

An Online Assistant for Remote, Distributed Critiquing of Electronically Submitted Assessment

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Abstract

This paper outlines the architecture for an online assessment management system implemented at the University of Southern Queensland. The system assists teams of academics in the management and marking of electronically submitted student assignments in large-scale classes. The system designed to provide a flexible yet structured method for providing feedback to students also offers semi-automatic file handling and grade recording. The system, Classmate, allows a team of markers to access and mark student assignments through a web interface designed to parallel paper-based marking systems. An online authoring tool replaces the red pen on paper analogy. A pilot study conducted on the use of Classmate has found the system to be of use in providing students with consistent feedback, allowing traditional assignment interactions and reducing trivial and repetitive assignment marking tasks.

Keywords

Online assignment submission management, Authoring tools, Electronic submission, Distance learning, Large-scale class management

Introduction

The University of Southern Queensland is a world leader in distance and online education. The University has a student body, in which more than 100 nationalities are represented, with more than 16,000 of its 22,000 students of all ages studying in their own locations world-wide. In the department of mathematics and computing, courses are taught containing up to 1200 students who either attend classes on campus or obtain teaching materials via the Internet.

As class numbers increase, new teaching methodologies are needed so students do not fall prey to the inadequacies of traditional student-teacher based models of interaction (Preston & Shackelford, 1998). On campus students in large classes often miss out on the personalised attention given in smaller classroom situations and for distance (online) students this type of interaction is logistically impossible. To cope with large numbers, a course is usually managed by a team consisting of the examiner (team leader), tutors and markers. The traditional approach in handling large class numbers has been to investigate the use of computers in batch processing student details. This has seen a natural progression toward Internet-based applications.

The growth of the Internet has caused dramatic growth in the number of online applications and development tools for educators (Lever-Duffy et al., 2003). Developers such as WebCT (<http://www.webct.com>) and Blackboard (<http://www.blackboard.com>) provide suites of software that assist teachers in developing online course content by supplying turn-key applications that offer content presentation, interactive learning environments and student activity tracking. The focus of online education has changed from the simple reproduction of teaching materials on webpages to the goal of motivating students to become interactive learners (Trotter, 1999).

Contemporary online teaching environments provide a plethora of assessment tools. However, while methods such as multiple choice, matching, fill-in-the-blank and formulaic questions lend themselves to online education and automatic marking (Goldberg, 2000), the primary disadvantage of these assessment methods is their poor ability to accurately reflect student learning (White, 2002). Although it is possible to integrate a more accurate means of testing a student's knowledge and understanding (for example, essays and projects (White, 2002)) into an online teaching environment (Ritchie & Hoffman, 1997), the advantages of using contemporary online education environments ends after the electronic submission. The expert judgment of the respective examiner is essential in marking and critiquing work (Korb et al., 1997). Many online educators shy away from electronic submission of essays and projects because of the level of technical expertise required to disseminate, open, critique and administer them (White, 2002).

Depending on the course, the format of the submitted file can vary (Word, Excel, MATLAB, text etc.). When the submissions are to be marked, the examiner must divide the submissions among markers. This may include printing the assignments and distributing paper copies or collating the electronic files and distributing them to the markers on disk, via email or a network. Depending on the format of the electronic submissions the markers may add comments directly into the submitted file or create a new text document, add feedback and email the feedback to the student. The markers record the individual results and when marking is complete, these are passed to the examiner. The examiner manually enters these results into a spreadsheet or database system.

Several shortcomings identified with this method are:

- Feedback can be inconsistent among markers (Preston & Shackelford, 1998).
- Markers need to organise and administer email lists.
- Markers wanting a more traditional approach to marking may print out the submissions, mark them with a pen and return via mail.
- Double handling of student results.
- The examiner cannot track the progress of marking without elaborate administration and continued communication with the markers.

From studies conducted by Preston and Shackelford (1999), the ideal online marking system would:

- place emphasis on the student's submitted work
- allow a holistic view of the submitted work
- provide quick and easy navigation between sections of the work
- highlight syntax to improve readability
- provide markers with a logical and consistent means of critiquing
- allow for student by student or problem by problem marking
- separate the interface of the system from the implementation
- automate grade submission and file downloading and uploading.

To address these criteria and overcome the current difficulties in managing electronically submitted student work, a prototype for an online learning agent system called Classmate, has been developed. For the purposes of this discussion an agent is considered a piece of software that works independently of the user to perform tasks on the user's behalf (Maes, 1994). Classmate allows a team of markers to assess students' work in an organised, virtual marking and critiquing environment that provides timely, valuable and consistent feedback to the students. The system consists of a collection of intelligent agents that semi-automate the marking of assignments.

This paper presents the architecture of the Classmate system and examines the use of the system in the course CSC1401 Programming in C. It begins with an introduction to related work in the domain of electronic assessment management. This is followed by a detailed description of the system before an example of the use of the system is outlined. We conclude by discussing planned future work and system enhancements.

Related Work

Developing automated assessment systems is not new in computing disciplines. Examiners who work within the computing domain have the necessary skills to design and write programs for their own use. It would be uncommon to find a computing department at a university that did not have its own course specific student batch processing systems whether they are for automated marking or final grade calculations. These types of narrow-focussed systems, while perfect for the course for which they were designed, are difficult to modify for broad usage in other disciplines and courses. In addition, as Internet companies have seen the value in developing sets of generic teaching tools as learning management systems (LMS), much of the work developed within the computing departments has been overlooked but not superseded.

