MarkEd: An Online Marking Tool for the University of Edinburgh School of Informatics

Andrius Girdžius

MInf Project (Part 1) Report

Master of Informatics

School of Informatics

University of Edinburgh

2020

Abstract

Motivated by the lack of tools satisfying course-specific needs, the rapid increase in student intake and the need for staff members to utilise combinations of different tools to complete their work, this project aims to explore the idea and design of a potential tool, named MarkEd, to support marking, feedback and moderation processes at the School of Informatics, University of Edinburgh.

Following the User-Centred Design [41] framework, the design process started with an extensive requirements gathering study, run with my partner, with academic, teaching support and administrative staff and students. The resulting data was analysed and a list of requirements for a potential tool was compiled. Work on design started using paper prototypes and later moved to more sophisticated interactive Figma [7] prototypes. Several iterations were produced and tested in formative evaluation sessions with academic and teaching support staff using the stakeholder walkthrough method. The final prototype of the tool was created using the suggestions from the feedback sessions and presented for summative evaluation.

The resulting tool design is a modular solution that can support expansion and integrations with existing tools while supporting existing workflows. The summative evaluation concluded that there is still work to be done before the solution can be implemented, but the idea presented was promising and had the potential of positively impacting the staff and student experience in the School.

Acknowledgements

I would like to express my gratitude to my supervisor Dr Cristina-Adriana Alexandru who was incredibly passionate about the project and helped me immensely throughout the year.

I also want to thank my parents, friends and flatmates who always listened to me, encouraged me to keep going and motivated to continue my work.

Lastly, I am grateful for all the participants in my studies. Dedication of some of these people has been outstanding and I truly hope the work I did with the project can benefit them someday.

Declaration

I declare that this thesis was composed by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification except as specified.

(*Andrius Girdžius*)

Table of Contents

Chapter 1

Introduction

1.1 Motivation

Marking and feedback play a critical role in the higher education context [31]. Students can benefit from a better understanding of how well they absorb the course content [31]. It can also can help them alleviate insecurities and offer encouragement, help with decision making that influences performance in the future. For the course organisers, it serves as an indicator on how the course is progressing, which concepts might require further attention and offers feedback on teaching. The institution itself is also determined to improve feedback processes to gain credibility, perform well in the national rankings and surveys (e.g. National Student Survey [17]).

The School of Informatics of the University of Edinburgh offers a variety of choices for students pursuing a Computer Science or related studies. The demand for experts in the field over the last decade has attracted increasingly larger numbers of applicants.

This rapid surplus in student intake, increase of large-sized classes and great variety of courses and topics for students introduced numerous challenges that impact both the staff (academic, teaching support, administrative) and students:

- Due to the lack of tool integration and the variety of topics in Informatics, academics use a variety of in-house, but also custom-built tools to accommodate different types of assessment - code, reports, presentations, etc.
- Large class sizes require minimising manual marking efforts using various degrees of automarking
- Academics encounter administrative overhead in handling student submissions, extensions and student result publication processes
- There is a lack of standardised format of returning student results after the marking processes to the administrative staff resulting in miscommunication or delays
- There is inconsistency in the methods and channels of retrieving marks and feedback for students

See Chapter 2 for more information regarding the associated issues.

1.2 Research Goals

This dissertation aims to explore the need and design for a tool supporting marking, feedback and moderation processes that would be applicable to most courses and all class sizes in the School of Informatics of the University of Edinburgh.

Because of the scale of the system explored and limited time allocated for the project, this first part of the MInf project focuses on the requirements gathering and design aspects of the process. Main objectives of this part include answering the following research questions:

RQ1. What is the current process of marking, feedback and moderation in the School of Informatics of the University of Edinburgh for:

- (a) academic staff
- (b) teaching support staff
- (c) administrative staff

RQ2. What tools to aid the marking, feedback and moderation processes are used by:

- (a) academic staff
- (b) teaching support staff

RQ3. What are the students' opinions on the current marking and feedback process and associated issues?

RQ4. What could be done to improve the current workflows of marking, feedback and moderation process in the School of Informatics of the University of Edinburgh?

RQ5. Would a tool streamlining the process be useful? What features should it have?

RQ6. How can we design a tool to address the needs of:

- (a) academic staff
- (b) administrative staff
- (c) teaching support staff
- (d) students

RQ7. How is the usability of the proposed design perceived by:

- (a) academic staff
- (b) administrative staff
- (c) teaching support staff
- (d) students

RQ8. To what extent does the proposed tool support the marking, feedback and moderation processes?

1.3 Dissertation Structure

The following chapters of the dissertation are structured as detailed:

Chapter 2 introduces the background regarding the marking, feedback and moderation processes in the School of Informatics of the University of Edinburgh, reviews research methods in Human-Computer Interaction.

Chapter 3 briefly outlines the methodology used in all the stages of the design processes of the tool proposed.

Chapter 4 explains in detail the process of requirement gathering, studies with stakeholders, as well as introduces the list of requirements obtained from data analysis.

Chapter 5 outlines the process of creating low and medium-fidelity prototypes. It also describes the formative evaluation sessions with academic and teaching support staff.

Chapter 6 details the summative evaluation study and its results of the final version of the medium-fidelity prototype.

Chapter 7 concludes the dissertation and presents some of the challenges faced, limitations of the results, outlines further work.

1.4 Distribution of Work

The core idea of the initially proposed Honours / MInf (Part 1) project was open ended - to develop a marking, feedback and moderation tool for the School of Informatics of the University of Edinburgh. The project has been assigned to me and my project partner.

We started off the project by jointly working on the requirements gathering studies. Collaboration happened throughout all the stages of the process, but the responsibilities were split once the list of requirements has been finalised. The work has been split into the front-end and back-end work - myself working on the former and my partner on the latter.

This dissertation presents both the work done by myself alone and, where noted, efforts completed together with the help of my project partner.

Chapter 2

Background

2.1 Marking in the School of Informatics

2.1.1 Overview

As outlined in chapter 1, the School has experienced a rapid surplus in the student intake (see fig. 2.1) - the number of Undergraduate students increased almost two-fold in the last 5 years alone [24]. For many courses, this introduced the challenge of finding methods of assessing large classes of over 400 students.

Moreover, the School offers many different types of assessment [28]. This includes programming exercises and exams, reports, physical hand-ins, presentations and demonstrations, formative coursework, group projects. In turn, course organisers encounter the issue of not having access to proper tools that satisfy various course-specific needs. They must resort to developing custom systems that are complex, costly to maintain and rarely reusable.

2.1.2 Typical Process

The typical process of marking, feedback and moderation in the School of Informatics of the University of Edinburgh could be generalised as follows [28]:

1. Course organisers design the assessment according to the course specification
2. A submission method is selected and set up
3. A coursework description is published and students work on the assignment
4. The students submit their work using a pre-determined method
5. The course organiser collects submissions and distributes between the markers
6. The marking process is performed by the markers
7. Processed submissions are collated and moderated by the course organisers
8. Feedback (and sometimes marks) are distributed to students

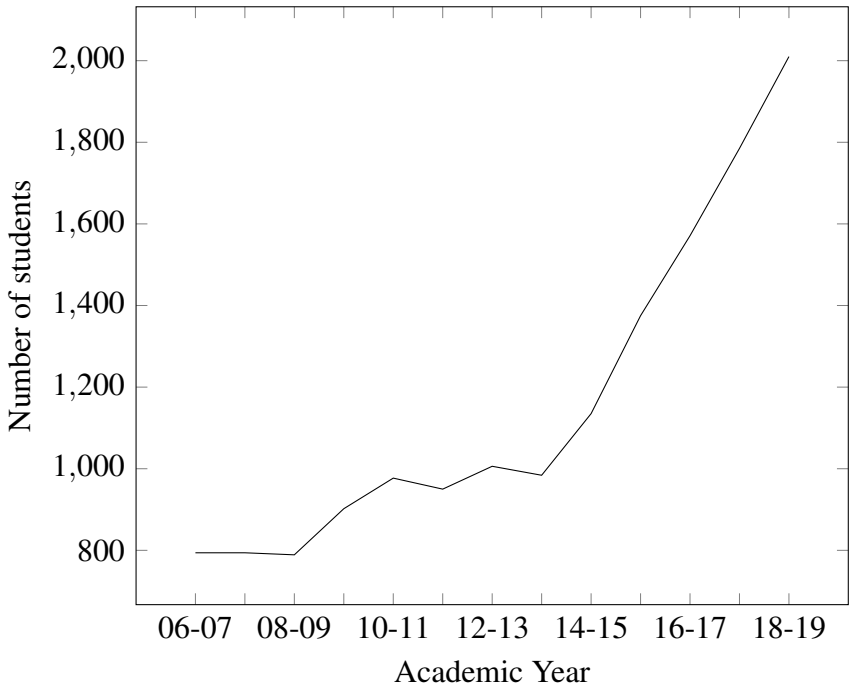


Figure 2.1: Number of students in the School of Informatics across academic years [24]

9. The marks are returned to the Informatics Teaching Organisation (ITO) [32]
10. The ITO [32] process and upload provisional marks to Euclid [29]
11. At the end of semester, Board of Examiners (BoA) [30] ratify the marks
12. The ITO [32] update the ratified marks and their status on Euclid [29]

2.1.3 Associated Issues

There are many problems associated with the approach described in Subsection 2.1.2.

There is no single, agreed way of handling student submissions. The choice largely depends on the course requirements and assessment type. Typically, the School's "in-house" Submit [18] command is used, but third-party solutions, such as Turnitin [21], are also frequently utilised.

In terms of marking, if there are multiple markers, submissions may split in various ways: a marker can mark a number of assigned submissions in their entirety, be assigned to a number of questions of every single submission or a combiation of the prior. Very few tools can support all three options, so course organisers are forced to consider custom solutions.

From the students' perspective, the channels used to return feedback and marks lack consistency. Most courses in Informatics return course feedback by email, however, it mostly depends on how the work was submitted - it could also be through Learn [11] (see 4.4.1), Turnitin [21] (see 4.4.2) or even a custom-built web app.

As mentioned, the Informatics Teaching Organisation (ITO) [32] deal with the ad-

ministrative processes across the School. Once an assessed piece of work has been evaluated, the marks are returned here by the course staff. However, no agreed, standard format exists, meaning the marks returned might require further processing by the administrative staff before they could be uploaded as a golden copy to Euclid [29].

Overall, there is great inconsistency throughout the workflow and staff must use a combination of multiple tools to complete the marking and assessment processes.

2.2 Research Methods In Human-Computer Interaction

This section provides a brief overview of the definitions of various Human-Computer Interaction (HCI) methodologies.

2.2.1 User Involvement In Design

2.2.1.1 User-Centred Design

User-Centred Design (UCD) is a process focusing on usability, active user involvement and simple design throughout the entire system development process [41].

Such design process requires continuous feedback from the potential user groups, multiple iterations of the system design to ensure the user needs are matched [26].

In general, the UCD process consists of 4 phases [27]:

1. Specify the context of use
2. Specify requirements
3. Create design solutions
4. Evaluate designs

2.2.1.2 Participatory Design

Participatory Design (PD) is an approach that aims to directly involve stakeholders in the design process [50]. Originating in Scandinavia and often referred to as the democratisation of the design process, it is guided by the idea that the more users get involved in the process, the more acceptable the final solution will be to the end-users.

As opposed to user-centred design (see section 2.2.1.1), users' wishes are the basis of the development, rather than noted by designers for further considerations [50] as part of the process.

2.2.2 Data Collection Methods

2.2.2.1 Interview

An interview is a qualitative research method that can be used in exploration, design and evaluation phases of the design process [42]. A standard interview consists of introductions, general issue and deep focus questions, retrospectives and wrap up [45].

An interview can be one of 3 types: unstructured, semi-structured or structured [19]. The more structured the interview is, the more comparable is data obtained. However, structured interviews require pre-existing knowledge of the domain, so some degree of flexibility can be introduced in a semi-structured setting. Finally, unstructured interviews offer the biggest amount of flexibility, but they are rarely repeatable and resulting data might become difficult to analyse and/or compare.

2.2.2.2 Focus Group

Similarly as with an interview (see 2.2.2.1), focus group is a qualitative research method [42]. As opposed to interviews, it puts the emphasis on ”group dynamic”. Primarily used in the planning and deployment stages of the design process, it is conducted in a group setting and guided by a moderator.

Main advantages include an ability to quickly gather group opinions, potential areas of conflicts [42]. Discussions that have not been anticipated by the researcher can be brought up by the participants to provide a well-rounded overview of the topic. However, focus group sessions can be become biased or easily overtaken by select participants, so the role of the moderated is key.

2.2.2.3 Questionnaire

Questionnaires are a useful method of gathering large amounts of written data such as opinions, attitudes, views [42]. Can be considered both qualitative and quantitative research method.

Although very powerful when questions are properly designed, this method of data collection is usually supported by additional methods of research, such as observation, to ensure data that participants may omit is captured [42].

Main advantages include possibility of anonymisation, effective and simple data collection with minimal input. Main disadvantage is that additional follow-ups cannot be made at the time of filling in a questionnaire so responses may lack clarity or detail.

2.2.2.4 Audio/Video Recording

Audio and video recording can be an effective tool to aid documentation of data captured by utilising other methods, such as interviews [47]. Recordings can be kept for a long period of time and retain authenticity of the records, can be used for transcription and are very easy to produce and use. It also helps to capture data such as emotion, non-verbal communication that is hard to textualize.

2.2.3 Data Analysis

2.2.3.1 Qualitative Data

Non-numerical data obtained in the qualitative research process [39]. May be categorised as verbal or non-verbal.

2.2.3.2 Quantitative Data

Numerical data obtained in the process of quantitative research [39]. Can be separated into categories based on measurement type.

2.2.3.3 Quantitative Analysis

Interpretation of numerical data [39]. This includes data manipulation, analysing the distribution and utilising mathematical modelling to assess an idea or hypothesis [49]. Can often be used to ”provide statistical support for qualitative interpretations” [39].

2.2.3.4 Thematic Analysis

Thematic analysis is a method of encoding information to identify themes in qualitative data [36]. It also helps to organise data and visualise it to the relevant stakeholders [42]. Application requires creating ”codes” that depict related topics or thoughts and then marking parts of raw data that match the relevant code.

There are two distinguished types of thematic analysis: top down (deductive) and bottom up (inductive) [37]. The inductive approach is data-driven, meaning the coding process happens without the use of preconceptions. The deductive approach is more analyst-driven with the researcher focusing on a specific research question and pre-existing themes rather than the overall data.

2.2.4 Usability Evaluation Methods

2.2.4.1 Stakeholder Walkthrough

Stakeholder Walkthrough is a group usability testing method adapted from the pluralistic walkthrough [35] method that gathers all stakeholders - designers, developers, researchers and potential users of the system - to evaluate prototypes early in the design process and provide actionable feedback [42]. End users are considered crucial in the feedback process and are reminded that their voice matters for further development.

Similarly as with pluralistic walkthrough, participants are asked to voice actions they would take to progress with a series of pre-determined tasks [35]. Comments are added between each task to note any apparent issues.

Although costly because of its group nature, it provides an opportunity for participants to interact with one another and discuss issues that individual expert sessions might not pick up [35].

2.2.4.2 Think Aloud

A cheap usability testing technique that captures qualitative data such as participant thoughts and opinions while interacting with a product [43].

Users are asked to interact with a product and vocalise their thoughts and actions [43]. This allows to gain an understanding of the user mental-model, exposes usability flaws

and even allows to gather suggestions, such as terminology, that could be incorporated in future versions of the product.

2.2.4.3 Cognitive Walkthrough

Cognitive walkthrough is a usability testing method that involves usability experts scrutinising a design of a product in attempting tasks through the eyes of a typical end user - a persona [43].

Experts follow systematic approaches when performing the tasks and decide how likely the user is to fail at a particular step [42]. This helps to define how usable a product is.

It is useful early in the design process as can be performed only by utilising a series of system requirements [43]. It is especially useful for evaluating systems that users are not expected to have prior knowledge of, such as parking garages [42]. Although quick to perform, this process requires input from a usability evaluation expert.

2.2.4.4 Observation

Observation is a method of gathering data on usability by simply observing and recording how participants interact with your design [44].

Observation method suffers from ambiguity as different situations might be interpreted differently and researchers bias can be introduced to the data unintentionally [44]. Participants are also likely to change their behaviour under observation.

Live observation, however, allows to gain rich data on behaviours participants might omit using other data collection methods, such as interviews [44]. It also allows the researcher to interact with the participant and ask clarifying questions and produce more meaningful data. The method also does not require substantial human-factor expert knowledge to conduct the research.

2.2.4.5 System Usability Scale

System Usability Scale (SUS) is a form of questionnaire that enables a comparable measure of usability [20]. It is used for all types of products and has a standard structure of 10 questions with 5 options each (ranging from Strongly Disagree to Strongly Agree). If all questions are given a neutral rating, the resulting score is 50.

The score is calculated as such [15]:

1. For each of the questions, options must be converted to numerical equivalents (Strongly Disagree = 1, ..., Strongly Agree = 5)
2. X = (the sum of all points in odd-numbered questions) - 5
3. Y = 25 - (the sum of all points in even-numbered questions)
4. The SUS [20] score is then equal to 2.5(X+Y)

The main advantage of using SUS [20] is that the questions are readily available, tested and reliable so it is very easy to set up a study and get meaningful results [20]. There

are various interpretations of the score available, but it generally allows a good comparison between the usability aspects of different products or iterations of the same product. See fig. 2.2 for an interpretation of adjective ratings for different SUS [20] scores [34].

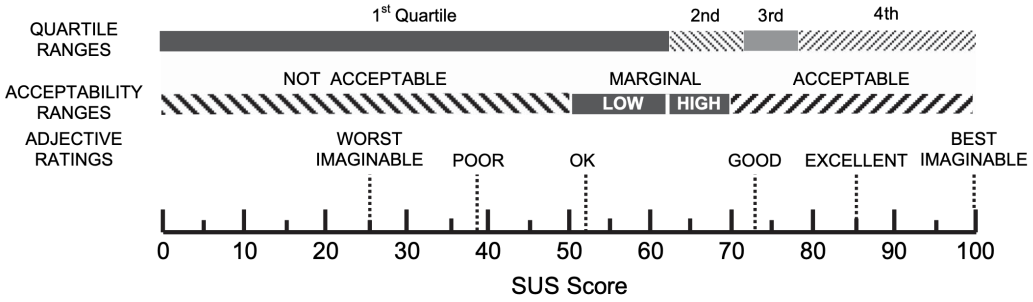


Figure 2.2: Mean SUS [20] scores by quartile, adjective ratings and acceptability [34]

Chapter 3

Methodology

This chapter outlines the methodology used throughout this project. Section 3.1 provides a quick summary of the process while the following sections provide more detail about each step separately.

3.1 Overview

The development of the online marking, feedback and moderation tool was split into 3 stages:

- **Stage 1** (Requirements Gathering): Stage to gather requirements from potential user groups of the proposed tool. Focusing on research questions:
  - RQ1 - What is the current process of marking, feedback and moderation in the School of Informatics of the University of Edinburgh for academic staff, teaching support staff, administrative staff?
  - RQ2 - What tools to aid the marking, feedback and moderation processes are used by academic staff, teaching support staff?
  - RQ3 - What are the students' opinions of the current marking and feedback process and associated issues?
  - RQ4 - What could be done to improve the current workflows of marking, feedback and moderation process in the School of Informatics of the University of Edinburgh?
  - RQ5 - Would a tool streamlining the process be useful? What features should it have?
- **Stage 2** (Design & Formative Evaluation): Stage to incorporate the requirements chosen from Stage 1 into a medium-fidelity prototype, conduct formative evaluation and produce an improved iteration. Focusing on research question:
  - RQ6 - How can we design a tool to address the needs of academic staff, administrative staff, teaching support staff, students?

  - RQ7 - How is the usability of the proposed design perceived by academic staff, administrative staff, teaching support staff, students?

- **Stage 3** (Summative Evaluation): Stage to assess the usability and usefulness of the final prototype design obtained in Stage 2. Focusing on research questions:
  - RQ5 - Would a tool streamlining the process be useful? What features should it have?
  - RQ7 - How is the usability of the proposed design perceived by academic staff, administrative staff, teaching support staff, students?
  - RQ8 - To what extent does the proposed tool support the marking, feedback and moderation processes?

3.2 Stage 1 - Requirements Gathering

The first stage aimed to gather requirements from the potential users of the system proposed. The identified user groups included academic staff, teaching support staff, administrative staff and students. This stage was carried out by both myself and my partner to clarify what is needed of the tool before we could split our projects.

Study methods used included semi-structured interviews (see section 2.2.2.1) for the staff members and focus groups (see section 2.2.2.2) for students. In total 42 participants (7 administrative staff, 9 academic staff, 6 teaching support staff, 20 students) were recruited in the span of 25 sessions.

The sessions were audio recorded (with consent) and transcribed to perform thematic analysis (see section 2.2.3.4) on resulting data using NVivo 12 [12]. After the data has been analysed, me and my partner composed a list of requirements and assigned priority to each. This list would be used in following stage - design.

See chapter 4 for the full details of this stage.

3.3 Stage 2 - Design & Formative Evaluation

Using the requirements list (table 4.6) obtained in the last stage of the process, the design process started.

In the first iteration, designs were in the form of rough paper sketches (low-fidely prototypes). This was to support the rapid prototyping idea in the early stages of the design process when discussions on the main design choices were still underway with my partner and supervisor. Before proceeding with the next iteration, the design was informally evaluated by my supervisor during our weekly meetings.

When some ideas began to solidify, design work was moved to Figma [7]. The decision to move to using a design tool was supported by the fact that a lot of paper-based sketches shared similar elements across the screens that had to be redrawn, as well as the need to further express the connection between different components which was

difficult on paper. Other software alternatives considered were Adobe XD [23] and Sketch [4]. Figma [7] was free, web-based thus compatible with every major operating system, had extensive collaboration features [7]. It was also the only tool that I had previous experience with so it was an obvious choice.

Based on the informal evaluation suggestions, a second iteration of medium-fidelity prototype interfaces for teaching support and academic staff were created. Formative evaluation sessions using the stakeholder walkthrough (see section 2.2.4.1) method were conducted. Participants included 8 academic and 8 teaching support staff members. Sessions were recorded, transcribed and analysed to perform thematic analysis (see section 2.2.3.4). Opinions and suggestions on design, usability and functionality were obtained.

Finally, a third iteration of a medium-fidelity prototype was produced that applied selected feedback from the formative evaluation sessions, as well as polished the design.

See chapter 5 for the full description of the process.

3.4 Stage 3 - Summative Evaluation

The third iteration medium-fidelity prototype design obtained in the design stage was evaluated in this last stage of the project.

For the summative evaluation, a questionnaire (see section 2.2.2.3) data collection method, along with observation (see section 2.2.4.4) of participant interaction with the prototype, was selected. This particular combination was chosen to accommodate the setting in which the evaluation was to take place - the Honours project poster fair organised by the School of Informatics, University of Edinburgh.

Participants (5 teaching support and 6 academic staff) were asked a series of questions about their experience with an interactive prototype while attempting some predetermined tasks designed to showcase the tool's functionality. The questions focused on impact and usability. To evaluate the latter, System Usability Scale (SUS) [20] (see section 2.2.4.5) questions were presented. Due to low participant numbers and unforeseen circumstances, all further evaluations had to be moved online without the possibility of observation.

The final results were analysed using a combination of thematic analysis (see 2.2.3.4) for qualitative data and quantitative analysis (see section 2.2.3.3) for numerical questions. The outputs of the study include opinions, suggestions and ratings on design, usability and functionality, proposals for potential features to be included in future work on the tool.

See chapter 6 for the full details of the summative evaluation process.

Chapter 4

Requirements Gathering

To compile a list requirements for a new tool, pre-design studies were designed and run with my partner. This chapter outlines the process of requirement gathering in detail with different user groups: students, academic staff, administrative staff and teaching support staff.

in particular, the chapter focuses on addressing the research questions RQ1 - RQ5 (reiterated in the relevant following sections).

The studies described in the chapter was certified according to the Informatics Research Ethics Process, RT number 2019/62506.

4.1 Studies With Staff Members

4.1.1 Aims

The main objective of the requirements gathering study with staff members was to answer the following research questions:

- RQ1 - What is the current process of marking, feedback and moderation in the School of Informatics of the University of Edinburgh for:
  - academic staff
  - teaching support staff
  - administrative staff
- RQ2 - What tools to aid the marking, feedback and moderation processes are used by:
  - academic staff
  - teaching support staff
- RQ4 - What could be done to improve the current workflows of marking, feedback and moderation process in the School of Informatics of the University of Edinburgh?

- RQ5 - Would a tool streamlining the process be useful? What features should it have?

4.1.2 Data Collection Methods

4.1.2.1 Interviews

We concluded we would use individual semi-structured interviews (see section 2.2.2.1) for staff members.

For academic staff, availability was prioritised to arrive at this decision. Such members of staff have varying degrees of duties and responsibilities, thus finding a suitable time for several academics at once (what would be the case of focus groups) would have proved to be challenging. In order to ensure high participation numbers, we made sure academics had the freedom to choose the individual time suitable for them, rather than needing to agree on a time we proposed. The type of interview chosen, semi-structured, allowed us to explore the domain of marking and feedback without having too many assumptions about the process but allowing us to obtain some comparable and structured data. The format of surveys or structured interviews was too constraining as we did not have enough expertise to formulate questions without requiring additional follow-ups that were possible in an interview setting, while unstructured interview data could have been difficult to analyse and draw conclusions from.

For administrative staff, the planned participation numbers were relatively low as we were mainly considering interviewing members of the Informatics Teaching Organisation *(ITO)* to gather their input on the administrative processes. We had applied ethical approval to do both interviews and focus groups. However, after several attempts, we had concluded that, because of the relatively small participant pool, it was impossible to schedule time-slots that even smaller groups of participants could make, as needed for focus groups (see section 2.2.2.2). As mentioned before, we were also lacking the necessary knowledge about the administrative processes so a survey would not have worked in this case. We decided that a semi-structured, individual discussion would yield us the most valuable information.

Since most of the teaching support staff *(TSP)* members are students as well, we expected to have a high turnout (as was the case with students) and schedule focus groups to save time. This did not prove to be the case. We struggled to recruit enough willing TSP members to run a large enough focus group, so we shifted focus to individual interviews. The question content remained largely similar, but it meant we had to do a lot more sessions. As with administrative and academic staff, we considered surveys to be inappropriate in this case because of lack of enough knowledge of the domain of marking and feedback to be able to ask all the right questions. The same reasoning meant we chose the semi-structured type of interviews for this user group.

4.1.2.2 Audio Recoding

We used a USB microphone to capture the audio of all sessions. Participants were asked if they would agree being recorded (none refused) with notes (see section 4.1.2.3)

being an option if approval was not given. They were also asked whether there was anything else they would like to add after the recording was stopped.

4.1.2.3 Notes

During the majority of the sessions, either me or my partner would take the role of a note taker. Notes were primarily used in conjunction with the audio recordings to summarise the sessions, including word-to-word transcription in some cases. In most cases, notes would be augmented with the information from the recording some time after the session to add any missed and/or important details omitted in the original write-up.

4.1.2.4 Other

During the interviews, other means of information would become available and were captured with the participants' approval. Examples included sketches of a currently used system framework, templates used by the ITO [32] for data processing and white-board diagram photos.

4.1.3 Materials

Adapting from the examples given in the School of Informatics Ethics Procedure [6] pages, me and my partner prepared Participant Information Sheets (see appendix A.2 for every user group, alongside a consent form (see appendix A.1) common to all groups. These, alongside the Ethics form, were submitted to the Informatics Ethics Panel who approved all documents and allowed to proceed with the study.

Aside from this, we had prepared a list of questions (see appendix A.3) for every user group. These were tailored to the background of the participant and the duration of the session.

For academic and teaching support staff, the questions focused on the background, typical marking, feedback and moderation processes, tools used to assist, gathering opinions on what the current process lacks and how it could be improved by utilising a new tool.

For administrative staff, aside from an overview of the marking, feedback and moderation process, we also asked about specific details of the process, tools currently in development and how different systems used connect with one another.

4.1.4 Participants

22 members of staff were recruited. Table 4.1 details the number of different participants for each targeted user group. Participant experiences of the relevant processes (administrative, marking, feedback) involved varied (see table 4.2 for a breakdown and table 4.3 for the experience to years of experience mapping).

Academics, administrative staff and teaching support staff were notified of the study through the relevant mailing lists by my supervisor. Additionally, individual emails

were sent to selected participants after the response to the mass emails was lacking.

After a participant has indicated agreement to participate in an interview, I would send a follow up email to them to arrange a suitable session time, attaching the relevant Participant Information Sheet (see section 4.1.3).

User group	Participants
Administrative Staff	7
Academic Staff	9
Teaching Support Staff	6

Table 4.1: Interview user group participation numbers

Participant	User Group	Experience
ADM1	Administrative Staff	High
ADM2	Administrative Staff	Medium
ADM3	Administrative Staff	Medium
ADM4	Administrative Staff	Medium
ADM5	Administrative Staff	High
ADM6	Administrative Staff	Medium
ADM7	Administrative Staff	High
M1	Teaching Support Staff	Low
M2	Teaching Support Staff	High
M3	Teaching Support Staff	Medium
M4	Teaching Support Staff	Low
M5	Teaching Support Staff	High
M6	Teaching Support Staff	Medium
A1	Academic Staff	High
A2	Academic Staff	Medium
A3	Academic Staff	Medium
A4	Academic Staff	High
A5	Academic Staff	High
A6	Academic Staff	High
A7	Academic Staff	High
A8	Academic Staff	High
A9	Academic Staff	High

Table 4.2: List of participants, user group they represent and level of experience

4.1.5 Protocol

We would meet our participants in a pre-booked room in Appleton Tower building of the School of Informatics of the University of Edinburgh (with an exception of a single session being in another University building) at a mutually agreed time. The agreed session time was 30 minutes.

