Teaching and Learning Portfolio

by

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This portfolio submitted in partial fulfillment of the requirements for the
Delta Certificate in Research, Teaching, and Learning

Delta Program in Research, Teaching, and Learning
University of Wisconsin-Madison

Table of Contents

Curriculum Vitae

THOMAS CARSTENS

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Education

University of Wisconsin-Madison
PhD Nuclear Engineering and Engineering Physics Expected 2012
Advisors: Professor Michael L. Corradini and Professor James P. Blanchard
Thesis: Self-Powered Wireless Sensors for Spent Fuel Monitoring
Cumulative GPA: 3.73/4.0

University of Wisconsin-Madison
Master of Science May 2007
Nuclear Engineering and Engineering Physics
Advisor: Professor Michael L. Corradini
Cumulative GPA: 3.71/4.0

University of Wisconsin-Madison
Bachelor of Science May 2004
Double Major: Mathematics and Physics
Cumulative GPA: 3.5/4.0
Mathematics Major GPA: 3.5/4.0, Physics Major GPA: 3.5/4.0

Delta Certificate Excepted 2012
The main goal of the Delta program is to improve student learning in science, technology, engineering and math.

Employment Experience

University of Wisconsin-Rock County
Associate Lecture for Physics 201-202 (General Physics), September 2009 – January 2011
Teaching Duties
- Developed the laboratory schedule
- Supervised laboratory
- Graded laboratory reports

University of Wisconsin-Madison, Department of Engineering Mechanics and Astronautics
Teaching Assistant for Engineering Mechanics and Astronautics 202 (Dynamics)
Teaching Assistant for Engineering Mechanics and Astronautics 201 (Statics)
Teaching Assistant for Engineering Mechanics and Astronautics 303 (Mechanics of Materials)
January 2006 - Present
Teaching Duties
- Led 2-3 discussion sessions; maintained weekly office hours
- Graded exams and homework; proctored exams

Duke University Talent Identification Program
Instructor for Physics of Energy Course, June 2009 - August 2009
Teaching Duties
- Designed new course
- Taught 16 academically gifted high school students
- Assigned duties for a teaching assistant

University of Wisconsin-Madison, Department of Nuclear Engineering and Engineering Physics
Lab Assistant, February 2005 - August 2008
Clean Room Experience
- Gained access to work with clean room equipment such as spinners, developers, evaporators, etc
X-Ray Lithography
- Acquired experience in using the beam lines at Synchrotron Radiation Center
- Proficiency in electroplating

University of Wisconsin-Madison, Department of Mechanical Engineering
Lab Assistant, December 2005 - February 2006 and May 2006 - July 2006
Data Analysis
- Used Matlab, Phantom, and Excel to analysis spray length and spray angle; edited spray movies
- Assisted in performing spray experiments

Epic Systems Corporation
Technical Service Engineer, September 2004 – January 2005
Programming Skills
- Modify standard M computer code to fit customers' needs
- Reviewed computer code for efficiency and errors
Communication Skills
- Assisted customers in setting up system environments
- Explained how to perform the various software functions
- Resolved any issues that the customer might find in the system

University of Wisconsin-Madison, Department of Physics, Plasma Physics Group
Lab Assistant, August 2002 – August 2004
Construction and Maintenance Skills
- Produced twelve half-ton inductors and fifty-five hundred pound inductors
- Assisted in repairing and maintaining capacitor banks and other equipment
- Gained basic machining and soldering knowledge

Safety and Upkeep
- Installed emergency switches and other safety devices in laboratory areas
- Cleaned and organized laboratory areas

Computer Skills

Knowledge of UNIX, Windows, and Mac operating systems
MS-Word, MS-Power Point, MS-Excel
Knowledge of M and Visual Basic programming languages
Experience with OrigenArp, Finite Element Heat Transfer, Engineering Equation Solver, and SolidWorks
Installation of computer hardware