In 1995, Dawson-Howe (1995) described a command-line system called submit. This system prompted computing students to run compilation examples and sample runs (testing) of their programs in the Unix environment. As the programs were tested and compiled a script of the session was recorded. When completed, the script and the files would be submitted into a central repository for collection by the examiner. This program became a standard on most versions of Unix and implemented in many computing departments world-wide. The electronic submission component of the submit program has been outdated by the web-based graphical user

interfaces of LMS's such as the dropbox provided by Blackboard. However, the prompting for testing and compilation has not.

Another system that provides students with the means of electronic submission is BOSS (Luck & Joy, 1999). This system expands on the ideas from the submit system by automatically testing programs submitted by computing science students. The system does not provide automated marking, but does give markers access to the program test runs for use in evaluating the student's work.

Blaine and Petre (1997) describe an electronic marking system that accepts electronically submitted assignments and forwards copies of the assignments to a marker. The marker uses Microsoft Word to analyse the work with a specially formatted template that presents inserted and deleted parts of the original file in a different font. The marker returns the files to the marking system, which returns the feedback to the student, enters the student's grade into the university student database and sends the marker a receipt.

A more structured approach to marking is given in (Preston, 1997) where the Grading Environment (GE) system is described. This system designed to improve the reliability and consistency of student performance evaluations among a group of markers, guides them through the marking process. The system takes the traditional pen and paper based approach to marking and places it on the screen. Each marker is asked a series of evaluation questions about the student's work. Through point and click interaction the system evaluates the student's work and calculates a grade for the student. The system also uses the marker's responses to set remedial work for each student based on the errors in their assignments. The system was designed for marking computing students' programs although it can be adapted for other courses. Other systems such as the one described by Mason & Woit (1999) allow annotations to be entered into the assignment files via a structured webpage. The webpage allows the marker to enter a comment into a textfield and this comment is further programmatically inserted into the student's submission. This allows single lines of text to be added in the student's file. However, the marker cannot correct or modify existing lines.

Another web-based assignment management system is illustrated by Darbyshire (2002). This system provides students with a means of submitting work via the Internet and limits the accepted file formats. It also allows markers to organise the files for downloading. This system places more emphasis on the submission and file management process than it does on marking. Darbyshire suggests improvements to the system would be

- the use of annotation tools such as the change tracking facility in Microsoft Word;
- the ability for markers to resubmit marked files (previously downloaded) back into the system; and,
- the expansion of content sensitive interaction by allowing more file formats to be submitted.

Classmate builds on the ideas developed in the before mentioned systems, marrying electronic submission and a grading environment with file management, course team management and automated student feedback in an online environment. It includes an online annotation tool, handles all file formats and allows markers to upload and download files. It provides both a free format method of critiquing students' work along with a structured grading template (similar to Joy & Luck, 1998). Unlike systems such as Ceilidh (Benford et al., 1994) and the semi-automated system described in Jackson (2000) which endeavour to provide facilities to both the student and the marker (including automated marking), Classmate focuses on the marker's needs and has therefore been developed with facilities not currently available in the before mentioned systems. Classmate has been developed with free format assignments in mind and does not require rigid formatting rules to be adhered to by the student as are needed in current automated marking systems. The architecture of this system will now be discussed.

Overview of Classmate

Classmate currently resides on the web server in the Department of Mathematics and Computing at USQ. The system was written using a mixture of C/C++, Perl and Java to give it the greatest flexibility. The system consists of 4 main agent entities. The main server-side agent works to manage student submissions, administer student receipts, distribute submission to markers and collate marker feedback. The smaller agents are distributed as necessary and act as clients on the user's machines. The agents are independent of any database system and currently reside over a file/directory structure. This makes the system modular (other system parts can be added) and platform independent.

A conceptualisation of the Classmate system is given in Figure 1.

