AC 2009-1398: A TABLET-PC-BASED ELECTRONIC GRADING SYSTEM IN A LARGE FIRST-YEAR ENGINEERING COURSE

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Tablet-PC Based Electronic Grading System in a Large First Year Engineering Course

Abstract

In Spring 2008, an electronic homework submission, grading, and return system was piloted at Virginia Tech in a freshman engineering course using Tablet PC technology and the Blackboard course management system. This course previously required students to turn in hardcopies of homework assignments once a week, which ranged from a single page to upwards of 10 pages per week per student. Following the successful pilot, a completely electronic grading system was deployed on a large scale in the Fall 2008 semester offering of the same course with over 1,400 students turning in and receiving grades and feedback on all of their assignments electronically. All freshmen in the Virginia Tech engineering program are required to own a Tablet PC and DyKnow technology is used to enhance classroom interactions. This electronic grading system is expected to further justify the use of Tablet-PC technology in instruction.

This paper explores the logistics of the grading implementation including the necessary technological and personnel infrastructure. The roles played by faculty members, graduate teaching assistants (GTAs), and undergraduate graders in the electronic grading paradigm are clearly described and compared with the roles played by these groups under the former paper-based system. In order to showcase the environmental benefits of such a system, an estimate of the reduction in paper usage under the fully electronic system when compared with the traditional pen and paper grading system is included. Several foreseen and unforeseen benefits and drawbacks of electronic grading are discussed and compared with traditional paper-based grading including the time graders spend marking assignments, the availability of assignment documentation, some technological challenges, and the training necessary to become a successful grader. Data is presented from student surveys to showcase student opinions on electronic grading. Feedback from graduate teaching assistants, faculty members, and undergraduate graders is also included to showcase the positive and negative aspects of the current grading system.

Introduction

Engineering freshmen at Virginia Tech are required to own a Tablet PC. This initiative began in Fall 2006. Since then a number of Tablet PC-based instruction activities have been implemented in a variety of engineering courses. Tablet PC technology makes it possible to do many tasks using a PC that were once much easier to do with pen and paper. Using Tablet PCs anything that can be drawn or written on paper can be representeddigitally in the same amount of time as it would take to draw on paper. This includes the preparation of engineering drawings and equations alongside text in a freer format than is possible using most software packages without digital ink. Throughout this paper an electronic grading initiative in a large first-semester engineering course will be discussed. In the following sections the course using this initiative will be described along with the roles each of the course personnel played in implementing electronic grading. Student, faculty, graduate teaching assistant, and undergraduate grader opinions will be introduced to showcase how the initiative was received. Data comparing electronic grading with pen and paper based grading will be discussed to illustrate the differences

in the traditional system and the newly implemented fully electronic grading system.Student and faculty perceptions will be discussed along with both foreseen and unforeseen problems and benefits.

Course Structure

All engineering freshmen at Virginia Tech take a two-credit *Engineering Exploration (EngE1024)* course during their first semester of enrollment. The course activities are designed to develop problem solving, critical thinking, and engineering design skills. The course delivery format includes a 50-min lecture followed by a 90-min hands-on workshop every week. Over the years, a number of hands-on activities have been implemented in this course, primarily due to a NSF grant funded under the department-level reform (DLR) program, to provide experiential learning experiences to freshmen right from their first semester. Some examples include: introduction to sustainability, introduction to global engineering issues, use of electronic portfolio (e-portfolio) for instruction, and a mechatronics initiativedesigned to introduce multi-disciplinary engineering concepts to engineering freshmen. In the 2006-07 academic year, Tablet PC-based instruction was introduced in this course. In Fall 2007, DyKnow, a classroom interaction software package, was implemented to develop a participatory learning environment in EngE1024. A number of assessment (formative and summative) activities are being implemented in EngE1024 as part of the DLR project to evaluate the learning experiences of freshmen. Typically, about 1700 freshmen take this course every year with about 1400 in the Fall semester. In the Fall semester, the EngE1024 teaching team typically involves five faculty members, 16 graduate teaching assistants (GTAs), and 12 undergraduate graders. Two faculty members act as the course coordinators and two GTAs are assigned workshop coordination responsibilities. One undergraduate grader coordinates the grading work of all graders and works with faculty and GTA coordinators in facilitating grading work. Table 1 gives the progression of Tablet PC/DyKnow based instruction activities in EngE1024 over the last three years.

This course serves as the test site to try and implement various pedagogical experiments targeted at enhancing engineering instruction. Best practices are then communicated to faculty colleagues in other departments and those teaching subsequent courses within the same department.

Electronic Grading Pilot

In Spring 2008 electronic grading was piloted in the EngE 1024 course for the first time. During this semester there were six workshop sections of the course offered and electronic grading was piloted in one section taught by the first author. The other five sections continue using traditional paper submission and hand grading of all student work. All students were required to submit their homework at the beginning of their workshop period regardless of whether it was being submitted online or in paper format. In the pilot section the first seven homework assignments were turned in using the traditional paper submission, the next five homework assignments were submitted electronically using Blackboard, and the final homework assignment was graded in class without a submission.

Table 1: Tablet PC/DyKnow activities in EngE1024

Fall 2006	Fall 2007	Fall 2008

First year of Tablet instruction:
  -Electronic note taking
  -Clickers were used for student feedback
  -Lecture PowerPoint annotations with digital ink
  -Problem solving activities and design documentation activities in workshops using MS OneNote
  -OneNote enabled online collaboration
  -About 36% students used their Tablet PC skills in other courses
  -Several students complained regarding use of OneNote software (OneNote 2003 used, 2007 not yet introduced).
  (Lohani et. al., 2007)
	Second year of Tablet instruction:
	  -DyKnow software introduced, Clickers discontinued
	  -Classroom feedback using DyKnow
	  -Activities piloted to expand the learning space
	  -At least 15% of students attended at least one lecture session from a remote location using TabletPC/DyKnow technologies
	  -Students saved class notes in DyKnow format
	  -TabletPC/DyKnow-based instruction limited to course lecture only
	  -About 50% of students used their Tablet PC skills in other courses
	  -OneNote related complaints reduced (using OneNote 2007 instead of OneNote 2003).
	  (Lohani et. al., 2008)
		Third year of Tablet PC enabled classroom instruction/ second year using DyKnow
		  -In-class problem solving using DyKnow
		  -Regular feedback from students using DyKnow for promoting formative assessment
		  -Electronic grading of homework for the first time in the history of this course
		  -Workshop GTAs began using TabletPC/DyKnow in their instruction
		  -OneNote related complaints continue
		  - At least 25% of students attended at least one lecture session from a remote location using TabletPC/DyKnow technologies
		  -Students continued saving class notes in DyKnow format
		  -About 55% of students used their Tablet PC skills in other courses.
		  -Summative assessment activity using DyKnow during last lecture session

