A System Designed to Support Formative Assessment of Open-Ended Written Assignments

Jun Zhang
IIST, Massey University
Palmerston North, New Zealand
junzhang@inspire.net.nz

Eva Heinrich
IIST, Massey University
Palmerston North, New Zealand
E.Heinrich@massey.ac.nz

Abstract

This paper introduces the MarkTool System – a software system designed to support formative assessment of open-ended written assignments. The MarkTool System brings together services from conventional Learning Management Systems, a marking application and other specialized tools to facilitate the formative assessment of open-ended written assignments. MarkTool System uses the services provided by the university's Learning Management System for assignment submission and returning of the marked assignments. It provides an onscreen marking tool which allows users to mark open-ended written assignments using their paper-based assessment skills. MarkTool System also supports the concepts of self-assessment and peer-assessment, assessment related discussion, quality/consistency control of feedback, and analysis of assessment results.

1. Introduction

It is widely accepted that formative assessment can promote student learning by providing students with detailed, relevant feedback that can be used by students to instruct their future learning [1, 2]. However, while the summative assessment of objective test questions (such as multiple-choice or true/false questions whose correct answers are predetermined) is well supported by various computer-assisted assessment applications [3], the formative assessment of open-ended written work is hardly supported by current eLearning technologies [4].

Based on the review of the formative assessment literature and the current computer technologies that can be used to support assessment, the requirements for using computers to support formative assessment of open-ended written assignments have been developed [5] and can be summarized as:

- All the activities that are potentially required for the assessment of assignments, like the management of submission, the working with markers or quality control issues, not only the marking itself, should be supported.
- A generic solution should be provided to support formative assessment of written assignments from a wide spectrum of subjects. From the technical viewpoint, this means that students should be allowed to use any printable document types to submit their assignments.
- A specific onscreen marking tool should be provided to display assignments to human markers and allow human markers to mark the displayed assignment using their paper-based assessment techniques.
- The concepts of self-assessment and peer-assessment, assessment related discussion, quality/consistency control of feedback, and analysis of assessment results should be supported.

This paper introduces the MarkTool System, a software system we designed and implemented according to the requirements presented above. The paper begins with the description of the architecture of the MarkTool System and outlines how the MarkTool System can be used to support formative assessment of open-ended written assignments. This is followed by the discussion of the distinctive features of the MarkTool System.

2. MarkTool System

We designed the MarkTool System as a client/server system (see Figure 1). The MarkTool System uses part of the WebCT services installed at Massey University as its server side software. The assignment management system of WebCT is used to manage class lists and student assignment submissions. The internal email system of WebCT is used to return marked assignments to students and it also acts as the bridge for assessment related communication.

IEEE
COMPUTER
SOCIETY
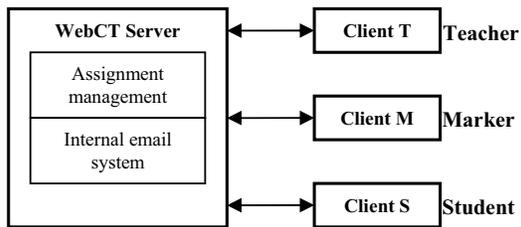
Figure 1. The MarkTool System

The client side software of the MarkTool System (Client T, Client M, and Client S in Figure 1) is distributed as necessary on the local computers of end users (teachers, markers, and students) and interacts with the WebCT server. We designed the client side software with the following features:

- All of Client T, Client M, and Client S provide an onscreen marking tool which enables users to mark the assignments stored on their local computers. The onscreen marking tool uses the PDF format to display assignment documents and is capable of converting all printable documents to PDF files. Users can use the onscreen marking tool to add free-text annotations on the surface of the displayed PDF page as the formative feedback of the assignment, and award numeric marks to assignments. For each assignment, the annotations and the marks will be saved on the users' local computers as an XML document. The onscreen marking tool is also used by users to view the marked assignments stored on their local computers.
- Client T allows teachers to create the assessment criteria for a specific assignment topic and save the criteria in a local XML document. The content of such an assessment criteria XML document can be parsed by the onscreen marking tools in Client T, Client M, and Client S for marking.
- All of Client T, Client M, and Client S provide a WebCT interaction module which interacts with the WebCT server using the HTTP protocol, for example, to download submitted assignments from the WebCT server, upload the assessment criteria XML document to the WebCT server, and to send/receive emails to/from the WebCT internal email system.
- All of Client T, Client M, and Client S support assessment related communication. For example, if a student has questions on the feedback provided by the teacher, after he/she has selected the questioned feedback (for example, a specific textual annotation) and input the questions, Client S will send the question and the information about the questioned feedback automatically to the WebCT internal email box of the teacher of the course. The teacher's Client

T parses the content of the email, presents the question and the feedback in the context of the assignment so that the teacher can easily identify which feedback is questioned and answer the question accordingly.
- Client T is able to extract the annotations and marks from the corresponding XML documents stored on the teachers' local computers to help teachers carry out quality/consistency control of feedback and analysis of assessment results.