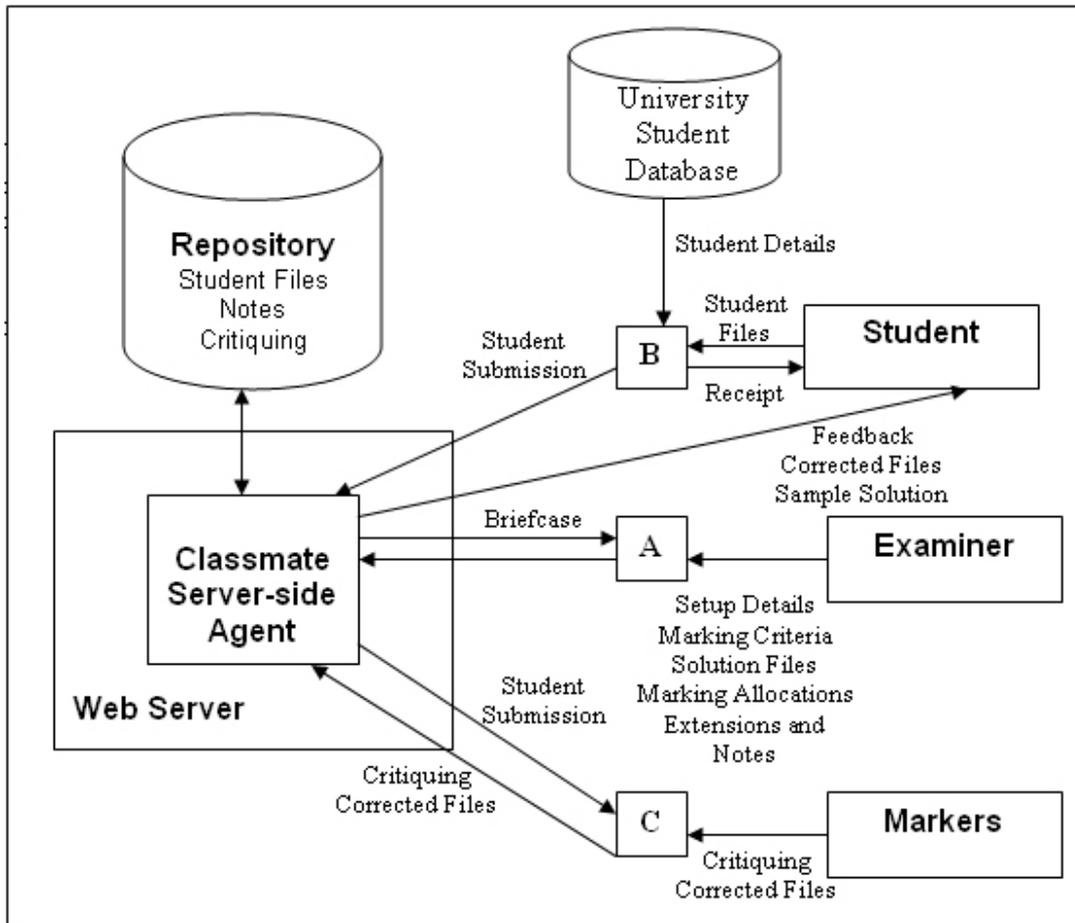


Figure 1. The Classmate System

In short, the steps involved in using the system are as follows:

1. The student submits an assignment electronically via the Internet.
2. The examiner sets the marking criteria.
3. The examiner assigns a marker to the assignment.
4. The marker marks the assignment using the examiner's marking criteria.
5. The marker inserts free formatted comments and suggestions into the student's assignment file.
6. The student's mark, a listing of the criteria and the edited assignment file are emailed back to the student.
7. The student's mark is uploaded to the university's student database.

These steps will now be discussed in detail.

The use of Classmate begins with Agent A being used by the examiner to setup the course details. This agent asks the examiner a number of pertinent questions, such as the number of assignments, the assignment due dates and the names and ids of the markers. The examiner must also provide the agent with a file containing a list of the students enrolled in the course and their contact details (including an email address). For each assignment the examiner can give Agent A a list of the marking criteria for an assignment along with the associated sub-marks for each. The examiner can also provide a solution file with answers to the assignment. The view presented to the examiner by Agent A is called the Briefcase (shown in Figure 2).

In the Briefcase view, the examiner can see a list of their students and the status of each assignment. If an assignment is waiting to be marked, it is displayed as a folder icon. If the assignment has been marked, a result will appear in the appropriate column. The Classmate system also allows the examiner to set cutoffs for grading and these are calculated automatically and displayed.

| Classmate V2.0 | | CM101 Classmate 101 | | | | bailliep | | | | | |
|----------------|-------|---------------------|------|-----------|------|----------|---------|--------|--|-------|--|
| Home | | Marking | | Briefcase | | Settings | | Assess | | Email | |
| Student ID | Title | Name | Ass1 | Ass2 | Ass3 | Ass4 | Total % | Grade | | | |
| bailliep | Dr | Baillie,Penny | 100 | 90 | B | 20 | 33.50 | HD | | | |
| deraadt | Mr | de Raadt,Michael | | 15 | | 40 | 22.25 | HD | | | |
| reushle | Mrs | Reushle,Shirley | | | | 23 | 11.50 | A | | | |
| 0039440142 | Mr | Berting,Bob | | | | | 0.00 | F | | | |
| 0014134662 | Mr | Bing,Bobby | | 30 | | 45 | 27.00 | HD | | | |
| 0018033162 | Mr | Burrows,James | | | | | 0.00 | F | | | |
| 0014134432 | Miss | Ching,Mei | | | | 34 | 17.00 | HD | | | |
| 0013302316 | Mr | Clays,Lawrence | | | | 67 | 33.50 | HD | | | |
| 0019433309 | Miss | Doyleys,Jack | | | | | 0.00 | F | | | |
| 0039440624 | Mrs | Dye,Joy | | | | 87 | 43.50 | HD | | | |
| 0019933413 | Mr | Esplin,Thomas | | | | 90 | 45.00 | HD | | | |
| 0039140536 | Mr | Fawcett,John | | | | 12 | 6.00 | C | | | |
| 0018033030 | Mr | Fowler,Bruce | | | | 34 | 17.00 | HD | | | |
| 0039413325 | Mr | Furnell,David | | | | 5 | 2.50 | F | | | |

Enter Marks Manually**
 **Available only for items NOT submitted electronically.

Figure 2. Briefcase View of Classmate

When a student wishes to submit an assignment, they download Agent B. This agent uses their student login id to access the universities central student database using LDAP (Carter, 2003). The agent displays these details to the student and provides them with a list of assignments and due dates from which to choose and submit their work. The student's details and submitted files are streamed to the Classmate server-side agent for storing in a repository located, for security reasons, outside the realm of the web server. Because of Classmate's modular nature, Agent B is replaceable with other file submitting software. For example, one examiner has written his own script for his students to submit files. For future versions of Classmate, the WebCT and Blackboard dropboxes are being examined as replacements for Agent B.

Before a marker can access the students' submissions and commence marking, the examiner must interface with Agent A in order to allocate students to specific markers. Until this is done, Agent C will report to the marker that they have no assignments to mark. Agent A will allow the examiner to manually assign students to markers, however for very large classes where this is impractical, the examiner can simply tell the agent what the maximum allocation (in numbers) for each marker is and the agent will randomly assign students to markers. Having done this, the agent reports back to the examiner the actual number of students that were allocated to each marker. At this time the examiner has the opportunity to make manual adjustments to the allocations as they see fit.

Once students have been allocated to a marker, the marker can obtain a view of their student list from Agent C. The view, called the Marker's Briefcase, is similar to the examiner's Briefcase of Figure 2 but with restricted administration functionality. The assignment critiquing process is twofold. Firstly, the marker can make corrections and feedback directly into the submitted file using free formatted text and secondly a grade can be calculated by following an examiner's marking criteria.

