

# Online Marking of Essay-type Assignments

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**Abstract:** This paper discusses ideas around the online marking of essay-type student work. Arguments are provided why essay-type assignments are required and why current forms of online assessment are not sufficient to assess students' knowledge and understanding. The paper then presents a requirement specification for an online marking tool, suggests a technical solution for such a tool and introduces a prototype application. The online marking approach is set into context of a university-wide project that deals with the administrative support structures required for handling the electronic submission of assignments on a large scale.

## 1 Introduction

In this paper we are discussing ideas around the online marking of essay-type student work and introduce a prototype application that provides some of the core functionality required. To set the scene we need to elaborate on the components that make up the title of our paper.

Online assessment is gaining in popularity. All the major eLearning environments like WebCT or BlackBoard are providing tools to assist in the assessment of students online. Because of advantages such as reduced time as compared to dealing with paper-based assessment, more and more educational organizations consider online assessment rather than traditional paper-and-pencil exams (Christie, 2002). Online assessment implies two important concepts. Firstly, it means that students give their responses online, secondly, that these responses are marked by an automated system. Yet this second part restricts online assessment, as it is currently understood, to very limited forms of online testing consisting of multiple-choice questions, ordering or matching questions or simple 'fill in the blank' questions. These forms of online testing are not sophisticated enough to examine students' understanding of complex content and thinking patterns. Essay-type submissions in form of assignments, reports or theses are required to assess students' knowledge in a more comprehensive way. If we follow this direction we cannot rely on automated marking as today's information processing is not sophisticated enough to understand and assess this type of cognitively complex content. What is required are human markers who manually assess the essay-type assignments in a supportive online environment.

We therefore work towards a system with the main characteristics of online submission of essay-type assignments, online marking of these assignments by a human marker using specialised tools and online feedback to students. Based on this core system we can then approach an interactive environment that allows students' access to comprehensive feedback on class level and facilitates peer assessment.

In the next section of this paper we state the requirements for the core system that we have briefly characterised in this introduction. This is followed by a more technical section on decisions we have made to implement our prototype system and we give a status report on this prototype. We then describe our vision for a complete online marking system. The following section sets our research project in context with the wider efforts within our university. The paper concludes with a review and an outlook to further work.

## 2 Core requirements for the online marking system

We have developed the requirements for our online marking system for essay-type work based on our own teaching experience and informal feedback from colleagues. With the help of the prototype system we have developed (see description in later sections) we will evaluate this requirement specification more formally over the coming months.

As stated in the introduction, the important factors for our work are that we deal with essay-type assignments and human markers. Conventionally, essay-type assignments are marked in printed, paper-based form. After writing their essays on a computer students either print these essays and submit on paper or the electronically submitted essays are

printed by the marker. The marker uses pens and highlighters to annotate the essays with textual comments, numerical marks or graphical signs like ticks or lines (to indicate approval or disapproval). What we want to achieve in our system is to provide a marking environment that mirrors these paper-based marking techniques plus takes advantage of the electronic environment. This leads to the following core requirements:

- Marking tools: the marker has to be able to add textual comments, numerical marks, highlighting, icons like ticks and crosses; it must be possible to add all these annotations freely to any place within the essay;
- Customised annotations: there should be different categories of annotations that the marker can define depending on marking scheme or subject area; examples are categories for type of comments on conceptual, grammatical or spelling aspects, statements of encouragement like 'good work' or 'interesting idea' or subject specific sentences for reoccurring situations like 'you need to declare variable first' (in case of a programming-related assignment);
- Integrity of assignment: it should not be possible, advertently or inadvertently, to modify the assignment once it has been submitted by the student; the marking annotations should not change content or presentation of the assignment in any way;
- Document format: the marking tool should work on a generic document format; the students should be free to write their essays using software of their choice and add all typical printable components like tables, graphics or images;
- Accessibility: the essays and marking annotations have to be accessible from everywhere via a network connection; additionally, there should be an 'offline' mode to allow, e.g., marking offline and later synchronisation with a central system;
- Database storage: the marking annotations have to be stored in a database system to allow for flexible access based on criteria like 'annotations for specific student', 'good answers to a specific question', or 'comments of a specific type';
- Separation of essay and annotation: the marking annotations should be stored separately from the assignments to facilitate flexibility in reviewing the marked assignment by the student (e.g., focusing on annotations of one specific type) or allowing independent re-marking by a second marker in a conflict situation;
- Privacy: assignments and marking annotations have to be treated as confidential; students' access has to be restricted to their own assignments and annotations, markers have to be able to restrict access until the marking is finalised;
- Useability: to be accepted by markers and students the online marking system has to be very easy and convenient to use.

