EasyProtocol: Towards a Digital Tool to Support Educators in Oral Exams

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Abstract: Along with written examinations, oral exams are an important form of assessment in higher education, providing examiners with deep insight into student understanding. However, conducting oral exams often requires significantly more effort as there is the need to carefully record all noteworthy incidents and results for legal and formal requirements. To ease the work of examiners and observers while increasing the validity and reliability of this type of assessment, a digital support software is proposed. This paper describes the design process of such a digital tool to support the implementation and note taking of oral exams, taking into account legal requirements, current oral examination practices, and the needs of both examiners and observers based on interviews and existing literature. The results were used to derive a concept and to implement a proof-of-concept prototype, which was positively validated in a small interview study. Features include automatic time recording and a guided, structured but flexible data collection (i. e. clickable items and free-text fields) and currently focus primarily on supporting observers. Further ideas regarding assessment analytics using the data are discussed.

1 INTRODUCTION

Examinations are an essential part of education as a summative assessment of learning outcomes (Kirkwood and Price, 2008). The goal of these assessments is to evaluate the learners' knowledge, understanding, skills, or competencies of/in a subject. In higher education, there are a variety of assessment formats, including paper-based tests, written exams, student assignments (e. g., portfolios, essays), or oral assessments (e. g., presentations, oral exams).

Different assessment formats have individual advantages and challenges, such as scalability and the time required for their preparation and execution. In general, administering examinations requires a significant amount of time and effort from educators. Early on, institutions and examiners used existing technologies such as learning management systems (LMS), scannable exams[1] or self-developed tools to (semi-)automatically grade submissions and reduce their workload – especially in large classes with several hundred students (Strickroth and Bry, 2022). Nowadays many generic commercial products such as LPLUS, EvaExam, or RISR are available to manage and deliver assessments in all phases from their creation to grading, and archiving.[2] Usually, e-assessment systems only support written exams and are therefore less useful for assessments formats such as oral exams (Memon et al., 2010). Oral exams (also known as *oral examination/assessment*, or *viva voce*, cf. Pearce and Lee, 2009) can be defined as an assessment in which the response is expressed verbally rather than in written form (Joughin, 1998). The main benefit of oral exams is to assess students' deep and conceptual understanding of knowledge (Gharibyan, 2005; Dicks et al., 2012; Huxham et al., 2012). Here, the examiner (typically an educator or teacher) conducts the oral exam, asking questions and evaluating the student's responses, while an observer (referred to as "Beisitzer" in German) documents the process, and ensures that all relevant events and interactions are recorded. Note-taking is mandatory for legal reasons and must be recorded in a *log* of the exam (in German "Prüfungsprotokoll"). This log can be compared to meeting minutes and contains formal information (e. g., date, start and end times, involved persons, results), but also relevant events during the exam (e. g., interruptions). In the context of oral exams, technological approaches to support teaching staff are rare.

Oral examinations have a different character compared to written exams: Although both are summative

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[1] e. g., https://www.auto-multiple-choice.net/

[2] https://lplus.de/en/; https://evasys.de/en/; https://risr.global/, last accessed: 2024-12-11

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formats that assess student knowledge, written exams are static and usually use the same set of questions for each participant. Hence, written exams can be used to assess large number of students simultaneously, and automated grading tools (e. g., for multiple-choice questions) can be used to ensure efficiency and objectivity. In contrast, oral exams provide a more interactive and dynamic assessment for individual (or small groups of) students, allowing the examiner to spontaneously choose questions and also the student to ask questions (e. g., in case of misunderstandings). This approach also assesses soft skills such as communication, confidence, and presentation. Even with rubrics in place, the scoring can involve subjective judgment. Thus, an oral exam requires a significant amount of examiner time per candidate due to the sequential nature of the exam sessions. By emphasizing reasoning and engaging in real-time discussions for example through follow-up questions for clarification, examiners can gain deeper insight into students' comprehension that go beyond the mere recall of content. This makes structured assessment and objective grading more difficult than in written exams. In addition, due to the rather unstructured oral examination logs, assessment analytics approaches are not used.

With the recent advent of (generative) AI, oral exams are "rediscovered" and used more frequently as an alternative to asynchronous written formats to prevent student misconduct (Nallaya et al., 2024). This underscores that there is an actual need for a support tool for this type of exam, especially for the mandatory writing of a log.

The goal of this paper is to explore the requirements for a support system for oral examinations and to propose a concept and a prototype. This research was primarily conducted in the context of science, technology, engineering, and mathematics (STEM)/Computer Science in German universities. This paper answers the following research questions:

- RQ1. What are typical activities and roles of examiners and observers during an oral exam?
- RQ2. What are the formal and functional requirements for a system to support examiners and observers in oral exams and what might a concept look like?
- RQ3. How is the developed prototype perceived by examiners and observers?

The key contributions of the paper are a concept for a support tool with a focus on observers for oral exams based on interviews and legal requirements from literature, and a proof-of-concept prototype.

2 BACKGROUND AND RELATED RESEARCH

This section presents the theoretical background and related research on phases of examinations, the oral assessment format, and existing support systems.