During the electronic grading pilot a variety of file formats were accepted from students including Microsoft Word documents, Microsoft OneNote files, and LabVIEWVIs during the programming unit. Since the Blackboard system only allows the upload of a single file for each assignment, any submissions involving multiple files had to be sent as a zip archive. This was used during the programming unit when students were required to develop more than one VI file for homework.

The Blackboard file submission process was demonstrated to students in their workshop and most students were able to submit files without much difficulty. Some students did have difficulty submitting files and during the pilot the instructor permitted those student to turn in a

paper version of their work if they found the electronic submission to be difficult. The grader found it somewhat difficult to grade student work since there were so many types of files that could be submitted. Additionally, some files were in formats that easily accept digital ink marks (OneNote and Word), but it was impossible to mark some other files (LabVIEWVIs) with digital ink. In the case of OneNote files and Word documents, the homework files were corrected as they would have been if they were submitted on paper and the marked file was uploaded back to the user on Blackboard. In the case of VI submission comments were made on Blackboard regarding the reason for any grade reduction, but no file was uploaded back to the user.

The grader found that during the pilot the time spent on electronic grading was comparable to the time spent on paper-based grading. There was an increase in time due to the need to upload files back to users rather than simply placing them in a folder to be handed back to students by the GTAs. There was a reduction in time because there was not a need to retrieve papers and return them to a specific location, the grading could be done in any location that was convenient for the grader without the need for paper exchange.

Full Electronic Grading Implementation

In Fall 2008 electronic grading was implemented in all sections of the course. Approximately 1400 students submitted each of their weekly homework assignments electronically. Some changes were made to the electronic grading system based upon the pilot study. First, all homework was required to be submitted as a Microsoft OneNote file and a file naming convention was prescribed. Having a single file type made it easier for the graders to mark student homework assignments without having to switch applications multiple times. This also eliminated the limitation of marking some files, such as LabVIEWVIs with digital ink. In order to submit LabVIEW files, students simply created a screen capture of the front panel and block diagram of the LabVIEW file and pasted these images into a OneNote document. The naming convention made it easier to identify homework files and their authors. Also, instead of having homework deadlines set at the beginning of students' workshop sections, a uniform deadline was chosen for all students to submit their homework each week. This made it easier for the graders to know when the electronic files were available because workshop times varied from Wednesday morning through Friday afternoon.

Under the former paper-based grading system, all homework submissions were kept in a centralized grading office. This system required the GTAs to collect all student work, the head grader to setup a drop off point for student homework, and periodic collection from the centralized drop off point to bring the files to the office. All of the graders had to do their grading in the grading office during normal business hours. Once the grading of an entire section was completed, the graders then alphabetized all the papers for a section and returned the graded papers to the corresponding GTA who entered the students' scores in the grade book on Blackboard. Under the paper-based system, undergraduate graders were never given access to Blackboard for grade recording purposes and they could only communicate information to students through the corresponding GTA. The new system allows graders the flexibility to grade in any location at any time. So long as a grader can download all the papers from Blackboard, they are free to grade at a time that is most convenient to them, including evenings and weekends when the grading office would not have been open. Through the use of Blackboard's assignment

comments feature they can also provide feedback to students directly as appropriate. This feature has been used if students upload the wrong file or if a major portion of their homework is missing or corrupted.

The establishment and management of the electronic grading initiative was a team effort and all of the course personnel played a role in the success of the grading initiative. The following section describes the role of the faculty, GTAs, and undergraduate graders in the electronic grading initiative. In order to ensure that all of the course personnel received adequate training on how to perform their role in the course, the first author created three instructional documents on electronic grading and the second author held a training session with the undergraduate graders. The first and fourth author also coordinated a two-day training session before the semester began for all course GTAs and electronic grading was discussed as part of this training. The electronic grading documents and training are described in more detail in a subsequent section.

Roles of Course Personnel in Electronic Grading

In addition to a main Blackboard course (website) used to deliver common course content to students and to administer weekly online quizzes, each workshop section had its own Blackboard course. GTAs were responsible for posting links on their workshop Blackboard courses on a weekly basis, so that students could submit their electronic homework files. GTAs were also responsible for giving Blackboard permission for homework submission to individual students who had legitimate excuses for late submission. Students occasionally submitted incorrect or incomplete files and requested an opportunity to resubmit their homework again before the deadline. In order for this to happen the GTA had to manually reset the submission using Blackboard. (Such resubmission was found to be burdensome and was no longer permitted in the Spring 2009 offering of the course) Additionally, GTAs were required to grade multiple assignments related to a design project assigned as part of the course curriculum; these project documents were typically electronic files submitted through Blackboard.

Faculty members were responsible for outlining guidelines for electronic submission during the first few weeks of lecture. This included explaining to students how to access the appropriate Blackboard courses, deadlines for homework, and how to upload homework using OneNote files. At the end of the semester, faculty were responsible for resolving any grading disputes, often requiring the re-grading of electronic homework files from students.

Faculty and GTAs were jointly responsible for making decisions when students requested a second submission of homework or late submission.

On a weekly basis, graders were responsible for grading electronic homework files from the workshop Blackboard courses that they were assigned to. Each grader was assigned to two to four workshop sections with responsibilities for grading 60 to 120 students each. The graders were hired on an hourly basis and spent an average of ten hours per week grading homework assignments. The course coordinators (one faculty member and one GTA) met weekly with the lead grader to establish a rubric that provided a fair assessment of student work. The grading procedure consisted of downloading the student files, assigning point values based on the rubric

provided by the lead grader, using electronic ink to make comments on each student's OneNote file, uploading the marked file back to the student, and entering a grade into the grade center in Blackboard. Graders were also asked to report their progress to their supervisors on a regular basis.