	User group		
Experience	Academic Staff	Administrative Staff	Teaching Support Staff
Low	Less than 2 years		Less than 1 year
Medium	Between 2 and 5 years		Between 1 and 2 years
High	More than 5 years		More than 2 years

Table 4.3: Auxiliary table indicating mapping between the Low / Medium / High scale of the ”Experience” column and the number of years in the role

Me and my partner would switch the roles (interview facilitator and note taker) every session. The person leading the interview would brief the participant about the goals of the session, guide them through the Participant Information Sheet, answer any questions and take written consent using the Participant Consent Form (see section 4.1.3 for more information about materials utilised). See section 4.1.2.3 for more details about the role of the note taker. Participants were notified when audio recording was started.

The interview would begin and questions from the study question list would be asked. Follow up or clarifying questions were also frequently present. To make things clearer, some participants chose to also use the whiteboard or paper sketches to illustrate ideas.

Depending on the situation, it was sometimes the case that we were running out of the allocated time (30 minutes) for the session. Participants were asked if they could spare some additional time to finish the remaining questions. If they were not able to continue, most crucial questions were prioritised and some of them were skipped to wrap up the session at the agreed time.

After our questions finished, we asked whether the participant had any questions or thoughts they would like to add. We would stop the recording and kindly thank the participant for their time and input.

4.1.6 Data Analysis

After all sessions were completed, me and my partner split the work of transcribing and analysis. Since I was also responsible for the administrative part of the study (emailing participants, arranging time, booking rooms), I was assigned to produce analysis for 12 sessions (out of 25).

Using the notes and the audio recordings, transcriptions were obtained. These were then imported to NVivo 12 [12] and thematic analysis was performed. Initially, top-down coding was done where high level topics from the session question lists were chosen as the themes [33]. Going forward, as more apparent themes emerged from the data (bottom-up coding), these were merged, split and renamed as appropriate. Coding was double checked multiple times to ensure consistency between the different sessions and the final code book was created.

See fig. 4.2 and fig. 4.1 for the visualisation of nodes created as part of the data analysis process for teaching support and academic staff, as well as administrative staff.

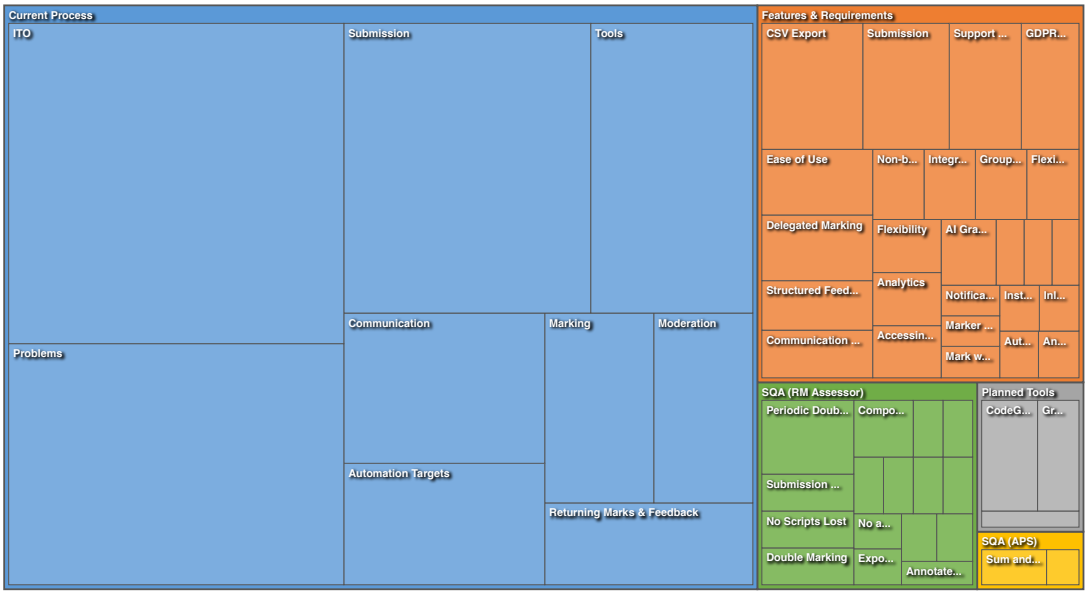


Figure 4.1: Nodes of the study with administrative staff as a hierarchical graph (sized by number of references)

4.1.7 Results

The following sections present the summarised results obtained by performing data analysis on the qualitative data obtained as part of the interview process with teaching support, administrative and academic staff.

4.1.7.1 Current Process

4.1.7.1.1 Submission Collection Typically, course organisers collect their submissions first. This can be from a variety of places, including Learn [11] (1 academic), Turnitin [21] (1 academic, 1 teaching support), Submit [18] (5 academic, 3 teaching support) and others. See the following section 4.1.7.2 for more information.

4.1.7.1.2 Splitting Up Responsibilities Afterwards, if markers have been determined, they are assigned work. The assignment process varies. Some assignments, for consistency purposes, are per-question (3 academic participants, 1 teaching support), some - per-submission (2 academic), some - a combination of both (1 teaching support). There are also cases where double-marking is employed (1 academic), as well as assignments that happen automatically based on the group the marker is tutoring in the case of tutorials (1 academic, 1 teaching support).

4.1.7.1.3 Pre-Marking Meeting Some participants (1 academic, 2 teaching support) mentioned that sometimes before the marking process starts, there is a meeting with course staff about the marking scheme where a course organiser may present some example marked work, discuss corner cases.

Figure 4.2: Nodes of the study with academic and teaching support as a hierarchical graph (sized by number of references)

4.1.7.1.4 Marking After the marking scheme is agreed and work has been assigned, the marking process starts. This process is typically done individually, but 2 participants (1 academic, 1 teaching support staff) mentioned this is done with all participants being present at the same time and collaborating with one another.

> *"<...> we met one weekend and just marked the entire batch all together in one room and ordered pizza and got it all done. So that worked really well, because if you have everybody in the room you can just communicate about stuff."* - A2

3 teaching support staff members and 3 academic participants mentioned automarking, at least partially, is done in their course. This is the case for all coding assignments, especially for classes with large student cohorts. Methods include both automated unit testing, as well as generating feedback based on number of marks given (or the other way around).

Feedback and marks are recorded in the tool used to mark or a spreadsheet (see section 4.1.7.2 for more details). For coding assignments, this can include unit tests results, outputs. For other types of assignment these are traditional comments on work. If the submission was physical, paper is annotated.

2 academics and 1 teaching support staff members mentioned being aware of potential bias issues when marking work that has not been anonymized. Also related to bias, 2 teaching support staff members expressed similar concerns when the idea of comparing your marking with other markers was introduced.

> *" We actually did something like this for one of the courses. It was tutors and the supervisors of the students working jointly. <...> But it depends on how it's implemented. You don't want to be influenced by the other*

person's grade if it's released first. So that could potentially contribute to how you would be marking it." - M6

4.1.7.1.5 Moderation Some form of moderation has been mentioned by almost all academic participants. Teaching support staff are typically not involved in this process so most of them were unaware of the practices. Though a single teaching support staff participant said they had participated in a meeting after the marking process has finished as well to correct any inconsistencies. Most common methods include checking the mark distributions, averages and standard deviation to determine outliers (1 academic, 1 teaching support), as well as random sampling and checking submissions in different grade boundaries, unclear cases (4 academic participants). A good number of participants used both of the previous methods as a combination (3 academic, 1 teaching support). If the submissions were automarked, the automarker gets adjusted to remark. Otherwise, manual remarking or scaling is employed.

"Course organiser goes over fails and borderlines, or some of the ones that you highlighted as a marker being uncertain about. They'll get a second and a third opinion. A few samples are also selected randomly to make sure their interpretation of grades would match with the tutors'." - M6

4.1.7.1.6 Feedback/Mark Return There is great inconsistency with how marks and feedback are returned both to students and the ITO [32].

The most popular way of handling the student side is sending them emails with mark and feedback (4 academics, 2 teaching support) which may be composed individually for small classes or generated automatically otherwise (custom scripts). Some academics (2) additionally provide general feedback that applies to all students. Aside from email, marks and feedback may also be distributed in the tool used to submit, i.e. Webmark [25] (1 academic), Turnitin [21] (2 academics), Gradescope [40] (1 teaching support), custom web GUI (1 academic) or paper if the submission was physical (1 teaching support).

Returning marks to the ITO [32] happens either by returning the marked physical submission (1 teaching support) or by issuing a summary of all results from an assignment. The format of the latter is not agreed upon so the ITO [32] receive either *.csv* files (3 academic, 3 teaching support), WebMark [25] (1 teaching support) data or fetch the results from the relevant submission system themselves.

"There's a something to generate a CSV file after this slot here and I email the CSV file to the ITO. <...> I mean it's just a list of UUNs and marks and they seep happy, yeah." - A1

4.1.7.1.7 Data Processing Communication between the course organisers and the ITO [32] is maintained through email (3 administrative staff), in-person (3 administrative staff) or using the ITO [32] ticketing system (2 administrative staff).

Once marks have been acquired from course staff using one of the communication

channels, they are checked and put into Euclid [29]. The difficulty of this depends on how the marks have been returned. As mentioned by the majority of the administrative staff (6), usually, additional, manual pre-processing must be performed for the marks to be compatible with Euclid's [29] import format. Late penalties, extension deadlines must also be applied if these have not been checked by the course organiser (3 administrative staff).

> *"I'd say generally, if it's an electronic submission, then it's most likely going to be some sort of Excel spreadsheet, but that's not always a guarantee. That's just the most common way we get it, but even then, there's a lot of variation as to how that spreadsheet is set out, how the information is presented. Some are very detailed and exact, and will have full breakdowns of each question, for instance, where others will just be like one column with just student numbers, one column with marks. An Excel spreadsheet is the most common but it's not the only way in which we'll get marks."* - ADM6

4.1.7.2 Tools Used

Staff members use a combination of different tools to achieve their needs for a particular course or assignment. Below is a list of the different tools used by participants that were mentioned in the interview process.

4.1.7.2.1 Submit [18]

6 academic and 3 teaching support staff use the Submit [18] tool for collecting student submissions.

This particular tool has been criticised a lot. Participants mentioned lack of functionality that allows students to see what they submitted. The tool also overrides any existing submissions, even after the deadline has passed which causes versioning issues. One participant mentioned lack of certain format enforcement was specifically difficult to work with.

> *"<...> the problem is it's hard to sort of check what's been submitted [by students] <...> So, I asked them to put their student numbers in that text file in a certain format <...> In practice, 10% of people, 5% of people will do arbitrary nonsense. I get rich text file formats, semicolons, all sorts of stuff"* - A9

4.1.7.2.2 Turnitin [21]

3 academics and 2 teaching support staff members mentioned Turnitin [21] is used in their course. This is used for handling submissions, checking them for plagiarism and inputting feedback to return to students.

Participant opinions on using this tool have been split. Participants mentioned the tool having both advantages (e.g. good support for criteria-based marking, reliability) and drawbacks (”laggy” and ”awkward” user-interface, markers being added as ”external-figures” which causes issues).

4.1.7.2.3 Learn [11]

Learn [11] has been used to collect submissions by 1 academic participant. The academic in question deals with report-based submissions.

> *"We don't have tools to use because it's mostly qualitative. It's not like in programming where you can run a program to check, or you can write some kind of tests. Everything is just [done] manually."* - A4

4.1.7.2.4 Spreadsheets

8 academic and 3 teaching support staff participants used spreadsheets as part of their workflow. Uses included tracking individual marking progress, handling and saving student marks and feedback, using shared documents for collaboration purposes, producing statistical data about markers and assignment marks.

This seems to be the most popular tool amongst academic participants - nearly every academic member uses it in some part of their workflow.

> *"We have spreadsheets to look at the distribution. <...> Most of the time it's kind of bimodal. So, if it's starting to divert a lot from that then I start looking more deeply [into it]"* - A5

4.1.7.2.5 Gradescope [40]

1 teaching support staff member used Gradescope [40] to aid their marking process. The participant mentioned liking the functionality that the tool provides - specifically enforcing markers to use consistent feedback by selecting the number of deducted marks, as well as the ability to assign marking per-question, as opposed to, more traditional, per-submission marking. However, the tool does have its limitations as well, such as lack of submission format enforcement and flexible user roles.

> *"One thing that Gradescope [40] doesn't supply is the ability, for example, to test that the student uploaded the correct thing. <...> Even for example just checking the length of the PDF which should be fixed – Gradescope [40] does not do that. The other issue that we had was, for example, in the access rights given for example to TAs, markers, etc. There is no sandboxing. So basically, you're either a student or a marker. And a marker has full access rights, which might be an issue."* - M1

4.1.7.2.6 CodeGrade [38]

Was to be trialled by a single academic participant, it enables an automarking solution where students may submit code directly to the tool. Although automarking for coding submissions is supported, it is lacking functionality, such as custom feedback, in comparison to a custom tool used by the academic in a different course.

> *"Well, the one that I use for the larger course, this automarker, I think is really nice, because it produces this great feedback, and that's a thing that Codegrade [38] doesn't have. So Codegrade [38] can produce feedback for you, but not if you use JUnit harness."* - A2

4.1.7.2.7 Euclid [29]

Used by almost all administrative participants (6), this system holds a golden record of all student and course result data. Although powerful, the system does require a specific format to enter the marks easily which can cause additional effort.

> *"<. . . > if we were given a paper handout of marks, <. . . > then we'd have to alphabetise them first so we could organise them, and then enter them into Euclid [29] one-by-one, which we did earlier this semester which was quite time consuming considering it was a coursework of about 400 people."* - ADM6

4.1.7.2.8 Custom Tools

5 academics and 3 teaching support staff members mentioned using custom tools or scripts to assist the marking process.

Areas used for included handling submissions (e.g. checking format correctness), splitting work, automarking and automatic assignment of feedback, publication of feedback and marks to students through a web interface or emails, statistics generation, marking GUIs, checking and flagging up missing marking.

Users of these tools have mentioned they built them themselves or inherited them from previous course staff. Reasons for use mentioned were being limited by the tools provided by the University (e.g. the Submit command), wanting to at least partially automate the current marking, feedback and moderation processes, minimising likelihood of error that can be a result of manual data processing.

> *"These have been generally written by my TAs, with some interaction and in some cases with me because I guide the building, but in some cases I'd come to a class where the script exists already."* - A3

Although widely used, custom tools were criticised by both markers and academics. Issues mentioned included re-usability and maintainability issues, lack of anonymisation, the process of development taking up a lot of marking time. It was also mentioned that, although many staff members are in possession of such tools, they are extremely reluctant to share them.

> *"So, I think the problem generally is that whenever you are given the task of marking any coursework you end up writing a bunch of scripts to reuse. You expect to reuse them, but you never do. So, a lot of marking time actually goes into developing the scripts that are never reused. And that also leaves you less time to actually mark."* - M5

4.1.7.3 Potential Functionality

Analysing the answers to questions about laborious and repetitive processes, what the currently used tools lack and what features a new tool should have to be useful, a list of possible improvements was noted and structured (ordered by number of mentions, per category).

4.1.7.3.1 Submission

- Submissions should be accessible to students to view after submission (2 academic, 1 teaching support, 1 administrative staff)

  > *"Students don't really know whether they had submitted or not <...> I had a student [to] whom, three weeks in, I gave everything back. <...> I said "Sorry I haven't received anything", and the student said "But it has produced a tar" and, "I don't know, must have not sent it", so, what can I do at that point? So, some kind of feedback to the student that this is now here and it will be marked, so, this is probably very helpful."* - A2

- File pre-processing steps should be possible to configure (2 academics, 1 teaching support)

  > *"There are manual processes like pulling all the submissions into one directory and then I have to extract as each one is like a .tar file and I need to extract it into a different directory."* - M4

- There should exist a submission dashboard that allows for a quick overview of all submissions (1 academic, 2 teaching support)
- Support for flagging up submissions for administrative purposes, e.g. this submission should be looked at later, this submissions has been moderated, etc. (2 academics, 1 teaching support)
- Support for group assignments (1 academic, 2 administrative staff)
- Code submissions should be sandboxed when run (2 teaching support)
- Support for anonymization of submissions (1 academic)
- Support for automatic plagiarism check (1 academic)

  > *"Just dump everything, plagiarism check is done, feedback is generated <...> automatically and then you insert customized feedback <...> "* - A7

- Support for enforced submission format that is checked at the time of a submission (1 teaching support)
- Support for late submissions, i.e. calculation of penalised mark (1 teaching support, 2 administrative staff)
- Support for assignment deadlines with extensions (1 teaching support)

  > *"It'd be nice if it could also handle like late submissions, it would know if somebody submitted late and do the deduction - that would be good."* - M4

- Support for submission versioning (1 academic)
- Support for accessing submission without the use of a web-browser, e.g. through a mountable file system (1 administrative staff)

- Support for submissions of non-Informatics students (1 administrative staff)

4.1.7.3.2 Marking

- Ability to quickly reuse the same feedback comment, e.g. for similar mistakes (4 academics, 2 teaching support, 1 administrative staff)

  > *"It's very common for some people to <...> [having] understood the assignment in particularly in the same exact way. And I would quite often have to write the exact same comment and the exact same feedback, which can become quite repetitive."* - M2

- Support for criteria-based marking (3 academics, 2 teaching support)

- Possibility to compare with other markers for the purpose of consistency (2 academics, 2 teaching support)

  > *"Generally, would think that the trade-off of <...> seeing all the markers interacting in the same place would be useful <...> Or at least knowing their progress in the marking"* - P25

- Support for changing marks and/or feedback for multiple submissions at once, e.g. when the marking criteria has been changed (2 academics, 1 teaching support, 1 administrative staff)

  > *"You might need to review marks later on (e.g. student appeals) and then there is a lot of overhead as you might need to change the same thing for other affected students, and this creates a lot of work."* - M3

- Support for automarking (2 academics, 1 teaching support)

- Automatic feedback generation, e.g. if 3 marks have been assigned, assign a specific feedback comment (2 academics)

- Support for programming assignment style checker (1 academic)

  > *"So every week they submit some lab exercises, and I just wanna see that they're engaged. So this kind of engagement is marked or part of the mark. And their last code submission is marked based on correctness and based on code style."* - A2

- Support for auto-saving marking progress (1 academic)

- Support for double-marking (1 academic)

- Support for issuing general-purpose feedback intended to be read by all students (1 teaching support)

4.1.7.3.3 Moderation

- Statistical data about marker progress in the form of a dashboard (3 academics, 1 teaching support, 2 administrative staff)

- AI-assisted moderation support, e.g. the system could notify the user that a lower mark with a similar comment has been given in comparison to previously marked submissions (2 academics, 2 teaching support)

> *"Or perhaps, it could ideally, and there's some AI that's going into this, if it's like "they're the same comments, the marker differs in only some sense", then the other comments should explain the difference, and you would perhaps automatically tag that <...> "* - A3

- Statistical data on student performance over the years for the purpose of moderation, as well as providing prospective students additional information (3 academics)

> *"<...> what would be useful would be for students to see roughly some of the stats about the previous years' course. I keep telling them my course is difficult, but it's only when they're doing it that they realise (laughs)."* - A5

- Ability to share sample marked assignments to markers in the system (1 academic)

4.1.7.3.4 Administrative

- Data storage should be flexible and allow interaction and manipulation in alternative ways to GUI, e.g. code access (3 academics)
- Support for handling data from various data sources, e.g. Piazza integration (3 academics)

> *" I also want data about my students from lots of different places that I'm quite interested in. You know, we use the public Piazza forum."* - A1

- Ability to enter marks directly into the system to avoid the step of ITO [32] mark publication (1 academic, 2 teaching support)

> *"I do worry about the ITO [32] re-typing things because it's very easy to transpose marks, so anything that got rid of manual steps would be good for making the marks safer."* - A9

- Support for feedback report generation and emailing to students (1 academic, 1 marker, 1 administrative staff)
- Enforced use of a standardised format to return marks to the ITO [32] (2 administrative staff)

> *"Yeah. If you get that from the markers, and we did ask for that from the markers, then it's much easier than just having to type in marks yourself."* - ADM5

- Support for accessing all student marks and feedback through a single interface (2 administrative staff)

- Ability to import scanned physical submissions and perform mark calculation automatically (1 administrative staff)
- Support for student notifications on mark releases to Euclid [29] (1 administrative staff)

4.1.7.3.5 Other

- Tool should contain aspects of modularity, behave like a framework (2 academics, 2 administrative staff)
- Tool should be intuitive and easy to use (3 administrative staff)

  > *"So there's all these different stakeholders that need to find the system intuitive, easy to understand... We don't want any of these stakeholders to have to read a manual on how to use the system, it should be obvious. If we could build a prototype of something like that, there is a huge market."* - ADM3

- Tool should not be over-complicating the existing workflows (2 academics)
- Tool should be easily maintainable, future-proofed (1 academic)
- Tool should have a centralised, GDPR-compliant communication method, e.g., to avoid sending sensitive data to the wrong recipient (1 administrative staff)

  > *"So we should have a system <...> where they can have these conversations on a supported platform that is GDPR compliant and everyone can be familiar with it and trained, and those conversations happen like that."* - ADM1

- Tool should have an audit trail of all user actions that is understandable without the support of an engineer (1 administrative staff)

4.2 Studies With Students

4.2.1 Aims

The main objectives of the requirements gathering study with students was to focus on answering the following research questions:

- RQ3 - What are the students' opinions on the current marking and feedback process and associated issues?
- RQ4 - What could be done to improve the current workflows of marking, feedback and moderation process in the School of Informatics of the University of Edinburgh?

4.2.2 Data Collection Methods

Focus groups were selected to conduct the studies with students.

Once again, consideration was given to availability to increase chance of participation. We realised that most students tend to finish their academic and work commitments at a similar time - in the evening - and saw potential of meeting groups of students together. This seemed to be more appealing to students we talked to as some were more reluctant to participate in individual interviews, as well as allowed us to hold less sessions in total and save time in the process. We also considered using a survey to gather requirements from students alongside focus groups. This would have been offered as an alternative to students who could not make our scheduled group time-slots. However, we decided to drop this format in favour of starting interviewing other user groups earlier as we had gathered enough student participants and started observing similar themes emerging in our focus group sessions.

As with the study with staff members, audio recording and notes were taken (see section 4.1.2.2 and section 4.1.2.3 for more details).

4.2.3 Materials

Similarly to the staff studies, a Participant Information Sheet (see appendix A.2.4) was prepared. The same consent form (see appendix A.1) was used.

A question list (see appendix A.3.1) was also prepared. The questions compiled focused on the student side of the whole process of coursework assessment - from submission to receiving ratified marks. This seeked a general overview of the different stages, as well as their opinions. It was important to understand what the general consensus was between students and ask them about potential improvements that would benefit their overall experience with the assessment processes.

4.2.4 Participants

In total we recruited 20 students. Table 4.4 details the participant numbers in each of the 3 focus group sessions. Students varied in degree programmes, year of study (see table 4.5 for a breakdown). First year students were not recruited as the study was running over the first semester and they had no prior experience with marked assignments. Consequently, higher year students were prioritised as they had more experience.

Student recruitment for focus groups was initially conducted through asking friends and acquaintances to participate. This allowed to arrange the first student group relatively quickly as we had a high response ratio. I also sent out a student recruitment email using the University of Edinburgh School of Informatics general students' mailing list. This was also relatively successful as we received several replies from students willing to share their experiences.

Similarly to the case of recruiting other user groups (see section 4.1.4), follow up emails were sent after receiving agreement to participate for further arrangements and information.

Session	Participants
First	S1 - S6
Second	S7 - S13
Third	S14 - S20

Table 4.4: Student participation numbers in focus group sessions

Participant	Degree Programme	Year of Study
S1	Computational Physics	2nd
S2	Computer Science	4th
S3	Artificial Intelligence and Mathematics	4th
S4	Computer Science	3rd
S5	Computer Science	4th
S6	Computer Science	4th
S7	Masters of Informatics	5th
S8	Electronics and Computer Science	4th
S9	Computer Science and Artificial Intelligence	4th
S10	Masters of Informatics	4th
S11	Computer Science and Management Science	2nd
S12	Masters of Informatics	4th
S13	Computer Science and Mathematics	4th
S14	Computer Science	4th
S15	Computer Science	5th
S16	Computer Science	4th
S17	Cognitive Science	2nd
S18	Computer Science	4th
S19	Masters of Informatics	4th
S20	Computer Science and Management Science	4th

Table 4.5: Breakdown of student participant background information

4.2.5 Protocol

A protocol similar to that detailed in subsection 4.1.5 was followed. There were a few notable differences, however.

The time allocated for a focus group session was 1 hour to accommodate the group setting and make sure all participants had the chance to express their input.

All the participants were asked background questions. The rest of the questions were used as discussion starting points. This enabled students to weigh in at any time they felt their input was valuable. The facilitator guided the discussion to avoid any conflicts or unnecessary interruptions, as well as give everybody an opportunity to have their say.

4.2.6 Data Analysis

The process of data analysis followed the same pattern as with the study with staff members (see section 4.1.6 for more details).

See fig. 4.3 for a visual breakdown of resulting nodes.

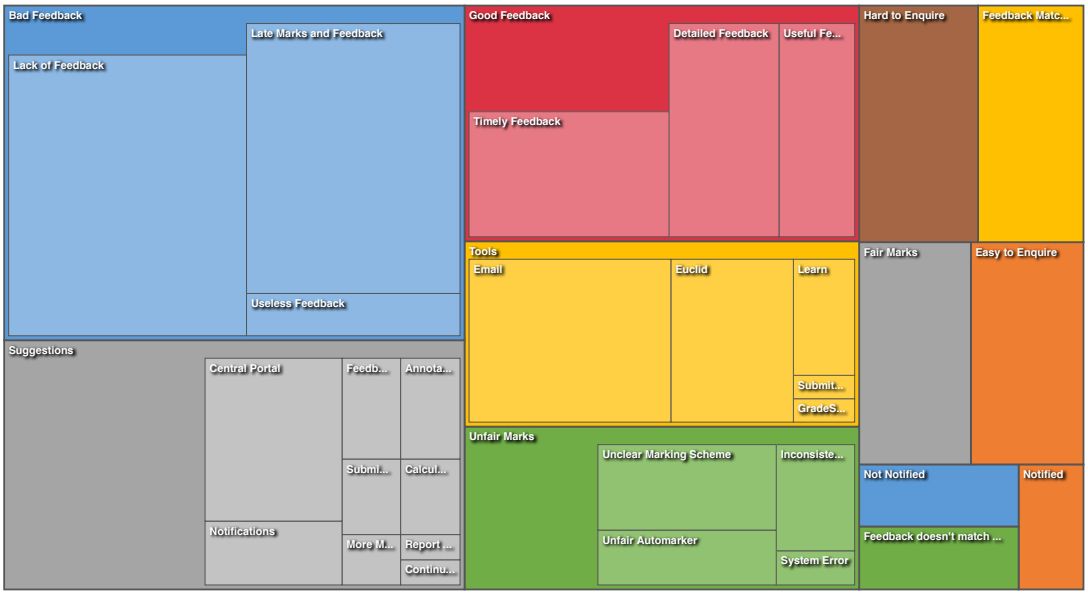


Figure 4.3: Nodes of the study with students as a hierarchical graph (sized by number of references)

4.2.7 Results

The following sections present the summarised results obtained by performing data analysis on the qualitative data obtained as part of the focus group sessions with students.

4.2.7.1 Student Opinions About Processes

Students were mostly concerned about the feedback process. A large proportion of students (15) have mentioned lack of feedback - in some cases even receiving none. On the contrary, 14 students also mentioned having really positive experiences with receiving detailed feedback, so the result on the feedback amount could be considered inconclusive. 12 students also reported experiencing lateness of feedback, particularly notable are cases when feedback is not returned before the next assignment is due.

> *"In my experience every time we were supposed to get our results back, they were delayed, whether they were exam grades or coursework feedback. We never got marks and feedback on the date they told us."* - S17

4 students also reported receiving feedback that was not useful - for example, that the automarker failed without providing a possible reason why that was the case. Only

4 students reported mismatches between feedback and the mark issued, with the rest (16) being happy with this.

The majority of students (12) were overall happy with the fairness of marks issued in Informatics. Though some students mentioned use of automarking is as fair as it gets, 5 students had a negative experience with it, usually due to compilation errors when a 0 mark is assigned if no manual checking is done.

> *"In that case they should definitely have a person look at the code, even though it does not compile."* - S5

6 students have mentioned experiencing lack of clarity in the marking scheme, 1 student's mark was incorrect due to an incorrect setup on the marker's machine. Finally, 3 students experienced inconsistencies in marks between those shared by the course organisers and those appearing in Euclid [29].

Enquiring about marks and feedback was overall rated positively. Although not every participant had experience contacting staff regarding the marking, many students (9) felt this was an easy and straightforward process, with several (5) participants having especially positive experiences where they were able to change their mark or receive additional feedback in the process. 4 students, however, noted that this process of enquiry is not advertised enough - they felt reluctant to email the course staff in fears of their message just ending up in a "sea of emails". 1 student had a particularly negative experience when they felt their mark was unfair but gave up because the process became too "lengthy".

> *"It's been good when they responded. Most of the time TAs would reply as they are not as busy. When I contacted lecturers for extra feedback I had negative experiences where they were either sick or away, and didn't reply for months."* - S7

Students were split on how marks and feedback are currently returned. 5 students mentioned email working great for this. Students specifically liked the email method because this also acts as a notification about new feedback or marks being released by email. Some students, however, were not satisfied with the process returning marks and feedback. 3 students said that Euclid [29] does not notify them about new marks being released. 2 students said feedback emails tend to get lost, while 1 student said Learn [11] notification emails in particular are ignored by most students as it is "impossible to know when it's a content update or when it's a mark".

> *"I like emails as you get notified, and it's easy and quick to read, and there's usually some feedback pinned on it. <...> Marks on Euclid [29] are a few clicks away so slightly more hassle than email."* - S19

> *"The majority of the time when I found out about feedback is because someone put it in the Informatics group chat on Messenger, as opposed to from anything else."* - S1

4.2.7.2 Possible Improvements

Below is a list of suggestions mentioned compiled from the student focus group sessions. As with the staff studies, items are sorted according to popularity amongst students.