2.1 Phases of Examinations

Overall, examinations encompass three phases (cf. Mu and Marquis, 2023): pre-exam *preparation*, *execution*, and *post-exam/review*.

Besides purely administrative parts (e. g., managing student registrations, assigning students to rooms and appointments), the *preparation* phase for teaching staff includes developing assignments/tasks/questions and putting them together for a specific exam. Frameworks such as Bloom's taxonomy (Krathwohl, 2002) can be used to categorize learning objectives, align the content of the exam with them, and estimate the difficulty of the exam. The *execution* of an exam may involve the teaching staff to be present (e. g., as invigilator or examiner). This phase also includes the grading of the exam. Typically, rubrics are used for an efficient and objective evaluation. In the *review* phase, the examiner reviews and evaluates the overall assessment, i. e. to analyzes the quality of the questions for example by calculating their actual difficulty or item discrimination. This phase is often skipped for paper-based and oral exams.

2.2 Oral Exams

The main characteristic of an oral exam is the verbally expressed answer, which makes this assessment type complex (Memon et al., 2010). This assessment format has the potential to generate many unique learning benefits, including authentic assessments (Nallaya et al., 2024), positive effects on underrepresented groups (Reckinger and Reckinger, 2022) and increased motivation in the subject (Delson et al., 2022). Oral assessments are widely used in various disciplines, such as business courses (Markulis and Strang, 2008), medical professions (Memon et al., 2010) and social sciences (Hazen, 2020), both nationally and internationally (Akimov and Malin, 2020).

In their review, Mu and Marquis (2023) discuss and analyze the effectiveness of oral exams in terms of their historical development. This includes the identification of key advantages such as fostering communication skills and deeper understanding (cf. Dicks et al., 2012; Huxham et al., 2012) due to their interactive and adaptive nature. Typical challenges relate to their validity, reliability and fairness, which are also discussed

in other publications (e. g., Joughin, 1998; Kang et al., 2019; Memon et al., 2010). However, none of the reviewed literature has systematically investigated these aspects of oral exams. Nonetheless, several conditions and ideas are proposed to address these aspects such as a specific training for examiners, using standardized questions for each student, and evaluating with rubrics that provide explicit criteria, or post-exam analysis with statistical methods (cf. Memon et al., 2010; Mu and Marquis, 2023). However, the authors omitted details on how this can be effectively implemented for oral exams. Especially the absence of standardized evaluation methods and long-term quality assurance creates vulnerability to unfair discrimination (Heppner et al., 2022).

A practical approach taking on the known issues are *structured oral exams* as used in medical and nursing education (cf. Abuzied and Nabag, 2023). Structured oral exams represent a balanced compromise between reliability, validity, and the required effort. These approaches typically use sophisticated templates to simplify the tasks of examiners and observers, providing a basic structure that has been proven to result in highly objective and valid examinations (Westhoff and Hagemeister, 2014). Ohmann (2019) provides a rubric for on-the-fly grading. However, these structured approaches limit the examiner's freedom to explore the students' understanding beyond the pre-defined topics (cf. Ohmann, 2019).

A focus of current research seems to be on students' perception (e. g., stress levels or anxiety, cf. Baghdadchi et al., 2022) rather than roles and tasks of examiners and observers. Guidelines are typically proposed to support teaching staff on conducting oral exams (Mu and Marquis, 2023; Burke-Smalley, 2014).

To train students to cope with the stress of oral exams, there is research using AI to simulate oral exams to familiarize students with the situation, reduce stress, and provide feedback.[3] This is, however, out of scope for this research.

2.3 Support and e-Assessment Systems

Many support systems are available that support specific or multiple phases of the examination process. Campus and learning management systems are often used for exam registration and reporting of grades.

As mentioned in the introduction, there is a plethora of (commercial) systems for conducting written exams. These usually support all phases. Also, LMS such as Moodle are often used to set up exams using quiz plug-ins, conduct, and finally review them (e. g., Strickroth and Kiy, 2020). Typically, systems used in summative assessments automatically log all student activity to protect against appeals and can automatically assess specific item types such as multiple-choice items. Additionally, specialized e-assessment systems for exams have been developed in a research context to facilitate an efficient process in specific domains such as programming education with full or semi-automatic grading (cf. Strickroth and Striewe, 2022; Strickroth and Holzinger, 2022). However, these systems do not provide specific support for oral exams.

Many systems allow the quality of an exam and its assessment items to be analyzed in terms of difficulty and item discrimination. This allows to identify suboptimal questions in the review phase. The analysis of data that is generated during an assessment/exam is often referred to as *Assessment Analytics* (cf. Ellis, 2013) and can be seen as a subfield of learning analytics (cf. Siemens et al., 2013). Assessment Analytics may also include an analysis of the time spent on specific questions or number of skips to identify patterns, predictive modeling to anticipate student performance, or data visualization to present assessment results in a more accessible and understandable way. As a result, the analysis can provide insight into the learning process and inform future instructional strategies. While these approaches can provide deeper insights, they are typically not applicable to oral examinations, because the data (i. e., the logs) are not available in a structured, digital, machine-readable format.

