Classroom Laptop Use by Students

Patricia M. Shamamy, P.E.
Lawrence Technological University

Abstract
Our university now requires that all incoming freshmen have laptops. Faculty have been encouraged to develop uses for laptops in class. This paper describes three examples of student laptop use developed by a faculty member. The first example covers the use of Powerpoint to create simple drawings (not a Powerpoint presentation), the second covers the use of Excel to create stress-strain curves, and the third covers the use of a data base program to select engineering materials with certain properties. Students are required to complete all these assignments and submit a hard copy of their work. These assignments are all begun in class, with the instructor starting the assignment and projecting the work on a screen for all to see while the students work on their individual laptops. The assignments are too long to be completed in class so the students must finish them outside of class. In spite of the increased computer literacy of our students, it has been observed that all of these exercises introduce students to new computer skills.

I. Introduction

There is heavy demand today for college graduates to possess a high level of computer literacy. Graduates are expected to understand the traditional programs found on essentially all computers, have the ability to apply this knowledge to a new situation, and be able to quickly learn how to use any analogous programs. Such skills cannot be learned solely in "computer courses." They are most easily acquired when computer usage is interwoven in courses of their academic discipline.

Recognizing this need to increase the integration of computers in university courses, our university has begun implementation of the requirement that all students have their own personal laptop. The requirement was instituted for incoming freshmen last year. This year the requirement included both freshman and sophomore classes. After the next two years the requirement will extend to all underclass students. Instructors are encouraged to develop ways to have students use their laptops in class.

This paper is concerned classroom laptop use by students in two lower level Engineering courses, Introduction to Engineering and Engineering Materials. The strategy for determining the types of use is discussed and three examples of use are explained.

II. Student Computer Literacy

Each year it seems that incoming college freshmen have increased computer skills from those of the previous year. They are more comfortable using the computer and less intimidated by it. But what exactly is meant by "increased skills?" What is the general level of computer literacy of these first year students? Basically, it has been observed that students have become quite skilled at:

- Simple word-processing
- Creating Powerpoint slides
- Creating simple graphs using Excel
- E-mail
- Surfing the Web
- Downloading images and music from the web
- Creating original desktops
- Playing video games

It can be seen that these "increased skills," although contributing to an increased computer "comfort level," do not necessarily translate into increased engineering-related computer skills!

There can often be a significant difference in skill level between those who are most adept and those who still are at the novice level. Some (but usually not many) will have better understanding of the operating system. Some may be familiar with AutoCAD (however, we do not use AutoCAD, we use Solid Edge). At the other extreme, some students have difficulty grasping the use of different usernames and different passwords and become upset when "This computer won't do what I ask it to do."

We thus conclude that student computer literacy is best described as "high school level." In most instances a solid foundation of skills has been established and the students are ready to start learning engineering applications. We also must note that there is a high probability that some students will not be as skilled as others, so any classroom computer activities must allow sufficient time for them to come up to speed.

III. Criteria for Classroom Laptop Use

Having acknowledged that the students should somehow use the laptops in class, the next step is to determine exactly what criteria should be used to develop these classroom laptop exercises. In reflecting on this, I have identified five characteristics as being important in this student use:

1. There must be a "Value-Added" aspect to the assignment. In other words, the laptop use in class should not be simply busy work. Further, the "value-added" aspect must be clearly evident to the students.
2. The student must be actively involved in using the laptop. The laptop should not be used to merely view a Powerpoint set of the instructor's notes.
3. The assignment should be introduced with instructor actually doing the work and projecting the work on a screen for all to see. Students should then begin the assignment, following the instructor's lead.

4. The classroom exercise must form the beginning of a required assignment that will need to be turned in at a later date. The assignment should be long enough so that it cannot be completed in class.
5. The classroom assignment should be difficult enough so that students will realize that they must begin it themselves in class and work on it in class in order to avoid having to spend hours on it at home.

In the next three sections of this paper, three different classroom exercises involving current student use of laptops will be explained.

IV. Creating Drawings Using Powerpoint

Engineers are often required to create simple drawings. These drawings may be sketches of a proposed design, flow charts, or just simple layouts. In today's electronic era, it is often desirable to have these drawings in an electronic format. Further, a fully dimensioned CAD drawing may not needed. In this instance, the best vehicle for developing these simple drawings is Powerpoint.