The marker can use the mouse to select a student's work to mark (by clicking on the folder icon). On selection, Agent C presents the marker with a list of submitted files (shown in Figure 3). If the submitted file is a zip file, the marker can ask the agent to unzip the contents of the file. When this request occurs, Agent C contacts the server-side agent who performs this task and provides Agent C with an updated list of the unzipped files to

present to the marker. The marker can view the contents of the file, through Agent C, by clicking on the filename. Agent C then requests the contents of the file from the server-side agent. The server-side agent accesses the file from the repository and streams it to Agent C for display. The file is displayed to the marker in an authoring textbox (shown on the right in Figure 3). For security reasons, the marker cannot modify the originally submitted file and therefore can ask Agent C to request a copy of the file for editing. Agent C relays this request to the server-side agent. The server-side agent creates a copy of the original file and transforms the file into Rich Text Format (RTF). The RTF file is sent back to the marker via Agent C. The RTF file was chosen as it allows different coloured text to be entered. As the marker critiques the student's file with comments and corrections, any text entered by the marker appears in red. Currently Agent C is capable of presenting plain text, HTML and RTF in its authoring textbox. For other submitted files, the marker has the option of downloading them to their own computer and opening them with the appropriate software (e.g. Word or Excel Documents). If the marker makes corrections to these downloaded files on their own computer, they can upload them via Agent C back into the repository.

The major difference between Classmate and other dropbox type electronic submission systems is that the submitted work stays in the repository during the marking process. This means that the marker knows where the file is at all times (not in a sub directory on their own computer or on a floppy disk in their office). Unlike in a paper based system if the marker goes missing (Jones & Behrens, 2003) the assignments do not go with them. Feedback and error corrections are entered directly into a copy of the submission. This copy also resides in the repository. The result of managing the marking of student submissions in this manner means that the marker's comments and notes are recorded with the submission and associated grade. This differs from traditional marking methods where annotations written on paper that describe and justify a student's grade for an assignment are usually lost (Preston, 1997).

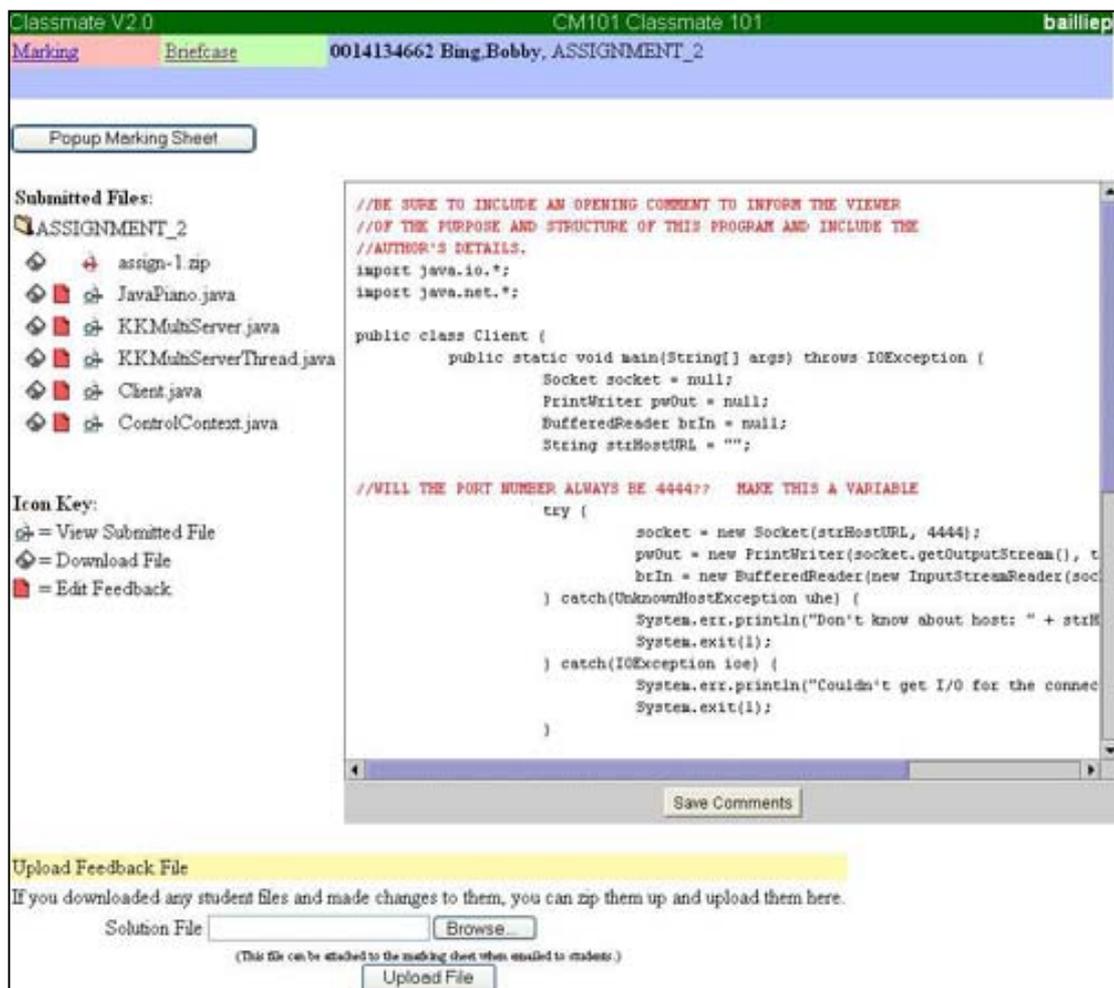


Figure 3. Marker's view of submitted files and freeform comment authoring

In addition to appraising the files in the authoring textbox, the marker also completes a marking criteria sheet (shown in Figure 4). This sheet is generated by Agent C from the criteria entered in by the examiner. The marker fills out the sheet by clicking on tick boxes and entering numeric values. Once completed, Agent C calculates a total number of marks for the student and sends the details to the server-side client for storage. The marker or examiner can revisit the marking of an assignment at anytime and make adjustments as necessary. The total calculation also takes into consideration any extensions given by the examiner. Agent C obtains extension information and the time stamp of the student files, compares them and calculates a deduction if applicable.