### **3 Technical issues in implementing the online marking system**

In this section we want to discuss two of the technical issues related to the implementation of the online marking system, the document format and the development environment. As indicated earlier, we want to give students the choice to select the word processing program they prefer (or have available on their home pc). We want our solution to be vendor independent in as far that we do not want to require from the university to purchase all possible programs for the markers. We need an environment that supports the combination of formatted text, tables, spreadsheets and images. Platform independence is a further criteria as the web environment naturally includes various computing platforms. One additional and very important criteria is that we want to be able to protect submitted assignments from modification.

Based on all these criteria we have chosen the Portable Document Format, PDF, by Adobe Systems Incorporated (PDF Reference, 2001) for our implementation. More or less any printable document can be converted into PDF format document. PDF documents are ideal for the web environment as they can be read on any platform and with any web browser. Choosing PDF as document format means that the university only has to purchase one software package, the PDF Writer software, to convert student submissions into PDF format. The students can use software of their choice to write their assignments.

PDF documents cannot be easily modified after they have been created from a source document. This is an important advantage compared to using a word processing format as the basis of our online marking system. Using a word processing software to mark assignments, for example with Microsoft Word's 'Comments' or 'tracking of changes' features, it would be easy for the marker to modify the original assignment inadvertently.

These and a few further advantages of the PDF format can be summarised as follows:

- Platform-neutral: can be used across different platforms;

- Widespread: one of the most popular file formats in the Internet;
- Integrity and correctness: protects documents from changes;
- Easy to publish: any printable document can be converted to PDF;
- Efficient: provides data compression, generally in small size and easy to be transferred via the Internet;
- Secure: provides data encryption mechanism for privacy protection (PDF Public-Key, 2001).

With the decision to use the PDF format the next issue to solve is the selection of a development environment. To briefly list the main requirements, our online marking system needs to be able to show the assignment that has been converted into PDF format, to allow putting annotations 'on top' of the assignment (without modifying it) and store these annotations in a database. We considered several possible approaches:

- Use and extend Adobe Acrobat (Acrobat SDK, 2001) to display and modify the PDF document.
- Build from scratch: develop our own application to analyse and display the PDF files directly.
- Use third party libraries for the PDF file manipulation.
- Use XML as the unified exchange file format when rendering the information and transforming between different file formats.

Acrobat is a set of programs provided by Adobe for reading and writing PDF documents. It contains a full range of functionalities to generate, convert, display, modify and print PDF documents. Adobe also provides a set of APIs for developers to extend Acrobat applications for adding specific functionalities to fit their own requirements.

It is also possible to develop an application to analyse and display the PDF files directly since all the detail information for PDF format is available to developers (PDF Reference, 2001). Adobe publishes detailed information on the PDF format and explicitly gives everyone permission to write software to generate and/or process PDF files. The advantage of this approach is its flexibility and customisability for the specific requirements. However, the PDF format is very versatile and a document can contain a large number of different inner objects. This can make the analysis of a PDF document very complex. The full understanding of the PDF format needs to be obtained for choosing this development path resulting in slow progress and an expensive system.

Using third party libraries for PDF manipulation can save the time and reduce the complexity of the development. The disadvantages include loss of control over quality, difficulties or conflicts when integrating with our own system, as well as the risks that the third party vendors may drop their products or go out of business.

The Extensible Markup Language (XML, 2002) is the universal format for structured documents and data on the Web. Since its introduction by World Wide Web Consortium (W3C, 2002) in 1998, XML has been a good way to structure, describe and exchange information. XML can be extended easily because of the definition of information structure is separate to the content of the information. However, the transformation between XML and PDF is complicated and the techniques are not mature at present (XML Documentation, 2002).

Based on these arguments presented here briefly we have decided to choose Adobe Acrobat as our development environment. Within this environment there are again several options for which we cannot all discuss here due to space restrictions (see Wang, 2002, for a fuller discussion). We have decided to use the Adobe Acrobat Viewer for JavaBean (Acrobat JavaBean, 2002) which is designed to support the development of PDF related Java applications. A customized application can manipulate a standard PDF document through the JavaBean interface. The Acrobat Viewer for JavaBean can be licensed free to bundle with Java-related products with agreement to the adobe licensing items. It includes several interfaces for developers to use in their own applications, through which the Java applications can read and display the standard PDF documents without being involved in the complex analysis and rendering of the inner objects of the PDF files. This significantly reduces the complexity of the PDF related applications.

Because of its standard Java implementation, Adobe Acrobat Viewer for JavaBean provides a good development interface to render PDF documents in the web environment. The JavaBean interface is therefore the ideal environment for the development of our online marking tool.

#### **4 Current status of our prototype system**

Using the JavaBean interface we have developed a prototype Java application that demonstrates the principles of online marking. The prototype program allows:

- Viewing of PDF files (including selection of different resolutions);

- Adding of marking annotations: numeric marks, icons like ticks and crosses, textual comments, highlighting of various areas;
- Saving the marking annotations in a database (separate from the assignment file);
- Viewing the assignment with and without annotations;
- Automatically adding up all marks.