- Centralised marks and feedback portal, i.e. a single place where students could see their result overview (11 students)

  > *"My idealistic picture of this is a feedback portal where you get all the grades for the courses you take, and you can see the people who marked you, so you can email them or something to ask for clarification."* - S2

- Consistent notifications about new result release, e.g. email message about Euclid [29] updates (6 students)

- Ability to see feedback next to the submission, i.e. comments in code, annotated PDFs, etc. (3 students)

- Ability to quickly determine how much your coursework result contributes to your overall mark (3 students)

- Ability to view and download submitted work (2 students)

  > *"When I submit I get a confirmation email which I really like. I would like to see the thing I submitted as well."* - S6

- Continuous feedback support for programming assignments (1 student)

  > *"For coding assignments I think continuous feedback is great. GitLab [8] should be used more so assessment could be done incrementally, have a few test cases to reassure people that they're on the right track."* - S19

4.3 Requirements

Considering the results of the studies with staff members and students, as well as our own judgement, I, with the help of my partner, have compiled a list of most important functional and non-functional requirements that the proposed tool should have. Each of the functional requirements has been assigned a priority level ('very low' to 'high') to indicate what should be prioritised in the design and development process. These priorities have been assigned based on the popularity of the requirement associated or by our own intuition if it seemed important or unique.

4.3.1 Non-Functional

The non-functional requirements I identified are:

4.3.1.1 Extracted From Participants

4.3.1.1.1 Usability The tool should be easy and intuitive to use to staff with varying degrees of experience, as well as accessible to all users and their needs and adjustments. Suggested by 3 administrative, 2 academic staff members.

4.3.1.1.2 Modularity The tool should be extensible, future-proof and support existing tools and workflows used by staff. Suggested by 2 academic and 2 administrative staff members.

4.3.1.1.3 Maintainability The tool should be maintainable to ensure continuous development and improvement. Suggested by 2 academic staff members.

4.3.1.1.4 Auditability The tool should document evidential audit logs of all user actions. Suggested by 1 administrative staff member.

4.3.1.1.5 Confidentiality The tool should provide possibility of anonymized marking, ensure student and staff confidentiality, fairness. Suggested by 1 academic staff member.

4.3.1.1.6 Compliance & Privacy The tool should be compliant with privacy and other country-specific laws. Suggested by 1 administrative staff member.

4.3.1.2 Other

4.3.1.2.1 Security The tool should be secure, handle data following modern security standards. Data stored as part of the system is very sensitive in its nature so all safety precautions must be taken to avoid potential data leakage and loss.

4.3.1.2.2 Performance The tool should be highly-performant and capable to work under stress conditions. Due to the nature of the marking, feedback and moderation processes, the system will have to bear the heavy load during peak times, e.g. end of semester.

4.3.1.2.3 Platform The tool should be web-based as the marking, feedback and process requires great flexibility. The system should be supported on as many platforms as possible to accommodate all users involved in the said processes and their devices, regardless of the background.

4.3.2 Functional

See table 4.6 for a list of functional requirements. The priority assigned has been justified according to one or more reasons, coded as follows:

- S - Supported by multiple participants
- I - Innovative or new (as considered by the researchers)

- C - Crucial or necessary
- N - Non-essential
- L - Limited support from participants

Category		Functional Requirement	Priority	Reason
1. Submission	1.1	Submission format enforcement (e.g. only PDF files accepted)	High	I
	1.2	Ability to submit	High	S
	1.3	Ability for students to view submissions	High	S
	1.4	Timestamp submissions, retain all submissions from the student	High	C
	1.5	Anonymized submissions	Low	NI
	1.6	Group submission support	Low	NL
	1.7	Ability for students to contact markers within the system to enquire about feedback	Low	NI
	1.8	Ability for students to view marks and feedback in the system	High	S
	1.9	Potential coursework result calculator	Very Low	L
2. Marking	2.1	Ability to reuse feedback comments quickly	Medium	SN
	2.2	Ability to record feedback	High	C
	2.3	Splitting submissions across markers: per submission / per question / custom	High	SI
	2.4	Dashboard of marking progress	High	S
	2.5	Command-line interface access to the system	Low	N
	2.6	Automarker support	Medium	SN
	2.7	Analytics on student performance	Low	SN
	2.8	Ability to custom flag submissions by markers for further support	High	SI
	2.9	Double marking / double blind marking	Low	LN
	2.10	Custom permissions for read / write access to submissions	Medium	C
	2.11	Sandboxing of student submissions	High	SC
	2.12	Custom user role support	Medium	LI
	2.13	Plagiarism checks	Very Low	NL
3. Moderation	3.1	Analytics on marker performance	Low	N
	3.2	Ability to modify feedback and marks across multiple submissions at once	Medium	SN
4. Administrative	4.1	Possibility of integrations with existing tools	High	SI
	4.2	Easy export of student data in a custom format	High	S
	4.3	Generation of analysis for Board of Examiners meetings	Very Low	LN
	4.4	Regular backups of data	Low	C
	4.4	Student notifications for marks and feedback / bulk emails	High	S
	4.5	Audit log functionality of system users	Low	LN

Table 4.6: Table of the functional requirement list for the system with the assigned priority level and justification

4.4 Existing Tools Overview

A plethora of different tools are used in the School of Informatics to aid both the marking and administrative processes. This subsection outlines some of the tools, including their benefits and drawbacks, indicating why the current solution does not satisfy all of the needs in the School.

4.4.1 Blackboard Learn [11]

Blackboard Learn [11] is a multi-faceted system used throughout the University of Edinburgh and many other institutions globally [11].

Course organisers are able to publish all course materials on the course page, as well as assign editing access to staff involved [11]. Submission boxes can be set up so students are able to upload their work directly in the system, download and view their attempts. When marking, the staff involved may see the marking rubrics (see fig. 4.4) and the submission at the same time side-by-side. Marks and feedback can also be imported into the system using a pre-determined data format. Students can access their grades and feedback comments right on the system as well, while course organisers can see an overview of all results in the ”Grade Center” section of the tool.

Although extremely powerful, it is designed to mark report-based submissions and lacks many features academic staff in School of Informatics require, such as support for coding assignments, making it an unlikely choice overall.

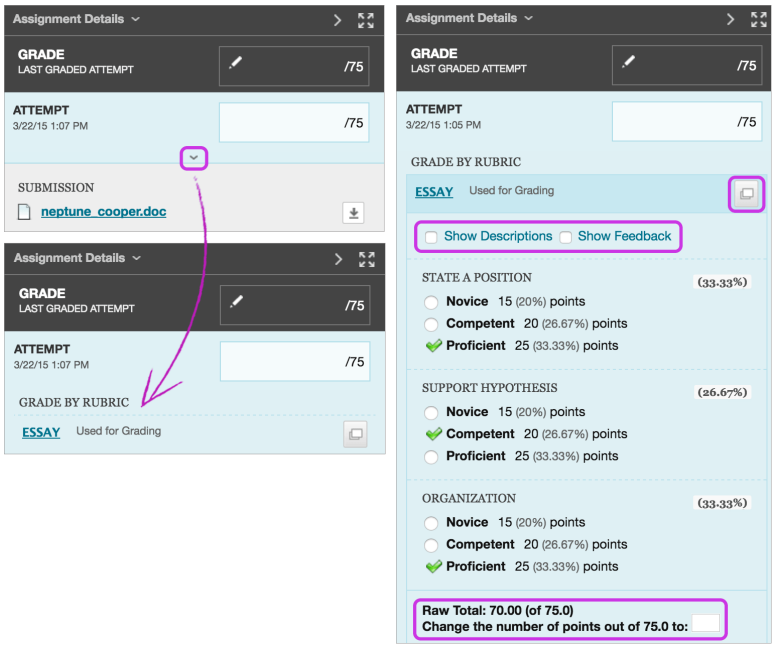


Figure 4.4: View of rubric based marking on Learn [9]

4.4.2 Turnitin [21]

Turnitin [21] is the primary submission and evaluation tool for written assignments used in the University of Edinburgh [21].

Advertised as a tool offering robust plagiarism checks, it has various features tailored to the higher education market [21]:

- Industry leading plagiarism checker
- Acceptance of many different formats of submissions
- Integration with popular learning management systems (LMS)

As was the case with Learn [11], it provides a nice view of both the submission and marking area side-by-side [21]. Markers may enter their feedback next to the submission, annotate parts of the documents (see fig. 4.5) and see the score of similarity obtained by checking the assignment against their extensive database. Students may access their marks and feedback in the system.

Although popular amongst many courses in the University, it is rarely used in the School of Informatics due to low numbers of report-based assignments in the School compared to other parts of the University.

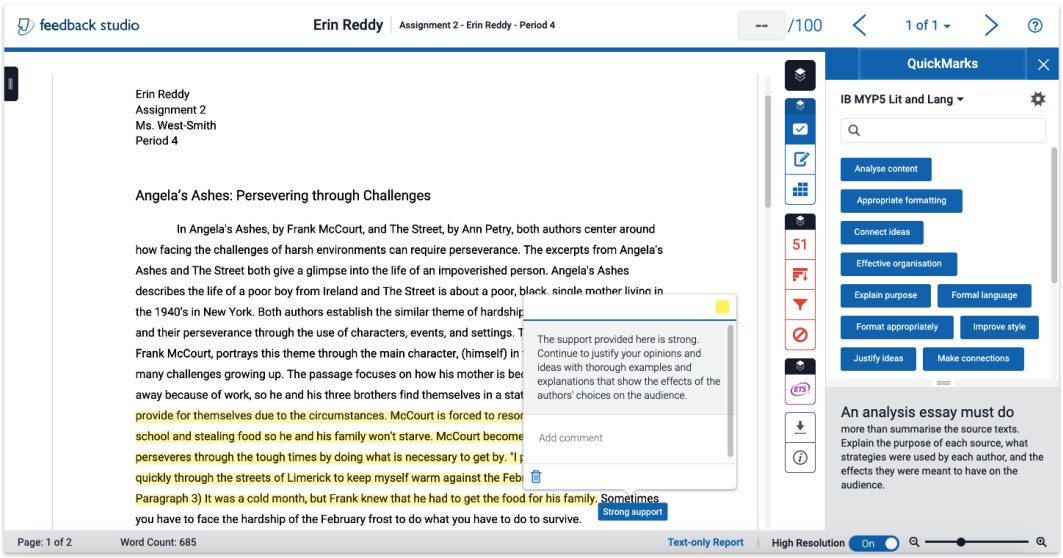


Figure 4.5: Annotating reports in Turnitin [2]

4.4.3 Gradescope [40]

Gradescope [40] offers an industry leading solution for assignment marking, used at over 600 institutions worldwide [40]. The product has been recently acquired by Turnitin [21] - a company whose products have been widely used throughout University of Edinburgh.

The system is standalone but offers many unique features that similar tools lack [40]:

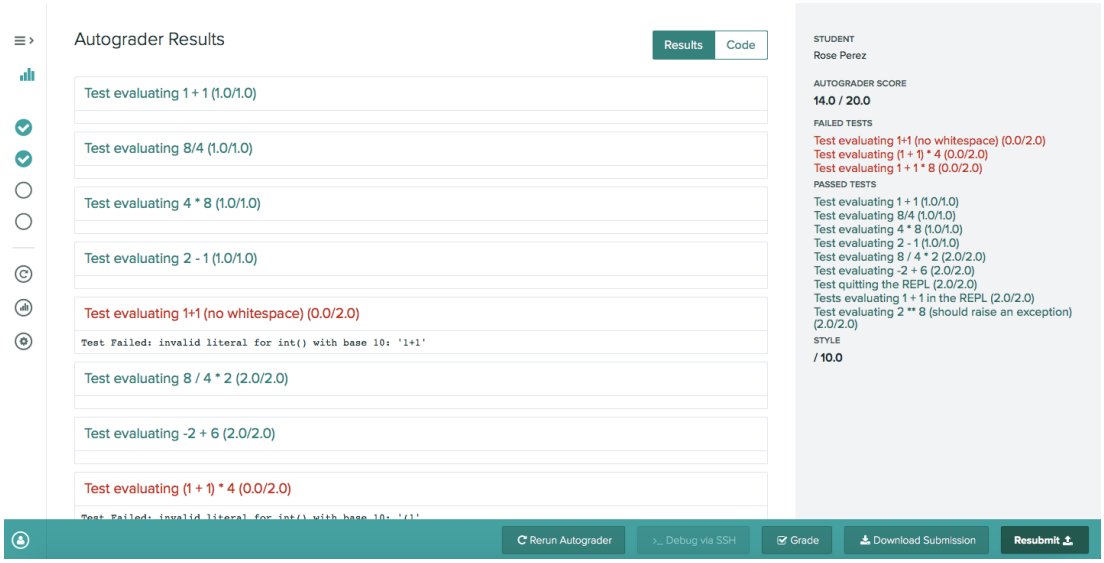


Figure 4.6: Gradescope's [40] automarker interface showing results of unit tests [40]

- Marking of both physical (supports scanned uploads, sections using AI) and digital assignment papers
- AI assisted answer grouping into buckets to minimise the number of submissions to mark
- Auto-marking of coding assignments (see fig. 4.6 for the automarker interface)
- Submission both in-system and using version control systems (VCS)
- Basic integration with learning management systems (LMS) like Learn [11]

However, it does lack some features academics use in their custom tools [40]:

- Enforced submission format check
- Limited user roles - either a marker or a student
- No command line interface (CLI) access to submissions for additional processing - this is important for the School of Informatics as many academics prefer dealing with data without the use of GUIs

Gradescope [40] has been successfully trialled in School of Informatics in Semester 1 of Academic Year 2019-2020. It has proven to have ticked most of the boxes any system in the School would require. However, it does lack support for certain specific functionality (see list above) some staff require and there are no plans to support these custom features.

4.4.4 CodeGrade [38]

CodeGrade [38] is a tool created specifically for marking programming exercises [38]. It was developed by students in the University of Amsterdam as they had noticed the lack of proper tools for the task.

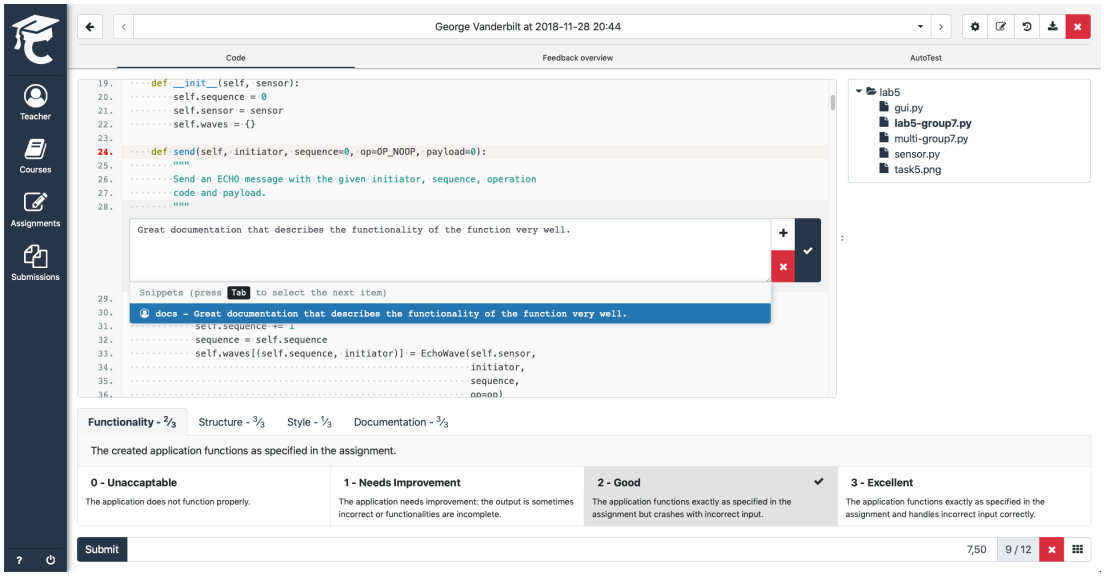


Figure 4.7: CodeGrade's code viewer interface [38]

Codegrade [38] offers a serious feature-set purely focused on efficiently marking coding assignments [38]:

- Inline feedback alongside code (see fig. 4.7)
- Automated grading using a set of tests, including custom test scripts and unit tests
- Ability to offer continuous feedback to students on a subset of tests before the submission deadline
- Access to submissions using a command line interface (CLI) by mounting a custom file system
- GDPR compliant plagiarism checker
- Learning management system (LMS) integration

As was the case with Gradescope [40], CodeGrade [38] is to be trialled in the School of Informatics. Although the tool seems to have most of the features academic staff need to set up programming assignments, other types of evaluation are not supported, meaning very few courses would be able to use this as the only solution for marking and feedback [38].

4.4.5 Comparison

Based on the research results, a table (see table 4.7) comparing the different tools and their functionality was compiled. As evident, none of the tools satisfy every requirement. For code-based submissions, CodeGrade [38] seems to tick the most boxes, however, it does not support other types of assignments. Gradescope [40] seems to be the all-around best solution, but like [40], it lacks certain features academics need (e.g.

plagiarism checks for all types of assignments), so they would still be forced to use a combination of different tools to achieve their course-specific needs.

Feature	Learn	Turnitin	CodeGrade	Gradescope
Integration with LMSs	N/A	✓	✓	✓
Ability to quickly reuse same feedback comment		✓	✓	✓
Support for multiple user roles	Limited	Limited	✓	Limited
Import / export data	✓	✓	✓	✓
AI-assisted grading for large classes				✓
Support for report-based submissions	✓	✓		✓
Plagiarism checks for report-based submissions		✓	N/A	
Support for code submissions / automarking			✓	✓
Plagiarism checks for code-based submissions	N/A	N/A	✓	Limited
Inline code comment support	N/A	N/A	✓	✓
Submission access via command-line interface			✓	Limited

Table 4.7: Comparison of different tools used to assist marking, feedback and moderation processes

4.5 Summary

In this chapter we outlined the approach taken for the requirements gathering study with students, academic, teaching support and administrative staff. Using the data collected from the interviews and focus group sessions, and a comparison between different tools used across the School, a list of requirements for a potential tool was created and presented. This will be used in the next stage of the process, design, which will be described in the following chapter.

Chapter 5

Design & Formative Evaluation

After committing to the requirements list presented in chapter 4, work begun on designing the system that satisfies the required functionality.

This chapter outlines the process of the design stage of the marking, feedback and moderation tool proposed. This includes detailing the several iterations of the creative process, as well as the feedback sessions with the potential user groups of the system. It focuses on the following research questions:

- RQ6 - How can we design a tool to address the needs of academic staff, administrative staff, teaching support staff and students?
- RQ7 - How is the usability of the proposed design perceived by academic staff, administrative staff, teaching support staff, students?

The studies described in the chapter was certified according to the Informatics Research Ethics Process, RT number 2019/62506.

5.1 Process Overview

An iterative design approach was used throughout the process [46]. This meant several iterations of the design have been produced based on notes from the feedback sessions to incorporate user feedback into the next iteration. The list below outlines an overview of the general approach:

1. First Iteration - Low-Fidelity Prototype
2. Second Iteration - Medium-Fidelity Prototype
3. Formative Evaluation - Teaching Support Staff
4. Formative Evaluation - Academic Staff
5. Third Iteration - Medium-Fidelity Prototype

5.2 First Iteration - Low-Fidelity Prototype

This first step of the design involved producing some rough sketches (paper prototypes) [42]. The approach chosen allowed for a rapid creative process with no commitment to discarded ideas.

The required flexibility of the proposed tool introduced lots of confusing terminology, allowing potentially complex workflows. Thus paper prototypes played a crucial part early in the design process - they were used to present the basic functionality and interaction within the system and its features to my supervisor and gain an understanding on how to proceed. They helped to determine the core sections and elements of the system that were to be later improved or remain part of the final design.

Several selected screens were designed for this early design stage. Priority was given to the necessary website components (common navigation, sidebars) and interfaces that were associated with the most complex aspects of the system - automated workflows (also known as *"Jobs"*) and submission database (*"Submissions"*).

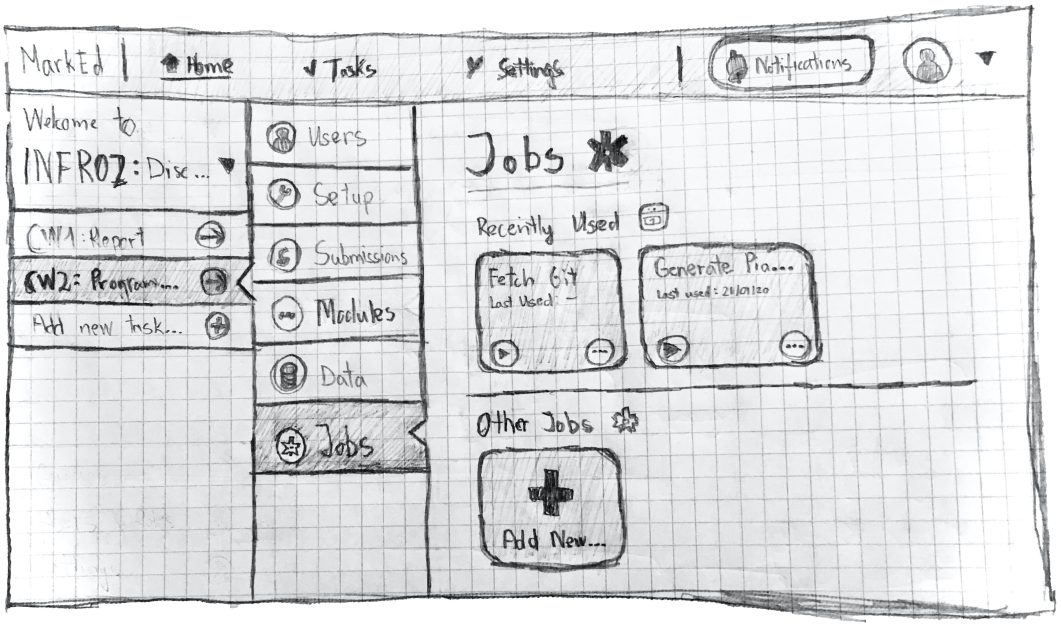


Figure 5.1: Paper prototype of the *"Jobs"* page for MarkEd

5.2.1 Core Navigation

The core navigation in the first iteration, as shown in fig. 5.1, was achieved with a menu bar at the top of the screen and an expandable, multi-column sidebar on the left side of the screen.

The top bar, which is consistent across many existing tools, provided site-level navigation as well as access to notifications and profile. The sidebar allowed to switch between courses, assignments and subsections within a single assignment. It also served to provide some system status visibility to the user.

5.2.2 Jobs

An important feature of the system was the notion of *"Jobs"*. These were created as a way to enable to design workflows for course organisers to be set up and run automatically (requirements 2.6, 4.1 in table 4.6).

After the requirements gathering process concluded, it was clear that the system needed a lot of flexibility to satisfy the specific needs for not only existing courses, but courses in the future. It was apparent that the tool had to be modular with expansion capabilities to future-proof it against new requirements. This introduced the notion of *modules* - small components that can act independently and be built by external developers, as long as they conform to the standard specification.

A single module can have a specific configuration and perform some actions with the data in the system, e.g. an "Export Module" could be configured to export data in the format that is agreed with the ITO [32] (requirement 4.2 in table 4.6).

A *"job"* can utilise a number of modules within the system to perform a series of predefined steps. Example of a module could be an *"Import Data"* module. Using several modules and their functionality, workflows, such as *"When a new submission is uploaded, send an email to the course organiser"* can be created and enabled.

A configuration page for an automarking job is pictured in fig. 5.2 and can be reached by selecting a single job from the page in fig. 5.1. As a high-level overview, this job utilises three modules - for automarking, scaling (adjusting marks according to a function, e.g. linearly) and emailing. The idea was to allow course organisers to run their custom code that automarks submissions, scales the resulting marks appropriately and emails the relevant results to students. This works by the module applying some processing on data that was configured to be used (in this case, students submissions and associated mark column in the database), producing some outputs (automarker results) and then using these as inputs (and any other data, if necessary) to perform the remaining steps.

Once a job is configured, it can be *duplicated* (i.e. by tapping an option to copy) and modified slightly to allow reuse of similar functionality in other courses or pieces of assessment, following the requirement on modularity.

The page was created after many conversations with my supervisor and project partner. These mainly involved decisions on what a module should be and what should be considered part of the framework, as well as how modules can be utilised, how their inputs and outputs work, what data formats they should support to not restrict the user too much. My initial idea of a module was to support one action at a time, but given these discussions, the notion was expanded to allow a series of automated steps, as discussed prior.

5.2.3 Submissions

Another key component of the system was the ability to quickly access and modify raw data on student submissions and how they have been marked. This is what is called the *"Submissions"* page.

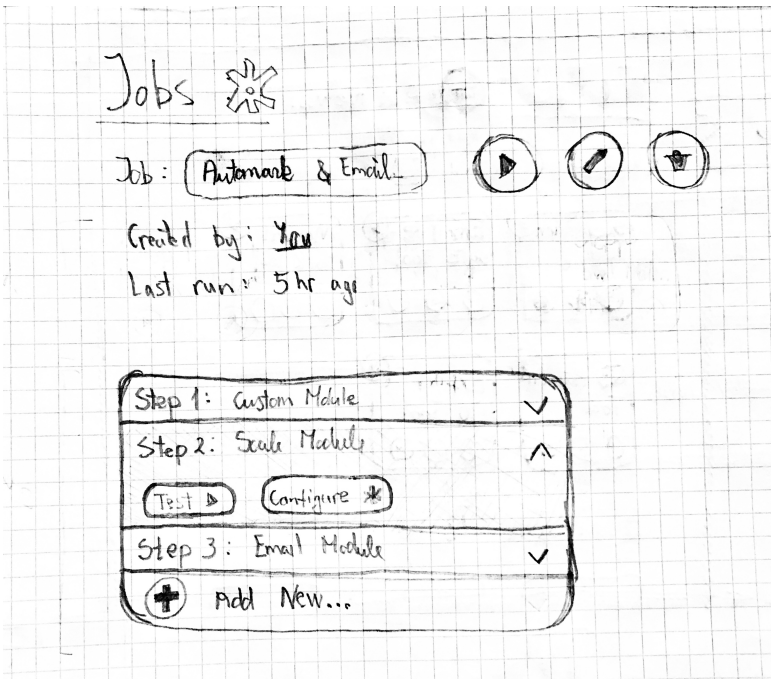


Figure 5.2: Paper prototype of the automarking job configuration page

The idea was to introduce a section in the tool that contains a large table (see fig. 5.3) with marking data. Course organisers and other user roles in the system that have the relevant permissions (requirement 2.10 in table 4.6) would be able to access this and have a quick overview of the results - all in one place. This would also provide an opportunity to spot any irregular patterns in results or any errors, fix them without leaving the page.

Each row denotes a single submission. The icons in the right of each row enabled to access some quick actions with the relevant submission, such as opening it, deleting, downloading.

We also needed a way to allow course organisers to assign marked pieces of assessment to their markers. The *"Submissions"* page is where the assignment (requirement 2.3 in table 4.6) option would be placed in - you may see this in fig. 5.3 as the *"Bulk Assign"* button. This would open up an overlay window that allows to select the assignment of different granularity (per submission, per question, custom) and the marker to assign.

This component was designed after discussions with my partner and my supervisor who have given me some informal feedback. Specific points of discussion included where should the assignment functionality be placed, as well as whether such a page is useful and what it should contain.

5.3 Second Iteration - Medium-Fidelity Prototype

After the general idea of how the most crucial components would be inter-connected was explored, I made a decision to move further design work to Figma [7].

Figure 5.3: Paper prototype of the submissions page

Design work on Figma was a lot more extensive than that for the paper sketches described in section 5.2. More interfaces were designed in preparation for formative evaluation sessions. The subsections below describe the functionality this prototype contained, as well as justification of design choices made.

5.3.1 Materials

Beginning with this iteration of the design, all icons and images used in the prototype have been sourced from the Iconify [10] and Unsplash [13] plugins on Figma [7] and licensed appropriately for prototyping purposes.

5.3.2 Core Navigation

Based on the formative feedback form my supervisor, the navigation has been severely simplified from what was described in section 5.2.1. As visible in fig. 5.5, the sidebar no longer has multiple columns. The sidebar now only allows to switch between different subpages (e.g. *"Dashboard"*) of the current assignment. Users are expected to make additional clicks to switch between different assignments and courses (selecting the home page and then choosing the desired assignment, see fig. 5.4), but the navigation is simpler overall and there is more free screen estate for main content.

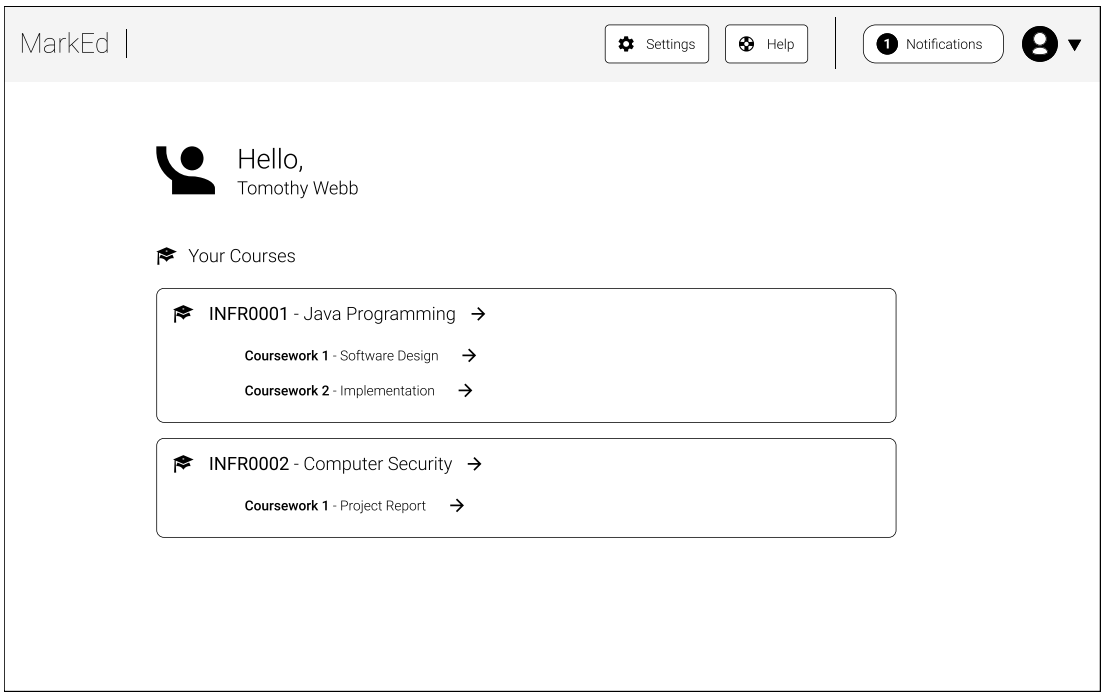


Figure 5.4: Home page in medium-fidelity prototypes

5.3.3 Assignment Dashboard

The assignment dashboard (see fig. 5.5) contains the overview information about the assignment (requirements 2.4, 3.1 in table 4.6). This acts as a landing page when a specific course has been selected on the homepage.