The following introduces how the MarkTool System can be used to support formative assessment of assignments. In preparation of using the MarkTool System, the teacher needs to create a new assignment topic and set the assignment settings via the WebCT webpage using a standard web browser (such as Microsoft IE or Mozilla Firefox). Students need to submit their assignments to WebCT using their standard web browsers, in the same ways as teachers and students are currently doing with WebCT online assignments. The steps of using the MarkTool System should be:

1. Using Client T, the teacher retrieves a list of all available assignment topics, selects a specific topic, creates the assessment criteria for the selected topic, stores the criteria in a local XML document, and uploads the XML document to the WebCT server.
2. Using Client M/Client S, markers/students retrieve a list of all available assignment topics, select a specific topic, download the assessment criteria XML document from the WebCT server, and store the downloaded XML document on their local computers.
3. Using Client T, the teacher selects a specific assignment topic, downloads the submitted assignments from the WebCT server, converts the assignments to PDF documents, and stores the PDF documents on his/her local computer.
4. The teacher uses Client T to allocate assignments to markers or students (in the case of peer-assessment). Client T will send the allocation information automatically to the markers' WebCT internal email box as an XML document. Client M of the markers parses the allocation XML document, downloads the assignments allocated to them, converts the downloaded assignments to PDF documents, and stores the PDF document on the marker's local computers. In the case of peer-assessment, the teacher's Client T will send the PDF documents to the students' WebCT internal email box since in WebCT students have no access rights to the assignments submitted by other students.
5. The teacher/markers (and students in self-assessment or peer-assessment) use the onscreen marking tool to mark assignments, and store the feedback (annotations and marks) in local XML documents.

For the marking, the onscreen marking tool imports the assessment criteria from the corresponding XML document so that users can associate each annotation with a specific criterion.

6. After markers/students have marked all the assignments allocated to them by the teacher, they use Client M/Client S to send the feedback XML documents to their teachers' WebCT internal email box.

7. The teacher uses Client T to collect the feedback XML documents for the assignments that have been marked by markers/students from the WebCT internal email system, and stores the feedback XML documents on his/her local computer.

8. The teacher uses Client T to check the feedback provided by markers to maintain quality and consistency. In the case of self/peer-assessment, the teacher needs to provide feedback on the feedback created by students using the onscreen marking tool.

9. Using Client T, the teacher returns the marked assignments (i.e. the PDF documents and the feedback XML documents) to the students via the WebCT internal email system, extracts the marks from the feedback XML documents, and uploads the marks to the WebCT grade record system.

10. Students read the marked assignments using the onscreen marking tool. If students have questions on the feedback, they can communicate with their teachers to discuss the questioned feedback using Client S.

11. The teacher uses Client T to analyze the marked assignments stored on the teacher's local computer to assist the teacher in assessing the overall knowledge level of the class and identifying in which area remedial work is required.

Currently, we have partially implemented the client side of the MarkTool System via three separate applications – the MarkTool application which is based on the original onscreen marking tool with the same name as described in [4], the WebCTConnect application, and the Analyzer application. A detailed description of these three applications is available from our website: *http://www-ist.massey.ac.nz/MarkTool*.

With the MarkTool application users can create assessment criteria for a specific assignment topic (each criterion is associated with a different color) and save the created assessment criteria as an XML document which can be imported by the MarkTool application later for marking. Formative feedback can be provided by adding annotations on the displayed assignment documents (in PDF format). Each annotation has a graphical component to indicate which part of the assignment the annotation refers to and one or more textual comments. The feature of the MarkTool application allowing one annotation to have more than one textual comment is important for self-

assessment and peer-assessment which require multiple people to express their opinions on a specific aspect of an assignment. In this way, teachers can add comments to the annotations created by students in self-assessment or peer-assessment. Each textual comment is associated with the corresponding assessment criterion. The title bar of the comment carries the color associated with the criterion so that students can identify quickly which criterion is applied. Users can also award numeric marks, which are also related assessment criteria, to the assignment. The MarkTool application saves the annotations and marks separately from the assignment as an XML document.