Professional Memberships

American Nuclear Society, March 2005 – Present
-Alpha Nu Sigma (American Nuclear Society Honor Society)
Institute of Electrical & Electronics Engineers, February 2011
American Society for Engineering Education, January 2006- 2009
University Physical Society, February 2003 - May 2004

Volunteer Experience

Teaching Improvement Program Volunteer, 2010
- Led 2nd Days: TA Best Practices Workshop
- Provided feedback and advice on issues concerned teaching assistants

New Educator's Orientation Volunteer, 2007-2012
- Led the Presentation Skills Workshop
- Provided feedback and advice on improving presentation skills
- Answered general questions

New Educator's Orientation Volunteer, 2006
- Assisted in the training of new teaching assistants
- Led large and small group activities
- Answered questions and shared personal experiences

Engineering Expo, 2005
- Provided general information to visitors
- Assisted in general maintenance and upkeep of the Engineering Expo

Awards

Polygon Outstanding Teaching Assistant Award, Spring 2007
Dean's List, Fall 2000 and Spring 2002
Nominated for membership in the Golden Key Honor Society

Departmental Service

University of Wisconsin, Department of Engineering Physics

- Review of Doctoral Qualifying Exam, January 2008

Presentations

Carstens, T., Corradini, M., Blanchard, J., and Ma, Z., 2011, Thermoelectric Powered Wireless Sensors for Spent Fuel Monitoring. *Advancements in Nuclear Instrumentation, Measurement Methods and their Applications*, Ghent, Belgium.

Carstens, T., Crall, A., Licker, R., and Rediske, R., 2008, Do You See What I See?. *Teaching and Learning Symposium*, University of Wisconsin-Madison.

Publications

Carstens, T., Corradini, M., Blanchard, J., and Ma, Z., "Thermoelectric Powered Wireless Sensors for Spent Fuel Monitoring" submitted for publication IEEE's Transactions on Nuclear Science.

Teaching Philosophy

When I was in high school I found out that one on my neighbors received $20 per "A" grade. After I discovered this I told my mom that I wanted to get money for good grades. She told me "no" and the reason for that is the world expects the best from me regardless of praise. After that I took ownership of my learning, and that performing at my best was its own reward. As an educator, I want my students to have the same ownership and pride in their learning. I want students to have significant involvement in their own learning. The way to get students involved in their learning is by accomplishing three different tasks, relating course material to every day experiences, developing connections among the students, and practice.

It is important to assist students in making the connection between the course material and the things they experience every day in their lives. The material taught in class should not exist in a vacuum. Courses need to balance between theory (lectures) and real world applications (experiments/design). Simple problems, such as a block on incline plane, can demonstrate Newtonian problem solving. However, it fails to get students excited and thinking about how science and engineering govern their lives. Such examples should be supplemented with real world examples and applications.

There are different types of connections a student can make during a course, student-student, student-instructor, etc. I strive to have an open classroom where these different connections can occur. The goal of these different connections is to improve communication skills, team work, and shows that people are invested in their learning. Working in a group provides a support structure for the students. This group allows one to ask questions, and increases the chances of the subject getting explained in such a way that the material makes sense. In addition, students must learn how to communicate ideas. As future engineers and scientist they will be required to explain their work to people who are not familiar with it, and these people will probably have a financial investment in their work. Hence, it will be important to communicate well.

As a learner and teacher, I believe that the best way to master material is through experience and practice. This practice and experience can not just happen in the classroom. The main purpose of lecture should be to lay out the basic building blocks of the course. One of the main ways to gain practice and experience is by doing homework and projects. I have gain the most understanding of the course material by doing homework and projects. It is important that this work is more than just "plug and chug" problems. I learned the most about a subject when projects do not go 'according to plan". This is when I have to challenge myself to find the cause of the problem, and to develop a solution. By doing this I end up learning more about the subject. It is important that homework and projects required seeing the big picture and how the different concepts are interwoven.

At the end of the course, not only do I want my students to understand the course material, I want to take pride and ownership of their learning and accomplishments. This can be accomplished by balancing theoretical problems with real world applications, developing the many connections that exist among the students, and applying the material through practice.