This page allows those involved in marking to see their individual progress, as well as the entire team's progress in marking. It also gives shortcuts to frequently accessed functions, such as accessing submissions assigned for marking to the user, or accessing information about specific team members.

This progress information was added to support the requirement of an ability to track marker progress, while shortcuts to various useful functionality was added based on my own judgement on what users might want to access when entering an assignment page.

5.3.4 Submissions

The submissions page (see fig. 5.6) had major changes from the low-fidelity prototype to allow for new functionality based on the requirements. It now allows to control, i.e. enable submissions with specific file formats only (requirement 1.1 in table 4.6), and see the status of the submission box, i.e. how many attempts did a student have at a submission (requirement 1.4 in table 4.6).

The submission page also acts as the primary page from which you can open the marking view (see section 5.3.5) of a submission. The user can select submissions from the submission box section and then open the marking view for these by tapping *"Mark"*.

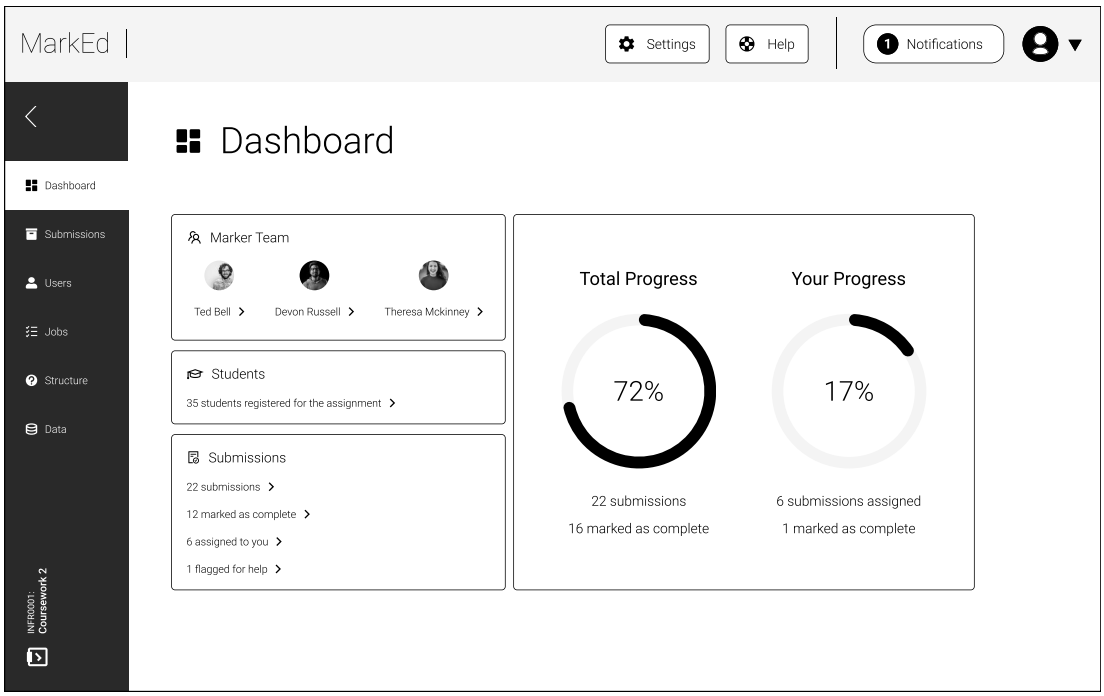


Figure 5.5: Assignment dashboard page in medium-fidelity prototypes

If more than one submission was selected, *Previous* and *Next* options would be visible in the viewer. The user can also open a submission without editing rights (read-only) by selecting the *"View"* option instead of *"Mark"* (only one option is active based on access rights).

The design was updated from the previous iteration while taking some inspiration from existing tools, like Learn [11], that contain similar mark overview pages, e.g. "Grade Center".

An important requirement for the academic user group was assignment of submissions or questions per submission to markers (requirement 2.3 in table 4.6). Another important feature was ability to import data to the tool, for example, if other tools are used to aid the marking, feedback and moderation processes (requirements 4.1 and 4.2 in table 4.6).

To accommodate both of these, two additional buttons (only visible to course organisers) were added to the "Structure" page. When the "Assign" button is tapped, an overlay window (see fig. 5.7) opens. This contains options such as selecting the marker to assign (A), the assignment type and an area to select which questions, students or both should be assigned (B), and a selection preview area that allows a quick overview over the table from the "Data" page with rows/columns relevant to the selection highlighted (C).

5.3.5 Marking View

Marking view (see fig. 5.8) is a new page in the system that allows to perform the more traditional type of marking. This page is part of a marking module that we created

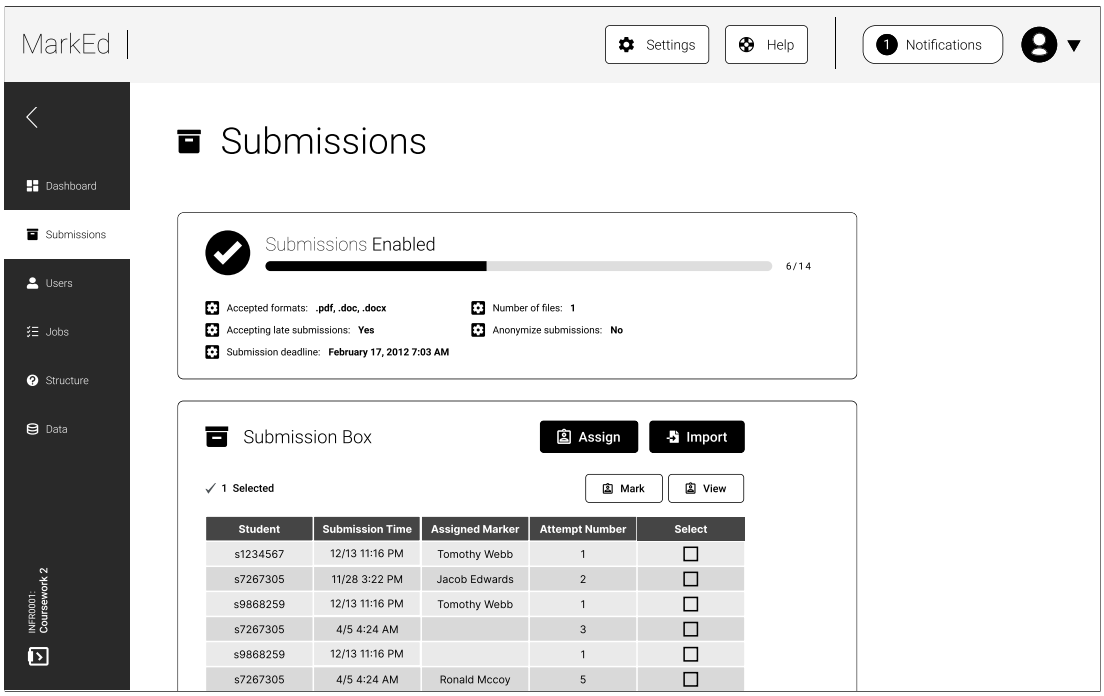


Figure 5.6: Submissions page in medium-fidelity prototypes

for demonstration purposes and would be considered a 'default', built-in module that can be replaced with other alternatives, if needed. The page consists of three main components - the file viewer, marking sidebar and a toolbar.

The file viewer is a scrollable frame that allows to see the submission files. It also allows to switch between multiple files or submission attempts at ease without reloading the entire page and losing your marking progress.

The column on the right of the file viewer is referred to as the *marking sidebar*. This contains the questions to be marked and areas to put the mark and feedback for each question (requirement 2.2 in table 4.6).

If specified by the course organiser, the markers can access a *"Marking Guide"* that shows notes to guide the marker. This feature did not have an associated requirement but was inspired by the course organisers mentioning they frequently tell information regarding the marking using pre-marking meetings, so this allowed support displaying some of that information in a non-verbal form when needed.

All the question boxes are expandable to allow for convenient marking and to minimise the need for scrolling, for example, by only expanding questions 1 and 3, if quick comparison between the two might prove to be useful.

The question boxes also contain a way to *flag* questions for further action (requirement 2.8 in table 4.6). The system allows any submission or an individual question/rubric to be assigned custom flags, for example *Help*. This allows those involved in the marking process to mark areas requiring further attention, leave notes to self. For example, a marker could signal to the course organiser that they were unsure about marking a particular question in the submission using the *Help* flag. Another use case could be

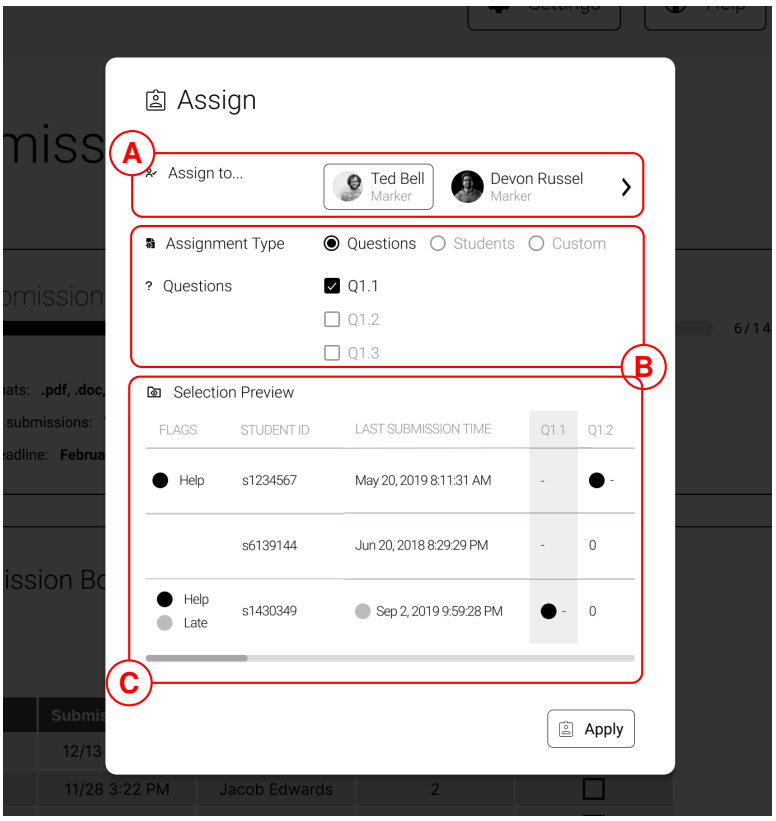


Figure 5.7: Overlay window for a new assignment accessible from the Submissions page in the medium-fidelity prototype

for the staff to flag certain submissions as *To Moderate* to signify that submissions with this flag should be involved in the moderation processes. New flags can be created or you can select ones that have already been created by other users, for example, if a course organisers wants to use a certain flagging system agreed in advance.

Finally, above the file viewer frame you can see the toolbar. This is for triggering the submission-wide actions, such as saving the work done for the submission (either as draft or as complete, the latter to allow the system to determine when the work was marked as finished for a particular submission) or tagging the full submission. It also displays the options to navigate between multiple submissions, if the viewer was opened with more than one selected.

5.3.6 Data Page

Marking data page (fig. 5.9) is an extension of the ideas for a Submissions page in low-fidelity prototype (see section 5.2.3). As mentioned previously, it allows to access all the raw marking data in a single table with the ability to quickly edit data and get an overview (requirements 2.4, 2.8, 3.2 in table 4.6).

This is separate from the Submissions page in the medium-fidelity prototype, which only gives the bare minimum information about submissions received, rather than the full marking data. This was the idea supported by my supervisor, as she, being an

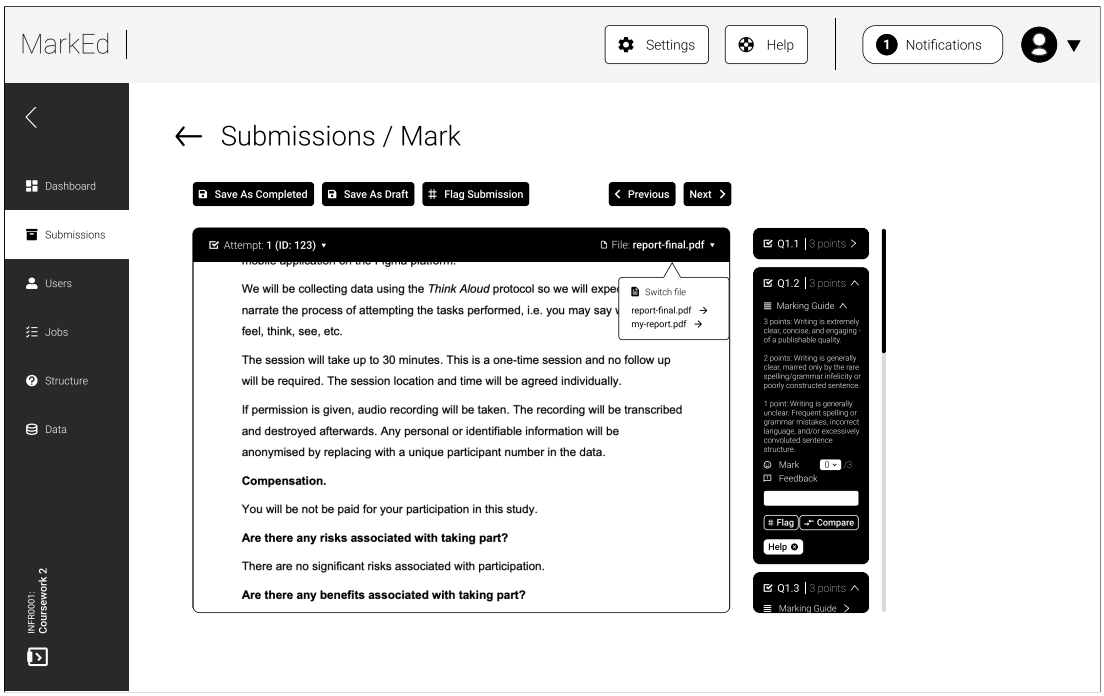


Figure 5.8: Marking view page in medium-fidelity prototypes

academic herself, says likes having a separate page that gives an overview of just the submissions to avoid having a cluttered page that does not usually require action.

To accommodate large amounts of data, the table supports both vertical and horizontal scrolling. Data might can be sorted based on columns and be easily edited without leaving the page by selecting a submission and tapping the ”Edit” button above the table.

One important aspect of this page is the ability to see questions/rubrics or submissions that have been *flagged*. The table provides an overview of all flags for the row using coloured circles and a legend at the front of each row. If a specific question/rubric was flagged, a circle appears in the relevant column. Otherwise, if the entire submission is flagged, the row only contains the flag in the first (legend) column.

Finally, similarly to the ”Structure” page, you can access the marking view for a submission by selecting a row for a particular submission and tapping the ”Mark” option above the table.

5.3.7 Structure

To accommodate a lot of functionality in the system (requirements 2.4, 2.7, 3.1, 3.2, 4.2 in table 4.6), such as setting up the databases and having an ability to import/export marks, the tool must have an understanding of the assignment structure. The ”Structure” page (see fig. 5.10) allows to establish the relationships between database columns and mark/feedback inputs.

From this page, the course organiser can see the questions (or rubrics) defined already

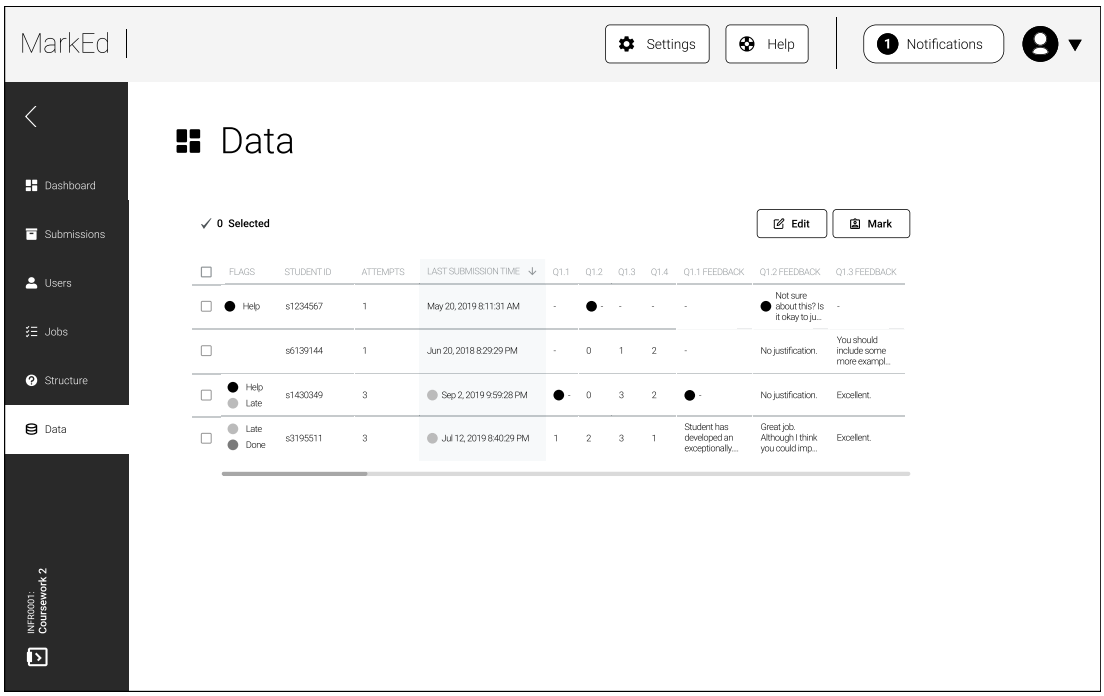


Figure 5.9: Marking data page in medium-fidelity prototypes

(A) or create a new marked element (B). The latter opens up an overlay window (see fig. 5.11) that asks for basic information, such as the name of the marked element, what type of input it should accept, marking guide entry.

This was made to be as flexible as possible. We did not want to force course organisers to use a specific format of marking, for example, just numbers for mark input. We gave options to input numbers, free text or even select from one of pre-defined options, if the assignment requires this.

The naming was given particular thought as well: we chose the word ”Element” to accommodate cases where this might be used for other types of marking. For example, element names could be both ”Code Readability” and ”Question 1”, depending on the context of the assignment.

5.3.8 Modules

The ”Modules” page (see fig. 5.12) offers an overview of modules currently installed and configured, as well as introduces a ”Module Marketplace” concept that allows developers to share modules that they have built.

Each module can be easily enabled or disabled through the use of a toggle and configured in a separate screen.

The module marketplace allows a search for modules functionality, as well as browsing the full list and ”Adding” the functionality as needed.

Figure 5.10: Structure page in medium-fidelity prototypes

5.3.9 Jobs

Following from the introduction to *modules* is the introduction of the notion of *jobs*. These define a way to link several modules into an automated sequence of steps - all defined by the course admin staff. This allows creating new an interesting workflows that automate the marking, feedback and moderation processes to a level that was not possible before.

An example job could be built to automark an assignment on submission an email the results by creating steps that utilise the functionality offered by the ”Run Code” and ”Email” modules. This crucially allows to, with an assumption that correct modules will be built, to satisfy some of the requirements (2.6, 4.1, 4.2, 4.4 in table 4.6) that required great flexibility - something was not possible to achieve using static off-the-shelf solutions.

Figure 5.13 shows the page that allows to create a new job for setting up email notifications to course organiser once a submission is tagged for moderation. Two components are a necessary part of any job - a trigger condition (A) and a sequence of steps (B). Outputs of any step become possible input for next steps to create a possibility of continuous work with the data.

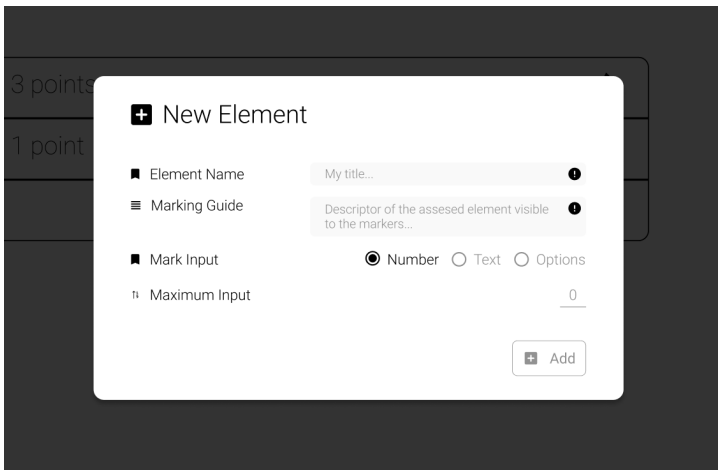


Figure 5.11: Overlay window for a new marked element accessible from the Structure page in medium-fidelity prototypes

5.4 Formative Evaluation - Teaching Support Staff

5.4.1 Aims

The formative evaluation session was designed to gain an understanding of what the teaching support staff involved in marking, feedback and moderation processes thought about the proposed design choices, whether this supported their way of working and provided advantages over other tools they currently employ (addressing RQ6). It was also crucial for understanding whether there were any apparent usability issues and served as an opportunity to ask about how they could be fixed (addressing RQ7).

5.4.2 Data Collection Methods

We used the stakeholder walkthrough (see section 2.2.4.1) method to guide the formative feedback session. The method allowed actionable feedback to be collected in a group setting which was particularly useful for us given we were able to organise a session after a training session (see section 5.4.3). It also saved us a lot of time by only having a single session as opposed to using methods like Think Aloud (see section 2.2.4.2) that require individual attention.

Audio recording (with consent) and notes were also taken.

5.4.3 Participants

The session was organised right after a training session for markers organised by my supervisor. All teaching support staff that were previously participants in the pre-design studies were invited to join. As well as that, markers who were participating in the training session were kindly invited to stay and participate in the study. We asked only people who marked at least once to participate.

The choice of the recruitment method is particularly important. The target group was relatively small - with some exceptions, undergraduate students are not allowed to be

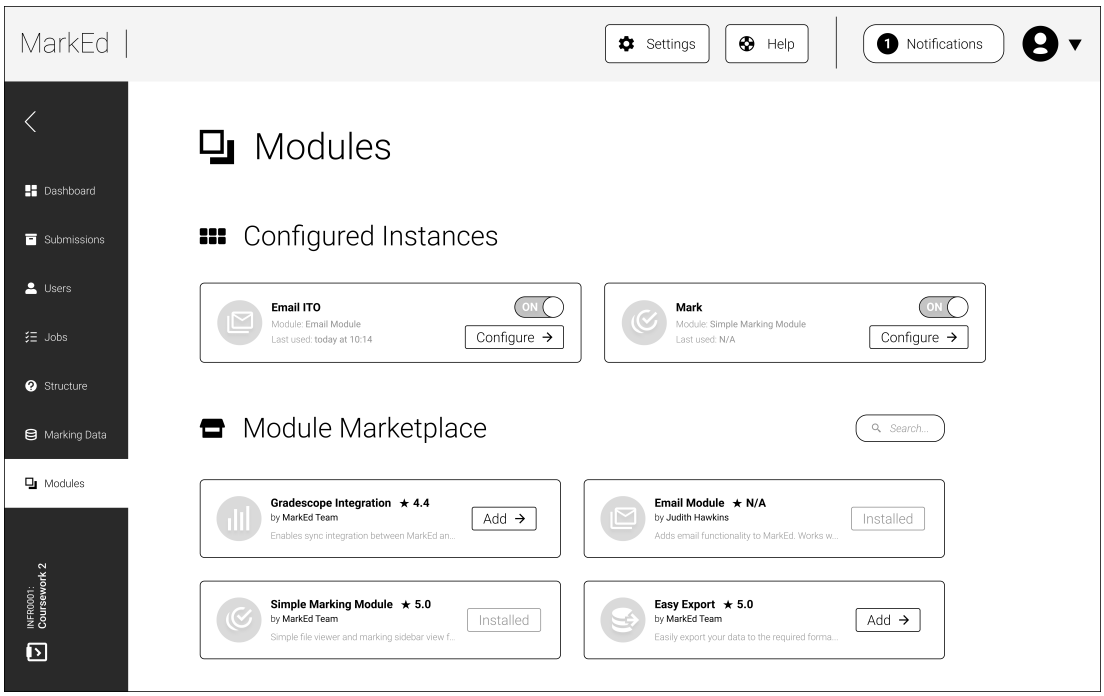


Figure 5.12: Modules page in the medium-fidelity prototype

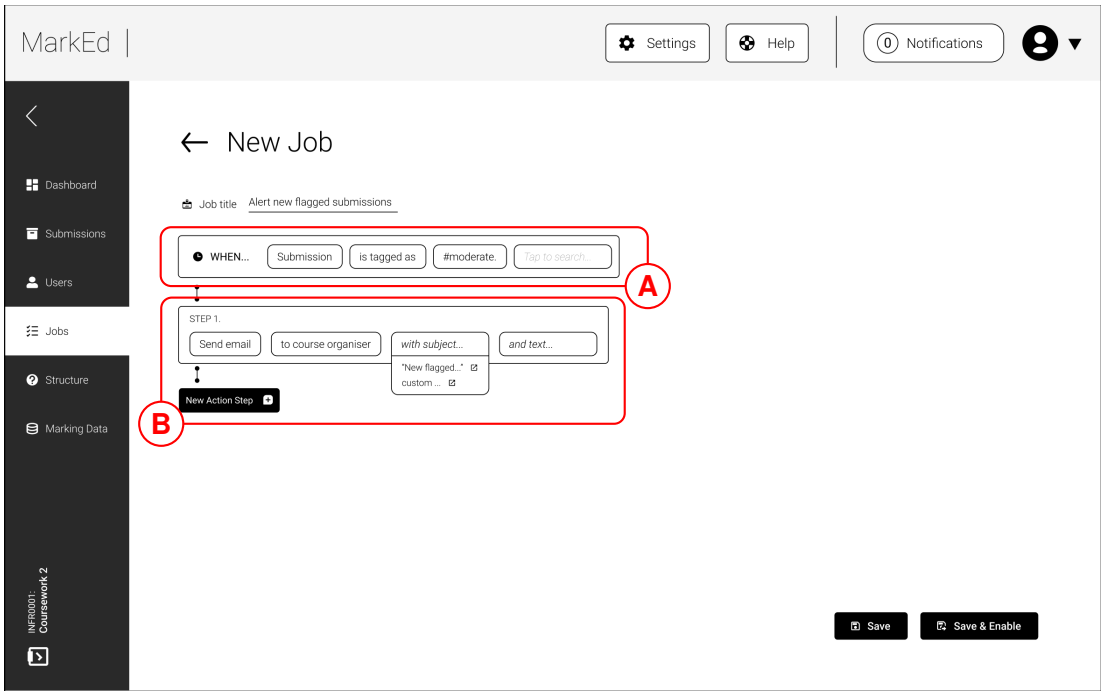


Figure 5.13: New job page in the medium-fidelity prototype

employed as markers, while few Masters students occupy this post because they are usually new to the university, PhD students are very busy with working on their theses. The sessions are time consuming so it is difficult to gauge interest in participation to those eligible. Markers who were already present in their training session at the time were more likely to be willing to participate, especially given that this tool was

intended to be designed for and used by them in the future. It also allowed us to do a single session with as many participants as possible instead of multiple sessions for smaller groups.

In total, 8 teaching support staff members participated in the study. Please see the breakdown of participants and their experience in table 5.1. As evident, most of the participants did not have high experience, but we were able to recruit several (3) more experienced markers.

Participant	Previous Participant	Experience
M7	Yes	Low
M8	No	Low
M9	No	Low
M10	Yes	Medium
M11	No	Medium
M12	No	Medium
M13	No	Low
M14	No	Low

Table 5.1: List of participants in the session with their level of experience (see auxiliary table 4.3 for the experience to years of experience mapping)

5.4.4 Materials

Adapting resources from the previous study, a new Participant Information Sheet (see appendix B.1.1) was prepared. The same Participant Consent Form (see appendix A.1) that was used in the requirements gathering studies was used.

As well as the PIS, some marker-targeted tasks were designed to test out the marking functionality of the system, as this is the primary type of task that markers are exposed to. The experiences noted were used to address RQ6 and RQ7. See appendix B.2.1 for the full task list. This list also contained several additional questions including background and the overall experience while interacting with the prototype, as well as asking for suggestions for improvement.

Every participant was also given a bundle of printed, stapled and ordered (according to the order of going through the tasks) screenshots of the interface - 1 screenshot per side. These were used to allow each individual to draw/write their interactions and comments on.

5.4.5 Protocol

During the session, I was acting as the lead researcher, my supervisor assisted and helped with the interaction with the participants and my colleague was taking notes and recording audio. Participants were asked to come to the Informatics Forum at the School of Informatics of University of Edinburgh. The agreed session time was up to 45 minutes.

As soon as everyone was seated in a semi-circle (to allow participants easier interaction with one another), I provided every participant with the necessary paperwork: interface screenshots, Participant Information Sheet and Consent Form (see section 5.4.4 for more details). Time was given for the participants to examine the Participant Information Sheet, ask any clarifying questions and sign the Consent Form. I also made sure everyone consented to being audio recorded.

