Work-in-Progress: Incoming Student Technology Education

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Abstract

There is a growing digital divide with incoming college students. The assumption is that since students are fluent with smartphones or downloading music that they are technology wizards and can handle all technology related items that are presented to them. The problem with this assumption is that it isn't always correct. Survey data from the J.B. Speed School of Engineering suggests that for a number of students, the Tablet PC they are required to purchase is the first computer they have been solely responsible for maintaining. Prior to entering engineering school, many students stated they had a parent who kept the family computer updated or no one in the family ever worried about updates and backups. As technology adoption grows in personal, professional, and educational use, the students need a better handle on the available technologies and what are involved in using and maintaining said technologies.

Some incoming students have been more exposed to technology than others by their parents, but even these students need some help in some technology pursuits. Universities and Colleges are expecting students to use more technology without always providing them with the basic common knowledge needed. The Department of Engineering Fundamentals has long believed in creating a common baseline in the beginning courses for the students' mathematical instruction. The department is starting to believe that the Introduction to Engineering course would be a good place to add a common knowledge scaffold for technology. This common knowledge will include some software dependent modules on Excel, Word, and PowerPoint, but also needs to include topics on maintaining your own computer; managing your online profiles, accounts, and privacy; learning about campus computing resources; and ethics in using computing / technology resources.

The maintenance module will include technology components regarding the operating system as well as supplementary software such as browsers, flash, java, etc. The online profiles, accounts and privacy module will focus on information security and some best practices to protect their online accounts and identities. The campus computing modules will cover items related to being a J.B. Speed School of Engineering student, some example modules would be on Blackboard, email, Office 365, etc. The last module would be related to ethics related to using technology as a user and as a student.

This Work-in-Progress is the documentation of the early creation of this technology common knowledge as well as the history and motivations behind each of the modules.

1. Introduction

The J.B. Speed School of Engineering introduced a Tablet PC requirement for the incoming students starting in 2007. This requirement was the first year for a computer requirement at the school and remains in place. Computers and information technology were certainly present at the school before the adoption of the Tablet PC requirement, but at that time there was a strong

dependence on general and specific computer labs to provide the students with access to required resources. These labs were maintained by the school and not the students.

The Department of Engineering Fundamentals decided that the Introduction to Engineering course would be the best place to help the students with the technology related to their Tablet PCs. This technology coverage started as a way to introduce students to the inking capabilities of the Tablet PCs as well as software that takes advantage of the inking, specifically OneNote, Journal, and DyKnow. In teaching this course for the past seven years it has become obvious that assumptions about basic computer skills had by all students should be avoided, in spite of the fact that some students already have substantially more skills than other students. The impact of this difference in skills has led faculty to realize the need to help level the playing field with respect to computer skills. This leveling is about creating a common ground for the students to be able to help each other as well as learning to help themselves. There are several papers about improving advanced computing capabilities in engineering students[1] as well as papers documenting methods on increasing the number of computer science students[2,3]. There is at least one study addressing the computing skills of non-traditional students[4]. At least one school requires their undergraduates to pass a computer skills exam[5] that covers Microsoft Word, Excel, Powerpoint, and web searching. This exam and skills set is a start of what the authors feel is necessary for engineering students who have completed their first year of study. There appear to be few studies, and even fewer recommendations, about assuring that all freshman engineering students have mastered a core set of basic computer skills and have an adequate understanding of security and privacy issues. This is the area that the authors feel is missing in undergraduate engineering education, particularly with the increased use of and dependence on digital technologies in the delivery of engineering education.

In thinking about developing a program, the authors have identified the following student learning outcomes:

- **Create and use Excel documents for complex computation, data analysis, and data presentation; effectively use Microsoft PowerPoint and Word to create documents that are visually appealing and meet specified formatting requirements.**
- **Operate and maintain a personal computing device (Tablet PC, or notebook computer) for which the student has primary responsibly.**
- **Identify, explain and follow best practices for information security, information backup, and privacy.**
- **Identify all campus technical resources, identify when and where to go for help, and is able to use campus wide computing resources effectively.**
- **Identify situations that require ethical deliberation, analyze and evaluate their own ethical reasoning in a specific situation, and act in accordance with their reasoning.**

Sections 2 through 6 provides justification for the identified learning outcomes and current plans for achieving that learning outcome in more detail for each identified student learning outcomes. Future directions are discussed in section 7.