To support oral exams, Ally (2024) proposed a tool for scheduling oral exams and automatically assigning a random examiner to a student. In addition, their software randomly assembles questions (and model solutions) from a database and provides a digital rubric with score boxes for dimensions such as communication skills, understanding, confidence, fluency, and accuracy. There are no freedoms for the examiner and no deeper dialog in the exam. Also noteworthy is an approach of Bayley et al. (2024), who used a quiz module of an LMS to conduct a synchronous "oral" examination with about 600 students. In their scenario, there was a fixed time slot in which students could answer a set of prepared, static questions by recording and uploading a video using the LMS. Limitations are, however, that there is no dialog in the exam, all recorded videos have to be viewed and graded manually, and there is no cheating prevention.

Apart from assessment systems, there have been recent advances in automatic speech-to-text transcription such as OpenAI Whisper. These approaches can significantly reduce the effort required to create the log, however, there are still significant challenges such as missing context and meaning, consideration

[3] https://www.uni-bayreuth.de/en/press-release/exam-simulator, 2025-02-11

of non-verbal communication, and quality or accuracy (Wollin-Giering et al., 2024; Kuhn et al., 2023). As a result, careful review and manual editing is often required to ensure a high level of quality. In addition, an audio/video recording may not be possible for legal or ethical reasons.

In summary, there is a research gap for a support system for oral examinations that assists examiners and observers. In particular, a structured recording of student performance can assist (novice) observers in creating good logs and may open up new possibilities for assessment analytics in oral exams.

3 METHODOLOGY

To answer the RQs and to inform the concept of a support tool, a requirement analysis using interviews and a literature review on examination law as well as exam regulations (in Germany) was conducted. The interviews were semi-structured and held during January, 22nd and March, 15th 2024. Overall, 17 persons participated (observers and examiners) in the interviews from seven different universities in Germany. The interview partners included ten professors (8 male, 2 female) with a lot of experience in conducting oral exams (4 to 20 years) and seven teaching assistants/PhD students with up to three years of experience. Ten of the interviews were conducted online and seven in person. Please note that all examiners have been in the role of observers themselves during their academic careers. Thus, they also took the observer's perspective in the interviews. Most of the interviewees ($N = 11$) have a background in Computer Science and other STEM fields, but also academic staff from educational sciences and language studies participated.

The interviews included questions about the typical process of an oral examination and general aspects such as the structure. A special focus was put on the preparation, execution, and review phases of this type of exam. Furthermore, the participants were asked to bring their templates and/or authentic, anonymized sample logs of oral examinations. The interviews were analyzed qualitatively using Mayring's thematic analysis method (Mayring, 2014).

Since no comparable support software exists, a Figma[4] design prototype was prepared based on first ideas and experiences from the authors (cf. Figure 1). This prototype was shown at the end of the interview to obtain feedback and suggestions for improvements. The reason for this was to allow participants who had no idea what a prototype might look like to give feedback, but at the same time not to influence participants by showing them a prototype too early. The design prototype included all relevant steps an examiner or observer would take (e. g., adding exams, questions) before, during and after an exam. Figure 1 shows the observer interface of the design prototype. On the left hand side, there is a navigation bar for quick access. The main parts (from left to right) are the selection of a question based on a topic and the options to record a new question and/or the student's answers. The answers can be recorded either by clicking on buttons for pre-defined answers or by writing them into a text field. There are additional buttons to select pre-defined notes, to count the number of hints/tips given, and to rate the answer using simple plus and minus buttons. A timer indicating the duration of the exam is displayed at the bottom, and the exam can be ended by clicking the "End" button.

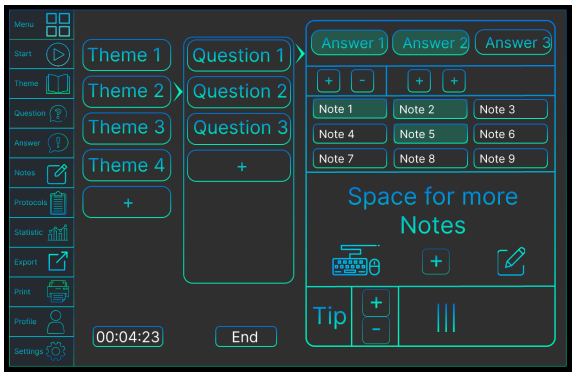


Figure 1: Example from the Figma user interface design prototype for the oral examination log support screen.

4 REQUIREMENT ANALYSIS

This sections presents the results of the interviews and the literature review on legal regulations/requirements.

4.1 Interviews

Understanding the current practices of examiners and observers is necessary to identify their requirements. In addition, the interviewees were given the opportunity to comment on an initial design to come up with additional ideas to accelerate the prototyping process.

4.1.1 Generals Aspects of Oral Examinations and Their Recording

The first aspect discussed in the interviews was the general structure of an oral examination – the situation where the student is assessed by the examiner and an

[4]https://www.figma.com, last accessed: 2024-12-01

observer is also present. This section provides some general information about oral exams, introduces the roles, and explains how the exam is generally recorded.