Some of the graders had difficulty keeping up with their grading assignments or were faced with a week where they were particularly busy with their own coursework. The third author worked with the graders to ensure all sections were covered each week and granted permission to Blackboard sites as appropriate when a substitute grader was needed.

The graders used e-mail to discuss any ambiguities in the rubric and to ask questions about how to appropriately grade papers based on specific problems not addressed in the rubric. E-mail sent to the lead grader and course coordinators proved to be a very effective medium to resolve such issues and face-to-face grader meetings were not necessary.

Training

Three training documents were prepared by the first author. One was posted online for the students to demonstrate screen-by-screen how to submit files for online grading. This document also showed how students could view their grades once the graders finished grading the files and how they could see the marks the graders made on their papers. A second document was prepared for faculty members and GTAs to show them how to create assignment submission links and to limit their availability so that the link disappeared when the assignment deadline passed. GTAs were also given instructions about how to reset student submissions in the event of a corrupted file or a need for a student to submit an updated file. A third file was prepared and distributed to the graders. This file showed graders how to access the online grade center on Blackboard in order to download student homework submissions and how to upload the marked files once they finished grading. Graders were instructed to append "_graded" to the file name of the downloaded file so they could differentiate between the original file submitted by the student and the file containing their comments and grading marks. These instructional files are included as an appendix.

The grading responsibility for GTAs was discussed in a pre-semester training and the head GTA discussed how to create electronic submission links and to manage an online gradebook. The head grader also held training for the graders, primarily to go over the provided instructional document and to answer any questions they had about the process.

Environmental Benefit

As was previously mentioned, approximately 1,400 students submitted their homework assignments electronically, instead of in a paper format, each weekfor 14 weeks.Assignments varied in length ranging from a single-page submission up to about ten pages. The number of pages used is dependent on many factors including the size of each student's writing and their verbosity, but it is estimated that on average students submitted about 5 pages for each homework assignment. By simple multiplication it can be determined that the paper savings by having all homework submitted electronically was

$$\text{Homework paper savings} = 1400\,students \times \frac{14\,\text{hom}eworks}{student} \times \frac{5\,pages}{\text{hom}ework} = 98000\,pages\,.$$

Students also submitted their project assignments electronically. Some of the project assignments were submitted on an individual basis and others were done in teams. The individual assignments included three two-page peer evaluations and a one-page sketch of their design. There were an average of seven groups in each workshop section and a total of 49 workshops making 343 total groups. Each group wrote a research report that was about 5 pages, completed a brainstorming activity that averaged 3 pages, completed a team log that was at least 6 pages long, and turned in a final report that averaged 10 pages in length. All of these files were graded electronically by the GTA and returned to the students. An estimate of the total savings of paper is listed in Table 2.

Table 2: Paper savings estimates for each deliverable of the semester-long design project

Assignment	Estimated Length	Number of Submissions	Total Paper Saved
Research Report	5 pages	343	1,715 pages
Brainstorming Inventory	3 pages	343	1,029 pages
Design Sketch	1 page	1,400	1,400 pages
Team Evaluations	2 pages	4,200	8,400 pages
Final Project Report	10 pages	343	3,430 pages
Team Log	6 pages	343	2,058 pages
Grand Total			**18,032 pages**

Thus, in total, using electronic grading rather than paper-based grading for all homework and project assignments saved an estimated 116,032 sheets of paper. Assuming standard 20 lb paper (which weighs 20 lbs for every 2000 sheets of 8.5" x 11" paper), an estimated 1160 lbs of paper was saved.

As a side note, although paper cost varies significantly based on weight, brightness, brand, recycled content, etc. it is estimated that a ream of 500 sheets of paper costs between $5.00 and $9.00 based on the prices at a local office supplies retailer. Thus, based upon the paper savings in one semester for this course alone it is estimated that electronic grading saved between $1100 and $2000 total in paper costs not to mention the ink or toner cost. It should be pointed out, however, that this cost was traditionally the students' responsibility and when it is spread amongst 1,400 students the financial savings per person is not very significant. Were such a grading system implemented university wide, however, the authors believe the costs savings could be significant.

Technological Issues

Over the course of the semester there was some difficulty with the electronic grading technology. One of the first issues to arise was browser incompatibility. It was determined that Blackboard was not completely compatible with Mozilla Firefox and students who attempted to submit their homework files using Firefox were not successful. This was resolved by simply instructing students to use Microsoft Internet Explorer when they submitted their homework. In the long term though, Blackboard should strive for browser independence.

There were also quite a few corrupted files submitted throughout the semester. It is not entirely clear why files became corrupted, but it was impossible for the graders to open and mark the corrupted files so they had to inform the corresponding GTA who then informed the students of the need to resubmit their files. When this happened the GTA had to manually clear the submission from Blackboard and then make the link appear again for submission of the appropriate assignment.

Blackboard supports multiple methods of uploading files. In addition to the assignment links, Blackboard also has a "Digital Dropbox" where students can submit files. The problem with the Digital Dropbox is that there is no way of organizing files and folders are not supported. Students were clearly instructed about where to upload their homework files, but some students used the wrong location, particularly early on in the semester.

Inevitably with such an implementation there will be technology failures. Some students had computer crashes that resulted in the loss of some homework files. The college of engineering strongly encourages students to purchase an external hard drive and to maintain a digital backup of all of their work, but suggestion does not always give rise to implementation. Some students had to send their computers off for repair during the semester and this made it difficult for them to do their homework electronically. Some of the graders also experienced difficulties with their tablet PCs and a loaner had to be provided so they could continue their job. A few students also lost the stylus that came with their tablet PC which made it impossible to use digital ink until a replacement was procured.

Faculty Feedback

Faculty feedback was generally positive, but some faculty felt that more graders were necessary to return graded work more rapidly. Some faculty expressed concern with the following issues that came up with electronic submission of homework:

1) corruption of some homework files that were uploaded
2) several students were confused towards the beginning of the term about where homework submission occurs on the workshop Blackboard websites
3) students claiming that technical problems, such as loss of internet connections or hardware failure, impeded their ability to upload their assignments on time
4) some GTAs made homework submission links available to the students only a day or two prior to the assignment deadline
5) Blackboard has limitations with submission of assignments (e.g., students can only submit a particular assignment once; if a student wishes to submit a new file, the Blackboard instructor must reset the student's attempt)

6) because faculty and GTAs no longer had to deal with returning student papers, they had to more closely monitor Blackboard grade centers to determine grading progress.