Powerpoint is primarily thought of as being a "presentation software program." However, it is also a very powerful graphics program. It has a number of advantages to the "Draw" function in Word. It is also a program that is found on essentially all business computers.

For one assignment, students are introduced to this aspect of Powerpoint by requiring them draw a simple 2-D sketch of a scanning electron microscope system. They are given a paper copy of what the drawing should look like (with no dimensions on it). They are directed to start their laptops and open the Powerpoint program.

The instructor then begins the drawing on his/her own laptop, projecting the work on a screen for all to see. Students follow the lead of the instructor, creating the drawing on their own laptop. After approximately 5-10 minutes of instruction, the students are able to continue drawing on their own. The instructor then stops drawing and moves around the room, giving individual help where needed.

The drawing that is assigned is a fairly simple one. However, it is sufficiently detailed so that students cannot complete the whole drawing in a fifty-minute class period. Drawing skills learned in this assignment include such items as:

- How to set up the drawing screen so that rulers and a crosshair are visible;
- How to draw a perfect square or a perfect circle;
- How to snap arrows or lines to the center of a rectangle;
- How to rotate a shape;
- How to turn off the grid system that is snapping all drawings to it;
- How to group drawing elements for copying and pasting.

It has been observed that very few students have ever used Powerpoint for this type of application. A comment often expressed by students: "I wish I had known how to do this before."

Below is a reduced-size copy of the scanning electron microscope drawing that the students have been assigned.

