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Technology Report

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Returning Written Assignments Electronically: Adapting Off-the-Shelf Technology To Preserve Privacy and Exam Integrity

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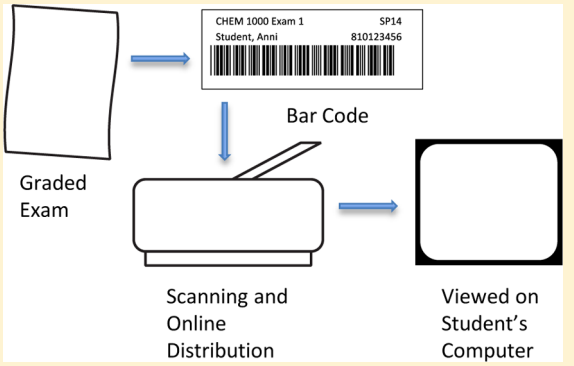
Supporting Information

ABSTRACT: The sophomore organic chemistry program at the University of Georgia offers four written exams each semester to approximately 1200 students at multiple exam sites across campus. Exam integrity and security are very real concerns both during administration of the exam and following return of graded exams. Graded exams that were altered by students and subsequently returned for reconsideration presented a significant problem using the free-response format commonly used for organic exams. With the use of commercially available equipment and a locally developed web application, exams are now returned to students electronically as PDF files. A >80% reduction of reconsideration requests has been observed accompanying implementation of the electronic return protocol. In addition, student responses and grading marks are preserved, thus facilitating more precise and careful evaluation of regrade requests.



KEYWORDS: *General Public, Testing/Assessment*

Approximately 1200 students enrolled in sophomore organic chemistry at the University of Georgia gather on four Wednesday nights during the semester to take written exams. The exams are written in a free response format that requires students to derive a priori answers for organic nomenclature, structural representations, synthetic transformations, and mechanisms, to name a few examples. Exams are subsequently graded by the instructors and teaching assistants. Exam scores are entered into a grade book and then posted to the University's course management system (CMS).

Prior to the Spring 2009 Semester, students signed releases that allowed their instructors to place graded exams in a common area for retrieval. This exam return protocol did not appropriately preserve student privacy or exam custody. Following return, if students believed that a question had been graded incorrectly they could submit the exam to their instructor for reconsideration. The number of such requests for each exam was significant, requiring instructors to review up to 150 of the 1000 graded exams. Unfortunately, there were many instances where students modified their exam after it had been returned and subsequently submitted it for reconsideration.

In an attempt to address these difficulties and to preserve exam integrity during the 2007−2008 academic year, students were issued erasable ink pens at the exam sites. The ink could be erased during the exam but would set after 2 days. This proved to be only marginally successful. While this prevented students from removing marks from the exam, they could still modify exams by adding marks. The pens were low-quality and presented further problems due to malfunctions.

One proposed solution described in the literature involves taking digital photographs of exams and returning the digital images to students online.[1] This solution is not feasible for multisection large lecture courses comprised of hundreds of students writing several thousands of exam pages. A second proposed solution from the literature employs the use of Scantron sheets modified to incorporate areas of blank space where students write their free-form responses.[2] This approach precludes the time-consuming process of photographing hundreds of individual exams but is still not feasible for multipage exams comprised entirely of questions that require free-form responses.

As a consequence of these driving factors and unsuccessful remediation, we ultimately determined that exams should be scanned and returned to students as PDF documents. Instructors would retain the original paper copies. This new return protocol was accomplished using a commercially available scanner, Microsoft Word, a barcode font, and a locally developed web application. In about 3 h, 1200 exams can be scanned to PDF files and made available for students to retrieve from the Web site.

PROCEDURE

Microsoft Word's MailMerge feature was used to generate labels (Avery 5160), Figure 1, from the roster for each course. The first line of each label included the course name (CHEM XXXX), the assignment title (Exam NO.), and the term (SemesterXX). The second line contained the student's last name, first name, and ID number. The last line contained the student's ID number printed

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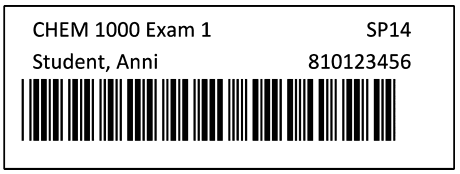

Figure 1. Example barcoded label.

in a TrueType barcode font, Code 39.[3] Following grading, labels were affixed to the exams ensuring that the last name and the ID number match.