Once the session started, participants were briefed on what would happen next. I was asking them to do one task at a time that I would read out. They would be told the page (screenshot) number they should begin the task at, and the page number they should be at after finishing the task. Participants were asked to perform some action on every page to proceed with the task and note/mark that action on the printed screenshot. Once they note the action, they were allowed to proceed to the next page.

After each task, I would ask everyone whether they had any difficulties in round robin style (getting to a different page, not knowing what to do, etc). If there were issues, I opened up discussion for everyone to state their opinions and moderated this, with the help of my supervisor, to make sure everyone had a say. I would then explain what were the expected series of actions and asked whether they had any suggestions to improve the workflow.

When all tasks were complete, I asked everyone some extra questions regarding their background and overall experience with the prototype. Once this was done, participants were given one last chance to add any comments or ask anything and then the audio recording was stopped. Afterwards, I kindly thanked them for their time.

5.4.6 Data Analysis

The recorded audio was used to produce a transcript. Unfortunately, some audio of the last part of the session had become corrupted, so notes were used to augment the remainder of the session transcription. This was imported into NVivo 12 [12] and coded using thematic analysis (see section 2.2.3.4) to understand what were the general feelings about the prototype and what fixes must be prioritised before the next iteration. A similar approach as in previous study (see section 4.1.6) was used in the coding process.

Resulting nodes can be seen visualised in fig. 5.14.

5.4.7 Results

This section contains a summary of the results from the thematic analysis performed. Given that a large portion of the audio recording was lost (see section 5.4.2), direct quotes and participant opinion numbers were impossible to retrieve for some of the tasks.

5.4.7.1 Navigation

The majority of required interactions to perform the tasks were identified correctly.

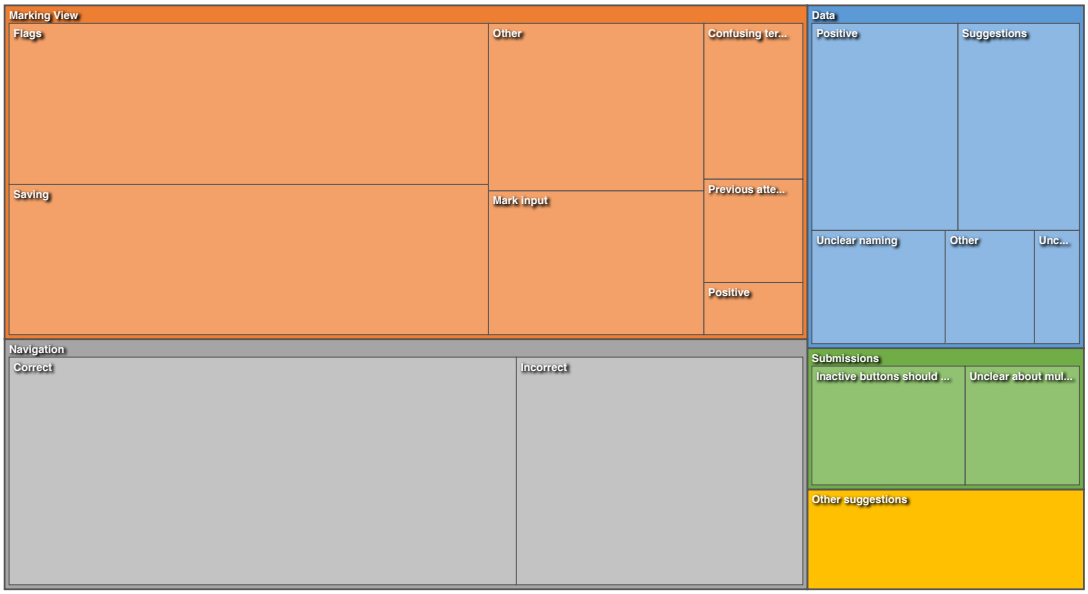


Figure 5.14: Nodes as a hierarchical graph (sized by number of references)

Some incorrect interactions were caused by wording of the tasks (2 participants selected the ”Compare” option instead of ”Previous” when asked to open the previous students’ submission). This might be a potential issue due to the phrasing of the question, but participants said it was clear when we explained the correct sequence of actions.

Problems occurred with participants incorrectly identifying the *”Data”* page when asked to open the page that would hold the overview of tagged submissions. Many participants (number unclear due to data loss) were either confused or made the wrong decision. Suggestions included to change the name of the page and merging it with the ”Submissions” page.

5.4.7.2 Submissions

In the submissions page, a participant mentioned (and others indicated agreement) that buttons, such as ”Mark” that appear only after at least 1 row is selected in the table, should always be visible - even if they are inactive.

> *“I think it would have been useful to have these buttons already visible even if you haven’t selected anyone - just so you know you have those options.”* - M7

There was also agreement that having both the ”View” and ”Mark” buttons was confusing as they seemingly pointed to the same destination page.

5.4.7.3 Marking view

There was a debate regarding the saving functionality in the marking view. 2 participants preferred to have the ”Save” button for each question marked, while others said

having it per submission was fine. 1 participant also mentioned having an expectation of an autosave feature.

> *"I didn't notice there was a draft button and I would not have expected there to be because I expect a web app to keep my state even If I don't press the button."* - M14

Two participants signalled that the "Previous" and "Next" navigation between the submissions was misleading, as there was no indication what was the next/previous ID.

There were also concerns regarding the mark input. 2 participants were expecting a free input (rather than a selector) so mark of any granularity is supported. It was also mentioned by one participant that ambiguity between 0 marks and unmarked should be cleared up:

> *"Also, maybe there should be a way to say "I gave 0 marks" to this question, rather than leaving it as unmarked. So that there's a difference between "I gave them 0 marks" and "I haven't marked this yet""* - M14

2 participants noted they do not need the switching between attempts functionality. It was mentioned that, according to Schools' policy, only last attempt should be looked at and marked. But this feature is something that requires additional investigation as it was mentioned as being used in some courses.

It was also mentioned by a participant that text size, particularly in the marking sidebar, should be increased in place of empty area around the marking interface.

Whilst the functionality of tagging was generally well received, the name caused confusion to several (2) participants. Suggestions for alternative naming options included "Tag" and "Label".

> *"I wasn't sure what "Flag" meant. Given you gave us that instruction it was clear to me that is what I had to do, but I would have been hesitant to click it, because I thought it would have to do with plagiarism or something."* - M11

5.4.7.4 Data

There was a generally positive outlook on the data page and its purpose. The ability to quickly glance over a large set of marks for comparison or error-spotting was particularly praised.

However, around half of the participants (unclear due to partial data loss) agreed that the name of the page was confusing (see section 5.4.7.1). Some suggestions to fix this included finding another name, potentially merging it with the table in the *"Structure"* page.

Suggestions for expansion included comparisons between academic years, adding filters, additional data such as average per column.

5.4.7.5 Other suggestions

Several participants (2) mentioned needing some textual/visual cues for help on different pages. For example, question icons with information on hover, or descriptions on the page with more information.

It was also suggested (1 participant) to have a possibility to view multiple submissions or the paper and the submission at once (split view).

5.5 Formative Evaluation - Academic Staff

5.5.1 Aims

The purpose of this evaluation was to determine what were the academic staff opinions about the tool's usability and feature set. The formative feedback, in conjunction to the feedback from the teaching support staff evaluation session (see section 5.4), would be used to improve the prototype and produce a third iteration that would be used for summative assessment.

5.5.2 Terminology Changes

Although changes to existing interfaces between the two formative evaluation sessions were kept to a minimum to avoid skewing comparative results (major changes would be applied to the third iteration after both evaluations are complete and analysed), a few tasks were found to be particularly challenging by previous teaching support staff participants because of confusing terminology.

Taking this into account, the ”Data” page was renamed to ”Marking Data”. Another minor change involved changing the terminology of the flagging functionality. As suggested by multiple users (see section 5.4.7.3), it was renamed to ”Tag”. To signify the purpose of the functionality further, all ”flags”, such as ”Assistance Needed” were changed into hashtag-like names, e.g. ”#help”.

5.5.3 Data Collection Methods

As with previous evaluation, the Stakeholder Walkthrough (see 2.2.4.1) method was used. Unfortunately, due to UCU [22] strikes happening at the time of the session, an online adaptation had to be pursued. Audio recording of the remote session and the chat history were collected.

5.5.4 Participants

As established, the session coincided with the UCU [22] strike meaning staff were generally hard to recruit because they were either striking or only attending meetings remotely in solidarity. This proved to be especially challenging in recruiting willing participants.

My supervisor proposed to dedicate the timeslot of a meeting that she was involved in with some University teachers in the School of Informatics at the University of Edinburgh. The meeting happens every two weeks and gathers expert teachers from the School, so this was a great opportunity to hear feedback from senior academic staff. This also meant that I avoided potential scheduling issues as most participants already had this meeting scheduled as recurring.

Previous academic participants that contributed to the requirements gathering study were also contacted and asked to join the meeting, if possible. In total, 8 participants attended the online meeting. See table 5.2 for a breakdown.

Participant	Previous Participant	Experience
A10	Yes	High
A11	No	Low
A12	No	Low
A13	No	High
A14	Yes	High
A15	No	Low
A16	Yes	High
A17	Yes	High

Table 5.2: List of participants in the session with their level of experience (see auxiliary table 4.3 for the experience to years of experience mapping)

5.5.5 Materials

Materials used are similar to the previous evaluation (see section 5.4) with some exceptions: a new Participant Information Sheet (see appendix B.1.2), new task and question list (see appendix B.2.2) and participants used an interactive Figma [7] prototype instead of paper screenshots. To guide through the online session, a set of slides was prepared with instructions (see appendix B.2.2.3).

5.5.6 Protocol

Participants were sent a Participant Information Sheet (appendix B.1.2) and Consent Form (appendix A.1) by email in advance and asked to return the letter before the session start. They were also given advice to contact myself if any questions arise.

The session was held on Blackboard Collaborate [1] and was due to last up to an hour. Once everyone joined the session, I briefed the participants about the Stakeholder Walkthrough (see section 2.2.4.1) process using the prepared slides. A link was given for the participants to access the interactive Figma [7] prototype and perform the tasks. They were asked to write down in text to the chat if any actions they were intending to do did not match up with our expectations, along with any other comments regarding the design and functionality that they had.

Once all the tasks were complete, I asked each participants a couple of additional questions (see appendix B.2.2), thanked them for their time and concluded the session.

5.5.7 Data Analysis

Similarly to the previous evaluation session (see section 5.4) the audio recording of the session was transcribed. This, in conjunction with the text data from the chat, was used to perform thematic analysis (see section 2.2.3.4).

See fig. 5.15 for an outline of resulting nodes.

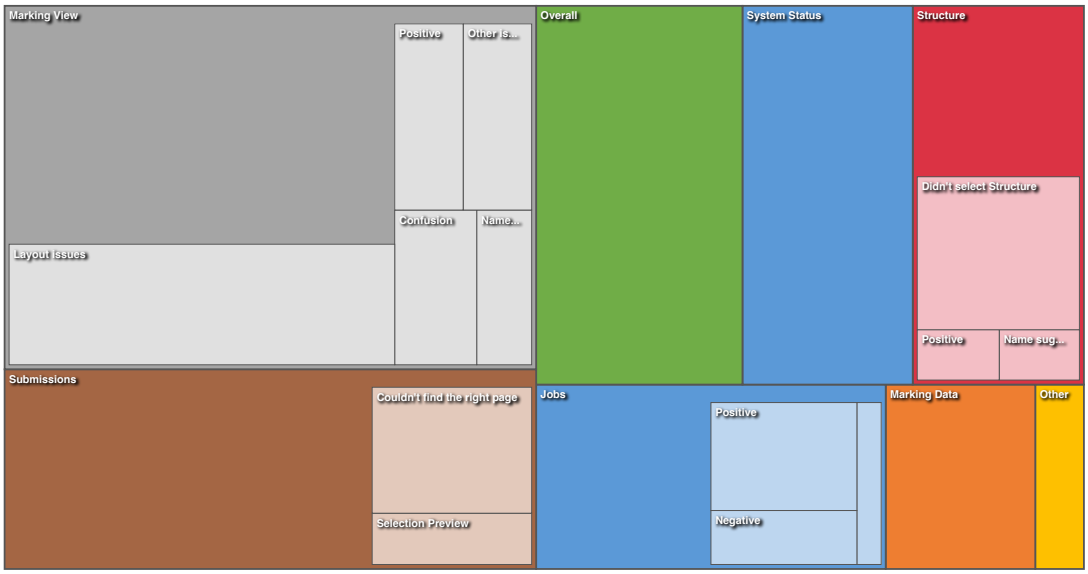


Figure 5.15: Nodes as a hierarchical graph (sized by number of references)

5.5.8 Results

The following is a summary of results from the academic staff formative evaluation session. These were gathered as part of data analysis and presented with direct quotes from participants where appropriate.

5.5.8.1 Structure

3/8 participants criticised the name of the page. Some of the suggestions given included ”Assignment Content”, ”Content”, ”Questions”. This could have been an issue with the task wording itself, as suggested by one of the participants and agreed by another three:

> *“I didn’t associate the word ’structure’ with the task you set.”* - A17

5.5.8.2 Submissions

6/8 participants were confused that they should open the ”Submissions” page once asked to assign a question to a marker. Part of this issue was the the immediately preceding task asked participants to add a new marked element in the ”Structure” page, so they expected the assignment to happen on the same page that they see the assignment setup.

> *"I was initially on the 'structure' page and tried to assign a marker for Q1.1 from there but couldn't. I only realised I should select the 'submissions' page due to the blue box hint. From there, it was all very intuitive."* - A14

In the assignment overlay, one participant mentioned they were unsure whether they correctly selected the marker because of the selection outline being unclear.

Another participant also highlighted that they were confused the "Selection Preview" area in the assignment overlay changes once some selection has been made.

5.5.8.3 Marking Data

In contrast to the previous evaluation, only 1 participant was unclear about the naming of the page and its purpose.

4 participants had suggestions and concerns regarding tags in the "Marking Data" page. 2 participants mentioned to add a visual legend of all tags in a single place, while another said the current layout suggest only having a fixed set of tags in the system. It was also brought up that the grey-scale colour scheme in particular added to the confusion when identifying tags on the screen.

> *"Does grey dot mean 'for moderation'? I did not get that part. If you use visual tokens, maybe have a key <...> "* - A15

1 participant mentioned that overall the task relating to the "Marking Data" page was useful and served as a good measure to markers who may be initially unfamiliar with the tool they are working with.

5.5.8.4 Marking View

In the "Marking View" page, 6 out of 8 participants highlighted some form of readability or design issues. White text on a black background, small font sizes and general under-use of space in the page were all mentioned. There were suggestions to make the marking sidebar bigger as that is the primary focus in the page.

> *"<...> majority of the screen real estate is taken up by the submission itself, i.e. normally an essay. Whereas in fact actually in Informatics most submissions are something that you would download. And so you don't need to take up so much screen real estate for the actual submission itself and you can expand that for the marking."* - A14

There were also concerns from one participant regarding button placement for various functions, such as "Save" and "Tag", being relatively far from one another.

One participant said the overall experience was very intuitive given that they had some prior experience with Blackboard Learn [11] which uses a similar layout for the marking process.

5.5.8.5 Jobs

3 participants stated they had a particularly positive outlook about the functionality of the page.

> *"It seems fairly straightforward for setting up what could be quite powerful rules."* - A12

One participant was unconvinced about the execution of this feature and preferred to have a grammar-driven approach.

> *"I'm old school. I found it really frustrating. Why would I want to create workflow with a GUI, rather than a language?"* - A16

One issues noted by a participant was the placement of the save buttons being on the bottom right (as opposed to top right elsewhere in the interface).

5.5.8.6 System Status

Majority of the participants (5) mentioned either not liking the way the course name and assignment are currently displayed (menu sidebar, vertical text) or missing it completely. They noted being worried of creating anything in the system without having a clear understanding on which course/assignment the action will applied to.

Suggestions were to move the information to top of the screen, making it a more visible part of the page and avoiding vertical text anywhere in the system.

5.5.8.7 Overall

Some participants (4) mentioned they were lacking an overall context of how the tasks connected to one another. Some additional textual guidance in the tool itself could have been helpful.

Overall the majority of issues outlined in the follow-up questions were due to colour, font sizing and styling choices, as well as confusing terminology.

> *"I think if clear labels are used it would make it friendlier. Otherwise I liked the interface."* - A17

Couple of participants mentioned the system being intuitive and helpful given their current experience.

> *"It did seem fairly straightforward to use. I mean especially given that it was the first time I was using it. Having battled with Learn [11] I can imagine that I would be pretty familiar with it after a few weeks."* - A12

5.6 Third Iteration - Medium-Fidelity Prototype

After evaluation sessions with teaching support staff and academics concluded, a final version of the prototype[1] was created. This included many small changes to the presentation, but also created full links between all interactive parts of the Figma [7] prototype that enabled an option of free exploration in the upcoming summative assessment.

5.6.1 Overall Design Changes

So far all the prototypes produced were grayscale. This was done to minimise the time required to design UI and spend more of it on the functionality. A redesign was done on the existing prototype to make the result look more like a finalised product (see fig. 5.16 and fig. 5.17).

The resulting design was cleaner, more colourful and overall helped to clearly indicate different parts of the tool which helps with usability. Components are more consistent, placement of buttons and other functionality was unified across different pages.

As suggested by the feedback from academics, assignment name is now visible in the menu bar, horizontal and easily switchable. Also following a suggestion, there is now also a single sentence description under the page name that gives a brief outline on what you may do in this page.

Several pages have received other, more specific changes based on the feedback from the evaluation sessions and will be presented in further detail in the following sections.

5.6.2 Setup

To replace the ”Users” and ”Structure” pages, a new page has been created - ”Setup” (see fig. 5.18). This was in reflection to the feedback from both evaluation sessions which signalled several issues - the word ”Structure” and the whole process not being clear. For example, one would not expect to add new questions to the assignment after the marking process started. For that reason, ”Setup” as a name seemed appropriate to denote something that would be rarely accessed to change the core assignment properties.

The interface has been unified with other pages. Several sections have been added based on existence in similar tools. Others, such as ”Team” and ”General Permissions”, have been added to support specific requirements (2.12 in table 4.6).

5.6.3 Submissions

Aside from polished design, the submissions page (see fig. 5.19) remained largely similar to previous iteration, with several changes. As suggested by evaluation participants, the options above the table are now visible when they are inactive and are

[1] Accessible at `https://www.figma.com/proto/XqhpMvZfFworhz0mAFCsos/MarkEd?node-id=478%3A100&scaling=scale-down`

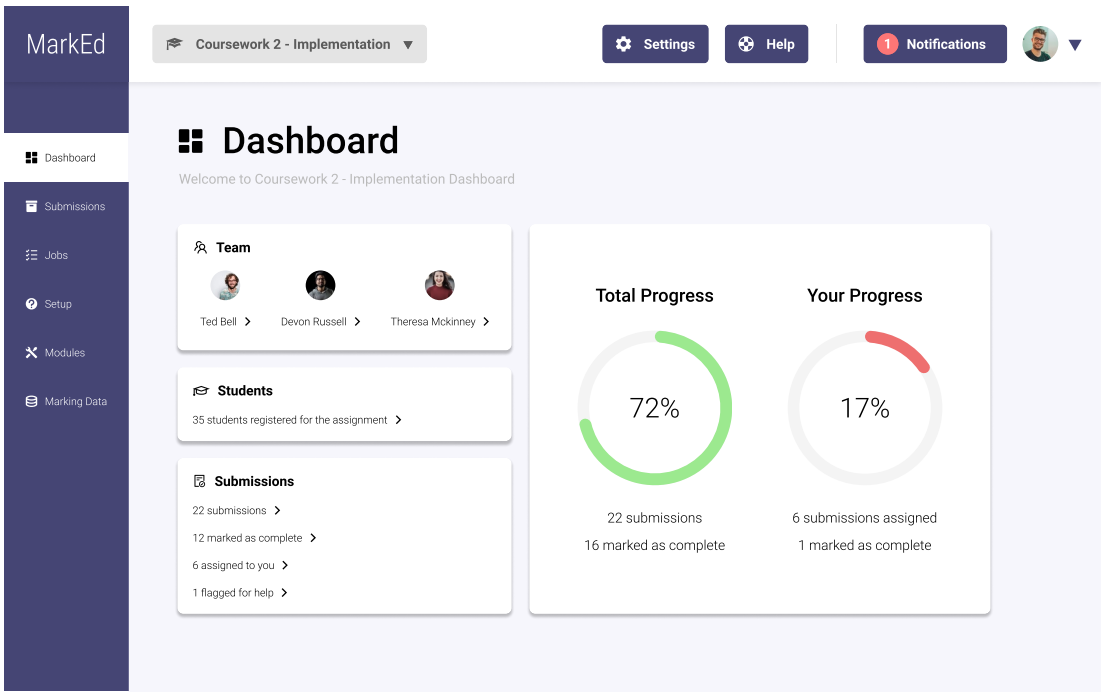


Figure 5.16: Dashboard page in the redesigned prototype

clearly coloured as such. The submissions table, by my own personal judgement, has also been redesigned to be more similar with the table in the ”Marking Data” page.

5.6.4 Marking Data

Once again, following a suggestion from the evaluation session with academic staff, the tags in the ”Marking Data” page (see fig. 5.20) are now coloured, clearly presented in the interface and have a legend above the table. Similarly as with the Submissions page, inactive actions are now visible and coloured to indicate their state.

5.6.5 Marking View

The ”Marking View” page (see fig. 5.21) has received attention the the sidebar that had a lot of concerns in the formative evaluation sessions. The sidebar has been extended to make more use of free space in the page. The background colour has been changed to white for the boxes (with the exception of the header) as it was suggested for better readability. Font sizes increased throughout as well.

Also appealing to the criticism, the submission IDs are now outlined more clearly and also presented on the ”Previous” and ”Next” buttons to provide a better understanding on the progress and flow between marking different submissions.

5.6.6 Jobs

The ”Jobs” page (see fig. 5.22) remained similar to previous prototypes. Taking into account the suggestion to place the ”Save” button similar to other pages this has been

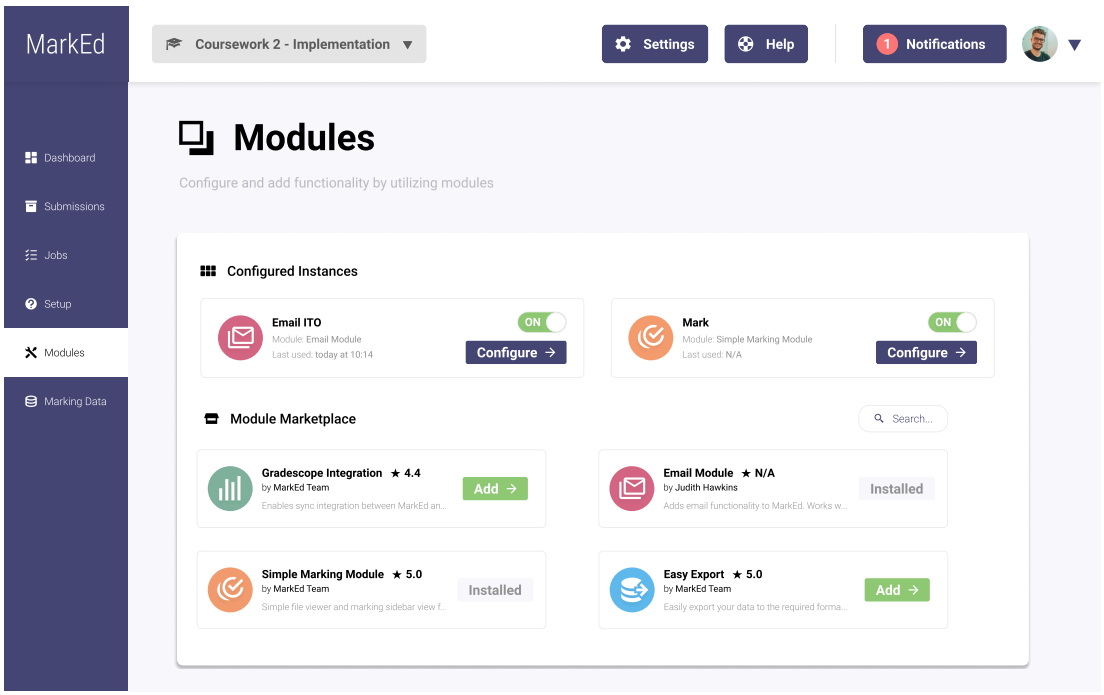


Figure 5.17: Modules page in the redesigned prototype

fixed. The rules creator interface has also received minor design touches (colourisation) to make a more explicit distinction between triggers and rule steps.

5.7 Summary

A functional Figma [7] has been created and improved over several iterations based on teaching support and academic staff formative feedback sessions. Due to time and complexity constrains, every feature from the requirements list was not possible implement. Missing functionality will be presented as future work in Chapter 7.