Overall, the interviews revealed that the structure of an oral examination in practice follows general rules, although the characteristics are more "free and dynamic" as described by the interviewees. Each examiner has their own examination style in terms of how they handle and react to incorrect answers, the order and way in which questions are asked, and also grading. Typically, examiners use a catalog of questions or have a list of important, recurring questions (either on paper or at least in mind), and expect certain keywords in the answer. However, the overall understanding of the content/concepts taught and their internal relationships/structure are often more important than the use of technical language. Thus, even without the use of formal language and terms, most examiners will accept the answers as correct. Although the oral assessment is a summative examination, some examiners enjoy having a professional discussion/dialogue with students.

The main task of the observer (typically a teaching assistant of the examiner) is to take notes on the course of the exam for log purposes. The way in which the log is written also varies among assistants, depending on their condition, experience, and individual approach to the examination process. The log is often written on a sheet of paper or a laptop is used with a standard office program and then printed afterwards. While some observers record each question and answer in detail to allow for detailed grading, others barely take any notes, only write down the questions and mark the quality of an answer with plus and minus symbols, note whether hints were given, or start writing only when the answer is too different from the expected solution. Shortcuts and abbreviations are often used to efficiently keep up with the oral exam. Furthermore, all relevant events are noted such as interruptions. At a minimum, the date, the student's metadata, the names of the people involved, the start and end times, and the final grade are noted. Finally, the log is signed by the examiner and the observer. Information about what the log should look like is often passed from the examiner in charge to their observer. Typically, the examiners received this information in the same way when they were in the role of the observer.

Many interviewees report using templates to guide and structure the collection of basic information for the oral examination log. These templates are rarely provided by the university/institution. As a result, most interviewees have created an individual template on their own. Three examiners brought a sample log of an oral exam. Overall, these logs are very different in details, content, and format. Details are discussed in Section 4.3.

4.1.2 Descriptions of the Examination Phases

This section provides more detailed descriptions of the process from preparation to execution to review.

The interviews show that the *preparation* for oral examinations is different for both examiners and observers. In general, there is the *generic* and *specific* preparation. Generic preparation refers to the gathering of materials and possible questions as well as taking notes on key topics of a lecture in advance of any oral examination. This is often done only once per module before the first examination and is reused for reincarnations of the same module. Prior to a specific oral examination or a group of examinations on a particular day, the examiners may do minimal preparation, often relying on their existing notes and their experience from previous examinations. Over time, most educators come to rely more on their gained experience and/or notes. There are examiners who reported that they have created question sets with questions classified by topic and Bloom's taxonomy. There is usually no (special) preparation for the observers. Typically, they are already familiar with both the examiner and the subject, so additional instructions are unnecessary. More experienced observers may already know the questions and exam structure from previous examinations. Not all examiners, however, provide new observers with specific guidelines or the expected structure of the exam. Overall, there may also be other people or systems involved, where the students can register for an exam.

In the following the results of the interviews regarding the *execution of an oral examination* is described. Most often, the oral exams are conducted as semi-structured assessments, which use a mixture of questions from a catalog and follow-up questions based on given answers. An archetypal structure of this exam variation might have the following procedure: The examination usually starts with a health check question to ensure the participant is fit for the oral exam, checking the identity, and preparing the log by writing down the meta data resp. administrative and academic data (i. e., name, date, subject). Then, the examiner starts with the oral assessment. Examiners often start with an easier or broader question, which leads to follow-up questions on the same topic, clarification of details, asking for examples or moving on to the next topic. There are also examiners who allow students to start with a short report on a topic of their choice. It is also possible for the candidate to draw sketches or to write something on paper or a black/white board. Meanwhile the observer takes

notes on every part of the exam. These steps are repeated until the scheduled time for the exam is up, or the examiner is confident of a grade and ends the exam early. Then, the examiner asks the candidate to leave the room so that the student's performance can be discussed and a grade assigned. For this part, the log is often used to revisit the course of the exam. There may also be updates and the addition of missing parts of questions or answers. After a grade is assigned, the student is invited back into the room. The examiner recalls the performance and also announces the grade. Finally, the log is signed and sent to the examination office – candidate's sketches are not always included. There are also variants such as fully structured (using only prepared questions in a certain order) or fully open (using no prepared or recurring questions) exams. Exams may also contain short presentations (like in thesis defenses or in a seminar).

Regarding a *review* of the oral examinations, the interviews show that, similar to the preparation, there are two different types of reviews. On the one hand, some interviewees reported that they have short daily or weekly debriefings to refine upcoming examinations. However, this review sometimes is omitted due to the limited time resources. On the other hand, interviewees reported that at the end of a semester after a full examination period, examiners rarely review past oral examinations. In general, the observer is not involved in the review after an examination phase.

Finally, ideas and requirements for a support tool were discussed using the created Figma user interface prototype.

4.1.3 Feedback on the Figma Prototype

Most of the interviewees had no specific idea of what a support tool for oral exams could look like at the beginning. Although, the majority of participants liked the idea for a support tool and could imagine to use such a tool. However, it was not seen as optimal for the open, unstructured variants of oral examinations. There was also one participant who initially thought that such a tool is not possible at all.