In general, most faculty members agreed with the following positive attributes of electronic grading:

1) electronic records of the ungraded and graded work were stored throughout the semester, making the handling of grade disputes easier
2) faculty no longer needed to coordinate the shuffling of paperwork between faculty, GTAs, and graders
3) office space was no longer needed to store student homework papers
4) graders could grade wherever they wanted, whenever they wanted (as previously mentioned, in some previous semesters, graders were required to sit in an assigned room to grade paperwork in order to minimize loss of paperwork)
5) grading work could easily be reassigned if one grader was unable to grade his/her work in a timely manner
6) faculty and GTAs no longer had to use class time to return homework papers
7) electronic work seemed to make good use of technology available to the students
8) students always had an electronic copy of their homework on their own computers, which made going over the homework easier in lecture (no need to wait for students' work to be returned to them first).

The benefits seemed to outweigh the shortcomings of electronic grading. In fact, one of the faculty members who had not used electronic grading on such a large scale before decided to implement electronic grading in a different first-year engineering class that has 900+ students during Spring 2009. The faculty members who originally piloted electronic grading in EngE1024 continue to use electronic grading.

GTA Feedback

A survey was given to all the GTAs at the end of the semester to get their feedback on many aspects of the course and they were specifically asked about how the electronic grading initiative went and any suggestions they had for improving the electronic grading initiative. The responses from the GTAs were overwhelmingly positive, but they noted some of the same concerns as the faculty. GTAs particularly thought that the submission process should be demonstrated to the students in either their lecture or workshop so that any confusion or erroneous submissions would be reduced. They felt this demonstration would also eliminate many excuses students had for not following directions properly. Some GTAs also noted that the electronic grading initiative hindered their ability to get to know their students' names. Under the paper-based grading system, the GTAs handed back each homework assignment each week and had that opportunity to put a name with a face. With the process being done completely electronically the GTAs needed to find different ways to learn their students' names. Some of the GTAs commented on the problems with Blackboard that were previously noted such as the corruption of files and having students submit files incorrectly. Most of the problems noted by the GTAs could be resolved with a quick submission example (which was done in Spring 2009) and resolving some of the incompatibility issues intrinsic to Blackboard.

Grader Feedback

Overall, the graders reacted positively to electronic grading, due to the convenience it provided with regards to their schedules and the relative ease of obtaining the homework submissions. The majority felt that the environmental impact of avoiding paper use in such a large class was considerable, although it was noted that the environmental impact due to the manufacturing of the Tablet PCs needed by the graders partially offset that benefit, albeit negligibly. (All of the graders had their own Tablet PCs and did not need to purchase any additional equipment in order to become a grader) The most commonly noted disadvantage of electronic grading was the substantial overhead time added by the use of Blackboard; individually renaming and uploading graded files and entering the grade in Blackboard contributed significantly to the overall time spent grading. Of the eleven graders surveyed, seven specifically mentioned that Blackboard needed to have a feature for optimizing the grade entry and uploading process for a large number of papers. While Blackboard does have a batch download process to download all of the homework files at once, there does not exist a batch upload process to return the marked papers to students on Blackboard. Opinions on whether electronic grading saved time, added time, or was comparable to paper grading were fairly evenly divided, although the plurality considered electronic grading to be more time consuming, as shown in Figure 1. Additionally, the average estimated completion times for the various steps involved in grading homework are shown in Figure 2. The total estimated completion times are similar, with the main difference being made by the aforementioned overhead time in returning grades electronically. Overall, the graders appreciated the convenience of grading whenever and wherever they wished, and streamlining Blackboard would alleviate much of the negative aspect of this method from the graders' perspective.
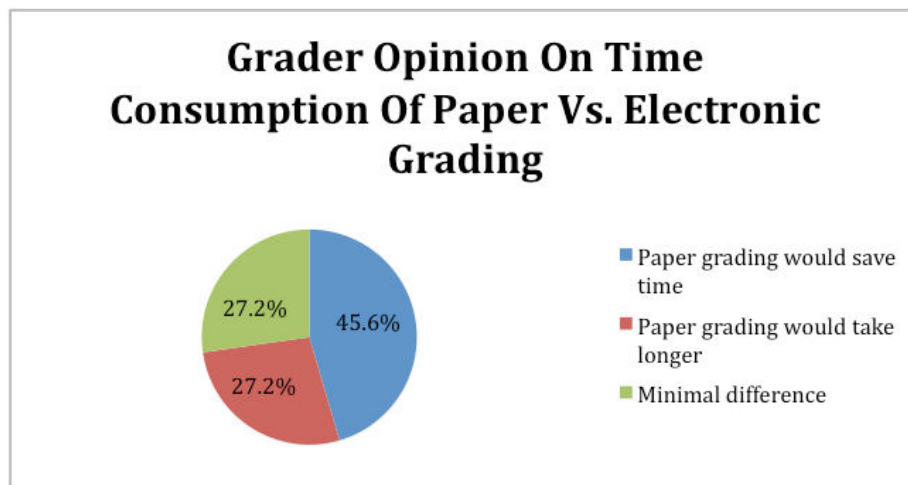
Figure 1: Graders' opinion on time consumption using paper vs electronic grading
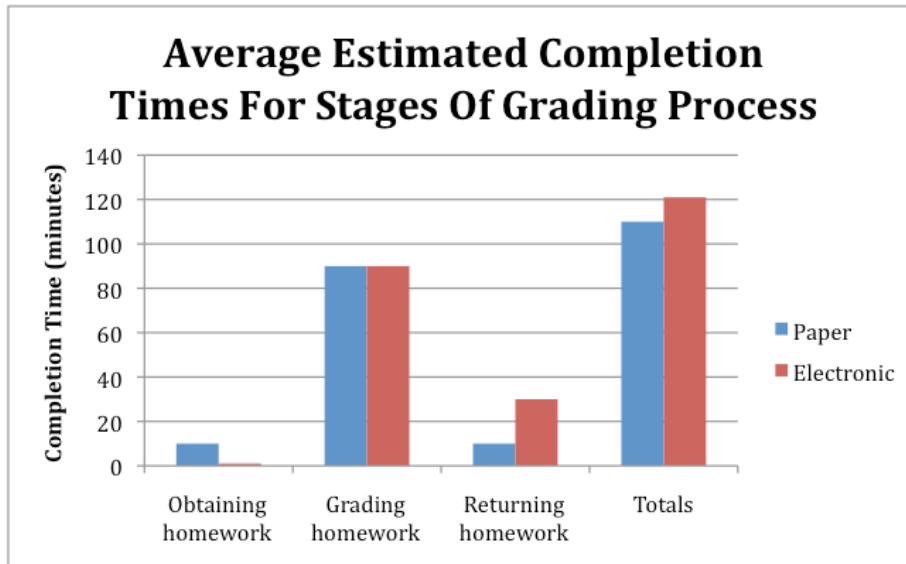
Figure 2: Average estimated completion time for each stage of the grading process. (Reported by graders)