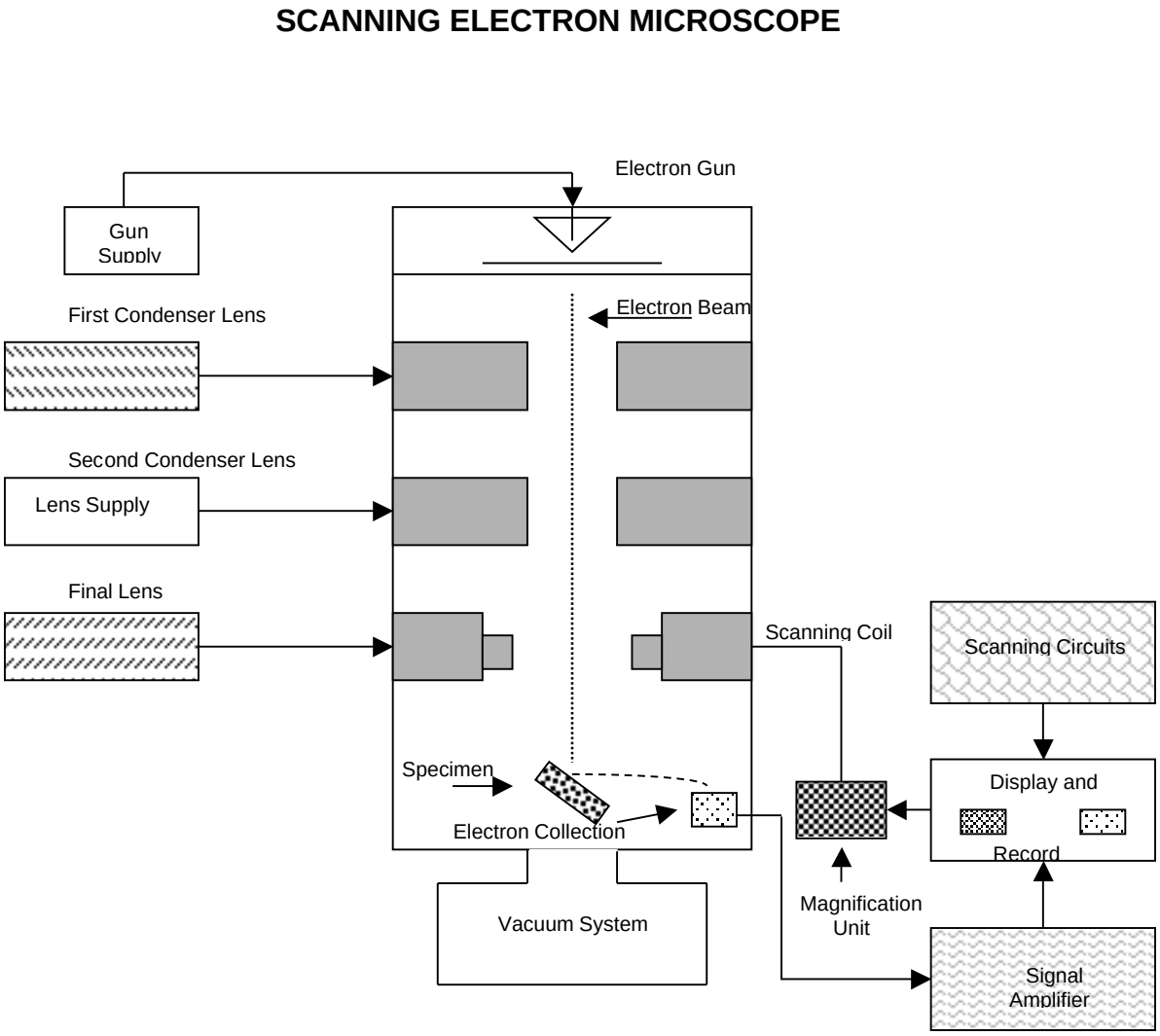


Figure 1. Scanning Electron Microscope

V. Graphing Using Excel

Excel can be used to do repetitive calculations and graphing. In another classroom laptop-based exercise, students are required to use Excel to calculate engineering stress and engineering strain from load and extension data obtained from running a tensile test. They then must use Excel to obtain graphs of stress versus strain.

This assignment is begun in class. The students are directed to turn on their laptops and open an Excel spreadsheet. The instructor then begins the assignment by typing in the data of load and extension, using his/her own laptop and projecting the work on a screen for all to see. Students follow the lead of the instructor, typing the data in their own spreadsheet.

The instructor then types in the equations needed to calculate stress and strain and has the program do the calculation. The students again follow the lead of the instructor. With stress and strain now calculated, the instructor shows the students how to use the "Chart Wizard" to obtain the necessary graphs.

Because students need to determine ultimate strength, yield strength at 0.2% offset, and the Elastic Modulus, three different graphs are needed. The instructor typically spends about twenty minutes beginning the graphing assignment for the class. The instructor then stops the demonstration and moves around the classroom giving individual help.

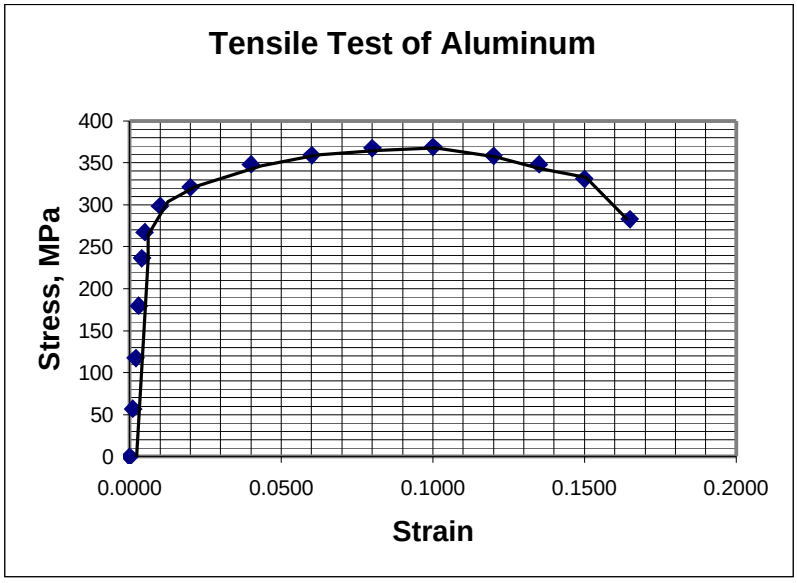
Students are required to develop nine more graphs (making a total of twelve). One more class period is devoted to this assignment. Most students cannot finish this assignment in the two class periods.