The screenshot shows a web-based marking sheet interface. At the top, it says 'Classmate V2.0' and 'CM101 Classmate 101' with the user 'bailliep'. The title is 'Marking Sheet' for student '0014134662 Bing.Bobby, ASSIGNMENT_2'. The criteria are as follows:

| | | |
|---|---|---|
| Program Compiles | <input type="text" value="10"/> | out of 10 |
| Program runs as specified | <input type="text" value="15"/> | out of 30 |
| • Program accepts user input from the command line | <input checked="" type="checkbox"/> (5 marks) | |
| • Program uses recursion to calculate the factorial | <input checked="" type="checkbox"/> (10 marks) | |
| • Program write a report to the file data.txt in the specified format | <input type="checkbox"/> (15 marks) | |
| Documentation and Code Layout | <input type="text" value="15"/> | out of 25 |
| • Indentation used correctly | <input checked="" type="checkbox"/> (5 marks) | |
| • Meaningful identifiers for functions and variables | <input checked="" type="checkbox"/> (10 marks) | |
| • Inline and function header commenting readable and useful | <input type="checkbox"/> (10 marks) | |
| Further Comments | <input type="text" value="Not your best work. A disappointing result"/> | |
| SUBMITTED 1 DAYS LATE <small>Deducts this percentage from the marks obtained.</small> | | <input type="text" value="10.00"/> % DEDUCTED |
| TOTAL | <input type="text" value="37.69"/> | out of 65.00 <input type="button" value="Calc"/> |
| ATTACH FILES TO FEEDBACK EMAIL | <input checked="" type="checkbox"/> Client.java.feedback | |

Buttons at the bottom:

Figure 4. Marking Sheet

When the marker is satisfied with the assignment mark, they can inform Agent C to complete the electronic assessment cycle by sending the assignment feedback to the student. This process begins when the marker clicks on an envelope icon displayed next to the students work (see Figure 2) in the Marker's Briefcase. Agent C sends this request to the server-side agent. The server-side agent accesses the student's files and critiquing, generates a feedback letter and emails this letter along with any marker corrected files and the sample solution to the student.

Discussion

The Classmate system has been in use since 1994 in differing formats. The latest evolution (as discussed in this paper) was implemented for the first time in semester 1 of 2003. To date, the Classmate system has been used by ten markers in four different courses. Of these, six were available to be surveyed on the characteristics of the system using Preston and Shackelford's (1999) ideal online marking environment qualities (as listed in the Introduction) as benchmarks. In addition to these qualities, the markers were asked to evaluate Classmate's

quality and quantity of student feedback. It should be noted that this survey constitutes a pilot study on the acceptance of the system. The small population provides insufficient power to discriminate adequately on statistical significance. The results are nonetheless helpful in guiding future developments of Classmate.

For each characteristic the markers had to indicate their agreement or disagreement by answering with Yes or No. After each question, the markers were given the opportunity to explain their answer. The questions and results are shown in Figure 5.

For the majority of the criteria the markers agreed that Classmate possessed the characteristics of an ideal online marking system. 66% of the markers found the Classmate system reduced some of the repetitive and trivial tasks associated with marking. One of the markers who answered No to this question commented:

“The same marking still needed to be done. This system allowed the trivial and repetitive tasks to be done more easily.”

50% of the markers commented that the annotation system allowed them to cut and paste frequently used comments, thus reducing marking time. They performed this task using an opened text editor and cut and paste comments from the editor into the submission. In the newer version of Classmate, Agent C keeps track of the marker's annotations and provides the marker with a drag and drop list with the authoring textbox shown in Figure 3.

