators better organise the marking of student performance. The examination administration unit of a university has to coordinate and document examination procedures and examination results with care. Moreover, much more examinations have to be processed, student marks must be recorded, safely kept and documented in Transcripts of Records. Universities react to these and other new responsibilities through expanding computer support for as many core activities as possible. Furthermore, computer-based examination management tools enable lecturers, students and other authorised persons to contribute to the data flow independantly from university administration staff through self-service functions.

2.2. Step-by-step guidance through the examination process chain

The new electronic examination administration process consists of a number of steps that are depicted in figure 1. Speed and quality of processing the examination data depend upon a frictionless cooperation of administrative staff (student office and IT administration) and lecturers.
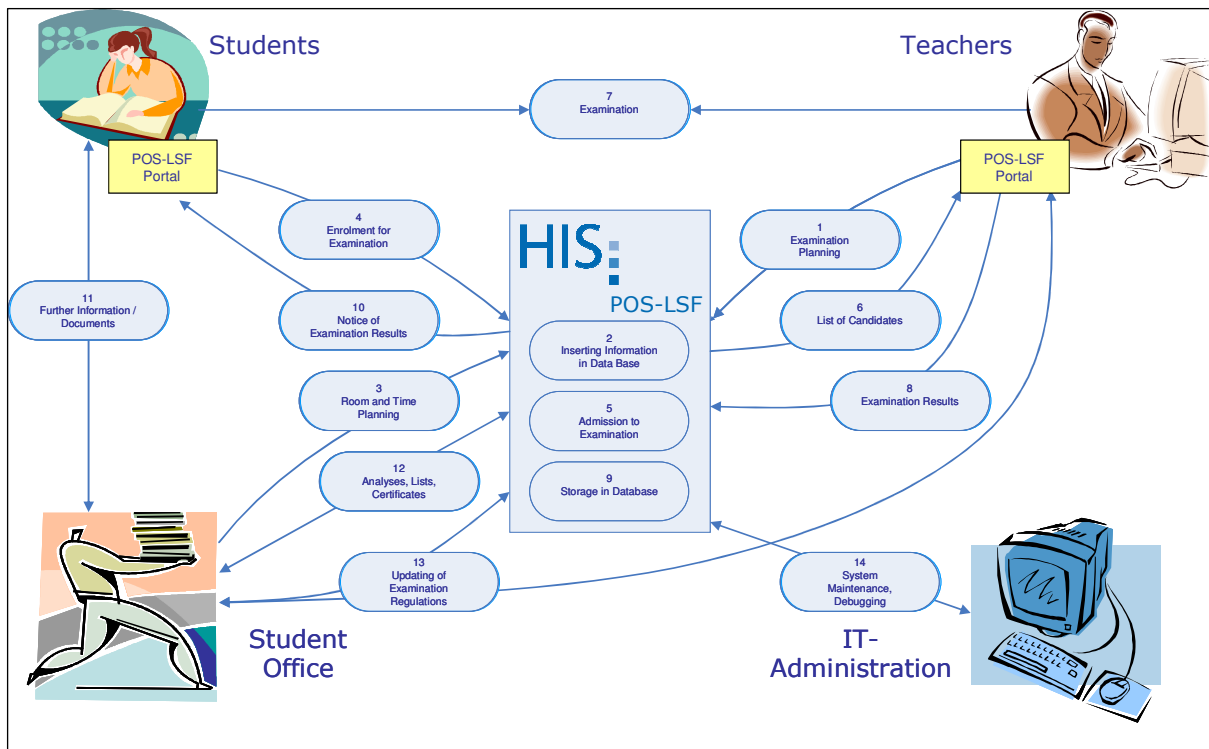

Figure 1: Examination with IT support and self service (workflow)

The complete examination process comprises the preparation phase of the examination including

- step 1: general examination planning
- step 2: recording of course and examination data
- step 3: carrying out time and room planning.

Enrolment and admission for the examination include

- step 4: student enrolment for examinations
- step 5: generation of registers for the exam registration
- step 6: verification of prerequisites for admission to examination.

The core part of the examination process chain is the examination itself (step 7).

Processing the examination results comprises

- step 8: assessment and recording of the examination results
- step 9: storage of data in the database.

Announcing the results means

- step 10: automated generation of mark information
- step 11: supplying additional information for examinees through administrators
- step 12: creating reports, lists and certificates.

Finally, there are several permanent tasks such as

- step 13: coordinating examination tasks between the examination office and the lecturers
- step 14: maintenance of relevant software systems.

At numerous German universities the standardised examination administration process as it is depicted above is being supported by the Internet-based examination and course management systems of the HIS Higher Education Information System GmbH.