2. **Create and use Excel documents for complex computation, data analysis, and data presentation; effectively use Microsoft PowerPoint and Word to create documents that are visually appealing and meet specified formatting requirements.**

Justification

While the authors believe strongly in being vendor neutral with respect to software, all engineering students at our university have access to Office 365, and faculty generally operate on the assumption that students know how to use MS Office products. In our experience over the last five years we have seen a very wide range of knowledge about office products of incoming students. MS Word and MS PowerPoint are reasonably easy to use without much of an introduction, and students with little or no training are usually able to use them to meet class expectations. However, effective use may be more elusive. For example: many students may not be aware of best practices in preparing PowerPoint slides or using styles, plugins, and the equation editor in Word. Excel, particularly for engineering students, is another matter. The range in proficiency of incoming students with Excel is quite large, but unlike Word and PowerPoint, without some introduction students may struggle to use Excel to complete class assignments. Particularly, students need to know how to use absolute and relative addressing, copy formulas using fill down and fill right, graph a variety of different types of data sets with different numerical properties and dimensions, and find and use formulas. There are other engineering software packages, such as MatLab, in which engineering students also need to gain proficiency, however informal conversations with faculty and students support our claim that freshman engineering students would benefit from a stronger foundation in using Excel.

Instructional Plan

Telling or showing students how to use Excel, or other MS Office products is simply not effective. Hands on doing is by far the best approach for learning these software tools. One way to do hands on is to quickly demonstrate key aspects of the software, then have students complete a task which requires the use of those aspects. In a classroom where students can then work on the assignment until completion, a subject matter expert such as a TA or instructor provides guidance and clarification as the students work on the assignment. There are several problems with this approach, finding enough TAs and/or instructors, and enough class hours. Also, with students having a variety of skill levels, class time might be wasted since some, perhaps many of the students would complete the task quickly. Complementary, those students needing the most help might run out of class time to complete the task, and then have to complete the task without assistance (which might very well contribute to an increase in cheating). Our plan for achieving this outcome would be to have students complete simulation based training programs such as MyITLab or other similar products. Students are trained in a simulator that mimics Excel (or Word or PowerPoint), completing the simulation as many times as needed, then they may take a "test" using the same simulation, but without indications of correct completion of specific tasks along the way. While these simulators are not perfect, sometimes not recognizing a sequence of steps that does achieve the goal, they do scale well for large number of students and continue to provide a "personalized learning experience".

3. **Operate and maintain a personal computing device (Tablet PC, or notebook computer) for which the student has primary responsibly.**

Justification
Increasingly BYOD (bring your own device) is becoming the norm for most engineering students. Our Tablet PC requirement assures that all students purchase their own device. Since the Tablet PC requirement lists Windows as the required operating system, this learning outcome will focus on Windows and Windows related software, while trying to maintain some operating system independence where possible.

During the past interactions with the freshmen students, it is apparent that some students to need to be shown how to update and maintain a stable version of Windows. This is sometimes as basic as showing them how to run Windows Update to convincing them to think about what they are installing. Friends sometimes convince them to install something because it is neat, but it could actually be a virus or a malicious piece of software that may affect their computer operation. So one of the things that needs to be included in the instructions, is how to properly vet a piece of software before installing it.

In addition to operating system issues, web browsers have become an integral part of the way students communicate, create, and interact with faculty, classmates and course materials. As previously mentioned, all university students have access to Office 365, which can be accessed by local apps, but also allows access via a browser. In addition to Office 365, the university uses Blackboard as the main content management system (CMS). So students need to rely on their browsers working. Some students do not know there are multiple web browsers, and many do not know the difference between the big three: FireFox, Chrome, Internet Explorer. Occasionally, each of these browsers may behave slightly differently with the required web applications that are required. So this learning objective also needs to incorporate how to update browsers and their plugins. Two of the plugins, which are handled differently by each of the browsers, are Flash and Java. Since these plugins are important pieces to accessing some course assignments through the MyLabsPlus portal, then how to make sure that their Flash and Java are up-to-date needs to be included.

Instructional Plan
The learning objective is probably best introduced in the form of videos, broken into small segments, allowing students to focus on each topic individually. After watching the videos, the students will have required hands on assignments.

One assignment will require them to install the different browsers and plugins. After installation, the students will need to blog in BlackBoard about the browsers and plugins. This will also allow the students to create a blog with a review of plugins. These reviews can then be commented on by instructors or other classmates, to help create a review repository of plugins.

Another assignment will focus on the operating system, and have the students execute windows update, set an update policy, a power policy, and set a security policy. After completion of the previous tasks, the next part of the assignment will send them to access a web site that has unsigned java code that will require them to force the browser to accept and run the code.

The last assignment in this learning objective is to have the students turn in a final short report (1-2 pages) detailing their recovery method in the event of a software or hardware failure.