This prototype can be used for testing the principles of marking online. The management tasks around the submissions of assignments, the conversion into PDF format or security aspects are not yet included. Further we do not yet have a student-side tool for viewing the marked assignments online.

## 5 Vision for a complete online marking system

In our discussions we have so far looked at the core component of an online marking system that deals with the actual marking. We now want to focus on support provided for lecturers and students. In university teaching it is common to split the assessment related tasks between lecturers and markers. The lecturer carries the overall responsibility for the assessment, sets the tasks for the students, develops marking guidelines and schemes, and gives overall feedback to the students. The marker follows the guidelines developed by the lecturer and applies the marking scheme to the individual assignments. The students receive their marked assignments and (hopefully) study the comments provided by the markers to learn from mistakes and improve their understanding of the subject. This division of interests leads to several modules required for an online marking system:

- The markers viewpoint: a full set of annotation tools, options in viewing the marked assignment, saving results per student and assignment;
- The students viewpoint, part1: access to the marked assignment, selective viewing of annotations according to criteria like type of annotation, ticks or crosses, marks, comments;
- The lecturers viewpoint: access to the assignments of a whole class, support for searching for patterns in students work or marking comments, selective viewing of 'good'/'bad' answers, compilation of feedback for the whole class;
- The students viewpoint, part2: access to a repository of marked assignments (under guarantee of anonymity of the authors) to study good solutions, alternative solutions.

Beyond these modules there is still more potential in the use of an online marking environment. So far we have looked at a traditional division of tasks. The student writes the assignment, the marker/lecturer assesses, the student learns from the feedback given by marker/lecturer.

As Laurillard (1993) outlined, a process of discussion, adaptation, interaction, and reflection that represents an exchange of ideas is essential to cognitive acquisition. Morris and Hayes by obtaining skills of assessment, communication, negotiation, and interpersonal cooperation, the students can thus achieve better learning outcomes (Morris & Hayes, 1997). To address these issues and to go beyond the traditional scenario we can look at a more interactive way of using online marking. The online marking environment can be extended by giving students access to the marking tools to annotate their own or their classmates assignments. This can be developed into an interactive system where students provide feedback and comments to others in a collaborative environment.

## 6 Context of the research project at Massey University

A system implemented according to the core requirements as stated in the previous sections can be used in isolation but will gain from being integrated into a wider system that handles administrative tasks around the submission of assignments. Massey University is New Zealand's largest provider of tertiary-level distance education. Currently, distance students submit the vast majority of assignment on paper via the postal system to a central administrative section at the university. Staff in this section record arrival of the assignments and pass on the assignments to academic staff responsible. After marking the assignments are returned to the students via the administrative section who again records the details of movement. This system of handling printed assignments is obviously very time and labour consuming and has the additional disadvantage that students have no way of checking where in this process their assignment currently is (or if it even has arrived). To address these issues the university has initiated a three-phase project:

Phase 1: assignments can be submitted online; the status of the assignments can be tracked via the web; initially selected file types only can be submitted; the submitted assignments are stored on a file server; some workflow management support is available for administrative staff; the assignments are printed centrally and distributed as paper copies to the academic staff;

Phase 2: the assignments submitted online are automatically routed to the relevant academic staff; the workflow management includes support for academic staff; academic staff print the assignments they receive electronically and mark the paper copies;

Phase 3: the assignments are marked online (as suggested in this paper) and returned to the students electronically.

The completion of phase 1 will provide students with the advantages of online submission (saving time for delivery and costs for printing and postage) and the check the status of their assignment in a web-based system (and therefore relieving administrative staff from responding to enquiries). Phase 2 will see a shift of workload from administrative staff to both a computer system (for the automated routing) and academic staff (for printing the assignments; a step that will require an adjustment of printing budgets within the university). The current position of the university is that participation in Phase 3 will be on a voluntary basis. Dependent on the hopefully positive outcome of our research project phase 3 will provide benefits to both students and teachers with the avoidance of printing and postal services and a more sophisticated level of feedback on marking comments.

## 7 Conclusion and further work

In this paper we have reported on our research project on the online marking of student assignments. Important parameters for this work are that we address essay-type assignments that are marked by human tutors in a web environment. We target essay-type assignments as we think this form of assessment is required to test students' understanding of cognitively complex content. We need to work with human markers as automated marking approaches are not yet sophisticated enough to deal with essay-type assignments. We want to provide an online marking environment to minimise time and administrative effort in handling assignments, to allow marking to take place anywhere, and to take advantage of the flexibility a database-supported web environment can offer.

We have introduced our current requirement specification for an online marking tool, have introduced our vision for a more complete online marking environment and have set our research in context to efforts at our university. Massey University works towards implementing the administrative support structures and systems required to handle electronic submission, storage and distribution on a large scale.

Our current task is to confirm our informally acquired specifications for the core online marking system with users. In conjunction with a group of researchers engaged in eLearning at our College of Education at Massey University we will test our ideas on online marking using our prototype implementation.

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