Student Feedback

Students were asked to voluntarily respond to an end of semester survey regarding several aspects of the course. About 315 students responded. They were specifically asked about the use of Tablet PCs in the course in general and as it pertained to homework submission. Student feedback in regards to use of the Tablet PC in general was mixed. When asked if students agreed with the statement "Use of modern technology (e.g., Blackboard, Tablet PC, DyKnow software, etc.) effectively contributed to my learning in this course," 31% strongly agreed, 47% agreed, and only 7% disagreed while the remaining 14% were neutral. The majority (54%) of students also reported that the use of tablet PCs helped them in other courses.

Students were asked what they believe was the most interesting aspect of the use of tablet PCs in the course and some excerpts from their responses are copied below.

"The capability of doing work without paper."
"That I could do my homework by hand and turn it in electronically"
"how it enabled us to more easily submit homework and share information"
"Doing the homework on it"
"was able to write out equations for the hw by hand and then submit the hw electronically"
"Electronic Grading/ Homework"
"How much easier it made documenting work."

Students also expressed some frustration with the use of Tablet PCs and the electronic grading initiative. The most commonly cited problem was the use of Microsoft OneNote; 63 out of 314 respondents (20%) specifically mentioned having to use this program for all homework as their main frustration with the Tablet PC. In cases where on-screen graphing or sketching was required, students cited OneNote as being unreliable, and most felt that the program was more time consuming than was necessary. The relatively high price of the Tablet PC added to the

students' general dislike of this method for doing homework. One student noted that "the amount of money I could have saved by using paper and pencil was the most frustrating [aspect]". However, a significant number of students also reported having very little frustrations with OneNote or their Tablet PCs, suggesting that it may simply be a matter of growing accustomed to the technology – this learning curve was another commonly noted issue, as many students found it difficult at first to learn how to use their Tablet PCs, which in turn made it more difficult to do the homework. The results of an end of semester survey asking students about the most frustrating aspect of the use of tablet PCs in the course is depicted in Table 3.

Table 3: Student responses regarding the most frustrating aspects of the use of Tablet PCs in the course.

Issue	Number of responses (N= 314)
OneNote specifically	63 (20%)
Technology learning curve	10 (3%)
Required use for homework in general (exclusive from OneNote responses)	19 (6%)

Conclusions

Based on the experience of electronic grading of homework submitted by a large number of students it was discovered that it is very important to maintain uniformityin both the grading scheme used by all graders and in the type of file submitted by the students. While the electronic grading pilot allowed for multiple file types to be submitted, this placed an unintended burden on the graders. The authors recommend that any programs implementing a similar electronic grading scheme ensure that all files be submitted in the same way and in the same format in order to increase manageability. A common deadline for all students also helps to reduce the complexity in establishing online submission rules. Detailed, step-by-step instructions are effective to ensure that all students know clearly how to submit their assignments and the graders know clearly how to access those assignments and to mark them appropriately.

Despite some minor technological frustrations due to course management system limitations and browser incompatibilities, the electronic grading system has been very successful. Blackboard provides some very useful tools for student file submission and grade management. A few improvements, as previously described, would make Blackboard much better to work with. The environmental benefit from using electronic grading is substantial and an important reminder to our students of our commitment to sustainability. The overwhelming response from the faculty, GTAs, and graders has been very positive in support of the continuance of an electronic grading system. Students have had a mixed reaction to the electronic grading initiative, mostly stemming from some problems using Microsoft OneNote. When the Tablet initiative was first introduced in this course in Fall 2006 there were significantly more complaints about errors using OneNote than there are currently. It is the authors' belief that OneNote 2007 is improved relative to OneNote 2003 and it is our hope that Microsoft will continue to improve upon their support for tablet-based technology.Our department continues to use electronic grading in this course and based upon a successful implementation in this course has added electronic grading to other courses also.

References

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Appendix A

Electronic Grading Instructions For Students in Engineering Exploration (EngE1024)

Motivation

As you are aware, the ENGE 1024 course will be piloting electronic grading for all student homework this fall. The College of Engineering at Virginia Tech is dedicated to using the latest technological innovations including Tablet PCs and DyKnow to enhance the learning experiences of students while maintaining an awareness of the global impact of the courses they teach. Over the years our students have used countless amounts of paper in submitting their assignments. Also, while the best efforts have been used to keep track of all papers, an occasional student assignment has been misplaced. Under the old system of paper grading, students were also required to wait for their graded work to be returned to them during the next workshop session after grading is completed and did not always have access to what was turned in until it was returned. We believe that implementing electronic grading will significantly reduce the environmental footprint left by this course while allowing students to have access to their graded work immediately after the graders finish grading their assignments. Students will be able to access the file that was turned in to the graders at all times so they know exactly what files the graders will see. The use of Blackboard to maintain a digital archive of all student work will also eliminate the possibility of any papers being misplaced.