The feedback shows that some changes were requested to the intended structure of the user interface. Overall, the interviewees preferred a hierarchical structure, where all lectures are presented first and after selecting one, all specific activities/options are available. In this way, the software is assumed to be more efficient than with the initial design idea. In addition, the user can directly start taking notes without having to fill in the lecture information. Other comments relate to the layout, which was found to be inefficient. The buttons for selecting topics and questions (cf. Figure 1) take up a lot of spacey and yet the space for button labels (especially for questions) may be too small to display the content properly. Adding new questions during an exam should be easier and the text field should not be hidden "behind" a plus button. The buttons for assigning pre-defined notes should be organized into categories such as keywords, process, or ratings for a better overview. This also includes the tips or hints counter, which needs to be more precise to add value to the examiner. Furthermore, help provided by the examiner can take various forms such as explaining a specific keyword, rephrasing a question, or moving a question back. Finally, there were comments on minor adjustments such the use of clear and familiar descriptions, terms, and icons to increase the readability and usability of the software.

In addition, the interviewees provided new ideas and suggested features such as an integration with other systems (providing an interface to the exam office or to existing platforms such as the used LMS), customization options (to meet individual needs of the stakeholders or to provide special options for other oral assessment types such as thesis defenses), import/export functions (to import questions, literature, slides, and other materials, or to analyze results outside of the tool), assistance and recommendation features (to order questions e. g. by usage frequency or to evaluate based on historic exams), and adding notes or comments (e. g. to record details/impression about the answers like fluency and presentation skills). Among other suggestions, options were proposed to compare individual exam logs either with a model solution, historic logs or among different students (with similar questions/answers/grades). Some participants suggested to upgrade the prototype to a fully-fledged examination system by integrating features to organize the examination appointments and archive the logs afterwards. This would enable to completely organize the examination within one tool.

4.2 Legal Regulations/Requirements

The following legal regulations/requirements are subject to Germany. German examination law requires to keep a record of the execution of an oral assessment in written format due to its highly dynamic nature (Hartmer and Detmer, 2022). Therefore, an observer, who is present in addition to an examiner, takes notes to document the progress of the oral examination in a log of the exam. The observer should also be an expert in the field ("sachkundiger Beisitzer" in German, cf. Fischer, 2022), is explicitly not a second examiner and may give advice to the examiner, but may not influence the final result of the exam (Fischer, 2022). At least, the observer and the student must be in the same room

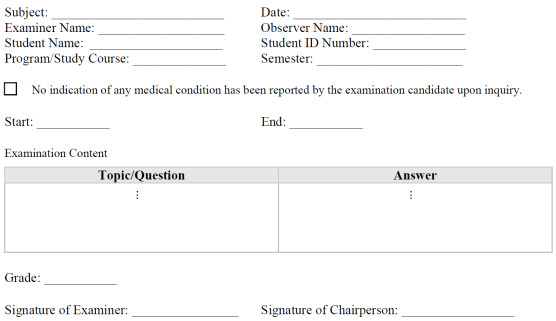
to prevent cheating – fully decentralized remote oral examinations are not allowed.

The log requirement ensures transparency and accountability of the entire assessment process by providing a record of what happened during the examination. By documenting all noteworthy events, universities can address any potential disputes about assessment results. Typically, a log should include information about the people involved, the exam tasks/questions, the exam's duration, all noteworthy incidents such as unintended breaks (e. g., noise pollution), and major events of the examination with their outcomes to recapitulate the oral exam (Fischer, 2022). In addition, information about the health condition of the examinee before the start of the exam needs to be recorded as well as deterioration in their condition. Unlike a court record, a verbatim (or complete) transcript is not necessary. Thus, without a template, the observer has a certain degree of freedom as to the content or details of the log and how it is written. Finally, the log must be physically signed by the examiner and the observer to certify its accuracy.

Some jurisdictions may require or allow audio and/or video recording of an exam, but this is not allowed in Germany (Fischer, 2022): On the one hand, recordings may miss deeper levels of the examination process, and student consent is required for privacy reasons (cf. General Data Protection Regulation, GDPR). On the other hand, there is a risk of adapting the oral exam to the recording system, which could negatively affect the atmosphere of the exam, increase the stress for the student, or reduce the validity of an oral exam. Therefore, a manual logging is necessary.

4.3 Typical Log Template

Three examiners brought a sample log of an oral exam and four templates were provided. Overall, these logs and templates are very different in details, content, and format. Therefore, these were used to compile a generic, common version (cf. Figure 2).


Subject: _____ Date: _____
Examiner Name: _____ Observer Name: _____
Student Name: _____ Student ID Number: _____
Program/Study Course: _____ Semester: _____

☐ No indication of any medical condition has been reported by the examination candidate upon inquiry.

Start: _____ End: _____

Examination Content

Topic/Question	Answer
⋮	⋮

Grade: _____

Signature of Examiner: _____ Signature of Chairperson: _____

Figure 2: Derived generic log template.

Each log and template contains essential information about the admission and academic data (e. g., subject, date, start and end times, and names of student, examiner and observer) at the top. This is supplemented by additional data such as the student's matriculation number and major, and the answer to the health question. The body of the log contains the questions and optional answers in vertical form. Finally, at the bottom of the common template, there is space for the grade and signature lines for the examiner and the observer. A support tool should be able to mimic this template.