2.3. The examination process chain as a change management task

The implementation of IT-supported examination processes entails organisational changes that are reaching far beyond mere technological aspects. The professional relation between administrative staff (student office and IT administration) on the one hand and scholars and students on the other is profoundly affected by the use of electronic administration processes since Internet-based self-service functions allow not only for the administrative staff to process data, but for students as well. Hence, the reorganisation of the examination administration provokes a change process affecting the university as a whole, and, as is generally known, changes frequently evoke opposition by the stakeholders involved.

However, there is a gain of efficiency that compensates for these organisational irritations. The general IT support of examinations disburdens the university administration from a multitude of manual operations. Numerous work steps that have been carried out redundantly before such as recording marks become obsolete. Furthermore, access to examination data is provided to all persons involved in the examination process according to a tiered model of roles and authorisations.

Further potential for facilitations of work originate from the emergence of computer-based, electronic examinations in higher education. The increasing number of learning management systems at universities has contributed to the popularity and acceptance of electronic assessment systems and on-screen exams. An effective combination and mutual exchange of data between the examination management software, and examination and assessment systems through standardised interfaces will allow for further simplifying the overall examination process in the future. Yet, even without a close linkage between such systems, stand-alone examination tools can reduce costs, and improve the quality and speed of the correction process.

3. COMPUTER-BASED EXAMINATIONS

First steps towards computer-based examinations at German universities were taken by e-learning pioneers who have developed cutting-edge examination tools since the late 1990s and have tested a wide range of different exam-related functions. Computer-based examination and test tools have been applied for different purposes, e.g. placement tests, entry-level tests (prognostic tests), self-assessment tests, regular written and oral examinations (selective and diagnostic examinations), and online surveys. Against all odds and substantial barriers, numerous benefits have created a growing interest in on-screen examinations at German universities at this stage.

3.1. Benefits and challenges

Today the development of electronic assessment tools and the use of electronic examinations have left behind their initial stage. Admittedly, many critical challenges had to be met on the way: the tremendous efforts that were necessary for the development of electronic exams or for the initial creation of a pool of questions through the lecturers, the insufficient familiarity of users with the new procedures, malfunctioning hardware components or operating systems or a failure in Internet access, legal security requirements that had to be met, insufficient flexibility of examination regulations or attempts at manipulation and fraud. Therefore, the development of a methodologically sound and juridically stable electronic exam scenario demanded overcoming many barriers.

Meanwhile a consolidation with regard to electronic examinations has been accomplished in many although not in all respects. Some of the potentially obstacles related to the transfer of examination procedures from a paper and pencil scenario into a computer-based environment are listed below:

- *Organisation of on-screen examination settings*: planning of simultaneous and of delayed exams, room planning with regard to PC pools and the number of available PC workstations, instruction of staff, establishing test centres, etc.

- *Conceptual design and methodology of exams*: design of examinations and planning of the exam process (generation of test item pools, designing exams along available question types, securing consistent levels of difficulty, etc.), computer-based preparation of the examination (conception and carrying out of practice exams and tests for the purpose of exercising, etc.)

- *Examination technology and tools*: guaranteeing an interference-free and fraud-protected examination process, considering test tool-based intolerance against orthographic or other minor mistakes in the automatic exam correction process, etc.

- *Judicial requirements*: setting up reliable authorisation procedures, guaranteeing a perennial verifiability of results, adding the new exam forms to formal curriculum and exams regulations, etc.

Electronic examinations lead to significant changes in almost all aspects of the organisation of examinations. Benefits and downsides will be reconsidered and weighed out against each other on the basis of the four dimensions of the electronic examination process depicted above.

A main reason for adopting electronic examinations is the possibility to process a significantly larger amount of examinations. Since the Bologna process has multiplied the number of tests that have to be arranged for during the semester, this possibility is of paramount importance for teachers and administrators. Examiners expect a reduction of workload regarding the preparation of exams and the correction process as well as considering administrative tasks such as the digital collection and announcement of examination results. Furthermore, potential sources of error are reduced: problems with the legibility of handwritten exam answers do not apply in the context of digital data processing. Even the administrative processing of exam results is facilitated since media breaks are avoided within a comprehensive electronic environment. Although only a fraction of exam questions is suited for an automatic correction (i.e. multiple choice, long menu etc.), and although some questions require manual (post-)correction through the examiner, the facilitation of exam corrections generally saves time and increases the correction quality even of complex questions through computer-based pre-correction procedures.