Reflection on Connecting Course Material to Everyday Experiences

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One possible way to connect classroom material to real world experiences is by thru experiments. Experiments provide an opportunity to collect data, analyze data, and draw conclusions about how the world is governed (which can enhance critical thinking). Some experiments have the added bonus that it deals with concepts students encounter every day in their lives {artifact 1}. Coupling experiments with lectures covers diverse learning styles (active vs. reflective). Experiments also provide the benefit of dealing with uncertainties of the real world. It forces the students to question themselves. How accurate are my measurements? Is the equipment functional and connected correctly? How should I analyze the results? Do the results make sense? These questions provide additional learning opportunities in problem solving. Below is my reflection on experiments conducted during a general physics course, to see how the students responded to the experiments.

Description: University Physics I, Physics 201, is an introductory course at the University of Wisconsin-Rock County. The University of Wisconsin-Rock County is a two year public school. At the end of two years many of the students transfer to a four year university. Since it is a two year school the majority of the students are freshman and sophomore level. However, the university has a large population of returning adults. On average the course enrollment for Physics 201 was twenty students. Physics 201 consisted of lectures and labs. A professor was in charge of lectures and an academic instructor (me) ran lab sections. Labs composed 15% of the students' final grade. The remainder of the student's grade is determined by exams and homework. During the semester the students performed thirteen different labs, and there was one make up lab. The labs corresponded to the material taught in lecture during that week. The lab period was three hours long. The students are required to submit a lab report the following week. The lab report was required to have procedure (short summary of what they did), raw data (graphs and tables), analysis of their data, comments (do their results agree with expected values and ways to improve the lab), and lab questions. Each lab report was worth a total of fifteen points. At the being of the semester all the students were given the grade rubric for the labs {artifact 2}. The goal of lab was to enforce the course material taught during lecture, and improve their analytical skills through the analysis of their data. When students were analyzing their data, they were required to show their process and provide explanations of what they did. Students were required to present their data in easy to read tables/graphs. Students collected data in groups of two (sometimes large groups were used due to lack of equipment). Each student had to submit individual lab reports (no group reports). However, the students were encouraged to work with their partner in analyzing their data and answering the questions at the end of the lab.

Analysis: After the students took their first mid-term, during the next lab period the students filled out an informal evaluation on the lab course to date. On a piece of paper the students were asked to answer the following three questions:

1. What do you like about lab?
2. What do you dislike or want to see changed about lab?
3. Other comments?

To help keep the students responses anonymous, the student wrote down their responses on a sheet of paper and a student volunteer delivered all the comments to another instructor. The instructor then typed all the responses into a word document {artifact 3} and emailed the students' responses to me.

From the students' responses one sees that nearly a third of the students' responses thought the labs were fun and interesting. Overall it appears that students enjoyed their time spent in lab. In particular one student mentioned the connection between theory and everyday events. The student states "I like the fact that Physics lab involved experiments involving real life situations that you can relate to out of class" {artifact 3}. Another common positive experience shared among the students is the lab instructions. Many students claim the instructions are clear and easy to follow.

On the negative side there is not a common theme among student opinions on ways to improve lab. There seems to be three points that the students took issue with {artifact 3}:

- Computer Problems
- Example problems and background
- Lab Reports

Through out the semester some students had issues with the classroom computers. These problems seemed to range from software issues (programs not opening or responding) to printing issues. The other area of concern is that some students wished more example problems were done in lab. They wanted to see example problems in order to gain a better understanding of the important equations used in lab. The final concern of the students dealt with the lab report. In particular the students thought it was too long to write up and would prefer worksheets.