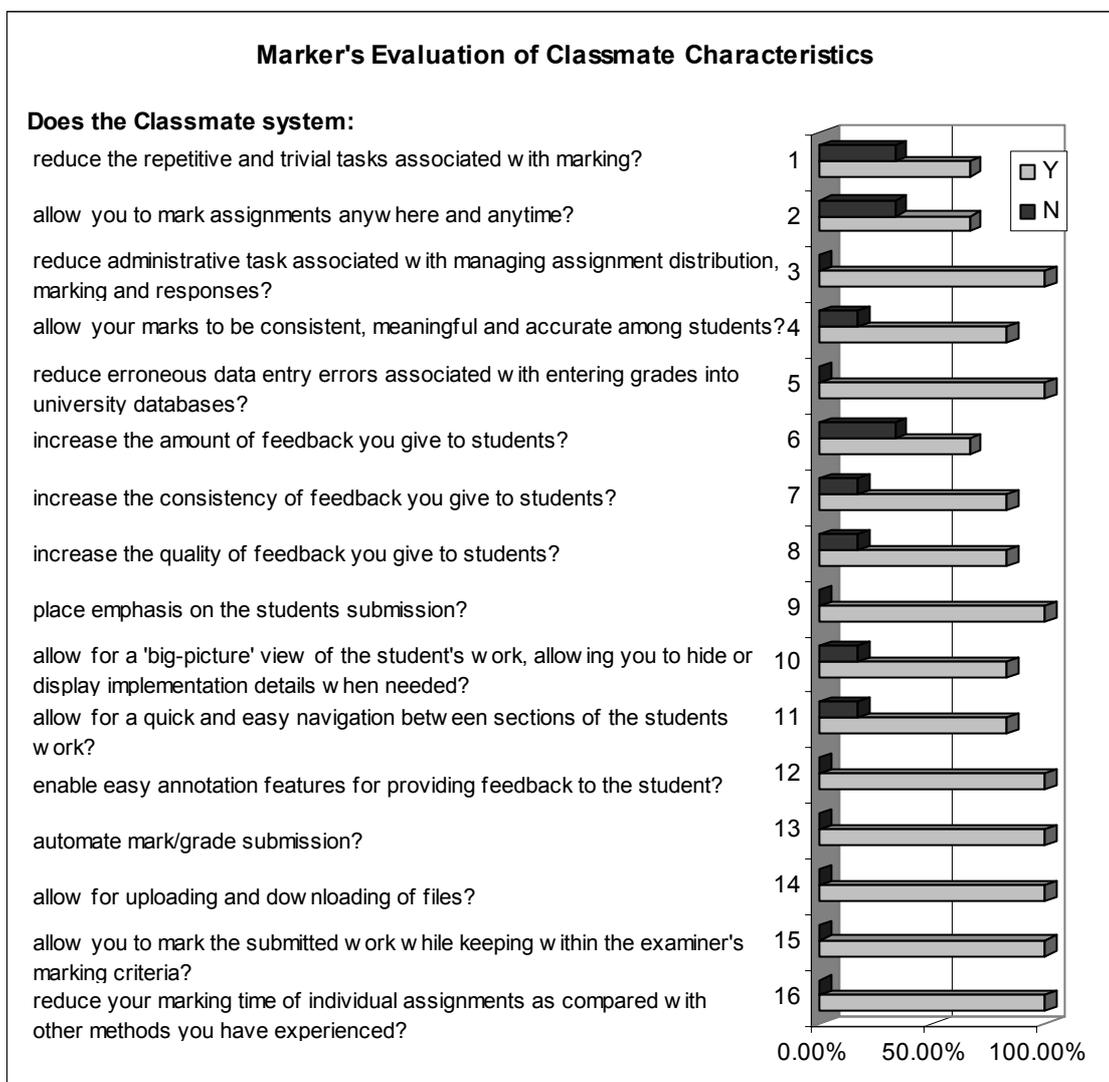


Figure 5. Classmate Evaluation

66% of the markers agreed the Classmate system allowed them the freedom to mark assignments anywhere anytime. Of the markers that disagreed, one stated:

“Previously, the system was too cumbersome to be used via a dial-up connection. The new system is faster and should allow this.”

It has been noted that while the Classmate system works successfully over the University of Southern Queensland's high speed internet connection, it has been found much slower over a dialup connection. While efforts have been made to reduce the size of the Classmate webpages for faster viewing the size of student assignments cannot be controlled as easily.

Five of the markers agreed that Classmate provided a consistent, meaningful and accurate way of assessing a student's assignment. One marker disagreed and commented that the marking criteria provided was not detailed enough. It should be noted that the supplied marking criteria are setup within Classmate by individual examiners and the lack of detail specified in a marking criteria webpage (shown in Figure 4) is the responsibility of the examiner and not a shortcoming of the Classmate system.

Five of the markers agreed that Classmate gave them a 'big-picture' view of the student's submitted work and allowed them to navigate between sections of the assignment. For the one marker who disagreed, the reason given was that they had not used these features of Classmate. As it is unclear how a marker using Classmate could not have used these features, it is assumed that they did not understand these questions.

All markers agreed Classmate performed favourably in reducing administrative tasks, placing emphasis on the student's assignment, providing annotation features for feedback, automating grade submission to the universities databases and marking within the examiner's criteria. In addition, all markers agreed that the Classmate system reduced their marking time. The markers reported a reduction in assignment turnaround time from 3 weeks for a paper based system to 4 days using Classmate. This is not unusual in other electronic submission management systems (Price & Petre, 1997) and it could be fanciful to think that a further reduction in this timeframe is possible. In this investigation some markers reported they did not start marking the assignment as soon as it arrived. This meant that the turnaround time was increased simply because the submitted file sat idle on the server for a couple of days (or even weeks in some cases). One keen marker had a turnaround time of 1 day. This was made evident in a class after the submission due date when a couple of students commented with surprise that they already had their assignment marks back.

Finally, all markers agreed that Classmate reduced the amount of erroneous student data as results are recorded within the system at marking time and uploaded to the university systems. The current version of Classmate uploads data into the universities Peoplesoft database whereas examiners using the WebCT platform still need to manually transfer their marks out of WebCT and into Peoplesoft.

In addition to these evaluations, the markers were asked to rate Classmate against other assignment handling methods they had experienced. The methods compared were pen and paper (handling of assignments submitted on paper), manual submission (assignments submitted on CDROM or floppy disk) and email (assignments emailed directly to the marker or examiner). They were asked to rate Classmate on a 5 point scale ('1' being Significantly Poorer to '5' being Significantly Better) in the areas of assignment turn-around time, feedback quality, feedback consistency and feedback quantity. The results are displayed in Figure 6.

As can be seen in the graph of Figure 6, in all areas for all handling methods Classmate performed favourably. Classmate was rated better and significantly better in all categories when compared to the handling of manually submitted electronic files and emailed files. Classmate was also rated favourably against paper based submission. As paper based submissions allows markers much greater flexibility in marking it was gratifying to have the system accepted as a more acceptable means of assignment handling.