From the students' viewpoint, there are even more benefits of electronic examinations such as new forms of self-contained knowledge diagnostics represented by digital practice exams (for the purpose of exercising) and periodic course-accompanying electronic tests. Self-contained knowledge diagnostics can also be fostered through supplying exemplary solutions to students' incorrect exam answers. Moreover, the (partial) automatic correction of tests leads to an increase in objectivity of examination marks. Additionally, the notification on results immediately after the end of the exam is highly welcome among students as an effective means of feedback.

3.2. Features of electronic examination and testing tools

Many on-screen testing tools (Enlight Candidate, Dynamic Media eTesting, LTMS, NetTest, Questionmark Perception, Respondus, and exam functionalities of learning management systems such as ILIAS, moodle, Stud.IP, Clix, Blackboard etc.) offer a broad range of functions and modules from designing examination questions to data storage:

- 1) *Functions for designing examination and assessment questions* such as question and assessment authoring with authoring tools, supporting different question types (yes/no, right/wrong, multiple choice, matching questions, matrix tasks, Likert items, long-menu questions, questions with free-text fields, clozes, including calculated and algorithmic formats and graphics, audio, and video elements), question banking by learning objective, alternatively retrieving exams from e-learning platforms or downloading answer databases for quizzes or surveys, randomising presentation of questions and choices, adaptive branching based on how questions are answered, rapid creation of random sets of questions and assessments through an exam wizard, determining point values and exam settings offline

- 2) *Preview and publish functions* such as previewing questions before publishing them to the server, publish examinations, assessments, and surveys directly to one or multiple online courses (batch publishing)

- 3) *Organisational functions* and workflow management such as the administration of software licenses, interfaces for data import, exam participants, etc.

- 4) *Control functions for the exam and the exam setting* such as supervising the computer-based examination using a role-based security structure for multi-author environments, controlling the exam room, PC monitoring and recording keyboard activities, and

- 5) *Reporting and retrieval features* such as giving students instant exam and assessment feedback to enhance learning, on-demand results delivered to browser, PDA, CD-ROM, or paper, printing and scanning assessments, customizable reports and item analysis, print exams directly from the exam tool, or save files to standard software, retrieve custom reports (student scores, summary statistics, answer distributions etc.), archive and restore examination projects.

Naturally, these features do not apply to all available commercial or open-source software systems. Different exam tools offer different profiles and features, have different technical and system requirements and are characterised by different options of integration into existing IT hardware and software infrastructures.

3.3. Lessons learnt at German universities

Since the development and use of electronic examinations still is like entering virgin soil for numerous German universities, the experiences we have outlined above shall be summed up here and are complemented through several recommendations.

The implementation of electronic examinations comes along with a significant change of the whole academic examination culture. As was shown above, a sustainable success in implementing electronic tests depends upon the overcoming of infrastructural, technical, methodological, and juridical barriers (furnishing adequate PC pools, procurement of adequate software, successful integration into curricula, adaptation of examination regulations, etc.). Due to the increasing amount of examinations related to Bachelor and Master study programmes, the interest in holding examinations and electronic exams more efficiently will stay on the rise. The expected

rationalisation effects and the benefits of an immediate feedback make the use of this type of examination attractive for lecturers and students likewise.

Nevertheless, electronic examinations are not appropriate for all bodies of knowledge and scientific disciplines alike due to the limitations of an automatic correction of complex questions and exercises. Therefore, electronic examinations unfold their strengths primarily in assessing basic knowledge in Bachelor programmes (as well as in examinations with huge numbers of students). For regularly recurring examinations a pool of test items with different question formats is advisable. Such a test item pool should be created collaboratively by several lecturers that mutually assess the others' questions and continuously add new items. A selection of items can be taken from this question pool and can be used for separate exams. A further benefit of on-screen exam tools for students is based upon electronic practice exams and tests for self-contained forms of knowledge diagnostics. Moreover, the use of digital placement tests contributes to a rationalisation of the universities' admission processes through allowing for a better matching of students' capabilities on the one hand and study requirements on the other.

Above all, what is needed for a frictionless operation of the new study programmes in the wake of the Bologna process, for coming to terms with a rising number of examinations in some disciplines, for the sustainable reduction of redundancies in data management and for the replacement of dispensable work steps is a tight interlocking of all the different components, institutions and persons that are involved in the examination process chain. This entails a stronger interconnection of IT infrastructures, and particularly a more flexible data exchange between campus management systems, learning management systems, and examination tools.

In addition, the cultural change associated with the implementation of new administration workflows will be put into effect only if substantial reorganisation processes are tackled with foresight. Furthermore, solely academic and administrative staff being positive about the long-term improvements of turning away from highly fragmented traditional examination processes will actually benefit from the disburdening effects supplied by the new electronic examination tools.

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