We developed the WebCTConnect application to demonstrate how to interact with the WebCT server. By using this application, users can retrieve from WebCT the lists of the available courses, the assignments required for these courses, and the students enrolled in these courses (providing that the user's WebCT role is Designer, Teacher, or Teaching Assistant), and send emails which are delivered via the WebCT internal email system to students. The WebCTConnect application is capable of emailing the whole class in a batch and users can formulate the path of the attached documents. In this way, the teacher can send emails with individual, personalized attachment to all students of the class in one operation.

The Analyzer application was developed to demonstrate how to help teachers to analyze assessment results. It extracts the textual comments from the feedback XML documents and presents these comments to users in the order of assessment criteria or markers who created the comments. In the Analyzer application, each comment is hyperlinked with the context in which it was created, i.e. selecting a comment in the Analyzer application will activate the MarkTool application to present the relevant assignment to the user with the selected comment highlighted.

We have used the MarkTool application and the WebCTConnect application to mark the assignments of a software engineering course on data modeling and return the marked assignments to students, respectively. We also installed the MarkTool application on the computers of our institute computer laboratory so that students can view the marked assignments.

The MarkTool application has helped our marking significantly and allowed us to provide students with more detailed and relevant feedback compared with the paper-based approach we used last year for the same assignment topic.

The process of returning the marked assignments electronically to our students using the WebCTConnect application has been very efficient. It only took us less than one minute to tell the WebCTConnect application in which folder the marked assignments were stored before the application began to send all the marked assignment to students. Without the WebCTConnect application, one

has to upload the marked assignments to WebCT student by student. This is a tedious process prone to human error, especially for large classes.

Although we have not carried out a formal survey to collect students' responses on receiving marked assignments via the WebCT internal email system and viewing marked assignments using the MarkTool application, it seems that our students are interested in these formats of receiving and viewing marked assignments, as revealed by the discussions with some students. Heinrich and Lu have designed a learning exercise in which students were expected to use the MarkTool application to view marked samples and add their own comments on these samples [6]. The authors conducted a survey at the end of the exercise. The survey contains some questions asking students to provide comments on the MarkTool application. The result shows that the MarklTool application is well accepted by students.

3. Discussions

Unlike Classmate [7] and the assignment assessment system presented in [8], both of which have their own server side software to manage assignments and student submissions, the MarkTool System does not have such server side software. The client side software of the MarkTool System interacts with the WebCT server software installed at Massey University and uses the services provided by the WebCT server software. The reasons why we decided to take advantage of the WebCT services instead of developing our own server software for the MarkTool System are:

- User acceptance – WebCT is widely used in our university. Teachers/students are familiar with managing courses and assignments, publishing/accessing course and assignment material, submitting assignments, and delivering grades in WebCT. Teachers/students could be reluctant to use a new system to manage assignments and submit assignments, as encountered by the system presented in [8].
- No extra management tasks – by using the WebCT services, teachers can concentrate on the assessment of assignments. There are no extra management tasks for teachers. For example, teachers do not need to provide the list of students enrolled in the course and the contact details of the students, as required by Classmate [7].
- Technical support issues – our solution eliminates the need for additional server hardware and the maintenance work to ensure that the server software runs in a reliable and secure way. An individual teacher can easily run the system by installing the client side software on his/her own computer and making the software available to his/her students without any support from the university or department.
- Development efforts – the workload of developing such server side software would be immense, especially for implementing the various management functionalities required for online assignments, such as the management of the assignment settings and student submissions.

The approach of using the WebCT services by interacting with the WebCT server via the HTTP protocol is also compatible with other web-based Learning Management Systems (LMS), like Blackboard. Furthermore, our solution presented by the MarkTool System does not need any licences or permissions from the vendor as it does not change any part of the server side of the LMS.

In the MarkTool System, the assignments are marked on local computers. This means that the marking does not need a continuous network connection as required by other online assignment assessment systems, such as Classmate [7] and GradeMark of Turitin [9]. It allows teachers/markers to mark assignments at any place and time independently from the availability of a network. Furthermore, online marking requires a reliable and high speed wideband network connection, which is not necessarily always available, to keep the marking process from being affected by the frequent data exchange between the client side and server side which will increase the network delays, especially with a large size assignment document.