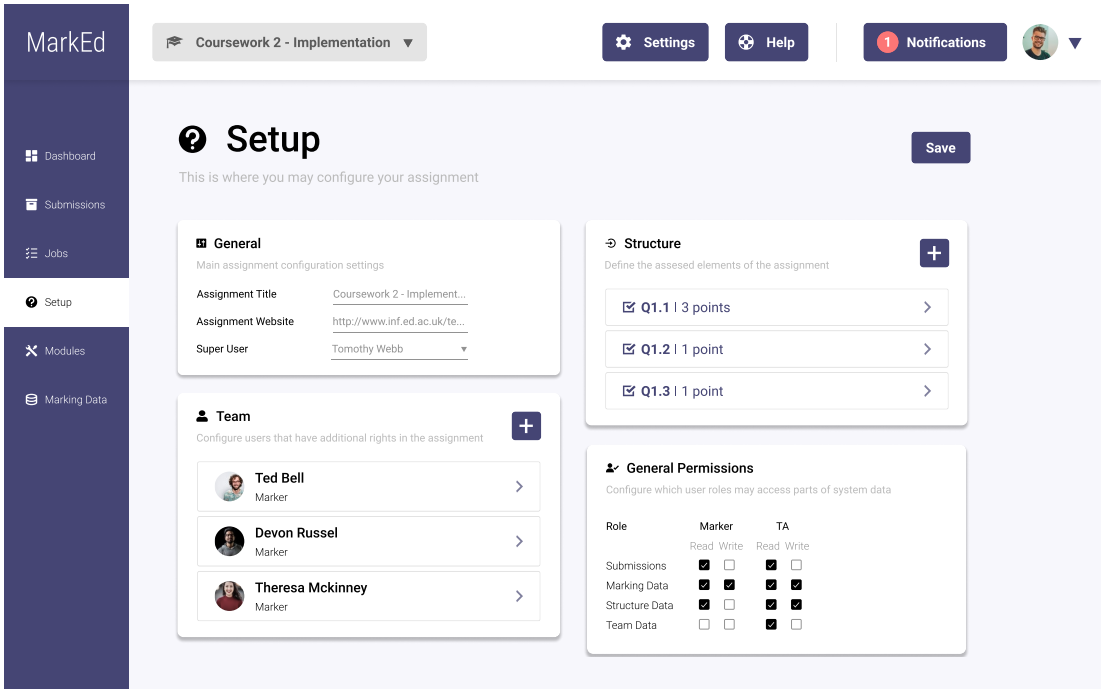


Figure 5.18: Setup page in the final prototype

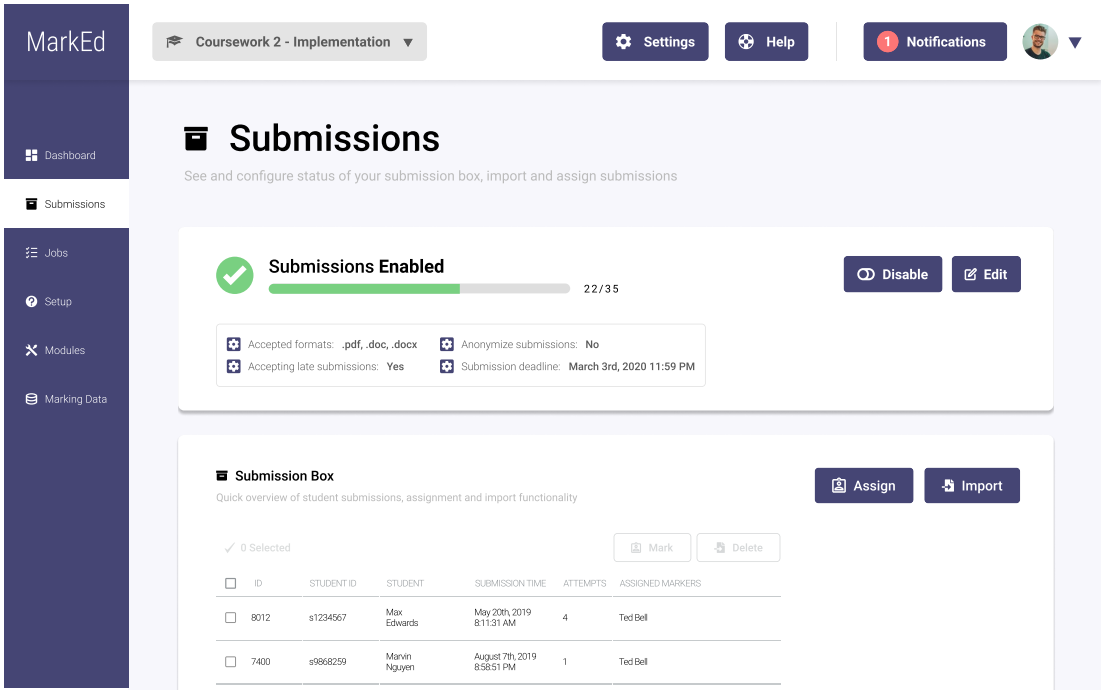


Figure 5.19: Submissions page in the final prototype

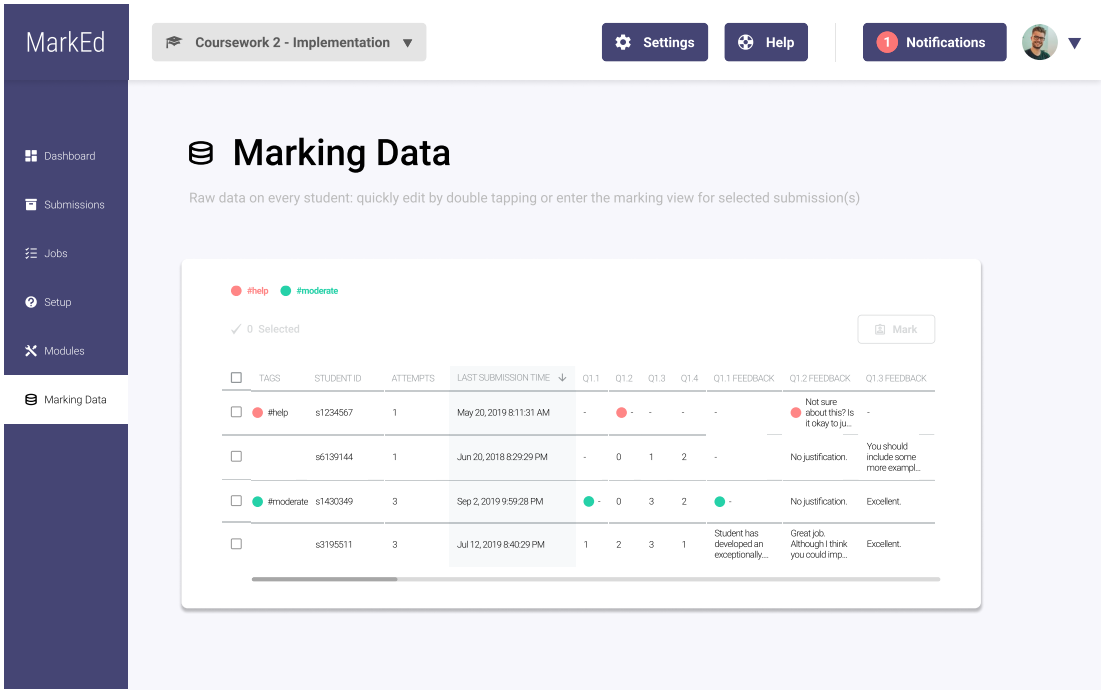


Figure 5.20: Marking Data page in the final prototype

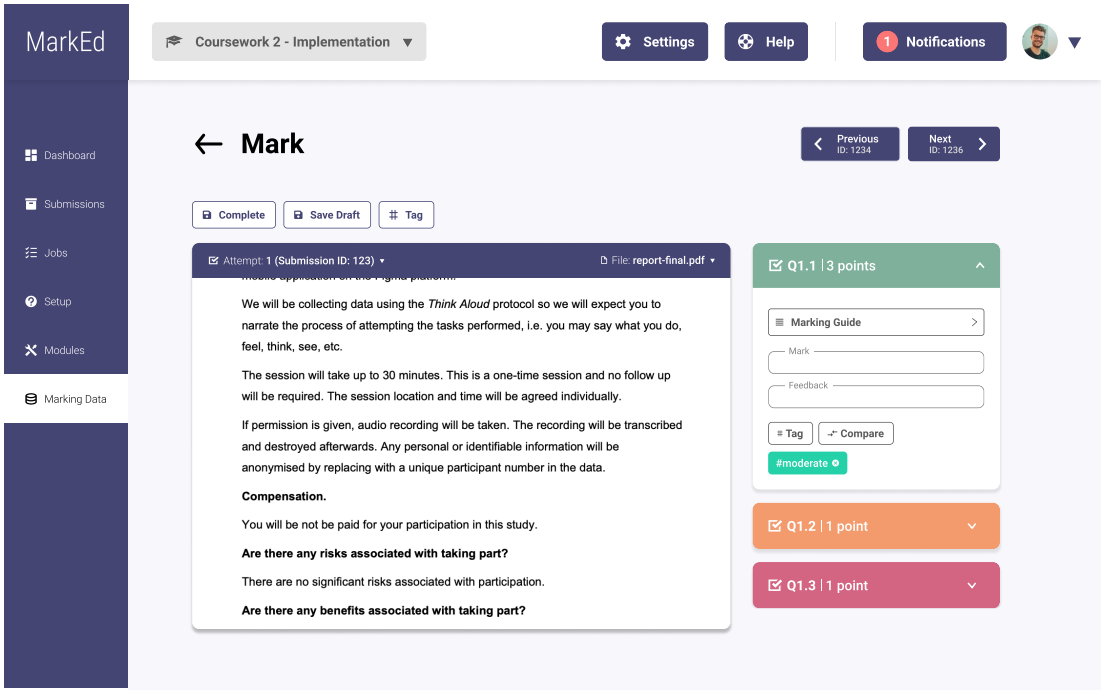


Figure 5.21: Marking View page in the final prototype

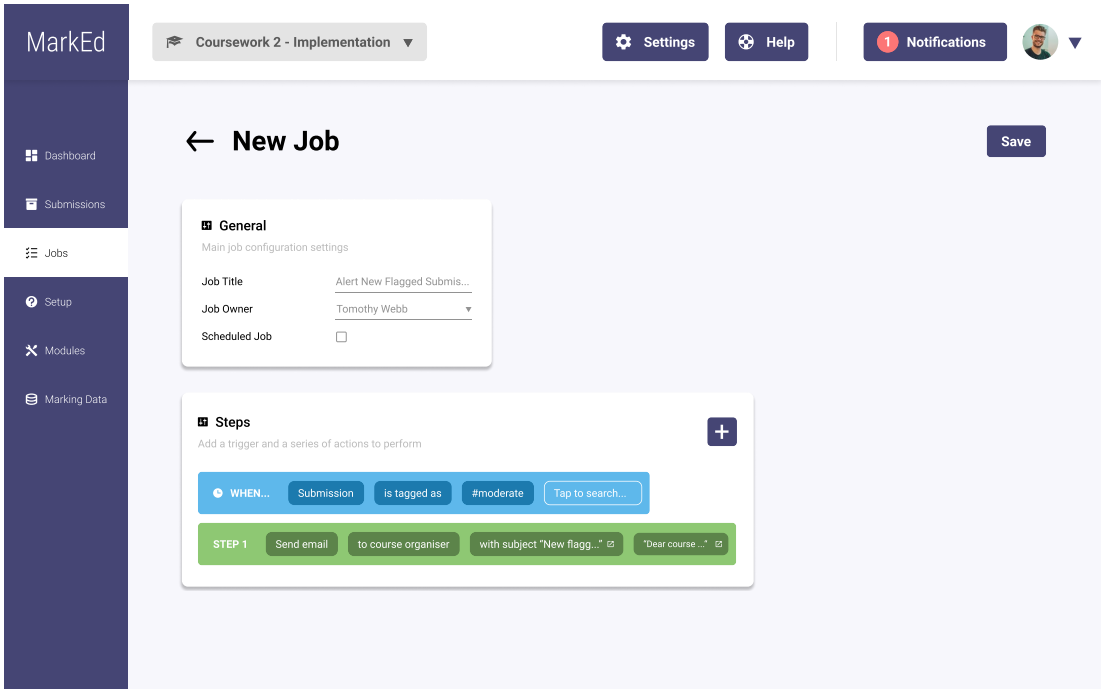


Figure 5.22: Jobs page in the final prototype

Chapter 6

Summative Evaluation

This chapter presents the summative evaluation study and its results of the last design iteration[1] of the MarkEd marking, moderation and feedback tool.

The study described in the chapter was certified according to the Informatics Research Ethics Process, RT number 2019/62506.

6.1 Aims

The study aimed to explore how is the usability and impact of the tool designed perceived by the academic and teaching support staff members. It was also important to gather feedback for improvements and ask for suggestions of potential new functionality that could become part of the tool in the future.

The study aimed to answer the following research questions:

- RQ5 - Would a tool streamlining the process be useful? What features should it have?
- RQ7 - How is the usability of the proposed design perceived by academic staff, administrative staff, teaching support staff, students?
- RQ8 - To what extent does the proposed tool support the marking, feedback and moderation processes?

6.2 Data Collection Methods

The data was collected using an online questionnaire (see section 2.2.2.3) hosted on Microsoft Forms [16] that included the SUS [20] (System Usability Scale) questions on usability (to address RQ7), as well as impact (to address RQ8).

[1] Accessible at `https://www.figma.com/proto/XqhpMvZfFworhz0mAFCsos/MarkEd?node-id=478%3A100&scaling=scale-down`

Utilising the SUS [20] provided a way of measuring usability with small sample sizes, few explanations to the user and having a comparable (industry standard) measure as the end result [20].

When participants were in the same physical location as the researcher, they were also observed (see section 2.2.4.4) as they interacted with the prototype. Notes were taken during the observation process. This was intended to support the data obtained from the questionnaire as, due to the method's limitations, participants tend to provide less detailed data than, for example, using alternative methods of usability testing, such as Think Aloud (see section 2.2.4.2). However, such alternatives required scheduling individual sessions with participants so due to difficulties in the recruitment process (see section 6.3 for more details) were dismissed.

The questionnaire and observation method was primarily chosen to accommodate the circumstances - the study was planned to run in a fair setting with participants having limited time to spend at the stand. This method enabled participants to spend some time with the prototype performing the tasks and exploring the interface while the researcher was still able to observe their actions. When exploration was over, participants filled in the questionnaire on a different device - again, allowing the researcher to have minimal input and also freeing up the original device for use by another participant as early as possible.

6.3 Participants

The study was run in a poster session designed for Undergraduate students to present their honours project work. It was an opportunity to approach both students, coming to learn about the work their peers were doing, and academics, who came to support their students and judge in the poster competition.

Unfortunately, as discussed previously (see section 5.4.3), the target group for students who acted as markers was particularly challenging to recruit due to availability and role eligibility. We were looking for markers that have had some previous marking experience already. Added to this, the poster session coincided with the UCU [22] strikes that a lot of the academic staff were involved in and some students supported.

Although my stand received a lot of attention from students, most of then were ineligible to participate in the study as they had not marked before. Very few academic staff attended, and they were mostly occupied with judging or organising the event itself.

The participant numbers that I managed to get involved in the Undergraduate project poster fair were extremely low - 3 students acting as markers and 1 academic staff member. Taking this into account, I decided to attempt the same approach a second time - at a poster competition (part of International Women's Day events) organised the same weekend by the Edinburgh Hoppers [5] society. Unfortunately, this time I was unable to recruit any participants (turned down 1 as they had already participated before) at all as the competition ran during lunch time.

After discussions with my supervisor, we decided to approach teaching support and academic staff directly and ask them to participate online at their own convenience.

My supervisor personally emailed several academic staff members who had not participated in my studies before, as well as all of teaching support staff by using a School-wide mailing list. She also advertised this in a marker training session. I contacted all my previous participants (both markers and academics) and also approached some friends who had been involved with marking in our School before. This turned out to be a lot more effective method of a recruitment, although additional factors (COVID-19 Pandemic [3] and subsequent University closure) meant participants were not as likely to respond as hoped.

Please see table 6.1 for a breakdown of all participants involved in the study. As presented, the majority of markers had limited experience with marking, but there was a single participant who was considered highly experienced. All academic participants, with the exception of one, were highly experienced. Two participants - 1 academic and marker each - had participated in the formative evaluation sessions and had prior experience with an interaction of the MarkEd tool.

Participant	User Group	Prior Participant	Experience	Recruitment
M15	Marker	No	High	Poster Fair
M16	Marker	Yes	Low	Poster Fair
A18	Academic	Yes	High	Poster Fair
M17	Marker	No	Low	Poster Fair
A19	Academic	No	High	Direct Contact
A20	Academic	No	Medium	Direct Contact
A21	Academic	No	High	Direct Contact
A22	Academic	No	High	Direct Contact
M18	Marker	No	Low	Direct Contact
M19	Marker	No	Low	Direct Contact
A23	Academic	No	High	Direct Contact

Table 6.1: List of participants with details regarding their recruitment, prior experience with the prototypes and experience with marking (see auxiliary table 4.3 for the experience to years of experience mapping)

6.4 Materials

As with previous evaluation studies, a new Participant Sheet (see appendix C.1) was adapted based on previous documents. This was linked at the top of the questionnaire. Participants confirmed their acceptance to terms by selecting ”I agree”.

The questionnaire (see appendix C.2) contained branching sections based on what user group the participant was in and whether they had any previous experience with the MarkEd prototypes.

To enable participants to discover different parts of the tool, a list of tasks was prepared (see appendix C.3). The tasks presented to both user groups were the same, but some of the tasks were designed for academic participants only and have been denoted as

such. The task list included the following activities: assignment setup and responsibilities splitting (academics only), tagging, marking, setting up automated workflows (academics only). Functionality required to perform these tasks was to be rated on a 1 to 5 scale to address RQ8 (5 being the highest). The same list of tasks was used for both the poster session and online evaluations.

To focus the research questions outlined in section 6.1, questions on impact (to address RQ8) and usability (in the form of SUS [20], to address RQ7) were asked. When possible, likert scale [14] options were presented to answer questions to assess opinions with limited explanation for participants needed whilst providing the options to remain neutral in their answers. Participants who had interacted with MarkEd interfaces before (the formative evaluation sessions) were additionally asked to rate the improvement since the last time they saw the (also to address RQ7).

6.5 Protocol

6.5.1 Poster Fair

During the poster sessions, people approached my stand to ask about my project. When engaging in conversations, I would ask them whether they had any prior marking experience. If they did, I would ask them to participate in the study.

I had set up two laptops on the desk in front of my poster. One of them had the Figma [7] prototype for interaction, and the other had the questionnaire opened on Microsoft Forms [16]. Using two laptops enabled participants to be involved in the study at once, which was important in the fair setting that had a limited timespan.

Once I had found a willing participant, I would briefly explain what they should do. They were asked to perform a series of tasks (see appendix C.3) while exploring the interface of the tool in Figma [7]. I would observe them and take notes as appropriate, for example, when participants were visibly struggling to find a page to progress with the task. When they were done, the prototype in the first laptop would be reset to the original state. Participants were then asked to fill in the questionnaire on the other laptop. Afterwards, I would thank them for their time and ask whether they had any questions.

6.5.2 Online Participation

Participants were sent guidance on how to participate in the study along in the recruitment email.

They were asked to open the link containing the interactive Figma [7] prototype in presentation mode and perform the tasks (see appendix C.3) listed in the email. They were also given a link to the questionnaire (see appendix C.2) and asked to fill in their answers after they were done with the tasks and their exploration process.

6.6 Data Analysis

Due to a mistake made in the branching configuration of the questionnaire, first few teaching support staff participants had not been presented with a portion (6, 9 and 10 - see appendix C.2) of the questions related to the tool functionality and overall helpfulness evaluation. The branching issue was fixed immediately after noticing the issue in the poster fair, but this is why some questions had a lower respondent number than others.

For likert scale [14] questions, the median and mode of the responses were determined to analyse the distribution of the answers. An alternative approach of assigning each option a numerical value and calculating mean and standard deviation was considered, but the results are considered meaningless by a significant portion of the experts in the industry [48].

The individual scores of the System Usability Scale [20] (SUS) was calculated using the steps, information and formulae outlined in [15] and described in the background chapter (see section 2.2.4.5). These were compared between participants in different user groups by calculating the mean, median, standard deviation, determining minimum and maximum values. The same statistical data was also calculated for the functionality rating questions.

For text-input questions, thematic analysis (see section 2.2.3.4) was performed by identifying the recurring themes across all responses. Data was already neatly organised based on questions because of the use of Microsoft Forms [16] for collection. My process included making a list of summary comments and notes, grouping them into sub-categories based on functionality and outlook. The sub-categories were then reviewed for merging and/or splitting in order to generalise and produce the final set of themes.

See section 6.7 for results obtained after the data analysis process.

6.7 Results

This section presents the summarised results from the questionnaire responses and observation notes. Please note some questions have a smaller number of responses due to a mistake in questionnaire branching (explained in section 6.6).

6.7.1 Improvements since previous iteration

Two participants (1 marker and 1 academic) have had interactions with a previous iteration of MarkEd in the respective formative evaluation studies. They were asked to rate the improvement in *navigation*, *interaction*, *content* and *presentation* (addressing RQ7).

Navigation improvements were rated as 'Fair (3)' by both participants.

Interaction improvements were rated as 'Fair (3)' and 'Good (4)'.

Presentation improvements were rated as 'Good (4)' and 'Excellent (5)'.

Content improvements were evaluated as 'Fair (3)' and 'Good (4)'.

Due to the small sample size, the results to this question regarding improvement are considered inconclusive and additional research would be necessary with more participants.

6.7.2 Usability

To measure perceived usability (adressing RQ7), SUS [20] questions were included in the questionnaire. The scores were computed for every participant separately - see table 6.2.

Some statistical analysis was conducted between different user groups (markers and academics) as well as all participants. This includes the mean, median, standard deviation, maximum and minimum scores. See table 6.3 for a breakdown.

Looking at overall results, usability was rated as a median of 64.55 (interpreted in words as 'OK', see [34]). This can partially be explained by the complexity of the system - users are expected to get acquainted with the system to fully utilise it and this was not possible in the study. Academic scores seemed to be better than those of markers in general, but the overall mean, median and standard deviation was similar. One explanation for lower marker scores could be that marker participants found the tool too confusing as the prototype included the functionality for academics as well that they would normally not utilise.

Scores of individual participants seem to very greatly from 37.5 (awful) to 95 (excellent) so the overall interpretation of the results seems to be unclear and more research is necessary.

Aside from the SUS [20] scores, some of the text answers also relate to design and usability. 3 academic participants expressed their support for the idea and praised design and the functionality of the tool. It was described as "a significant step up from Learn's [11] current functionality", "a very well-considered design".

> *"Well done, looks nice and shiny. If a system like this exists, I would certainly consider using it."* - A20

In fact, the majority of the participants (3 academics, 3 markers) mentioned the overall design or parts of the interface as their favourite part of the tool. Design was described as "nice", "quite intuitive and helpful", "easy to navigate", "modern", "friendly", "very pleasant and straightforward to use".

> *"Clarity of presentation of information, intuitive use"* - A21

In contrast, several participants (1 marker, 1 academic) were dissatisfied with label names and the placement of buttons. One of them mentioned this could be due to not being familiar enough with the system.

> *"Sometimes labels not super informative - couldn't find where non marked submissions were (this could be down to having not used system before*

though!)" - A18

1 academic participant mentioned logic of the tool not always being clear.

Participant	SUS [20] Score
M15	55
M16	55
A18	60
M17	80
A19	42.5
A20	67.5
A21	75
A22	95
M18	82.5
M19	37.5
A23	60

Table 6.2: List of participant SUS [20] scores

User Group	Samples	Mean	Median	Std	Min	Max
All	11	64.55	60	17.46	37.5	95
Academic	6	66.67	63.75	17.58	42.5	95
Markers	5	62	55	18.99	37.5	82.5

Table 6.3: Summary of SUS [20] score data per user group

6.7.3 Evaluation of main functionality

Participants were asked to rate the main functionality presented in the prototype relevant to their role on a 1 to 5 scale (5 being highest). They were also asked to, optionally, suggest what could be done to improve this.

The summary of the data is presented in table 6.4. This includes the number of responses, the mean, median, standard deviation (Std), minimum (Min) and maximum (Max) values for each of the features.

Functionality Rated	Samples	Mean	Median	Std	Min	Max
Assigning work to the team	6	3.33	3.5	1.37	1	5
Setting up assignment structure	6	3.67	3.5	0.82	3	5
Marking	10	3.9	4	0.57	3	5
Tagging	10	3.9	4	0.99	2	5
Automated workflows	6	4	4	0.63	3	5

Table 6.4: Response data summary to the questions asking to rate main functionality of the features relevant to the role of the participants

Due to the limitations of the data collection method chosen and the questions chosen, it was hard to judge why some participants gave particularly low or high scores as most

did not indicate their reasoning. Given that the questionnaire is anonymous, there was no possibility of a follow-up with the participant for clarification regarding this.

6.7.3.1 Assigning Work

For assigning work within the team, the median (3.5) seems to be the most appropriate measure as the standard deviation of the rating is relatively high. This was caused by the feature receiving scores at both ends of the extremes.

Suggestions given by the participants for improvement include making the setup process and labels more clear (3 academics), adding reminders for markers to progress with their assigned tasks (1 academic), even splitting (e.g. 20% of the submissions assigned to 5 markers) feature (1 academic).

> *"It might be helpful to have a tool that can create even splits. If I have a few hundred submissions and I want to give 20 percent each to 5 different markers, for example."* - A20

There was an outlier score (1) given by one of the participants who was frustrated, seemingly because of lack of clarity of the functionality, as well as confusing navigation required to reach the feature:

> *"Tried first Setup, then Jobs tabs, before finding [the] Submissions tab was [the] right place. Wasn't clear from [the] submission box that different markers could be assigned different parts of a question. Seemed that each student got assigned to just one marker. In [the] pop-up after clicking Assign button, unclear how I select which students Ted Bell is going to mark for. Instructions never suggested I could select some subset of students."* - A23

6.7.3.2 Assignment Structure Setup

Setting up assignment structure was received relatively similarly as with work assignment - median of 3.5.

1 suggestion was given by an academic participant to make more space for entering marking guidelines.

1 academic participant also said the setup was ”convoluted” and felt ”over-engineered”, although no suggestion to improve this was noted.

6.7.3.3 Marking View

Marking functionality was generally well received - mean of 3.9 and median of 4 with the lowest standard deviation of 0.57.

Two academic participants noted in their text answers that they liked features such as ”being able to comment on individual questions in a GUI, searchable tags, rubrics”, the marking progress dashboard.

1 academic participant suggested that a different version of a marking view should be created for coding submissions.

Another academic participant said they found the instructions on the page unhelpful, although it is unclear which instructions they refer to.

1 academic participant was unsure whether criteria based marking was supported.

> *"It seems like only additive marking can be used rather than, for example, criteria based marking. But maybe I overlooked something in the prototype.)"* - A19

Three marker participants had expressed concerns with the layout - 2 mentioning that the feedback text box was too small and did not seem like it would expand, while another mentioned having expandable boxes (e.g. for questions) involves a lot of clicks and might be counter-productive.

1 marker mentioned liking having the marking guide functionality, while another marker participant wished for a way to give more targeted feedback.

> *"Maybe a way to select a specific part of the submitted solution to give some specific feedback to that point, not for the entire question."* - M18

1 participant also wished to have marking guides spanning over multiple questions.

Although overall positive opinions were given about the marking view, 2 academic participants noted that an API could be introduced to handle all marking outside of the system as well, especially if custom tools are already used.

> *"Many academics have their own tool chains setup and might need to use them at least partially together with this kind of system. Therefore a public API to allow scripting or export for data feature would be helpful."* - A20

6.7.3.4 Tagging

Tagging was also well received with scores (3.9 mean, 4 median) similar to that of marking functionality.

1 academic participant noted that this was very useful, while 2 markers were unconvinced and wanted to see more examples.

1 marker participant suggested to add some documentation to make the extent of use of tags more clear, while another marker suggested having tags set by administrator only.

1 marker participant was also confused whether there was any correlation between the colour of the question box in the marking view and the colours of the tags.

6.7.3.5 Automated Workflow Setup

The automated workflow creation was the functionality that was rated the best with the mean and median of 4.

Academic participants (4) noted they liked having this functionality and its flexibility, once calling it ”very convenient”.

However, 2 academic participants noted the full extent of this was hard to evaluate in the prototype and it would need a lot of testing for a finalised version.

> *“Nice to have. Reminded me a bit of configuring mail filters. Number of options is possibly confusing, but also could be frustrating if some desired option is missing. Would need a lot of iterated testing and feedback gathering.”* - A23

6.7.4 Impact of the tool

Participants were asked to rate how helpful the tool would be in several key areas relating to their work in marking, feedback and moderation processes (to address RQ8). The summary of responses is presented in table 6.5. The number of responses differs between areas as some of these were presented exclusively to academics (see table 6.5 for full details).

As we can see by inspecting the mode (most popular) of the responses, all areas, except for error-prevention, had responses as ”Somewhat helpful” or ”Very helpful” as the most frequent. This seems to indicate the response to helpfulness of the tool as mostly positive.

”Understanding your progress”, ”Splitting responsibilities within the team” and ”Asking for assistance” were evaluated as areas that the tool would be most helpful for. ”Asking for assistance” in particular is interesting because marker participants seemed unconvinced by the tagging functionality, but rated this highly, perhaps because the tasks designed did not establish a clear connection between the two.

The median of the responses looks mostly the same as the mode, with the exception of error-prevention whose mode is ”Neither helpful nor unhelpful” and the median is ”Somewhat helpful”. This signals participants had mostly similar opinions with few outliers regarding the impact of the tool.

As well as this, a couple of participants (1 marker, 1 academic) mentioned in parts of different questions particularly liking the overall idea of having such a tool at their disposal.

> *“Idea of having such a tool is good. All features demoed in walkthrough seem worthwhile.”* - A23

6.7.5 Other comments / suggestions

1 marker participant mentioned they felt there were admin features that they would not be using as a marker. This was due to the limitation of the study prototype where all interfaces (including those for academic participants only) were accessible to all participants.

Area	User Group	Samples	Mode	Median
Saving time	All	10	Somewhat helpful	Somewhat helpful
Ensuring fairness	All	10	Somewhat helpful	Somewhat helpful
Error-prevention(avoiding mis-clicks)	All	10	Neither helpful nor unhelpful	Somewhat helpful
Combining strengths of other tools	All	10	Somewhat helpful	Somewhat helpful
Understanding your progress	All	10	Very helpful	Very helpful
Splitting responsibilities within the team	Academic	6	Somewhat helpful / Very helpful	Somewhat helpful / Very helpful
Leaving ”to-do” notes for future work	All	10	Somewhat helpful	Somewhat helpful
Automating your work	Academic	6	Somewhat helpful	Somewhat helpful
Asking for assistance	Marker	4	Somewhat helpful / Very helpful	Somewhat helpful / Very helpful

Table 6.5: Summary of response data to the question ”How helpful do you think the tool would be in the following areas?”

1 marker participant mentioned ”I don’t like new things” as the least favourite aspect of the tool, but did not provide any further justification or clarification about this.

Several participants (1 academic, 1 marker) mentioned the overview of the overall marking progress in the dashboard as their favourite part of the tool. 1 marker and around half of academic participants (3) participants said they would work on making the dashboard more detailed and would prefer seeing more statistical analysis about the progress of each marker.

> *“I would also work on making the dashboard visualisation more effective. For example, to show ”16 marked out of 22 and 22 submitted out of 35”, I would use a single doughnut chart.”* - M19

Finally, some other suggestions from participants included removing the ”redundant” user photographs (1 academic), adding a ”Days Late” column to the marking data (1 academic), moving the ”Marking Data” page higher up in the menu options (1 marker), making the tool title background on the top left white (1 academic), adding support for keyboard shortcuts (1 marker), restricted file structure for code submissions (1

academic).

6.8 Summary

This chapter detailed the final evaluation for the MarkEd marking, feedback and moderation tool. The main functionality of the tool was trialled with teaching support and academic staff by utilising the interactive Figma [7] prototypes produced in the last part of the design process and online questionnaires.

Overall the feedback seemed to be positive about the major functionality of the system, but the usability score has been ranked as 'OK', perhaps due to the complexity of the tool. Given the limitations of the data collection method utilised, there was no possibility of following up or clarifying with participants about their opinions and suggestions. Taking this into account, as well as the low participants numbers due to recruitment issues, I believe more thorough evaluation should be done for a conclusive answer about the impact and usability of the prototype produced.

Chapter 7

Concluding Discussions & Future Work

This chapter concludes the dissertation and provides a discussion about some of the major challenges faced when working on the project, limitations of the prototypes of the MarkEd marking, feedback and moderation tool produced. It also covers the future work and possible extensions of the tool, as well as provides a high-level overview of all contributions made.

7.1 Discussion

7.1.1 Challenges Faced

Participant recruitment was perhaps one of the biggest challenges. Teaching support staff acting as markers specifically was a small target group as most Undergraduate students are ineligible to mark, while Masters and PhD students are primarily occupied with their thesis work. There are also very few experienced markers given the timespan of their projects and the time consuming nature of marking work. It was crucial to recruit a reasonable number of participants for each user group to achieve a good representation of the overall opinions and themes. We were extremely thankful to participants who have agreed to participate in several of the studies we were running, but this obviously came at a cost of introduced bias in some cases.

During the requirements gathering stage, me and my partner have discovered how complex the existing solutions for handling marking, feedback and moderation processes are and how much administration differs between courses and their organisers, sometimes even contradicting previous findings. The requirements list we were preparing grew exponentially with every participant and it was nearly impossible to capture everything so we had to limit our focus to key areas. After the interviews and focus groups were complete, we established that pretty much every potential group, with the exception of the administrative staff, introduced enough requirements to build a product on its own. But that defeated the entire purpose of the project which was the consolidation of different tools to provide a unified solution. At times, I personally felt

extremely overwhelmed with the requirements and was struggling to conceptualise a product meeting them all of them.

Although we had discussions whether to include student interfaces in the system, I decided to focus on the teaching support and academic staff side due to time constraints. However, to address the potential of extensions to the tool, we proposed a solution that would be flexible and modular. The modularity aspect of the system was a particularly important discussion theme in our weekly meetings. Myself, my project partner and our supervisor held discussions on many different occasions until we came to an agreement about how this can be introduced, what should be considered a module and how exactly they interact with one another. To present the idea of modularity to academics, for whom this was most important, I had to focus on designing some 'default' modules for use case demonstration purposes. This, unfortunately, was complicated to explain to some of our participants and it is possible the modularity aspect might have been mistaken for features embedded in the tool itself.

7.1.2 Skills Acquired

As part of the project, I had to work with different software solutions. Before the project, I was not aware of NVivo [12] and what it was used for. In the short amount of time I had for data analysis after the requirements gathering study, I had learned to effectively code data and organise nodes in the process. The tool is extremely powerful, but it did take me a while, until my third study, to actually learn all the different ways data can be visualised and queried, which made my subsequent result analysis much quicker.