5 CONCEPT

Based on the results from the previous section, a concept for a support tool for oral examination was derived. This concept follows the archetypic structure of a semi-structured oral exam for individual students to support examiners and observers. The tool should support in all three phases of exams. Therefore, for the preparation phase, it needs to support entering questions into a database and possibly classifying those into topics of a module and Bloom's taxonomy. Additionally, possible keywords may be entered that are expected in students' answers. Import options to include other material such as lecture slides or literature can assist the examiner prepare.

The main focus of this concept is to facilitate the most laborious task during the execution phase of the exam, which is the creation of the log by the observer. To guide this process, the tool concept provides a structured approach. Prior to the exam's start, an identity check of the student and a health check question are required. As a basic feature, a template with the relevant admission and academic data (e. g., module, names of the student, the examiner and the observer) is provided as a form that ensures all information are entered for a formally correct and accurate log. If any information is missing, the tool will prompt the observer to enter the relevant data to finish the preparation of the log. In addition, a mandatory check-box for the health check serves as a reminder to ensure the student is fit for the exam and the answer to this question is recorded. While the observer has to enter this data manually, the recoding of the time (date, start and end times) can be recorded automatically.

The exam starts with an initial question or task from the examiner. The observer's main task is now to write down the questions and possibly the corresponding answers, as well as notable events and details. The concept provides flexible options for entering the questions, either as free text or by selecting questions

stored in a database. A combination of the two should also be possible to add details or small variations to existing questions. Newly entered questions should optionally be stored in the database annotated with a topic for future reuse. The observer can enter the student's answers simply as a free text or by clicking on pre-defined keywords mentioned by the student that correspond to the question and are also stored in a database. A combination of the two should also be possible to elaborate or comment on the student's answers. The time taken by the student to answer a question is automatically recorded when the observer clicks a button to proceed to the next question. Other recurring details about students' answers or notes about the process are typically recorded using abbreviations or symbols. For this part, various buttons can be set up for quick access such as specific recurring process notes such as postponing or skipping a question. In addition, assistance or details provided by the examiner during the exam such as hints can also be recorded by clicking buttons. This flexible approach using buttons also allows quick recording of further details, which are relevant to individual examiners for grading. For example, various options for evaluating the answer from simple correct/incorrect to points or plus/minus scales. This process of asking questions and answering is repeated until the examiner ends the examination. During the exam a support tool should always display the total time elapsed. At the end of the exam, a clear log should be provided to support the evaluation. The log can be used to recap the exam, to discuss unclear responses, and to grade the student's performance. To finish the exam, a grade must be entered. In addition, it should be possible to add general notes about the exam to comment on details, or to add student (written) notes or sketches to complete the log. All this information should be stored in a database. Finally, the log needs to be printed, signed, and sent to the examination office. If an API exists, the grade may also be submitted electronically.

For the review phase, the tool should provide analysis features on the data stored on the oral exams and questions. For example, the average grade or distribution of grades (within an examination phase), comparison of different oral exams (including historical ones), descriptive statistics, and statistical measures of validity or reliability. Filtering options to summarize the results for a specific time frame e. g. daily or weekly can provide feedback to the examiner. Since all question-answer items are recorded individually, each item can be reviewed in detail, for example to compare among different participants the average time needed to answer, number of questions, skips, and also the grading. An overview of the assessment results of different students with similar content can help the examiner to decide how to grade. Furthermore, it is possible to calculate the difficulty and discriminative power of questions which allows for long-term quality optimization (of the exams and also the lectures).

There are many possible extensions to the concept such as a separate view for the examiner where they have access to all notes and stored questions (incl. statistics such as difficulty, usage frequencies, or last usage) independent to the observer during the exam. Also if an API exists, student registrations may be imported and/or academic data may be automatically read from student ID cards and inserted into the form.

Overall, the concept of the support tool provides benefits to all three phases of oral exams, the preparation, execution, and post exam review. The log's structured data which is available in a machine-readable format, allows for a variety of ways to present and analyze the information. In addition, a tool should have a modular and configurable structure to meet the needs of different types of oral exams and the individual preferences of examiners and observers.

5.1 Implementation of a Prototype

Based on the interviews and the derived concept, an exploratory prototype was implemented as a proof-of-concept (Jebing et al., 2024). As there are so many possible features, the main focus of the implemented prototype is to support the creation of the log by the observer, yet the prototype was designed to cover many of the mentioned features in one tool.

The prototype has been implemented as a client-server architecture using web technologies (Angular for the front-end, Node.js for the back-end using a REST API, and MongoDB as the database), but at this stage the prototype is intended to run on the observer's computer (e. g., on an USB key) – there is no permissions and user/role management included, yet.