How to Submit Your Homework Electronically
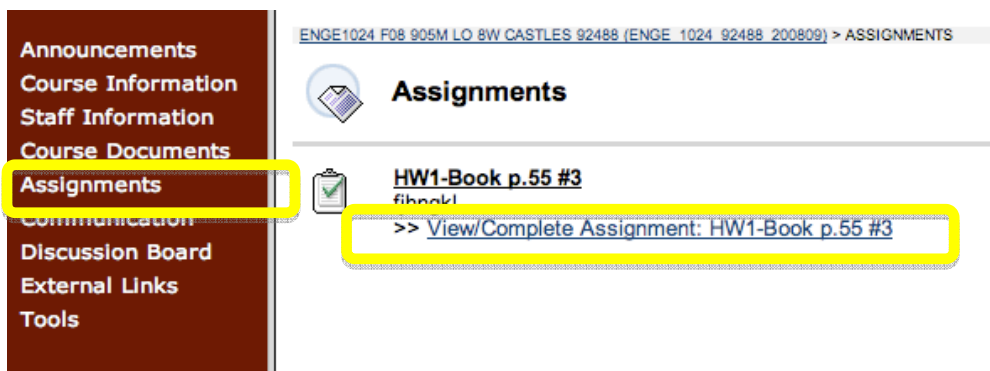
1. Check the assignments section of the "ENGE1024 Fall 2008 Main Site" each week to determine which homework is due.

2. All homework is to be submitted in Microsoft OneNote 2007 format unless otherwise specified. You should use the template provided on Blackboard. Instructions for using this template are at the end of this document.

3. Create a new OneNote section for each week's homework assignments. You may wish to organize all of these sections into a section group.

4. Create a different OneNote page within that section for each assigned problem. Name each page with an intuitive name (i.e., "p. 55 #7" or "LabVIEW Problem 3") so that it is obvious to the graders which problem is on each page. Use the appropriate heading on each page as you were shown in the first lecture. Please see pages 94-100 of your text for examples.

5. Each problem must be completed using the 7-step method outlined on pages 86-87 of your textbook unless you are specifically told it is not required. Some of the seven steps may not be applicable to a particular problem; in this case write a heading for that portion and simply write N/A to indicate that portion is not applicable.

6. Once all of your homework is completed and you have satisfied yourself that you have completed the assignment to the best of your ability, save the section to a location you will remember on your computer. It is recommended that you create a folder on your computer for all ENGE homework assignments. Name the homework section using the following naming convention:

<Last>_<First>_ENGE_1024_HW_<Homework #>.one

For example, if your name is Sally Jones and you are submitting homework 3 then your file should be named **Jones_Sally_ENGE_1024_HW_3.one**

7. Once you have completed the assignment and saved it using the proper naming convention, it is time to upload your work to Blackboard. This will be done on the WORKSHOP Blackboard site.Log in to Blackboard and select the Workshop course site. Navigate to the Assignments section and locate the link for uploading the current homework (there should only be one link present). Click on the link that begins with "View/Complete Assignment…" followed by the name of the assignment you are submitting.

8. Click on the button labeled "Choose File" and find where you stored the section containing your homework on your computer.

9. If there is anything the graders need to know to understand your work, write that in the comments section. Also, if you did not do a particular problem, note that in the comments section so the graders know to not look for it.

10. Click on the SUBMIT link to send the file to the graders. Note: <u>DO NOT USE SAVE</u>, this will not send your file to the graders.

11. Congratulations, you have successfully uploaded your homework for the week. (Note: This whole process must be completed by **5PM each Tuesday** in order for you to receive any credit for that week's homework. No late work is accepted without a university-verified excuse (illness, family emergencies, etc.)) If for any reason you find you have made an error in submitting your homework and need to submit a new file, you must contact your workshop leader to get the assignment reset so you may submit again. This may take some time, so please make sure everything is ready before you submit to make that a one-time process. Your workshop leader may not receive your request before the homework is due and making a mistake on homework submission does not merit the opportunity for an extension on the assignment due date.

Viewing Your Homework Grades and Seeing Marked Up Files

1. Once your homework is graded, the grade for that assignment will show up on Blackboard and you may access a file with digital ink markup showing you what you did correctly and incorrectly. To access your grades click on Tools in the left navigation pane on the workshop blackboard site. Then click on "My Grades"

2. You should see a list of all of your grades. To view a marked up version of your graded work, click on the grade for the assignment in question. If the assignment has not been graded yet, it will show up as an exclamation point ('!').

View Grades

Your grades for this Course

Item Name	Details	Due Date	Last Submitted, Modified, or Graded	Grade	Points Possible	Comments
Contemporary Issues	Details			-	100	
Weighted Total	Details			-	0	
Total	Details			75	100	
HW1-Book p.55 #3	Details	Aug 29, 2008	Aug 24, 2008 3:07 PM	75	100	good work

Icon Legend

3. You should then see details of the homework in question including the file you uploaded, any comments made by the graders, and a link to the marked up version of your homework file.

Using OneNote 2007 Homework Template

A template file is provided on Blackboard for you to format your homework. This template contains blocks for all the information that should be contained in your header for each homework page.

1. Begin by downloading the template file from Blackboard. Double click on the file to open it up in OneNote 2007.

2. Edit the template so that the left most box displays the time and day your workshop meets and the last name of your GTA. The first number should be the hour of the day when the workshop begins to the nearest hour before your class, so if your workshop begins at 9:35AM, you would simply put 9. Also, please use 24-hour timing (2PM for instance is 14). Use the letters W, R, or F to designate Wednesday, Thursday, or Friday respectively. For example if you were in Ricky Castles' 8AM Wednesday class, you would enter "8W-Castles."