As well as NVivo [12], I learned a lot about working with Figma [7]. I had limited experience with the tool in the past, but the prior knowledge really helped to speed up the design process by utilising components, grid layouts and other tricks I was aware of. Some of the features (e.g. auto-layouts, color selectors) were even released as I was working on the designs and I quickly adapted them to my style of work, e.g. I remade all my tables in the design using auto-layout so their content can be modified a lot easier.

7.1.3 Limitations

An important limitation was discovered in the data analysis stages of group studies. Although care has been taken to support audio recordings with notes, an unforeseen issue of determining concrete numbers of participants agreeing with someone arose. The recordings have been already challenging to transcribe for groups that had several participants with similar voices, but this has been further amplified when participants had to be identified from a single word of agreement, hums or interjections. What looked like unanimous agreement at the time of the session was often inconclusive when listening to the recording as some people expressed agreement in nodding while other participants were talking. Like I mentioned, notes were taken, but it is challenging to do this effectively while interacting with the group at the same time. This is something that could be dealt with by utilising video recordings, but introduces different ethical

and privacy concerns in the process.

Another observation was related to focus group (see section 2.2.2.2) studies with students. When analysing the data, it was apparent that different sessions of students had very different opinions of the marking, moderation and feedback processes in the School. A limitation of this data collection method is that students can introduce unconscious bias to one another. Upon inspection, this seemed to be the case here as, when asking students in order around the table, they were more likely to have a negative (or vise-versa) opinion if the first few respondents had the particular judgement. Although not true for all participants, it is likely that this had an impact on the results obtained.

Finally, I must address the difficulties introduced in the stakeholder evaluation (see section 2.2.4.1) session with academic staff due to it being held online. The session was very difficult to moderate - there were many technical issues with the platform used, audio quality being poor and internet connection being spotty. As well as this, the Figma [7] prototype presented for interaction to participants was limiting (e.g. there was no possibility of text input) and felt artificial to some participants. This was something that we anticipated might happen, but since the session had to be held online due to the UCU [22] strikes, we had to adjust and try our best to work around this.

7.1.4 Other Insights

Working together with a partner on the project has been challenging, but insightful. At the beginning of the project, it was definitely difficult to get adjusted to our different working patterns, as well as the need of regular communication and agreement between us. However, it is safe to say that, given there was only one of us working on the requirements gathering stage, we would have had significantly smaller participant numbers and, consequently, missed a considerable amount of the requirements. My partners' insights were also useful when brainstorming about design choices with my supervisor. My ideas and understandings were definitely challenged, but opposing ideas helped to shape the solution and make it more well-rounded.

If I had an opportunity to start over, I think I would try to involve users in the design stage, perhaps utilising the Participatory Design (PD) [50] framework. This would obviously be challenging as it requires dedication and a lot more availability from the stakeholders, but I think it would help with the assurance that the work done truly reflects the needs at an earliest opportunity in the process, as well as receiving more extensive feedback, even if there are fewer participants in the process.

7.2 Future Work

The primary piece of work left for the future is the extension and implementation of the prototypes. This would be the continuation of the work presented in this report, as well the work done on the core framework development by my project partner.

As discussed, due to time constrains and the complexity of the project, some of the requirements presented in table 4.6 are not present in the final prototype. These include:

1. Interfaces for student views: ability to submit and view submissions, grading center, ability to enquire about marks and feedback, course result calculator
2. Features for expert users: command-line interface access, grammar-based job creation process, APIs for managing database state
3. Marking functionality: double and blind marking support, plagiarism checking, ability to update sets of marks and feedback all at once, group submission support
4. Administrative features: backups and audit logs, Board of Examiners [30] reports generation

Aside from functionality, key components of a system, such as authentication, must also be designed and implemented. These were considered secondary-requirements and not included as part of the essential work in this project - focus was towards exploring what could be done to improve the marking, feedback and moderation processes.

I think the most important work to focus on next includes introducing some functionality for students and focusing on the features for expert users. As evident from the study with students, there is a real demand for a centralised place for students to receive their results - this was supported by the majority of students and would reduce inconsistency. From the formative and summative evaluations, we concluded that the style of work that is imposed to academic staff by using MarkEd might still not be the preferred option for some over the GUI-less solutions, so spending additional time is necessary to ensure that there are possibilities for these users to still interact with the data held in the tool database.

In the evaluation stages, it was apparent that, although the proposed functionality of the tool was well received, the product was far from being complete. I came to a conclusion that a system of this scale is something that several student iterations might still be working on for years to come. The project was (and still is) very ambitious, but I believe steps have been taken in the right direction to achieve something that would truly fit the majority of user needs.

7.3 Conclusions

Throughout the duration of the project, an interactive Figma [7] prototype was produced and evaluated. The process followed the iterative user-centered design [41] framework and started by running an extensive requirements gathering study with focus groups (see section 2.2.2.2) for students, interviews (see section 2.2.2.1) for academic, teaching support and administrative staff. The resulting data was analysed and a list of requirements (see table 4.6) was compiled. Following this, the design process started. This included deliberations on how the system components interconnect and work, producing early paper prototypes based on feedback from my supervisor and finally moving to the more sophisticated, medium-fidelity interactive prototypes in Figma [7]. Two iterations of the medium-fidelity prototype were produced based on the formative feedback sessions run with markers and academic staff. Finally, the last version was evaluated by running a summative evaluation study using a questionnaire.

To conclude, the project addressed the following research questions:

- **RQ1** - What is the current process of marking, feedback and moderation in the School of Informatics of the University of Edinburgh for academic staff, teaching support staff, administrative staff?

  Addressed in chapter 4. After the interview (see section 2.2.2.1) process with 7 administrative, 6 teaching support and 9 academic staff members, I deducted that the overall process can be described in 7 steps: submission, responsibility splitting and pre-/post- marking meetings with course staff, the marking process, the moderation process, feedback and marks return, data processing (ITO [32]). Generally, the process and key steps differ substantially amongst the staff members and different approaches of each were described in the aforementioned chapter.

- **RQ2** - What tools to aid the marking, feedback and moderation processes are used by academic staff, teaching support staff?

  Addressed in chapter 4. The staff utilise a large number of different tools to aid the relevant processes, including the School of Informatics Submit [18] tool, Turnitin [21], Blackboard Learn [11], spreadsheets, [40] and others. The tools and their specific use cases were compared and described in detail in the chapter, but the consensus is that none of the tools used satisfy every need the staff require in their workflows.

- **RQ3** - What are the students' opinions on the current marking and feedback process and associated issues?

  Addressed in chapter 4. After the analysis of data obtained in the focus group (see section 2.2.2.2) sessions with 20 students, it was apparent that the opinions regarding the associated processes varied. Students were mostly happy with the fairness of marks and ability to enquire regarding marks and feedback, but were critical of the feedback process and the timeliness of results being returned.

- **RQ4** - What could be done to improve the current workflows of marking, feedback and moderation process in the School of Informatics of the University of Edinburgh?

  Addressed in chapter 4. It was discovered during the studies with staff that they must utilise a variety of systems to cover their course-specific needs. Even worse, many of them they must resort to building custom tools that are hard to maintain, hardly reusable and not easily applicable to other staff members. The use of different tools, as we learned in the studies with students, negatively impacts the student experience. The overall experience could have a positive impact if a way to streamline these processes was introduced.

- **RQ5** - Would a tool streamlining the process be useful? What features should it have?

  Addressed in chapter 4 and chapter 6. The majority of staff and students agreed that a tool streamlining the process would be helpful, if designed appropriately.

Features of the potential tool were collected using the suggestions of participants, taking note of the functionality that they liked in existing tools, as well as noting down why the current process might not be working as effectively as they wish. This helped to compile a list of requirements (see section 4.3) outlining the functionality the tool should feature. After the summative evaluation process, additional suggestions that were not part of the prototype were noted down as future work.

- **RQ6** - How can we design a tool to address the needs of academic staff, administrative staff, teaching support staff, students?

  Addressed in chapter 5. After analysing the list of requirements, it was evident that a traditional tool supporting every requirement was not feasible. Following the suggestion by several senior academic participants, we proposed a solution that acts as modular and extensible framework that allows integrations of already existing tools, as well as enables an option to develop modules shareable in the module marketplace between different users. The design of such framework ensures course-specific needs can be met and the tool is flexible for future expansion.

- **RQ7** - How is the usability of the proposed design perceived by academic staff, administrative staff, teaching support staff, students?

  Addressed in chapter 5 and chapter 6. This research question was answered partially as interfaces for administrative staff and students were not developed. Selected feedback from participants in the formative evaluation sessions was applied to a medium-fidelity prototype in Figma [7]. The final prototype's usability was evaluated using the System Usability Scale [20] with 6 academic and 5 teaching support staff members. The mean of the scores suggest the usability could be described as 'OK' [34], but the individual scores of participants varied greatly and participation numbers were low so results are to be considered inconclusive and further research is necessary.

- **RQ8** - To what extent does the proposed tool support the marking, feedback and moderation processes?

  Addressed in chapter 6. In the summative evaluation study, the tool was mostly described as 'Somewhat helpful' as being helpful in the key areas of the processes, with 'Understanding your progress' and 'Asking for assistance' being rated the most positively at 'Very helpful'. As mentioned in the previous research question, however, the participant figures in this last study were low, there were a lot of outliers in the data and the chosen method of data collection - questionnaire (see section 2.2.2.3) - did not allow further contact with participants for clarification. Given this, the results are considered inconclusive and require more evaluations to answer the research question appropriately.

Bibliography

[1] Blackboard collaborate — blackboard.com. https://www.blackboard.com/teaching-learning/collaboration-web-conferencing/blackboard-collaborate. (Accessed on 04/02/2020).

[2] Blackboard direct v2.5 - release notes. https://help.turnitin.com/release-notes/blackboard/blackboard-direct-release-notes.htm. (Accessed on 04/14/2020).

[3] Coronavirus disease 2019. https://www.who.int/emergencies/diseases/novel-coronavirus-2019. (Accessed on 04/04/2020).

[4] The digital design toolkit. https://www.sketch.com/. (Accessed on 25/03/2020).

[5] Edinburgh hoppers. https://edinburgh-hoppers.github.io/website/. (Accessed on 04/04/2020).

[6] Ethics procedure — infweb. http://web.inf.ed.ac.uk/infweb/research/ethics-and-integrity/ethics-procedure. (Accessed on 04/16/2020).

[7] Figma - the collaborative interface design tool. http://www.figma.com/. (Accessed on 25/03/2020).

[8] The first single application for the entire devops lifecycle - gitlab — gitlab. https://about.gitlab.com/. (Accessed on 04/14/2020).

[9] Grade with rubrics — blackboard help. https://help.blackboard.com/Learn/Instructor/Grade/Rubrics/Grade_with_Rubrics. (Accessed on 04/14/2020).

[10] Iconify - unified icons framework. https://iconify.design/. (Accessed on 04/15/2020).

[11] Learn - university of edinburgh. https://www.learn.ed.ac.uk/. (Accessed on 25/01/2020).

[12] Learn more about data analysis software — nvivo. https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/about/nvivo. (Accessed on 03/31/2020).

[13] License — unsplash. https://unsplash.com/license. (Accessed on 04/15/2020).

[14] Likert scale - wikipedia. https://en.wikipedia.org/wiki/Likert_scale. (Accessed on 04/05/2020).

[15] Measuring and interpreting system usability scale (sus) - uiux trend. https://uiuxtrend.com/measuring-system-usability-scale-sus/#calculation. (Accessed on 04/05/2020).

[16] Microsoft forms. https://forms.microsoft.com. (Accessed on 04/04/2020).

[17] The national student survey. https://www.thestudentsurvey.com/. (Accessed on 25/01/2020).

[18] Practical submission system. http://computing.help.inf.ed.ac.uk/practical-submission. (Accessed on 25/01/2020).

[19] Rwjf - qualitative research guidelines project — interviewing — interviewing. http://www.qualres.org/HomeInte-3595.html. (Accessed on 04/08/2020).

[20] System usability scale (sus) — usability.gov. https://www.usability.gov/how-to-and-tools/methods/system-usability-scale.html. (Accessed on 04/04/2020).

[21] Turnitin. https://www.ed.ac.uk/dentistry/students/turnitin, Nov. (Accessed on 25/01/2020).

[22] Ucu - home. https://www.ucu.org.uk/. (Accessed on 04/01/2020).

[23] Ui/ux design and collaboration tool — adobe xd. https://www.adobe.com/products/xd.html. (Accessed on 25/03/2020).

[24] University factsheet. https://www.ed.ac.uk/governance-strategic-planning/facts-and-figures/university-factsheet. (Accessed on 25/01/2020).

[25] Web marking service. http://www.dice.inf.ed.ac.uk/units/research_and_teaching/documentation/unit/webmark/webmark.html. (Accessed on 04/13/2020).

[26] What is user centered design? — interaction design foundation. https://www.interaction-design.org/literature/topics/user-centered-design. (Accessed on 04/08/2020).

[27] User-centered design basics. https://www.usability.gov/what-and-why/user-centered-design.html, Apr 2017. (Accessed on 22/01/2020).

[28] Coursework, assessment & feedback. http://web.inf.ed.ac.uk/infweb/student-services/ito/admin/coursework-projects/coursework-assessment-feedback, Aug 2018. (Accessed on 25/01/2020).

[29] Euclid staff information. http://web.inf.ed.ac.uk/infweb/student-services/euclid/euclid-staff-information, Feb 2018. (Accessed on 25/01/2020).

[30] Exams & boe. http://web.inf.ed.ac.uk/infweb/student-services/ito/staff/exams-boe, Feb 2019. (Accessed on 25/01/2020).

[31] *The impact of feedback in higher education : improving assessment outcomes for learners*. Palgrave Macmillan, Cham, Switzerland, 2019.

[32] Informatics teaching organisation. http://web.inf.ed.ac.uk/infweb/student-services/ito, Sep 2019. (Accessed on 25/01/2020).

[33] C. Auerbach and L.B. Silverstein. *Qualitative Data: An Introduction to Coding and Analysis*. Qualitative Studies in Psychology. NYU Press, 2003.

[34] Aaron Bangor, Philip T. Kortum, and James T. Miller. An empirical evaluation of the system usability scale. *International Journal of Human–Computer Interaction*, 24(6):574–594, 2008.

[35] Randolph G. Bias. Interface-walkthroughs: efficient collaborative testing. *IEEE Software*, 8:94–95, 1991.

[36] R.E. Boyatzis. *Transforming Qualitative Information: Thematic Analysis and Code Development*. Transforming Qualitative Information: Thematic Analysis and Code Development. SAGE Publications, 1998.

[37] Virginia Braun and Victoria Clarke. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2):77–101, 2006.

[38] CodeGrade. Codegrade programming education made intuitive. https://codegra.de/. (Accessed on 21/02/2020).

[39] L.M. Given. *The Sage Encyclopedia of Qualitative Research Methods: A-L ; Vol. 2, M-Z Index*. A Sage Reference Publication. SAGE Publications, 2008.

[40] Gradescope. Help — gradescope. https://www.gradescope.com/help#help-center-item-programming-assignments. (Accessed on 21/02/2020).

[41] Jan Gulliksen, Bengt Göransson, Inger Boivie, Stefan Blomkvist, Jenny Persson, and Åsa Cajander. Key principles for user-centred systems design. *Behaviour & IT*, 22:397–409, 2003.

[42] Bruce Hanington and Bella Martin. *Universal Methods of Design : 100 Ways to Explore Complex Problems, Develop Innovative Strategies, and Deliver Effective Design So*. Quarto Publishing Group USA, Osceola, United States, 2012.

[43] James Hom. The usability methods toolbox handbook. *Fuente: http://www. idemployee. id. tue. nl/gwm rauterberg/lecturenotes/UsabilityMethodsToolboxHandbo ok. pdf (Consultado el 23-09-12)*, 144:73–80, 1998.

[44] P.W. Jordan, B. Thomas, I.L. McClelland, and B. Weerdmeester. *Usability Evaluation In Industry*. Taylor & Francis, 1996.

[45] M. Kuniavsky and Engineering Information Inc. *Observing the User Experience: A Practitioner's Guide to User Research*. ITPro collection. Elsevier Science, 2003.

[46] J. Nielsen. Iterative user-interface design. *Computer*, 26(11):32–41, Nov 1993.

[47] Rohit Pawar. Use audio-visual data in the qualitative research work: Ijsrp february 2013 publication, Aug 2013.

[48] Jeff Sauro and James R. Lewis. Chapter 9 - six enduring controversies in measurement and statistics. In Jeff Sauro and James R. Lewis, editors, *Quantifying the User Experience (Second Edition)*, pages 249 – 276. Morgan Kaufmann, Boston, second edition edition, 2016.

[49] D.J. Treiman. *Quantitative Data Analysis: Doing Social Research to Test Ideas*. Research Methods for the Social Sciences. Wiley, 2009.

[50] J. Vallverdú. *Handbook of Research on Synthetic Emotions and Sociable Robotics: New Applications in Affective Computing and Artificial Intelligence: New Applications in Affective Computing and Artificial Intelligence*. Information Science Reference, 2009.

Appendix A

Requirements Gathering Study

A.1 Participant Consent Form

Participant number:_____

Participant Consent Form

Project title:	MarkEd: An Online Marking Tool for the University of Edinburgh School of Informatics
Principal investigator (PI):	Cristina Adriana Alexandru
Researcher:	Andrius Girdžius, Oktay Şen
PI contact details:	Cristina.Alexandru@ed.ac.uk, +44 (0) 131 651 1739

Please tick yes or no for each of these statements.

		Yes	No
1.	I confirm that I have read and understood the Participant Information Sheet for the above study, that I have had the opportunity to ask questions, and that any questions I had were answered to my satisfaction.		
2.	I understand that my participation is voluntary, and that I can withdraw at any time without giving a reason. Withdrawing will not affect any of my rights.		
3.	I agree to being audio recorded.		
4.	I consent to my anonymised data being used in academic publications and presentations.		
5.	I understand that my anonymised data can be stored for a minimum of two years		
6.	I allow my data to be used in future ethically approved research.		
7.	I agree to take part in this study.		

Name of person giving consent	Date dd/mm/yy	Signature

Name of person taking consent	Date dd/mm/yy	Signature

THE UNIVERSITY of EDINBURGH informatics

A.2 Participant Information Sheets

A.2.1 Academic Staff

Participant Information Sheet - Academic Staff

Project title:	MarkEd: An Online Marking Tool for the University of Edinburgh School of Informatics
Principal investigator:	Cristina Adriana Alexandru
Researcher collecting data:	Andrius Girdžius, Oktay Şen
Funder (if applicable):	N/A

This study was certified according to the Informatics Research Ethics Process, RT number 2019/62506. Please take time to read the following information carefully. You should keep this page for your records.

Who are the researchers?

Andrius Girdžius, Oktay Şen, Cristina Adriana Alexandru *(supervisor)*.

What is the purpose of the study?

The study is performed as part of two undergraduate projects aiming to develop an online marking tool to help with the marking, feedback, moderation and related administrative processes in the School of Informatics. The purpose of the study is to learn about the different approaches and tools used by academics in the aforementioned processes, determine what currently works well and whether there are any issues; gather views about the usefulness of the proposed marking tool, its potential impact, and requirements for it.

Why have I been asked to take part?

You are a member of the academic staff in the School of Informatics. Your contribution is important to determine the usefulness and requirements for the proposed tool, which could improve the student and staff experience with assessment in the future.

Do I have to take part?

No – participation in this study is entirely up to you. You can withdraw from the study at any time, without giving a reason. Your rights will not be affected. If you wish to withdraw, contact the PI. We will stop using your data in any publications or presentations submitted after you have withdrawn consent. However, we will keep copies of your original consent, and of your withdrawal request.

What will happen if I decide to take part?

You will be asked questions about your organisation of assessed coursework or exam papers, the tools and/or methods that you use for marking, feedback and moderation, your opinions about them. We will also ask for your opinion about the usefulness and potential impact of the proposed marking tool, and your requirements for it.

We will also ask for information about your background, i.e. your role, level of experience, characteristics of taught courses.

Information will be collected in the form of an interview.

The interview will take up to 30 minutes to complete.

If permission is given, audio recording will be performed during the study.

Compensation.

You will not be paid for your participation in this study.

Are there any risks associated with taking part?

There are no significant risks associated with participation. Your role in the University of Edinburgh will not be affected.

Are there any benefits associated with taking part?

By participating in this study you may help to improve the overall marking, feedback, moderation and related administrative processes for the School of Informatics in the future if and when our proposed tool is developed and used.

What will happen to the results of this study?

The results of this study may be summarised in published articles, reports and presentations. Quotes or key findings will be anonymized: We will remove any information that could, in our assessment, allow anyone to identify you. With your consent, information can also be used for future research. Your data may be archived for a minimum of 2 years.

Data protection and confidentiality.

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Your data will be referred to by a unique participant number rather than by name. Your data will only be viewed by the research team.

All electronic data will be stored on a password-protected encrypted computer, on the School of Informatics' secure file servers, or on the University's secure encrypted cloud storage services (DataShare, ownCloud, or Sharepoint) and all paper records will be stored in a locked filing cabinet in the PI's office. Your consent information will be kept separately from your responses in order to minimise risk.

What are my data protection rights?

The University of Edinburgh is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance with the Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk. Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer at dpo@ed.ac.uk.

Who can I contact?

If you have any further questions about the study, please contact the lead researcher, Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk, +44 (0) 131 651 1739).

If you wish to make a complaint about the study, please contact inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.

If the research project changes in any way, an updated Participant Information Sheet will be sent to you by email.

Alternative formats.

To request this document in an alternative format, such as large print or on coloured paper, please contact Andrius Girdžius (s1642301@sms.ed.ac.uk), Oktay Şen (s1663938@sms.ed.ac.uk) or Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk).

General information.

For general information about how we use your data, go to: edin.ac/privacy-research

A.2.2 Teaching Support Staff

Participant Information Sheet - Teaching Support Staff

Project title:	MarkEd: An Online Marking Tool for the University of Edinburgh School of Informatics
Principal investigator:	Cristina Adriana Alexandru
Researcher collecting data:	Andrius Girdžius, Oktay Şen
Funder (if applicable):	N/A

This study was certified according to the Informatics Research Ethics Process, RT number 2019/62506. Please take time to read the following information carefully. You should keep this page for your records.

Who are the researchers?

Andrius Girdžius, Oktay Şen, Cristina Adriana Alexandru *(supervisor)*.

What is the purpose of the study?

The study is performed as part of two undergraduate projects aiming to develop an online marking tool to help with the marking, feedback, moderation and related administrative processes in the School of Informatics. The purpose of the study is to learn about the different approaches and tools used by teaching support staff (markers, teaching assistants) in the aforementioned processes, determine what currently works well and whether there are any issues; gather views about the usefulness of the proposed marking tool, its potential impact, and requirements for it.

Why have I been asked to take part?

You are a member of the teaching support staff acting as a marker and/or teaching assistant in the School of Informatics. Your contribution is important to determine the usefulness and requirements for the proposed tool, which could improve the student and staff experience with assessment in the future.

Do I have to take part?

No – participation in this study is entirely up to you. You can withdraw from the study at any time, without giving a reason. Your rights will not be affected. If you wish to withdraw, contact the PI. We will stop using your data in any publications or presentations submitted after you have withdrawn consent. However, we will keep copies of your original consent, and of your withdrawal request.

What will happen if I decide to take part?

You will be asked questions about your involvement in assessment processes, tools and/or methods that you use for marking, feedback and moderation, your opinions about them. We will also ask for your opinion about the usefulness and potential impact of the proposed marking tool, and your requirements for it.

Information will be collected in the form of a focus group, but we will also ask about your background in the form of a short survey, i.e. your role, level of experience with assessment, characteristics of the courses involved.

The session will take between 45 minutes to an hour to complete.

If permission is given, audio recording will be performed during the study.

Compensation.

You will not be paid for your participation in this study.

Are there any risks associated with taking part?

There are no significant risks associated with participation. Your role and/or studies in the University of Edinburgh will not be affected.

Are there any benefits associated with taking part?

By participating in this study you may help to improve the overall marking, feedback, moderation and related administrative processes for the School of Informatics in the future if and when our proposed tool is developed and used.

What will happen to the results of this study?

The results of this study may be summarised in published articles, reports and presentations. Quotes or key findings will be anonymized: We will remove any information that could, in our assessment, allow anyone to identify you. With your consent, information can also be used for future research. Your data may be archived for a minimum of 2 years.

Data protection and confidentiality.

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Your data will be referred to by a unique participant number rather than by name. Your data will only be viewed by the research team.

All electronic data will be stored on a password-protected encrypted computer, on the School of Informatics' secure file servers, or on the University's secure encrypted cloud storage services (DataShare, ownCloud, or Sharepoint) and all paper records will be stored in a locked filing cabinet in the PI's office. Your consent information will be kept separately from your responses in order to minimise risk.

What are my data protection rights?

The University of Edinburgh is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance with the Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk. Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer at dpo@ed.ac.uk.

Who can I contact?

If you have any further questions about the study, please contact the lead researcher, Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk, +44 (0) 131 651 1739).

If you wish to make a complaint about the study, please contact

inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.

If the research project changes in any way, an updated Participant Information Sheet will be sent to you by email.

Alternative formats.

To request this document in an alternative format, such as large print or on coloured paper, please contact Andrius Girdžius (s1642301@sms.ed.ac.uk), Oktay Şen (s1663938@sms.ed.ac.uk) or Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk).

General information.

For general information about how we use your data, go to: edin.ac/privacy-research

A.2.3 Administrative Staff

Participant Information Sheet - Administrative/Support Staff

Project title:	MarkEd: An Online Marking Tool for the University of Edinburgh School of Informatics
Principal investigator:	Cristina Adriana Alexandru
Researcher collecting data:	Andrius Girdžius, Oktay Şen
Funder (if applicable):	N/A

This study was certified according to the Informatics Research Ethics Process, RT number 2019/62506. Please take time to read the following information carefully. You should keep this page for your records.

Who are the researchers?

Andrius Girdžius, Oktay Şen, Cristina Adriana Alexandru *(supervisor)*.

What is the purpose of the study?

The study is performed as part of two undergraduate projects aiming to develop an online marking tool to help with the marking, feedback, moderation and related administrative processes in the School of Informatics. The purpose of the study is to determine the tools and procedures currently used and/or planned for the future to support the aforementioned processes in the School of Informatics; determine the advantages, disadvantages of the current tools and procedures, and any gaps; gather views about the usefulness of the proposed marking tool, its potential impact, and requirements for it.

Why have I been asked to take part?

You are a member of the administrative/support staff in the School of Informatics. Your contribution is important to determine the usefulness and requirements for the proposed tool, which could improve the student and staff experience with assessment in the future.

Do I have to take part?

No – participation in this study is entirely up to you. You can withdraw from the study at any time, without giving a reason. Your rights will not be affected. If you wish to withdraw, contact the PI. We will stop using your data in any publications or presentations submitted after you have withdrawn consent. However, we will keep copies of your original consent, and of your withdrawal request.

What will happen if I decide to take part?

You will be asked questions about your side of the administrative work; the currently used or planned tools and/or processes for marking, feedback and moderation; collecting results and feedback from markers; handling student data and results in the various systems used by the school. We will ask for your opinion about the usefulness of the proposed marking tool, its potential impact, and your requirements for it. We will also ask for information about your background, i.e. your role, title.

[OPTION 1 - FOCUS GROUP]

Information will be collected in a focus group.

The focus group will take up to 1 hour to complete.

If permission is given, audio recording will be performed during the study.

[OPTION 2 - INTERVIEW]
Information will be collected in an interview.

The interview will take up to 30 minutes to complete.

If permission is given, audio recording will be performed during the study.

Compensation.

You will not be paid for your participation in this study.

Are there any risks associated with taking part?

There are no significant risks associated with participation. Your role in the University of Edinburgh will not be affected.

Are there any benefits associated with taking part?

By participating in this study you may help to improve the overall marking, feedback, moderation and related administrative processes for the School of Informatics in the future if and when our proposed tool is developed and used.

What will happen to the results of this study?

The results of this study may be summarised in published articles, reports and presentations. Quotes or key findings will be anonymized: We will remove any information that could, in our assessment, allow anyone to identify you. With your consent, information can also be used for future research. Your data may be archived for a minimum of 2 years.

Data protection and confidentiality.

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Your data will be referred to by a unique participant number rather than by name. Your data will only be viewed by the research team.

All electronic data will be stored on a password-protected encrypted computer, on the School of Informatics' secure file servers, or on the University's secure encrypted cloud storage services (DataShare, ownCloud, or Sharepoint) and all paper records will be stored in a locked filing cabinet in the PI's office. Your consent information will be kept separately from your responses in order to minimise risk.

What are my data protection rights?

The University of Edinburgh is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance with the Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit

www.ico.org.uk. Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer at dpo@ed.ac.uk.

Who can I contact?

If you have any further questions about the study, please contact the lead researcher, Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk, +44 (0) 131 651 1739).

If you wish to make a complaint about the study, please contact inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.

If the research project changes in any way, an updated Participant Information Sheet will be sent to you by email.

Alternative formats.

To request this document in an alternative format, such as large print or on coloured paper, please contact Andrius Girdžius (s1642301@sms.ed.ac.uk), Oktay Şen (s1663938@sms.ed.ac.uk) or Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk).

General information.

For general information about how we use your data, go to: edin.ac/privacy-research

A.2.4 Students

Participant Information Sheet - Students

Project title:	MarkEd: An Online Marking Tool for the University of Edinburgh School of Informatics
Principal investigator:	Cristina Adriana Alexandru
Researcher collecting data:	Andrius Girdžius, Oktay Şen
Funder (if applicable):	N/A

This study was certified according to the Informatics Research Ethics Process, RT number 2019/62506. Please take time to read the following information carefully. You should keep this page for your records.

Who are the researchers?

Andrius Girdžius, Oktay Şen, Cristina Adriana Alexandru *(supervisor)*.

What is the purpose of the study?

The study is performed as part of two undergraduate projects aiming to develop an online marking tool to help with the marking, feedback, moderation and related administrative processes in the School of Informatics. The purpose of the study is to determine student experiences with marking and feedback; what works well and what could be done to improve the current processes

Why have I been asked to take part?

You are a student in the School of Informatics. Your contribution is important to determine the usefulness and requirements for the proposed tool, which could improve the student and staff experience with assessment in the future.