4. **Identify, explain and follow best practices for information security, information backup, and privacy.**

Justification

There is little reason to expect that incoming students have any better grasp of information security, backup, and privacy (as it relates to them!) than the public at large. With cyber-security issues increasingly facing nations, companies, and individuals, we argue that basic knowledge of information security, backup, and privacy issues should be a specific part of an introductory curriculum for all students, and certainly for our engineering students. Students have lots of digital identities (Chegg WebAssign, etc.), and we see it as imperative that they understand authentication, including two factor authentication, and password management.

In addition to information security, it is essential in today's world to be able to recover your digital information in the event of a hardware failure. Backups are no longer a nice thing to do, but are a necessary part of maintaining one's information. There have been students who have lost semesters of notes by not backing up their information regularly or at all. Sometimes the students are not aware of the importance of backing up items to prevent loss due to hardware failures, thefts, etc.

Because students have mostly grown up with social media and continue to use it extensively, they need some foundational instruction with respect to privacy. What is their "expectation of privacy"? What are others "expectations of privacy"? They also need to understand threats, attacks, and vulnerabilities, so that they can be proactive in protecting themselves and their devices. University email accounts are particularly attractive for Phishing attacks, so students need to understand these types of attacks. Recently on our campus one student sent a message from another students twitter account (as a joke). We must help student to always see this within the larger context of information security and privacy, and not just a humorous incident.

Implementation Plan

A completely hands on approach for this SLO is not possible, however we do see a hand-on component. The instruction would begin with several small video modules would be developed that introduce students to the following topics:

1. Authentication. Including passwords, two-factor authentication, weak passwords, strong passwords, and (since they are engineering students) a brief explanation of cryptographic hashes. This would include a discussion of password attacks, including phishing attacks. This section should probably include a discussion of password management software, compared to browser based password storage.
2. Malware. This would include types of malware, various common attack vectors, and best practices for defending against malware (including a discussion of available security software).
3. Backup. This would include information about how to maintain current backups, as well as examples of popular software services, such as Carbonite, CrashPlan, and Backblaze. This video module should also include a comparison of the different backup methods including pros and cons.

4. Legal and privacy issues. Brief entry into the topic, presenting a discussion of where email storage, Facebook content storage, FERPA and DMCA.
5. And when Encrypted email becomes more standard, this is the learning objective where it will be covered as well as public-private key encryption.

Following each video students will take a quiz delivered on-line that assess key facts from the videos. Following the quiz, students will be required to set up and use two factor authentication with some site, based on current popularity as a personal email account gmail would be the default followed by Dropbox. The last part of the assignment is to write a one page paper relating how an aspect of information security impacts them personally and professionally.

5. Identify all campus technical resources, identify when and where to go for help, and is able to use campus wide computing resources effectively.

Justification
All incoming students to the University of Louisville will at some point be expected to access the campus CMS, Blackboard, email, Office 365, DyKnow, etc. So the students need to be made aware of the applications that are specific to the university. In addition to these applications, the university has come on campus computing resources as well as technology related helpdesks.

Implementation Plan
The implementation of this learning objective would once again start with small videos. These videos would focus on each of the applications, location of the helpdesks (including the differences of each), and the location of general computing laboratories. The active portion of this assignment would involve the students emailing their instructor, accessing an assignment in Blackboard which would include an assignment submission, accessing a blog assignment in Blackboard.

6. Identify situations that require ethical deliberation, analyze and evaluate their own ethical reasoning in a specific situation, and act in accordance with their reasoning.

Justification
There are times when anyone is faced with an ethical decision regarding technology. Some recent examples of technology related ethical decisions are: copying solutions to an assignment (not just a technology related decision), copying a music or movie file, downloading cracked software, borrowing intellectual property that isn't the students, and accessing and using another persons' account or electronic identify without explicit permission.

Implementation Plan
The plan for providing students with instruction in this area would be to have them work in groups and do role playing with developed scenarios. Students would do a table top exercise, with different students playing different roles from the scenario. Afterwards the students would discuss and reflect as a group. The groups would then share out information from their discussion and reflections with the whole class. This would allow for a whole class discussion after allowing the students some time to process it in smaller groups.

7. Future Directions

Before beginning work on executing these different student learning objectives' implementation plans, the authors plan to seek additional input from the committee that is investigating the revision of the J.B. Speed School of Engineering's current first year engineering curriculum. In addition to the committee's input, a survey of current faculty, current students and alumni needs to be administered to determine the importance that faculty, students and alumni attribute to these learning outcomes for freshmen curricula. This survey would be used to validate the assumptions that the learning outcomes identified in the previous sections are needed, and potentially identify any overlooked desirable outcomes.

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