For the purpose of evaluating the Classmate system from the students' point of view, 27 students were surveyed on the turnaround time, quality and quantity of the feedback they received. They were asked to compare Classmate with the same assessment handling methods evaluated by the markers using the same scale. The results were inconclusive as the students' experience with other assignment handling methods was limited. Only 20 of the students could compare Classmate with paper-based submission, eight students could compare with manual electronic submission and seven students could compare with emailed assignments. On average students rated their feedback from the system as the same or better than other systems.

However, as the students could only evaluate the system based on what they experienced of it (the feedback) it was difficult to gauge if the students were evaluating Classmate or the feedback given by their marker. Although the examiner can specify the marking criteria used by the marker, they cannot control the amount of free formatted guidance given to the students by individual markers. It was suspected that students were evaluating the system based on which marker assessed their work when comments about the system included personal criticism directed at their marker rather than the actual system. Comments made included:

“Increased amounts of feedback are beneficial to future assignments. In my case I only received 2 lines of comments for the 10 marks that I lost in my code. The comments were very brief. I think it would be more beneficial to hand write comments and feedback so you can pinpoint exactly what is wrong with your code”.

and

“Your feedback [NAME OF MARKER] and responses for the single assignment were excellent and satisfactory.”

These two extremes in student opinion suggest that some markers may not have explored the full potential of the Classmate system and used all the facilities available. This implies that further training for the markers in the system’s use is needed.

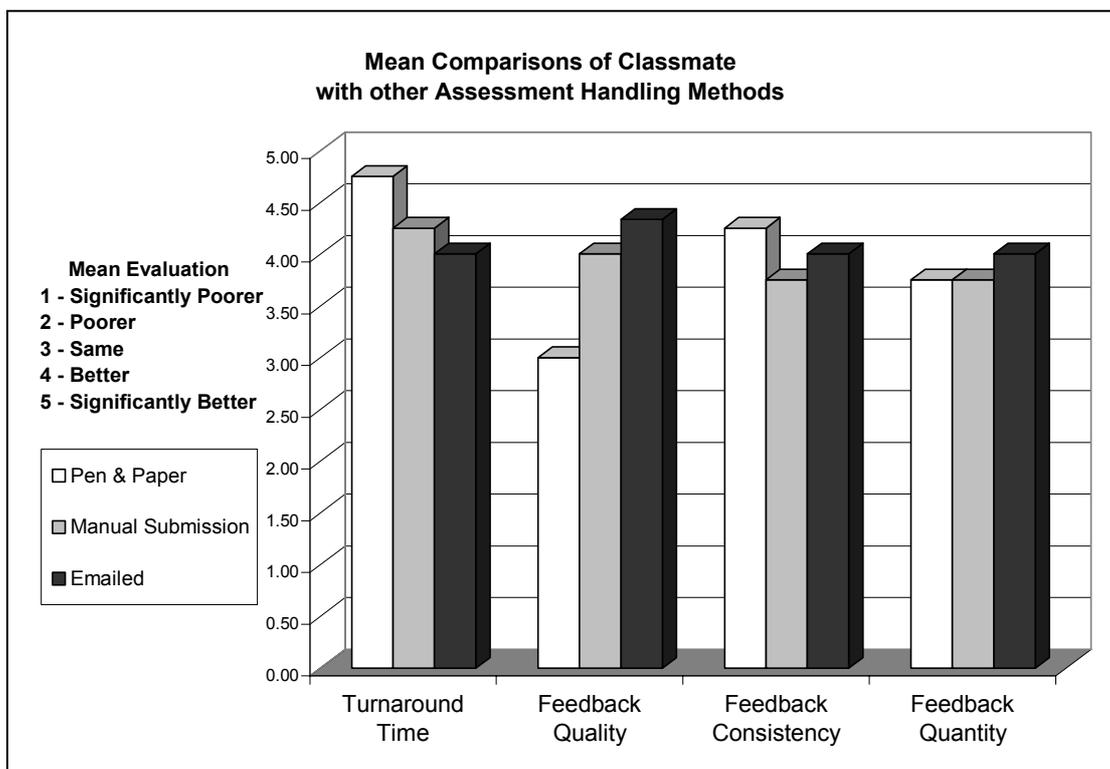


Figure 6. Marker's Comparison of Classmate with other Assignment Handling Methods

Further to comparing Classmate with other systems, the students were asked for their opinion of the turnaround time for marking and the method used for assignment feedback. The answers were given on a five point scale from very disappointing to very acceptable. The results are displayed in Figure 7.

These preliminary results suggest the majority of students are happy with the use of Classmate in assessing their assignments. More evidence the students were tending to evaluate their experience with their marker and examiner rather than the Classmate system can be seen in Figure 7. The student who rated the method of feedback as very disappointing gave the reason:

“Unfortunately there has been NO virtual feedback on any of the tutorials or work leading up to this - resulting in a diminished result for my efforts on the later marked assignment. If the system was more responsive for ALL work and not just some I would be both very impressed and very much helped by it.”

In the above comment, the student referred to parts of her course that were not integrated with Classmate. It is evident that she was impressed with the Classmate system used for marking her assignment and she wished it could have been used for other work involved in the course.