Excel/graphing skills learned in this in-class laptop exercise include:

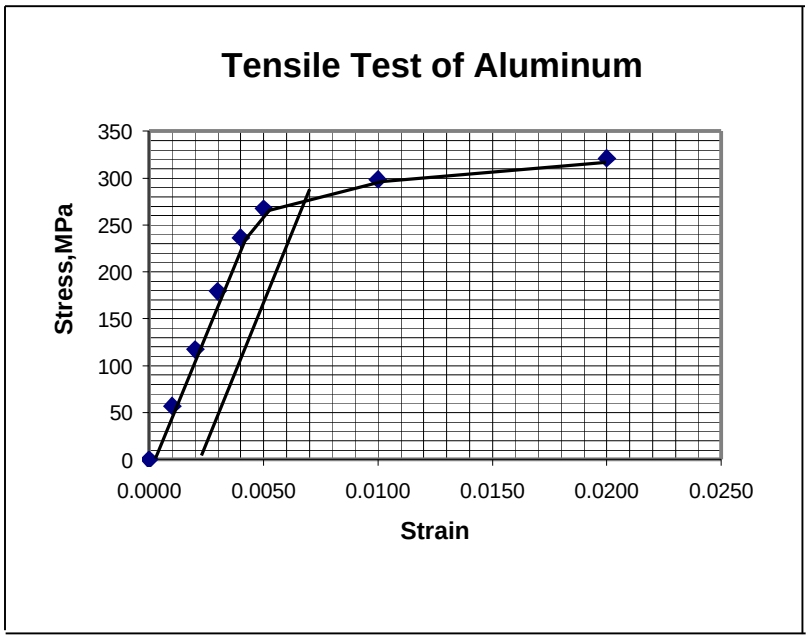
- How to write an equation needed for a calculation;
- How to "fill down" a calculation;
- How to deal with very large numbers that Excel doesn't like to list;
- Which type of graph is best to use for engineering ("x-y scatter");
- How to easily control what is plotted on the x-axis and what is on the y-axis;
- How to best use the curve-fitting function;
- How (and when) to connect points manually;
- How to get the equation of a line;
- How to use the "right-click" function of the mouse to speed up graph adjustments.

Although students are quick to assert that they "know how to use Excel," almost all admit that they did not know how to use Excel for this type of assignment. They also typically were not aware of the many types of adjustments that can easily be made to line graphs, or that the type of graph that is usually chosen for graphing engineering data is called "x-y scatter."

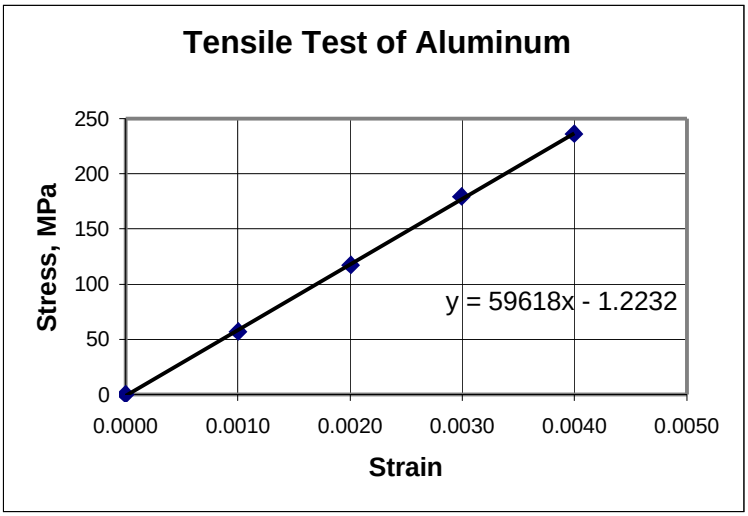
Samples of the graphs that the students must create are shown below:



Graph 1. All data plotted. This graph is used to determine Ultimate Strength.



Graph 2. First eight values of stress only. This graph is used to determine Yield Strength at 0.2% offset.



Graph 3. First five values of stress only. This graph is used to determine the Elastic Modulus.

VI. Using a Database Program for Materials Selection

This exercise illustrates the use of a database program to select materials with specified mechanical properties. The database program is on a CD that is packaged with the course textbook, "Materials Science and Engineering – An Introduction" by William D. Callister, Jr. The database program contains information on the properties of 183 different materials - -metals and alloys, ceramics, polymers, and composites. The properties include:

- Density
- Modulus of Elasticity
- Poisson's Ratio
- Yield Strength
- Tensile Strength
- Percent Elongation
- Fracture Toughness
- Coefficient of Thermal Expansion
- Thermal Conductivity
- Specific Heat
- Electrical Resistivity
- Cost

The program can be used to find materials with certain ranges of properties, rank materials by a certain property, or find materials based on up to three combinations of properties.