3. Enter your name in the appropriate box in the format Last Name, First Name.

4. Leave the date, assignment title, and page numbers alone for now.

5. Save the page so that you can use this as a template for all homework assignments. From the menu, select Format→Templates…
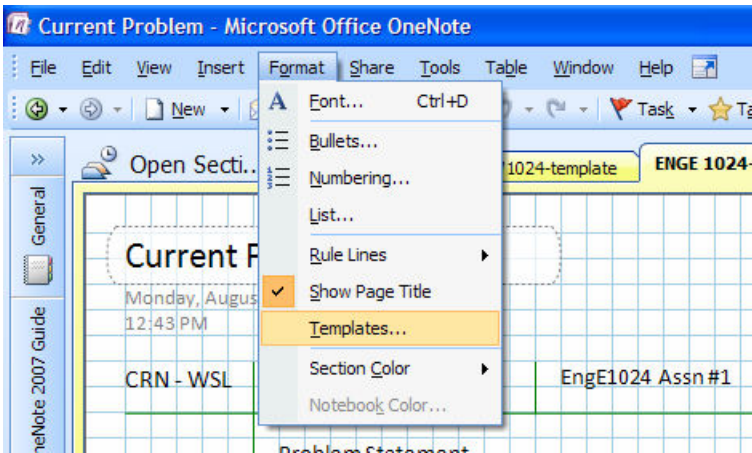
6. This should open up the template panel on the right-hand side of your window. At the bottom right-hand corner there should be a link that says "Save current page as a template." Click on this link. That should bring up the dialog shown below. Enter the name as shown below and if you want you may check the box to make this the default template in this section so that all your pages will use the same template.
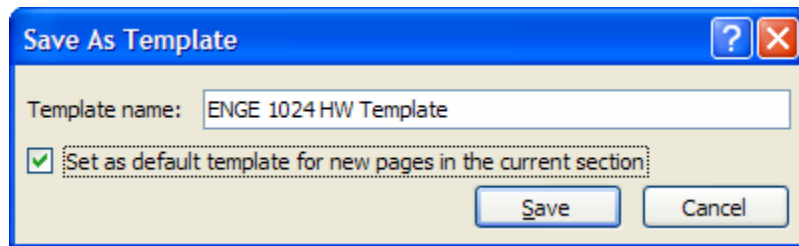
7. When you need to access this template in the future, you may find the template again by selecting Templates… from the format menu again to bring up the templates panel and then selecting the template from the "My Templates" section.
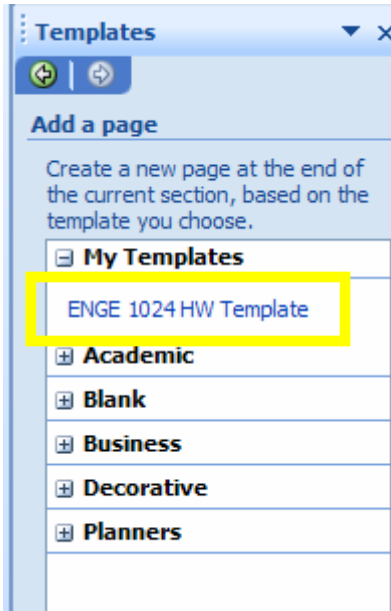
8. One each assignment you complete using this template, change the date and assignment title as appropriate. Also enter into the title block the intuitive description for the problem you are solving as described previously. Keep track of the number of problems you have to do and which problem this is so you keep an accurate page count in the upper right hand corner of the page. If you are working on the third of four problems, your page should say ¾ for instance. Header for each of the 7 steps are included and you simply have to move these around the page above each section. You are free to hand write using digital ink or to type, whichever is your preference. You will usually need to use digital ink for diagrams and may find it easier for equations.

9. An example is shown below of how complete formatting of the header may look.
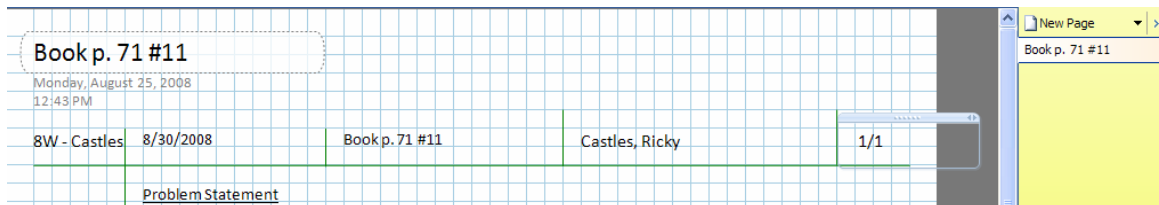
Appendix B

Electronic Grading Instructions For Faculty/GTAs working with Engineering Exploration
(ENGE 1024)

Creating An Assignment

You must create an assignment on Blackboard each week in order to give your students a link to upload their homework. Please do this as soon as you can in the week right after the new assignment is posted.

1. Log into Blackboard and navigate to the assignments section of the common Blackboard site to determine what assignments are due in the coming week.

2. Navigate to the workshop course site for which you wish to create a new assignment. (You will need to repeat this process for each workshop)

3. Click on Assignments in the left hand navigation frame

4. Click on Edit View in the top right corner

5. This should open up a window allowing you to add content to the page. In the top right hand corner of the screen scroll down to Assignment. Then click on the Go button right next to this drop down menu.
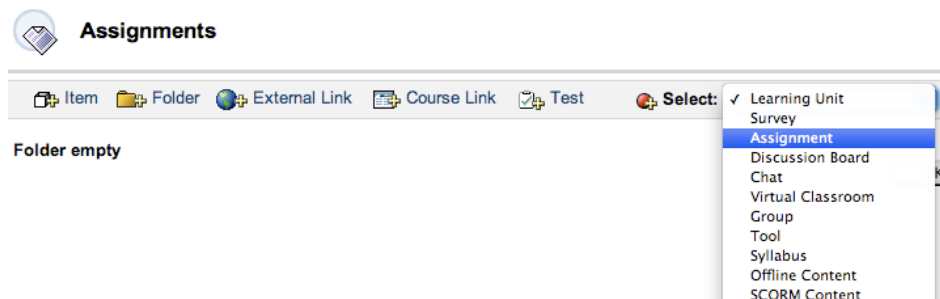
6. This brings up a dialog allowing you to enter the information about the assignment. Begin by giving the assignment an appropriate name. It is recommended that you format the name with something descriptive such as HW<num>- <What is due>. For example, the first homework is problem 11 on page 71 of their textbook, so you could name the assignment:

HW1- Book p.71 #11.

Typically there will be multiple problems due, but make a single link and list all the deliverables separated by a comma in the link name

(i.e. HW<num>-<problem 1>, <problem 2>, etc)

Enter the number of points possible; this is always 100 for homework assignments in this course.

Be sure to check the due date box and enter the date the assignments are due. This will always be on Tuesday at 5PM.

Enter any specific instructions for the assignment. Usually this will be covered on the common blackboard site so there will not be much need to add anything here most of the time.