The prototype (cf. Figure 3) uses the space more efficient (compare to Figure 1) and implements the following key features: Exams are organized in a hierarchy under the corresponding modules. When an examination is started, academic and administrative data are collected as described in the concept, also the health check and recording of the start time is implemented this way. The recording of questions is mainly implemented as a large free-text field, but there are also buttons for quick access to typical questions (also organized in a hierarchy below their topics; left hand side of Figure 3). These question can be added to the database in advance or during an exam. The text field also allows for easy additions and small changes to the selected question. The duration of each answer

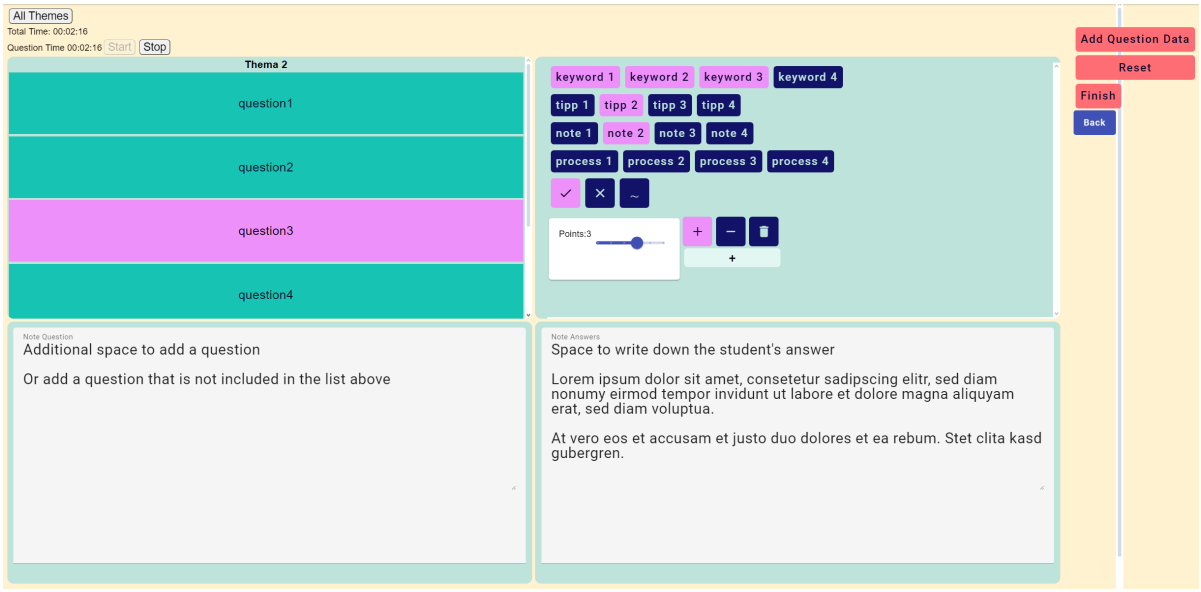


Figure 3: User interface of the input mask of the prototype filled in during an oral examination with sample entries.

is recorded automatically when a question is selected or a question is entered into the text field. A timer at the top left displays the elapsed time and can be paused. The students' answer can be recorded using the controls on the right hand side by either selecting relevant keywords (currently only placeholders) or by typing notes into a free-text field – also a combination of the two is possible. In addition, various buttons are prepared to capture details on the process such as counting the number of provided hints, skipping a question and rating the answer (correct/incorrect/ sill acceptable, point scale and plus/minus symbols). Figure 3 shows all currently hardcoded buttons that can be displayed/hidden individually. After a student answered a question or a question is skipped, the "Add Question Data" must be clicked to proceed to the next question. Finally, the "Finish" button is clicked, which generates a "traditional" log in HTML. This can then be used to revisit the exam and can be exported as a PDF or printed using the browser without the need to render HTML to a PDF itself. All (meta) data is stored in the database.

6 EVALUATION OF THE PROTOTYPE

The prototype was evaluated in two settings. First, using short, unstructured interviews with three of the former interview partners in June, 2024. After a brief introduction, the prototype was presented and participants' questions and comments were addressed and recorded. Two of the interviews were conducted in person, allowing for on-site testing of the prototype. The main goal was to get feedback on functionality, design and usability aspects. The main results show that the functionality of the tool fulfills the expectations of the interviewees. The design and layout was found adequate for the task, although some features were (again) mentioned to improve the current version of the prototype such as import features for questions and lecture materials, features to collect and summarize free-text questions, and options to add details to questions such as comments from the examiner or a classification based on Bloom's taxonomy. To increase "quality of life" elements, one participant requested more options to customize the interface (e. g., to toggle features).

Overall, there was a high interest in an updated and extended version of the tool and actually being able to use it, even though it is still work in progress and has some minor bugs.

Second, the prototype was presented as a demo at the educational technology conference DELFI in Germany to discuss the idea (Jebing et al., 2024). Several researchers, professors, and academic staff provided feedback on the current version. A major result from the conversations is the need for a configurable tool that can be tailored to the own examination style and/or variations of oral examinations. Possible customizations may be based on the subject (e. g., language studies may need different features) as well as the necessary support (e. g., novice examiner or observers get a different view than experienced teams, some features are only enabled for specific oral assessments types such as thesis defenses).

7 DISCUSSION

The ways how oral exams are conducted are very diverse (RQ1). This is in line with related research (cf. Gharibyan, 2005; Ohmann, 2019) and the archetypic structure distilled from the interviews has also been reported in a similar way in other research (Willert, 2018). There also is a great variation in the way the logs are created. However, the interviews show that legally required parts of exams (e. g., the health check question) are not always conducted.