An HP Scanjet N9120 Document Flatbed Scanner[4] was used to scan the exams. The included HP Smart Document Scan Software 3.1 was configured[5] to generate PDFs where the scanned pages were simply images, new documents began when a barcode was detected, and files were named using the information encoded in the barcode. The stapled corner of each exam was removed before being placed into the scanners automatic document feeder. The exams were then scanned in batches that contained ~175 pages.

To further improve the use of the scanner, it was connected to two computers through a USB switch and a keyboard/video/mouse (KVM) switch, Figure 2. This configuration allowed a batch of documents to be scanned on the second computer while the first computer was converting the scanned data into PDFs. This configuration has cut the time to scan exams in half. It should be noted that care must be taken not to switch between computers while the scanner is actively scanning.

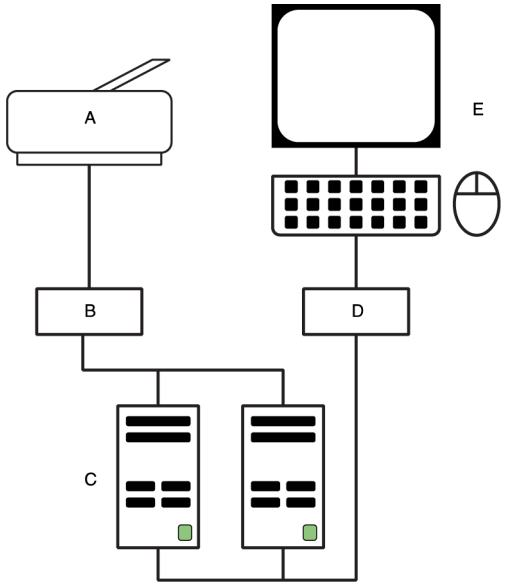

Figure 2. Setup scheme for scanning exams. (A) HP Scanjet N9120 Document Flatbed Scanner, (B) USB switch, (C) computer towers, (D) KVM switch to share keyboard, mouse, and monitor, (E) keyboard, mouse, and monitor.

Once all of the documents were scanned, the documents were uploaded to the Web server and loaded into a locally developed web application.[6] The application compared the directory of scanned documents to a roster of students who took the exam to ensure that every student that took the exam had a scanned document and that there were no extra documents in the uploaded data. The documents were then tagged by term, course, and assignment and associated with the appropriate student based on the filename taken from the student's ID number encoded in the barcode on the label. Students logged in to the web application using their University username and password and downloaded or printed an electronic copy of their graded assignment. In addition, instructors had permission to view every assignment for students in their courses. This retrieval protocol allowed students to uniquely access their exams and allowed instructors to access exams for students enrolled in their classes.

CONCLUSIONS

Exam integrity and security are very real concerns both during administration of the exam and following return of graded exams. This system has greatly improved exam custody and integrity and has resulted in a decrease of greater than 80% in the number of reconsideration requests submitted to instructors. Importantly, this system has also brought the sophomore organic courses into better compliance with the Family Educational Rights and Privacy Act (FERPA). Our system has proven to be so successful that it is currently being used by several academic departments at The University of Georgia including Biology, Genetics, Biochemistry and Microbiology.

ASSOCIATED CONTENT

Supporting Information

Instructions for configuring the HP Smart Document Scan Software 3.1 are available. This material is available via the Internet at http://pubs.acs.org.

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Notes

The authors declare no competing financial interest.

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(2) Jones, L. A. Technology assisted grade capture and electronic distribution of paper tests. *Teach. Learn. Innovations J.* **2013**, 16.

(3) Website to download the free barcode font: http://www.barcodesinc.com/free-barcode-font/ (accessed Mar 2015).

(4) HP Scanjet N9120 Document Flatbed Scanner product page: http://shopping1.hp.com/is-bin/INTERSHOP.enfinity/WFS/WW-USSMBPublicStore-Site/en_US/-/USD/ViewProductDetail-Start?ProductRef=L2683A@WW-USSMBPublicStore&jumpid=reg_r1002_usen_c-001_title_r0001&lang=en&cc=us, (accesed Mar 2015).

(5) Configuration information for the HP Smart Document Scan 3.1 software is available in the Supporting Information.

(6) The web application, locally known as 'OUTBOX', was developed by the authors using a few PHP scripts, a MySQL database, and the Apache engine on a Linux box. Because the code is owned by the University, the authors are not at liberty to release the code. However, a competent undergraduate computer science major should be capable of creating a similar application with a simple requirements document that described what faculty wanted the application to accomplish.

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