The onscreen marking tool of the MarkTool System uses the PDF format to display assignment documents and is capable of converting all printable documents to PDF files. This allows students to use any printable document types to complete and submit their assignments. The onscreen marking tool adds annotations on the surface of the displayed PDF pages and leaves the assignment's original formatting intact. This is different from the marking tools of Classmate [7] and the Markin application described in [10] which insert comments in the displayed RTF document. With the MarkTool application teachers can create customized assessment criteria and associate each comment with the corresponding criterion. This association can help students identify quickly their strengths and weaknesses as suggested by educational researchers [2]. Saving the feedback separately from the assignment document makes it easy to process the feedback data, for example, to control the quality and consistency of feedback, to communicate with others on a specific comment, and to analyze the feedback for a large number of assignments.

IEEE
COMPUTER
SOCIETY

4. Conclusions and Future Work

In this paper we have introduced the MarkTool System which was designed to support formative assessment of open-ended assignments. The MarkTool System uses the services provided by the WebCT server installed at Massey Univeristy to manage online assignments. It provides an onscreen marking tool which allows users to mark open-ended written assignments on their local computers. The marked assignments are returned to students efficiently via the WebCT internal email system. The MarkTool System supports the concepts of quality and consistency control of the feedback, assessment related communication, self-assessment and peer-assessment, and the analysis of assessment results.

The future work mainly falls into two categories. First is the further implementation of the client end of the MarkTool System. A number of functionalities should be added to the current implementation according to our design of the MarkTool System, for example, the automatic downloading of the assignments from the WebCT server using the WebCTConnect application, automatic conversion to PDF documents, and further analysis features of the Analyzer application. Second is the further evaluation of the effectiveness of the MarkTool System – not only its effectiveness in supporting assessment of open-ended written assignment should be further evaluated by our colleagues, but also the effectiveness of the formative feedback created using the MarkTool application on improving student learning.

5. References

[1] P. Black, and D. Wiliam, "Inside the Black Box: Raising Standards through Classroom Assessment", *Phi Delta Kappan*, Vol. 80, Issue 2, Oct 1998, pp139-149.

[2] R. Freeman, and R. Lewis, *Planning and Implementing ASSESSMENT*, Kogan Page Ltd., London, UK, 1998.

[3] J. Bull, and C. McKenna, *Blueprint for Computer-Assisted Assessment*, RoutledgeFalmer, London, UK, 2004.

[4] E. Heinrich, and A. Lawn, "Onscreen Marking Support for Formative Assessment", *Proceedings of Ed-Media2004 World Conference on Educational Multimedia, Hypermedia & Telecommunications*, Norfolk, USA, 2004, pp1985 – 1992.

[5] J. Zhang, and E. Heinrich, "Using Computers to Support Formative Assessment of Assignments", accepted as presentation paper by Ed-Media2005 World Conference on Educational Multimedia, Hypermedia & Telecommunications.

[6] E. Heinrich, and J-Y, Lu "Opportunities in Learning from Marked Student Work", accepted as presentation paper by Ed-Media2005 World Conference on Educational Multimedia, Hypermedia & Telecommunications.

[7] P. Baillie-de Byl, "An Online Assistant for Remote, Distributed Critiquing of Electronically Submitted Assessment", *Educational Technology & Society*, International Forum of Educational Technology & Society, Vol. 7, Issue 1, 2004, pp. 29-41.

[8] J. A. Preston, and R. Shackelford, "Improving On-line Assessment: an Investigation of Existing Marking Methodologies", *Proceedings of the 4th annual SIGCSE/SIGCUE ITiCSE conference on Innovation and technology in computer science education*, Cracow, Poland, 1999, pp. 29-32.

[9] "Turnitin", [Online], iParadigms, LLC, CA, US, 2004 [cited Feb. 01, 2005], available from World Wide Web: http://www.turnitin.com/static/home.html

[10] D. Stephens, G. Sargent, and I. Brew, "Comparison of assessed work marking software for the ideal Integrated Marking Tool (IMT)", *Proceedings of the 5th International Computer-Assisted Assessment Conference*, M. Danson, and C. Eabry (Eds), Loughborough University, Leicestershire, UK, 2001.