The preparation of the Figma prototype turned out to be very beneficial as most of the interviewees had no specific idea of what a support tool for oral exams could look like. Hence, these interviewees could directly comment on the provided example and provide helpful insights and ideas. Many innovative ideas for a support tool were mentioned in the interviews. While some of the interviewees showed interest in getting recommendations for questions or suggestions for grades, it was always emphasized that the human examiner must always have full control and the final decision. This again underlines the freedom which was also mentioned by Ohmann (2019).

The main idea of the support tool concept is to support the examiners and observers to reduce their workload and to provide them with analysis features and feedback (RQ2). In literature, there were different approaches proposed to make the examiner interchangeable, e. g. by enforcing a fully structured oral exam, dictating specific questions and a strict grading rubric. Although this may help to overcome the issues of validity and reliability, these approaches are likely to limit the freedom of the examiner and the advantages of oral exams to dig deeper into student understanding (cf. Ohmann, 2019). Therefore, different support measures are required compared to existing approaches. Still, related literature emphasizes the need for quality assurance (Pearce and Lee, 2009). Therefore, analysis features for reviewing exams are an integral part of the concept. Furthermore, there is usually no (formal) training for examiners and observers. The knowledge of how to create the log is often passed on from the examiner to the observer just before an exam, and the examiner got their knowledge in the same way. Hence, special support for novices is needed. In particular, the form proposed in the concept and integrating mandatory steps may help unexperienced observers to create high quality logs.

The developed prototype so far focuses on supporting the observer and only implements essential features (RQ3). The prototype has to compete with log creation in standard office programs and also with handwriting on paper, where special symbols can be easily added. Probably the prototype will be comparable or outperform standard office programs based on the provided shortcuts. Still, the special, innovative features may provide significant advantages over the other two approaches currently used in practice. An evaluation in an authentic exam setting has not yet been possible, because of the sensitivity of these scenarios, which pose high demands on a prototype, and because it is not easy to find examiners for mock oral exams. Nevertheless, it was well received in the two evaluations. Therefore, the proposed concept serves as a good basis for the many features that still need to be implemented for a ready-to-use product.

Overall, the potential benefits of analyzing the log data is still uncovered. The interviewees rarely came up with ideas to use the results or how (assessment) analytics could be beneficial to improve this type of assessment. This indicates a potential gap and allows for possible improvements in future research.

8 LIMITATIONS

The concept is primarily based on the interviews and their qualitative analysis. Therefore, the inherent limitations of qualitative research must be acknowledged.

The reports of the current practice of oral exam are based on experiences of the examiners and observers. Here, two limitations need to be considered. First, the interview study included 17 persons from German higher education institutions, mainly from STEM fields. Therefore, the results may be biased towards national or domain specific aspects. However, the interview included people with different backgrounds such as language studies and educational sciences, which broadened the view and led to additional ideas and features. There was also a saturation of different ideas and oral examination processes. To meet field specific requirements, experts in these fields would need to be consulted. Second, the discussed legal regulations/requirements are subject to Germany. Different countries and/or universities may have different regulations. Still, there are likely many similarities that can be made configurable in the prototype. For example, voice recording, transcription, and automatic summarization may be optional and/or only available with explicit student consent. It is assumed that this fact does not limit generalizability.

The final evaluation of the concept had a small number of participants. Note here, that in practice, just five users are enough to identify the most serious usability problems (cf. Nielsen and Landauer, 1993; Lindgaard and Chattratichart, 2007). The final version also needs to be evaluated in authentic exams.

9 CONCLUSION AND FUTURE WORK

This paper presents the concept development of a support tool for oral exams. Based on a requirements analysis by interviewing examiners and observers requirements were collected. An initial design prototype was developed to streamline the concept development process. Based on the results, a concept has been developed that considers all phases of the exam (preparation, execution, and review) and focuses on the execution phase to support observers in STEM exams, but can probably also be used in and extended to other disciplines with little effort. Based on the concept a proof-of-concept prototype was implemented and evaluated. The results indicate that the concept is generally well received, does not lack significant features, and is a good basis for further research.

There are many possible extensions to the concept that have been suggested by participants in our studies. For the initial proof-of-concept prototype only an essential fraction could be implemented. In particular, a few minor bugs need to be fixed, placeholders need to be replaced, which would be necessary for a fully usable product. Furthermore, a separate, distinct examiner view that displays the current log, the elapsed time and stored questions should be added.

The complete digital, structured logging of an oral exam is fundamental to conducting assessment analytics. Because of a machine-readable database, the prototype lays the foundation to built promising analytics features to support grading (in terms of reliability and validity) and to optimize exams/questions in the review phase. This also opens up possible extensions for an examiner view, which can then use the stored data to display covered topics and to recommend (rarely used or good follow-up) questions. Such features would not be possible without the structured recording of exam data and the usage of a specialized tool and may increase the reliability of oral exams.

Next steps include bug fixing, conducting case studies in authentic oral examinations, making the features configurable, and researching additional features with a focus on usability and assessment analytics. Further research should also focus on examiners as stakeholders, for example, by investigating different types of visualizations of the log to support them in asking the "right" questions and in the grading.

More information about the current state of the EasyProtocol project and the software is available at https://www.tel.ifi.lmu.de/software/easyprotocol/.

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