This assignment is begun in class. The students are directed to turn on their laptops and open the database program. The database program resembles a spreadsheet in that the 183 materials are listed in the first column and the various properties are listed in twelve columns to the right.

The program can be used in either the "Browse" mode or the "Query" mode. When using the program in "Browse" mode, clicking on any column heading (material property) will then sort the materials in decreasing numerical or decreasing alphabetical order, based on the values of that property. In "Query" mode, materials can be selected based on three types of criteria: combinations of properties, ratio of two numerical properties or the product of two numerical properties.

Since the students in this class are studying Engineering Materials, the assignment is intended to have them realize the often-large difference in properties of the various types of materials. In this assignment the students must first construct tables listing:

- Five materials with the highest elastic modulus
- Five metals with the highest elastic modulus
- Five plastics with the highest elastic modulus
- Five plastic matrix composites with the highest elastic modulus

They must next repeat this for highest tensile strength, highest fracture toughness, lowest density, and lowest cost, making a total of twenty tables needed.

The instructor begins this assignment, projecting the database table on the screen. Since a simple sorting of properties is needed, the program will be used in the "Browse" mode. The students observe that as the instructor clicks on a properties column, the materials are sorted and they can easily identify those with the highest (or lowest) values. Having demonstrated the program for the elastic modulus, the instructor now leaves the remaining tables for the students to do themselves.

From the use of this database program, students gain the following insights:

- The highest strength material is not a metal;
- Some plastics are stronger than metals;
- The material with the lowest cost is concrete;
- Database programs can reduce materials selection searching time;
- Database programs can have sorting limitations.

Two class periods are spent on this assignment. In the first class, the students begin the assignment. Students then usually finish the assignment at home. The second period is used to verify that the assignment has been done correctly.

VII. Conclusion

This paper has illustrated how students use laptops in two different freshmen level courses. The Powerpoint drawing assignment is used in Introduction to Engineering. The Excel assignment and the database assignment are used in Engineering Materials. Feedback from students on these assignments has been very positive. Further, students feel that the approach of having the instructor begin the assignment in class is very valuable.

Students like to be actively doing these assignments in class. Those, who for some reason do not have their laptop, do not just sit back and watch. They can usually be seen trying to take as many notes as possible so that they will know how to do the assignment when at home.

This paper discusses only three types of classroom laptop assignments. This author has others, including creating 3-D drawings with Powerpoint, creating different types of engineering graphs, and working with a 3-D CAD program. Further, all courses have websites and students are also required to download (and use) information posted on the website. In the various classes that this author teaches, students are currently using laptops during approximately 25% of the class meetings. Assignments used all must support a course's goals - -and also satisfy the criteria mentioned in the beginning of this paper.

Students like using the laptops in class. The assignments allow them to make connections between engineering and computer applications. It is not uncommon to hear a student comment that he/she sees how to apply some of these new computer skills to other courses or to a part-time job. Laptop use in class by students has definitely added to the technological literacy of our students.

VII. References

1. Callister, William D., "Materials Science and Engineering – An Introduction," John Wiley & Sons, Inc., New York, 2000.
2. Oakes, William C. et al, "Engineering Your Future," Great Lakes Press, Wildwood, Missouri, 1999.
3. Finelli, Cynthia J. et al, "Strategies for Improving the Classroom Environment," Journal of Engineering Education, vol. 90 no. 4, pp. 491-497, 2001.
4. Webb, Wendy, "Laptop Lessons," Online Learning, vol. 5 no. 3, pp 50-54, 2001.
5. Wankat, Phillip and Oreovicz, Frank, "An Over-stuffed Curriculum," Prism, vol. 11 no. 2, pp. 40-41, 2001.

Biographical Information

PATRICA M SHAMAMY, P.E. is Professor of Mechanical Engineering at Lawrence Technological University in Southfield, Michigan. Besides teaching she currently does consulting work in materials and manufacturing and also serves on the University E-Learning Committee and the College of Engineering Entrepreneurial Program Planning Committee.

Address: Mechanical Engineering Dept., Lawrence Technological University, 21000 West Ten Mile Road, Southfield, MI 48075; e-mail: shamamy@ltu.edu.