Do I have to take part?

No – participation in this study is entirely up to you. You can withdraw from the study at any time, without giving a reason. Your rights will not be affected. If you wish to withdraw, contact the PI. We will stop using your data in any publications or

presentations submitted after you have withdrawn consent. However, we will keep copies of your original consent, and of your withdrawal request.

Compensation.

You will not be paid for your participation in this study.

What will happen if I decide to take part?

You will be asked questions about your opinion and experience with marking and feedback for courses in the School of Informatics.

Information will be collected in a focus group, but we will also ask for information about your background in the form of a short survey, i.e. your year of study, degree program.

The session will take up to 1 hour to complete.

If permission is given, audio recording will be taken during the study.

Are there any risks associated with taking part?

There are no significant risks associated with participation. Your studies in the University of Edinburgh will not be affected.

Are there any benefits associated with taking part?

By participating in this study you may help to improve the overall marking, feedback, moderation and related administrative processes for the School of Informatics in the future if and when our proposed tool is developed and used.

What will happen to the results of this study?

The results of this study may be summarised in published articles, reports and presentations. Quotes or key findings will be anonymized: We will remove any information that could, in our assessment, allow anyone to identify you. With your

consent, information can also be used for future research. Your data may be archived for a minimum of 2 years.

Data protection and confidentiality.

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Your data will be referred to by a unique participant number rather than by name. Your data will only be viewed by the research team.

All electronic data will be stored on a password-protected encrypted computer, on the School of Informatics' secure file servers, or on the University's secure encrypted cloud storage services (DataShare, ownCloud, or Sharepoint) and all paper records will be stored in a locked filing cabinet in the PI's office. Your consent information will be kept separately from your responses in order to minimise risk.

What are my data protection rights?

The University of Edinburgh is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance with the Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk. Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer at dpo@ed.ac.uk.

Who can I contact?

If you have any further questions about the study, please contact the lead researcher, Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk, +44 (0) 131 651 1739).

If you wish to make a complaint about the study, please contact inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.

If the research project changes in any way, an updated Participant Information Sheet will be sent to you by email.

Alternative formats.

To request this document in an alternative format, such as large print or on coloured paper, please contact Andrius Girdžius (s1642301@sms.ed.ac.uk), Oktay Şen (s1663938@sms.ed.ac.uk) or Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk).

General information.

For general information about how we use your data, go to: edin.ac/privacy-research

A.3 Question Lists

A.3.1 Focus Group - Students

1. Year of study
2. Degree programme
3. When was the last time you received marks on an assignment?
   (a) How was this experience?
   (b) What was particularly positive/negative about your experience with the marks?
4. When was the last time you received feedback on an assignment?
   (a) How was this experience?
   (b) What was particularly positive/negative about your experience with the feedback?
5. Describe your best/ideal marks and feedback experience you have had so far.
6. Describe your worst marks and feedback experience you have had so far.
7. In general, how satisfied are you with the following in the School of Informatics?
   (a) Fairness of marks
   (b) Usefulness of feedback
   (c) Length of feedback
   (d) Feedback matching marks
   (e) Timeliness of marks
   (f) Timeliness of feedback
   (g) Channel for getting marks
   (h) Channel for getting feedback
   (i) Ability to enquire about marks
   (j) Ability to enquire about feedback
8. What do you think could be done to improve the current marking and feedback process? Please elaborate on addressing the criteria mentioned in the previous question.

A.3.2 Interview - Academic Staff

1. Role
2. Level of experience

3. Who is responsible for evaluating student submissions in your course?
   (a) Lecturer
   (b) Course organiser
   (c) TA
   (d) Markers
   (e) Tutors
   (f) Other (please specify)
4. Could you walk us through the typical assessment process for your course?
5. What tools / frameworks / services do you use for...
   (a) Collecting submissions?
   (b) Marking?
   (c) Moderation?
   (d) Collaborating with markers?
   (e) Generating feedback reports?
   (f) Sending marks with the ITO?
6. Is there anything that you think the current tools are lacking?
7. What task(s) in the process of marking or administration do you find the most laborious / repetitive? Why?
8. Are there any tasks which, in your opinion, could be automated to make your experience better?
9. Have you ever built/used a custom tool / script to automate parts of the marking process?
   (a) How did it work?
   (b) What step in the process did it replace or enhance?
   (c) Do you think it improved your experience/performance?
10. Do you think there is any potential for human error in the marking process?
11. Do you think a tool could help in your marking process? What features would you like this tool to have?
12. On a scale of 1 to 10, how useful would each of these proposed features be?
    (a) Joint marking with other markers
    (b) Ability to record feedback alongside marks
    (c) Communication features between markers

(d) Ability to compare with other markers for the purpose of consistency

(e) Ability to export and send marks to the ITO

(f) Ability to send mark and feedback emails to students in bulk

(g) Ability to gather statistics and generate reports on student performance

13. If there was anything else that could make your overall experience and/or performance in the marking processes better, what would it be?

A.3.3 Interview - Administrative Staff

1. Role
2. Title
3. Could you walk us through the typical process of marking and feedback in the School of Informatics?
   (a) Communicating with the academic and teaching support staff regarding assessed coursework and exams?
   (b) Collecting/accessing student submissions?
   (c) Moderation?
   (d) Gathering marks and/or feedback from the course markers?
   (e) Inputting collected marks to Euclid [29] and/or other systems?
      i. What files/formats are used to handle this?
      ii. what information is stored by these systems?
   (f) Generating reports on course/year statistics?
   (g) Handling student data and results on various systems used by the School?
4. What tools do you currently use in to simplify your workflow for the tasks previously mentioned?
   (a) Which task do they assist with?
   (b) Why are you using them?
   (c) Are there any alternatives? Why are they not being used?
   (d) Is there anything that these tools lack? Or is there anything that could be done to improve them?
5. How is this process working for you? Are there any areas which you would improve?
6. Are there any areas which, in your opinion, would benefit from automation?
7. Are there currently any administrative tools that are planned / in development?

   (a) What are they?

   (b) Which task would they assist in?

   (c) Why are they being built / What are they replacing?

8. Do you think a tool could help in your marking process? What features would you like this tool to have?

9. If there was anything else that could make your overall experience and/or performance in the administrative processes better, what would it be?

A.3.4 Interview - Teaching Support Staff

1. Role

2. Level of experience

3. Could you walk us through the typical marking/feedback process for courses where you were a marker in Informatics?

   (a) How are marking responsibilities split between markers?

   (b) Do you collaborate with other markers?

   (c) Do you provide feedback?

4. What tools / frameworks / services do you use for...

   (a) Splitting responsibilities?

   (b) Collecting submissions?

   (c) Marking?

   (d) Collaborating with other markers?

   (e) Writing feedback?

   (f) Sending marks to the ITO?

   (g) Sending feedback to students?

5. Is there anything that you think the current tools are lacking?

6. How do you ensure your marking is fair (here also including consistency between the way you mark different students)?

7. How do you ensure you are being consistent with other markers who mark other students?

8. What task(s) in the process of marking do you find the most laborious / repetitive? Why?

9. Are there any tasks which, in your opinion, could be automated to make your experience better?

10. Do you think there is any potential for human error in the marking process?

11. Have you ever built/used a custom tool / script to automate parts of the marking process?
    (a) How did it work?
    (b) What step in the process did it replace or enhance?
    (c) Do you think it improved your experience/performance?
12. Do you think a tool could help in your marking process? What features would you like this tool to have?
13. On a scale of 1 to 10, how useful would each of these proposed features be?
    (a) Joint marking with other markers
    (b) Ability to record feedback alongside marks
    (c) Communication features between markers
    (d) Ability to compare with other markers for the purpose of consistency
    (e) Ability to export and send marks to the ITO
    (f) Ability to send mark and feedback emails to students in bulk
    (g) Ability to gather statistics and generate reports on student performance
14. If there was anything else that could make your overall experience and/or performance in the marking processes better, what would it be?

Appendix B

Formative Evaluation Studies

B.1 Participant Information Sheets

B.1.1 Stakeholder Walkthrough

Participant Information Sheet

Project title:	MarkEd: An Online Marking Tool for the University of Edinburgh School of Informatics
Principal investigator:	Cristina Adriana Alexandru
Researcher collecting data:	Andrius Girdžius
Funder (if applicable):	N/A

This study was certified according to the Informatics Research Ethics Process, RT number 2019/62506. Please take time to read the following information carefully. You should keep this page for your records.

Who are the researchers?

Andrius Girdžius, Cristina Adriana Alexandru *(supervisor)*.

What is the purpose of the study?

The study is performed as part of two undergraduate projects aiming to develop an online marking tool to help with the marking, feedback, moderation and related administrative processes in the School of Informatics. The purpose of the study is to query about the design of a prototype of the proposed tool and identify key areas of improvement for further iterations and the development stage.

Why have I been asked to take part?

You are a member of the School of Informatics and thus a potential user of the tool. Your contribution is important to determine the usability of the tool and evaluate the design choices. Successful participation could have an impact on improving the student and staff experience with assessment in the future.

Do I have to take part?

No – participation in this study is entirely up to you. You can withdraw from the study at any time, without giving a reason. Your rights will not be affected. If you wish to withdraw, contact the PI. We will stop using your data in any publications or presentations submitted after you have withdrawn consent. However, we will keep copies of your original consent, and of your withdrawal request.

What will happen if I decide to take part?

- You will be be asked to participate in a walkthrough of a prototype design of a marking and feedback tool. You will be shown a series of screens and asked to indicate your steps on performing some predetermined tasks. This will include discussing your choices and the design within the group setting. Afterwards a series of questions in the form of a questionnaire relating to your opinions about the usability and design of the prototype presented may be asked.
- We will also ask for information about your background, i.e. your role, level of experience with assessment, characteristics of the courses involved.
- The session will take up to 45 minutes to complete.
- If permission is given, audio recording will be performed during the study.

Are there any risks associated with taking part?

There are no significant risks associated with participation.

Are there any benefits associated with taking part?

By participating in this study you may help to improve the usability and design of the tool aiming to improve the overall marking, feedback, moderation and related administrative processes for the School of Informatics.

What will happen to the results of this study?

The results of this study may be summarised in published articles, reports and presentations. Quotes or key findings will be anonymized: We will remove any information that could, in our assessment, allow anyone to identify you. With your consent, information can also be used for future research. Your data may be archived for a minimum of 2 years.

Data protection and confidentiality.

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Your data will be referred to by a unique participant number rather than by name. Your data will only be viewed by the research team (Andrius Girdžius, Cristina Adriana Alexandru (supervisor).

All electronic data will be stored on a password-protected encrypted computer, on the School of Informatics' secure file servers, or on the University's secure encrypted cloud storage services (DataShare, ownCloud, or Sharepoint) and all paper records will be stored in a locked filing cabinet in the PI's office. Your consent information will be kept separately from your responses in order to minimise risk.

What are my data protection rights?

The University of Edinburgh is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance with the Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit

www.ico.org.uk. Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer at dpo@ed.ac.uk.

Who can I contact?

If you have any further questions about the study, please contact the lead researcher, Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk, +44 (0) 131 651 1739).

If you wish to make a complaint about the study, please contact inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.

If the research project changes in any way, an updated Participant Information Sheet will be sent to you by email.

Alternative formats.

To request this document in an alternative format, such as large print or on coloured paper, please contact Andrius Girdžius (s1642301@sms.ed.ac.uk) or Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk).

General information.

For general information about how we use your data, go to: edin.ac/privacy-research

B.1.2 Stakeholder Walkthrough (Online)

Participant Information Sheet

Project title:	MarkEd: An Online Marking Tool for the University of Edinburgh School of Informatics
Principal investigator:	Cristina Adriana Alexandru
Researcher collecting data:	Andrius Girdžius
Funder (if applicable):	N/A

This study was certified according to the Informatics Research Ethics Process, RT number 2019/62506. Please take time to read the following information carefully. You should keep this page for your records.

Who are the researchers?

Andrius Girdžius, Cristina Adriana Alexandru *(supervisor)*.

What is the purpose of the study?

The study is performed as part of two undergraduate projects aiming to develop an online marking tool to help with the marking, feedback, moderation and related administrative processes in the School of Informatics. The purpose of the study is to query about the design of a prototype of the proposed tool and identify key areas of improvement for further iterations and the development stage.

Why have I been asked to take part?

You are a member of the School of Informatics and thus a potential user of the tool. Your contribution is important to determine the usability of the tool and evaluate the design choices. Successful participation could have an impact on improving the student and staff experience with assessment in the future.

Do I have to take part?

No – participation in this study is entirely up to you. You can withdraw from the study at any time, without giving a reason. Your rights will not be affected. If you wish to withdraw, contact the PI. We will stop using your data in any publications or presentations submitted after you have withdrawn consent. However, we will keep copies of your original consent, and of your withdrawal request.

What will happen if I decide to take part?

- You will be be asked to participate in a walkthrough (carried out online using a GDPR compliant service) of a prototype design of a marking and feedback tool. You will be shown a series of screens and asked to indicate your steps on performing some predetermined tasks. This will include discussing your choices and the design within the group setting. Afterwards a series of questions in the form of a questionnaire relating to your opinions about the usability and design of the prototype presented may be asked.
- We will also ask for information about your background, i.e. your role, level of experience with assessment, characteristics of the courses involved.
- The session will take up to 1 hour to complete.
- If permission is given, audio recording will be performed during the study.

Are there any risks associated with taking part?

There are no significant risks associated with participation.

Are there any benefits associated with taking part?

By participating in this study you may help to improve the usability and design of the tool aiming to improve the overall marking, feedback, moderation and related administrative processes for the School of Informatics.

What will happen to the results of this study?

The results of this study may be summarised in published articles, reports and presentations. Quotes or key findings will be anonymized: We will remove any information that could, in our assessment, allow anyone to identify you. With your consent, information can also be used for future research. Your data may be archived for a minimum of 2 years.

Data protection and confidentiality.

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Your data will be referred to by a unique participant number rather than by name. Your data will only be viewed by the research team (Andrius Girdžius, Cristina Adriana Alexandru (supervisor).

All electronic data will be stored on a password-protected encrypted computer, on the School of Informatics' secure file servers, or on the University's secure encrypted cloud storage services (DataShare, ownCloud, or Sharepoint) and all paper records will be stored in a locked filing cabinet in the PI's office. Your consent information will be kept separately from your responses in order to minimise risk.

What are my data protection rights?

The University of Edinburgh is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance with the Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit

www.ico.org.uk. Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer at dpo@ed.ac.uk.

Who can I contact?

If you have any further questions about the study, please contact the lead researcher, Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk, +44 (0) 131 651 1739).

If you wish to make a complaint about the study, please contact inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.

If the research project changes in any way, an updated Participant Information Sheet will be sent to you by email.

Alternative formats.

To request this document in an alternative format, such as large print or on coloured paper, please contact Andrius Girdžius (s1642301@sms.ed.ac.uk) or Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk).

General information.

For general information about how we use your data, go to: edin.ac/privacy-research

B.2 Tasks and Questions

B.2.1 Teaching Support Staff

B.2.1.1 Tasks

1. Open the Coursework 2 page for course “Human-Computer Interaction”
2. Attempt to mark submission for student s1234567, simulating entering your marks and feedback
3. Find instructions to mark question Q1.2
4. Ask for more assistance for question Q1.2
5. Save your work
6. Change the file you are viewing to ”my-report.pdf”
7. Look at how the previous student’s submission was marked
8. Find a view of all of your flagged submissions for Q1.2
9. Open and edit the mark for Q1.2 for one of those flagged submissions

B.2.1.2 Post-Task Individual Questions

1. What is your level of experience in marking?
2. What part of the tool did you like best?
3. What part of the tool did you like least?
4. Any suggestions for future improvement?

B.2.2 Academic Staff

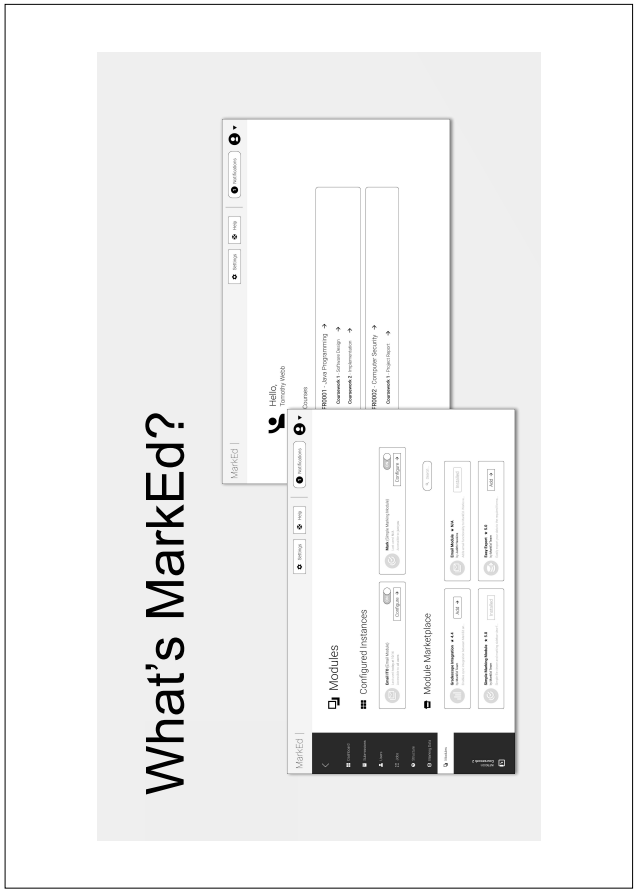
B.2.2.1 Tasks

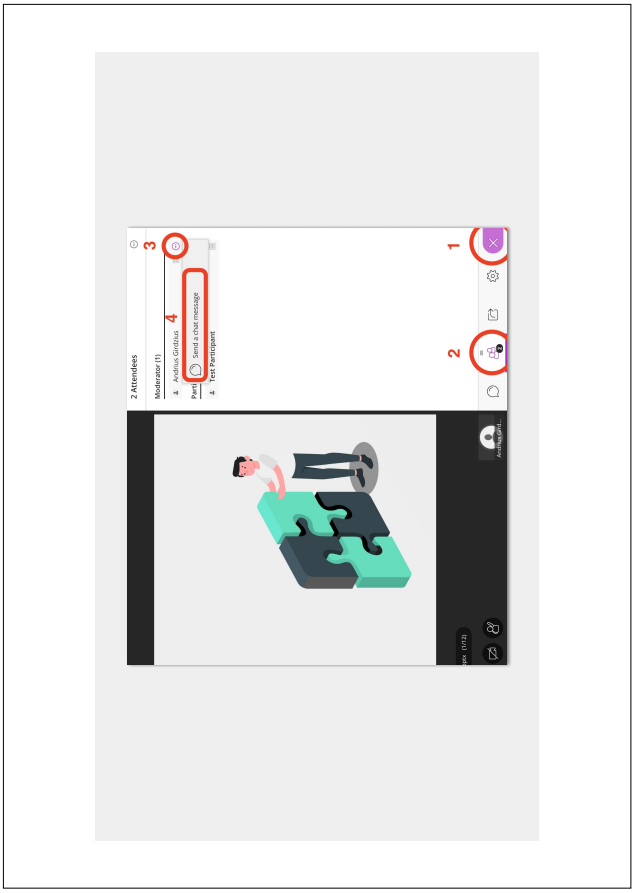
1. Find and open the Coursework 2 page for the Java Programming course.
2. Add question/rubric Q1.3 to the assignment setup.
3. Add question/rubric Q1.3 to the assignment setup.
4. Find and access the marked submission that has question Q1.1 tagged for moderation.
5. In the marking page, edit feedback for question Q1.1. Remove the moderation tag. Save your work.
6. Create and save an automated workflow to notify the course organiser about newly tagged submissions.

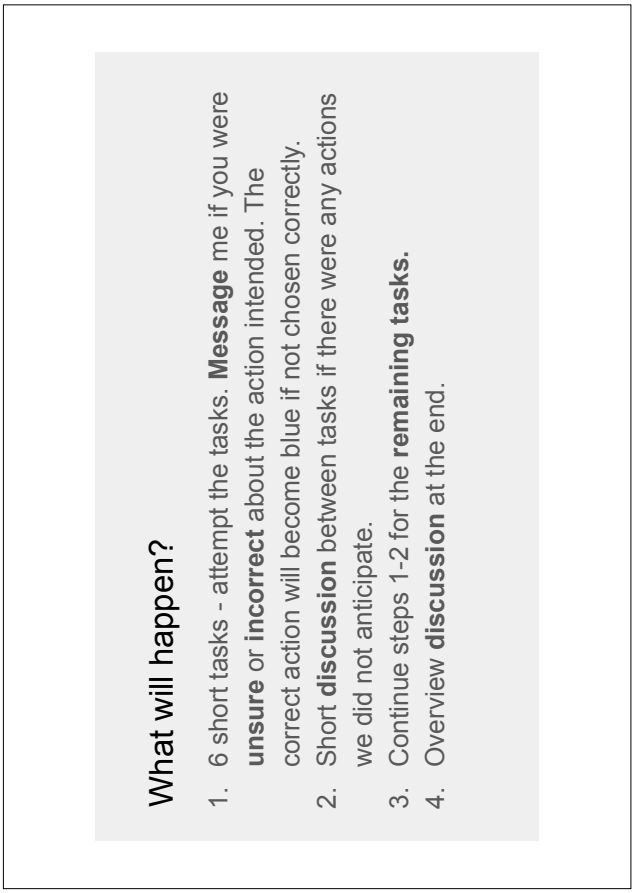
B.2.2.2 Post-Task Individual Questions

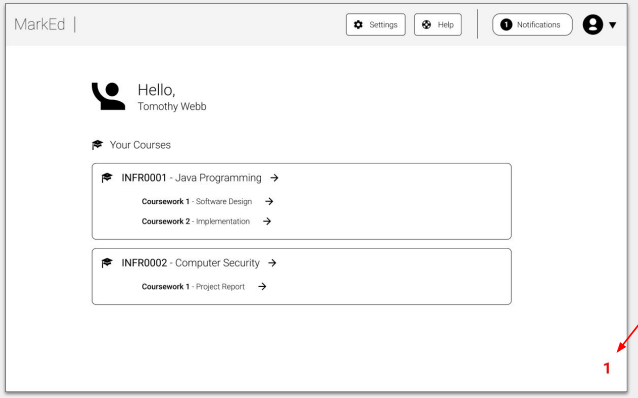
1. What did you like most?
2. What did you like least?
3. What could be improved? How?
4. Any other suggestions?

B.2.2.3 Academic Staff Session Slides









Task 1 (*warmup!*)

Find and open the **Coursework 2** page for the **Java Programming** course.

Start: **1**

End: **2**

Task 2

Add question/rubric **Q1.3** to the assignment setup.

Start: **2**

End: **4**

Task 3

Assign question **Q1.1** to marker **Ted Bell**.

Start: **4**

End: **6**

Task 4

Find and access the marked submission that has question **Q1.1** tagged for moderation.

Start: **6**

End: **9**

Task 5

In the marking page, edit feedback for question **Q1.1**. Remove the moderation tag. Save your work.

Start: **9**

End: **12**

Task 6 (*last one!*)

Create and save an automated workflow to notify the course organiser about newly tagged submissions.

Start: **12**

End: **18**

Anything else to add?

1. What did you like most?
2. What did you like least?
3. What could be improved? How?
4. Any other suggestions?


Thank you!
Your input is greatly appreciated.

Appendix C

Summative Evaluation Study

C.1 Participant Information Sheet

Participant Information Sheet

Project title:	MarkEd: An Online Marking Tool for the University of Edinburgh School of Informatics
Principal investigator:	Cristina Adriana Alexandru
Researcher collecting data:	Andrius Girdžius
Funder (if applicable):	N/A

This study was certified according to the Informatics Research Ethics Process, RT number 2019/62506. Please take time to read the following information carefully. You should keep this page for your records.

Who are the researchers?

Andrius Girdžius, Cristina Adriana Alexandru *(supervisor)*.

What is the purpose of the study?

The study is performed as part of two undergraduate projects aiming to develop an online marking tool to help with the marking, feedback, moderation and related administrative processes in the School of Informatics. The purpose of the study is to query about the design of a prototype of the proposed tool and identify key areas of improvement for further iterations and the development stage.

Why have I been asked to take part?

You are a member of the School of Informatics and thus a potential user of the tool. Your contribution is important to determine the usability of the tool and evaluate the design choices. Successful participation could have an impact on improving the student and staff experience with assessment in the future.

Do I have to take part?

No – participation in this study is entirely up to you. You can withdraw from the study at any time, without giving a reason. Your rights will not be affected. If you wish to withdraw, contact the PI. We will stop using your data in any publications or presentations submitted after you have withdrawn consent. However, we will keep copies of your original consent, and of your withdrawal request.

What will happen if I decide to take part?

- You will have an opportunity to attempt a series of predetermined tasks using a prototype design of a marking and feedback tool while being observed by the researchers. Afterwards a series of questions in the form of a questionnaire relating to your opinions about the usability, design, usefulness and impact of the prototype presented may be asked.
- We will also ask for information about your background, i.e. your role in the School of Informatics, level of experience with assessment (if any).

Are there any risks associated with taking part?

There are no significant risks associated with participation.

Are there any benefits associated with taking part?

By participating in this study you may help to improve the usability and design of the tool aiming to improve the overall marking, feedback, moderation and related administrative processes for the School of Informatics.

What will happen to the results of this study?

The results of this study may be summarised in published articles, reports and presentations. Quotes or key findings will be anonymized: We will remove any information that could, in our assessment, allow anyone to identify you. With your consent, information can also be used for future research. Your data may be archived for a minimum of 2 years.

Data protection and confidentiality.

Your data will be processed in accordance with Data Protection Law. All information collected about you will be kept strictly confidential. Your data will be referred to by a unique participant number rather than by name. Your data will only be viewed by the research team (Andrius Girdžius, Cristina Adriana Alexandru (supervisor).

All electronic data will be stored on a password-protected encrypted computer, on the School of Informatics' secure file servers, or on the University's secure encrypted cloud storage services (DataShare, ownCloud, or Sharepoint) and all paper records will be stored in a locked filing cabinet in the PI's office. Your consent information will be kept separately from your responses in order to minimise risk.

What are my data protection rights?

The University of Edinburgh is a Data Controller for the information you provide. You have the right to access information held about you. Your right of access can be exercised in accordance with the Data Protection Law. You also have other rights including rights of correction, erasure and objection. For more details, including the right to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk. Questions, comments and requests about your personal data can also be sent to the University Data Protection Officer at dpo@ed.ac.uk.

Who can I contact?

If you have any further questions about the study, please contact the lead researcher, Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk, +44 (0) 131 651 1739).

THE UNIVERSITY of EDINBURGH
informatics

If you wish to make a complaint about the study, please contact inf-ethics@inf.ed.ac.uk. When you contact us, please provide the study title and detail the nature of your complaint.

Updated information.

If the research project changes in any way, an updated Participant Information Sheet will be sent to you by email.

Alternative formats.

To request this document in an alternative format, such as large print or on coloured paper, please contact Andrius Girdžius (s1642301@sms.ed.ac.uk) or Cristina Adriana Alexandru (Cristina.Alexandru@ed.ac.uk).

General information.

For general information about how we use your data, go to: edin.ac/privacy-research

C.2 Question List

1. In total how long have you been involved in marking and/or course organisation duties?
   (a) Less than 1 year
   (b) Between 2 and 5 years
   (c) More than 5 years
2. Have you had prior interactions with the MarkEd interface before today?
3. What did you like the most about the MarkEd tool?
4. What did you like the least about the MarkEd tool?
5. Your role
   (a) Student marker
   (b) Academic
6. How helpful do you think the tool would be in the following areas?
   (a) Saving time
   (b) Ensuring fairness
   (c) Error-prevention (avoiding mis-clicks)
   (d) Combining strengths of other tools
   (e) Understanding your progress
   (f) (MARKERS ONLY) Asking for assistance
   (g) (ACADEMIC ONLY) Splitting responsibilities within the team
   (h) Leaving ”to-do” notes for future work
   (i) (ACADEMIC ONLY) Automating your work
7. (ACADEMIC ONLY) How would you rate the design of assigning work to the team? Do you have any suggestions for improving this? If so, please state them.
8. (ACADEMIC ONLY) How would you rate the design of setting up the assignment structure? Do you have any suggestions for improving this? If so, please state them.
9. How would you rate the design of the marking functionality? Do you have any suggestions for improving this? If so, please state them.
10. How would you rate the design of the tagging functionality? Do you have any suggestions for improving this? If so, please state them.

11. (ACADEMIC ONLY) How would you rate the design of the automated workflow functionality? Do you have any suggestions for improving this? If so, please state them.
12. (PREVIOUS PARTICIPANTS ONLY) Since the last time you had seen the interface, how would you rate the improvement in the following areas on a range of Very poor (1) to Excellent (5)?
    (a) Navigation
    (b) Interaction
    (c) Presentation
    (d) Content
13. Please score the following 10 questions on usability using options ranging from Strongly disagree (1) to Strongly agree (5).
    (a) I think that I would like to use this system frequently.
    (b) I found the system unnecessarily complex.
    (c) I thought the system was easy to use.
    (d) I think that I would need the support of a technical person to be able to use this system.
    (e) I found the various functions in this system were well integrated.
    (f) I thought there was too much inconsistency in this system.
    (g) I would imagine that most people would learn to use this system very quickly.
    (h) I found the system very cumbersome to use.
    (i) I felt very confident using the system.
    (j) I needed to learn a lot of things before
    (k) I could get going with this system.
14. Are there any features you think the tool currently lacks? How should they work?
15. Any other comments / questions / suggestions?

C.3 Tasks

1. Find and open the Coursework 2 page for the Java Programming course.
2. (ACADEMIC ONLY) Add question/rubric Q1.3 to the assignment setup.
3. (ACADEMIC ONLY) Assign question Q1.1 to marker Ted Bell.
4. Find and access the marked submission that has question Q1.1 tagged for moderation.

5. In the marking page, find marking instructions for question Q1.1. Remove the moderation tag.
6. (ACADEMIC ONLY) Create and save an automated workflow to notify the course organiser about newly tagged submissions.