Under the Options, check the box that says "Display Until" and select the date the assignment is due. Set the time to 5:05 PM to allow 5 minutes leeway. After this

time the link should disappear and the homework is no longer accepted. Be sure this date matches the due date set above.

Click submit.

7. Once this process is completed this should automatically create a link for students to submit their homework and should create an entry in the Grade Center automatically for the assignment.

Resetting a student submission

Students are not allowed to remove a file once they turn it in. Occasionally students will make mistakes when submitting a file and will need you to reset their submission to allow them to send it again. To do this, log into the appropriate blackboard site and go to the grade center via the control panel. Click on the cell in the grade center for the grade in question for the student in question. Click on the two downward arrows in the right of the cell and click on "Grade Details".

In the dialog the pops up, locate the attempts table. Under the actions column select "clear attempt" and confirm that you want to do this. This should then allow the student to make another submission. (The instructions for students are worded to discourage this so you don't have to do this very often.)

Appendix C

<u>Electronic Grading Instructions For Graders working with Engineering Exploration (ENGE 1024)</u>
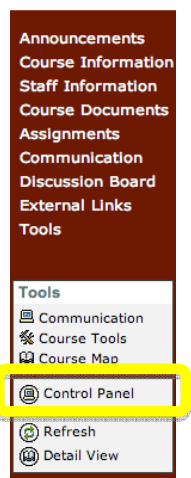
<u>Grading Responsibilities</u>

Graders will be responsible for downloading all the work the students have submitted, marking the papers electronically using a provided rubric, and assigning a score for each homework based on that rubric. Graders will also enter the grades for the assignments on Blackboard and upload the marked files to Blackboard for student access. This document outlines how to accomplish all the Blackboard tasks and discusses how to properly grade the student assignments using Microsoft OneNote.

<u>Downloading All Student Files Submitted For An Assignment</u>

Blackboard allows graders to download a zip archive of all the work students have submitted for a single assignment. The following steps are used to do this:

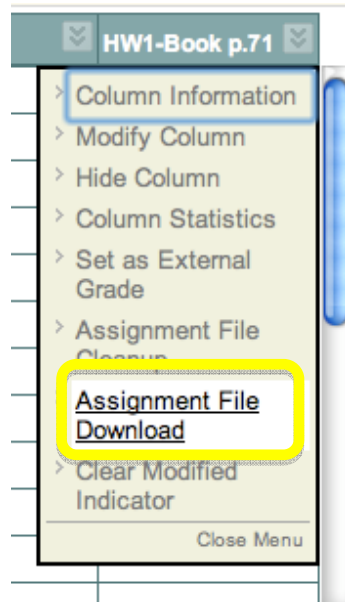1. Log into Blackboard and navigate to the workshop site for the particular workshop you are currently grading.

2. Go to the control panel.
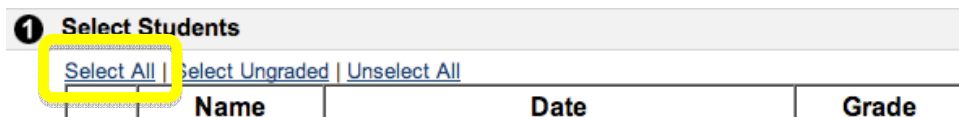
3. Enter the Grade Center.

4. Locate the assignment you wish to download in the grade center. Click on the two downward arrows next to the file name and select "Assignment File Download" from the menu that drops down.

5. In the window that comes up, be sure to click on "select all" and then click on "Submit" at the bottom of the screen.

6. You should then see a screen that looks like the one below. If you simply click on the link, you will download the zip file, but the name of the file will be a long string of numbers and letters which will not tell you much of anything about what section it is. It is recommended that you right click on the link and save it as an intuitive name so you can distinguish the files for each workshop.

Otherwise the default name is a long string of numbers and letters that is unintelligible.

Download Assignment: HW1-Book p.71 #11

The assignments have been packaged. Download assignments now. (409 KB)

Marking the files

1. A rubric will be provided to you each week. Open the files one at a time and mark the homework with digital ink in OneNote 2007 and indicate all the points that have been taken off. Please also make a quick comment as to why the points have been deducted.

2. Put the score the student receives on the assignment on the top of the first page in the file inside a circle so it is easy to locate.

3. Once you are done grading a file, save the file as the original name but append an underscore and the word graded to the file name. For example if the file I submitted was named Castles_Ricky_ENGE_1024_HW1.one then the name of the graded file should be:

   Castles_Ricky_ENGE_1024_HW1_graded.one

4. If you have any questions about how to grade a specific issue, please e-mail the head grader Eric Scott at escott06@vt.edu. Make sure your e-mail also copies all the other graders so that it may be answered and sent out to all graders so each of you grades the same way.

Entering Grades and uploading marked files

1. Navigate back to the grade center for the workshop you are currently grading (see instructions 1-3 for downloading grades)

2. Find the cell corresponding to the student name and the assignment you are grading. There should currently be an exclamation point in the cell.

3. Click on the double downward arrow in the right hand side of cell to show the menu
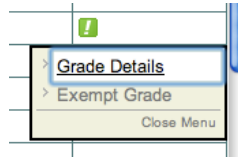
below. Click on "Grade Details."

4. In the screen the comes up, locate the attempts section as shown below and click on "View Attempt"

5. In the screen that comes up (see figure below), replace the '!' in the grade with the grade the student received.

6. Under feedback to user add any comments to the comments section as needed (This will usually not be needed, but if you have problems grading the files such as the file not opening or a problem missing this is a good place to note it)

7. Under feedback to user, click on Choose File to attach the graded file. Locate where you have saved the graded files and select that file to be sent back to the students.

8. Click submit at the bottom of the screen.

Grade Assignment: HW1-Book p.71 #11

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❶ Assignment Information

Name   HW1-Book p.71 #11

Instructions

Clear Attempt   Click this button to clear this attempt.   [Clear Attempt]

❷ User's Work

User's Comments

User's Files   Mohary_Michael_ENGE_1024_HW_1.one

❸ Feedback to User

Grade   o t of 100.0

Comments

ABC ✔

Attach local file   [Choose File] n   file selected

Currently Attached Files: [Add Another File]