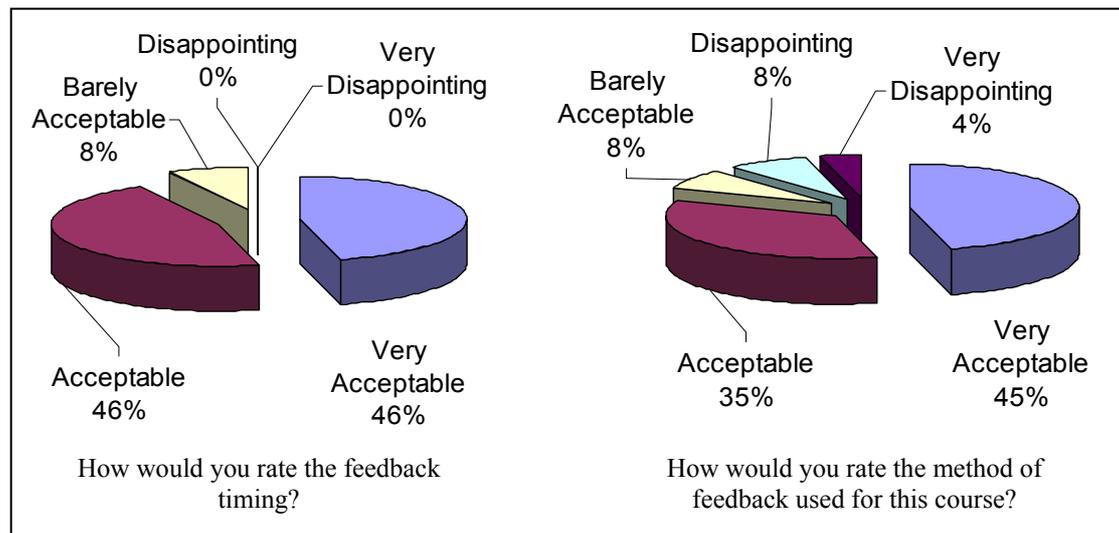


Figure 7. Student's opinion of Classmate system

As the Classmate system is mostly transparent to the students it is difficult to gauge their acceptance of the system. What they expect in the feedback to their assignments still lies in the hands of the examiner and markers. With Classmate's flexibility, the examiner can create as elaborate marking criteria sheet as they wish and with the online annotation system the marker can add as little or as much feedback as they see fit.

The success with acceptance of Classmate among markers can be attributed to the interface design being modelled on the paper based system. Classmate attempts to add value to the electronic submission management and marking process with semi-automated processes while allowing markers to interact with the students' work in a traditional manner.

The Classmate system has proved useful in:

- reducing repetitive and trivial assessment related tasks (such as computer code compilation);
- providing markers with the flexibility to mark assignments anywhere, anytime without having to have all the submitted files on their own computer;
- managing the administration of electronic submission among a group of markers;
- providing an interface that allows markers to mark an assignment via a coherent interface (no matter what the file format) in a traditional manner (red pen on paper) and keeping within the examiners guidelines;
- presenting real time information on the progress of assignment marking and the status of student submissions to the examiner via the web interface; and
- reduces erroneous student grade data through the agents' management of results collection, the emailing of feedback to students and the uploading of result data directly into appropriate university administration systems

Conclusions and Future Work

Classmate has proven affective in providing examiners and markers with a semi-automated electronic submission management system. Classmate endeavours to streamline the process of marking electronically submitted assignments while not placing restrictions on the content of these assignments. To date, Classmate has been used primarily for the marking of programming code as it was developed in the environment of a computer science department. The latest version of Classmate is now being trialed by a surveying examiner for the management of Excel spreadsheet assignments.

Classmate's independence from a database and platform would make it ideal for integration with WebCT and Blackboard like systems. For example, the student list displayed in the briefcase could be easily populated with an API call to the Blackboard system. The latest version of WebCT (Vista) allows network drive mapping to areas of the system that store the student's uploaded files. As the location and structure of these files is known they could easily be streamed by the server-side agent to Agent C for marking management.

The focus for future developments of Classmate will be to upgrade the agents. While no specific agent architecture has been identified for development, it is planned to implement a learning mechanism in the marking Agent C. Over time, the agent will learn to identify repetitive mistakes in assignments and be able to add commentary feedback to assignment files before the marker attends to them. For example, a common mistake in CSC1401, Programming in C, is the improper use of recursive programming. The agent, with assistance from the marker, will learn how to identify recursion and subsequently semi-automate the marking of a group of assignments by pre-assessing and adding appropriate feedback. After an agent learns a critiquing procedure from one marker, it will communicate this with other marker's agents via a central knowledge base, thus distributing the knowledge of one marker among the marking team. The distribution of expert knowledge within the agents and the storage of this knowledge would then be available for use in marking future assessment tasks and new offerings of a course.

Another area identified for inclusion in the system would be offline processing. Currently the Classmate agents work by having continued access to the server. In some situations this is not ideal and markers need to be able to mark assignments while offline. Improvements to Agent C will allow the agent to download copies of students' work and the examiner's marking criteria to the marker's local machine. The same marking process would be adhered to however feedback and marks would be reported locally. When Agent C senses it is online it would be able to synchronise the locally marked work with that on the server.

Although Classmate and systems like it have been in use for the past ten years, not a lot of progress has been made in moving the domain of online assessment management systems forward. It seems that duplicate and hybrid systems evolve from time to time, but without any real progress. The future task of researchers in this domain should be to examine the scope of use for such systems beyond the confines of computer science departments and first year programming subjects and to scrutinise the requirements of examiners from other subject areas on their current processes and needs. Only then will such systems and methodologies find their way into commercially available learning management systems.

Glossary

As it is common for different Universities to refer to the same entities using differing terminology, for clarity the contents of this paper is accompanied with a definition of the language used herein. A single class in which a student is enrolled is referred to as a course, the manager of this course is called an examiner and a marker is a person that evaluates a student's work. The term marking is defined as a process undertaken by a marker in which a student's work is critiqued for the purpose of determining a grade. Critiquing is taken to mean the process by which a marker uses a specific set of criteria, defined by the examiner, to assess a student's work and provide relevant feedback and grading.

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