Conclusions: Overall labs, such as Energy in Gasoline {artifact 1}, are an overall success. The course structure of Physics 201 creates an environment where diverse learning styles are used (learning through diversity). Laboratory courses allow for a more active learning style. The student actively collects data and draws conclusions from the analysis of the data. While the course lectures geared more towards reflective learning styles. Laboratory work also develops learning communities among the students. They get to work together accomplishing a mutual task. I notice on several occasions groups would asked other groups for assistance, instead of waiting for help from myself. Students need to work together in collecting data, and analyze the data. Also, laboratory work has the added benefit of trouble shooting the experiment. When doing experiments there is going to be occasional equipment issues the students will have to address.

Laboratory work is one way to connect course material to the real world. Ideally, the labs should be related to the student's everyday experiences. Once again based on the students' comment {artifact 3}, the students in lab were able to make this connection on their own without much guidance from myself. The students claimed to enjoy lab. Getting the students to enjoy the course is important since it shows that they are engaged in the course material. Cars are an item that every student has experienced with. The Energy in Gasoline lab involves calculating the efficiency of their cars. The questions at the end of the lab try to get the students to think about how efficiency and weight influences miles per gallon. Improving energy efficiency is an ongoing research field among many industries.

Most of the concerns the students have with labs can be easily addressed. The labs are designed to that the students can collect and analysis their data with some time to spare. The lab section is scheduled for a three hour block. Therefore it will not cause a time rush on the students if the instructor takes a few minutes at the start of lab to do an example problem that deals with the concepts using in lab. The issue with the computer is more problematic. I do not really see that anything can be done about other than inform IT staff about the issues as soon as they appear, and remind the students to be respectful of the lab equipment. Once again the computer problems are a fact of life and it is important that the students learn how to address them when they occur. The last issue that needs to address is the lab reports. Some students thought the reports took too much of their time. The ability to write is an important skill to develop. This is a major way researchers communicate with each other. Once the student enters the job market the ability to write journal articles and technical reports will be an important skill. Writing lab reports is a way to improve their writing skills. The major goals of lab were to master the content and data analysis. Technical writing is an important secondary goal. However, using worksheets as one student suggested would eliminate the experience gained from writing. One of the students who dislike the lab reports admitted to fact this is college and writing reports is a part of college. Based on all the students' responses it does not seem that writing the reports were unreasonable since only three students mentioned it. However, it will be important to monitor this every semester to make sure students are not overwhelmed by the writing process. Regardless, lab reports play an important part of the research process and should not be overlooked.

Reflection on Developing Connections

There are different types of connections learners can develop, student-student, student-instructor, student-content, student-community etc. These different connections establish a support system for the learners. One way I tried to establish these various connections were by using concept tests. The idea of the concept is to focus on course concepts (not equations) and with a goal of allowing the students to explain the course concepts to each other (student-student connection). Below is my reflection on using concepts tests for dynamics course which I was the teaching assistant for. This reflection is based on the idea of teaching as research. I first discover an issue in teaching I wanted to address (equations vs. concepts), developed a hypothesis to address the issue (concept tests), collected and analyzed student data (grades and confidence), and developed conclusions based on the results.

Description: Dynamics (EMA 202) is a course in the College of Engineering at the University of Wisconsin-Madison. Many different departments (EP, BME, CEE, and ISE) in the College of Engineering require their students to take this course before getting accepted into their respective department. Dynamics is taught through a combination of lectures and discussion. There are three lectures taught by a professor and the discussions are run by teaching assistants. All the students in Dynamics attend the same lectures. However, the students choose one discussion section to attend once a week. The average size of discussion is about 20 students, and there are six sections. The students in the class are primarily sophomores, who have taken Statics (EMA 201) the previous semester. My goal for the students in my discussion sections was to gain content mastery of the subject. The majority of the students' grade was determined through exams and homework assignments.

Dynamics contains many key concepts that are described in terms of mathematical equations. It has been shown that many students are able to solve these mathematical equations; however, these students do not understand what these equations mean[1]. For my Delta Internship, I attempted to address this issue. Course material was used to focus the students' attention on the core concepts of dynamics. To achieve this goal, concept tests were employed. The concept tests were the same as the ones used in some introductory Physics[2] courses. This was deemed appropriate since many of the concepts taught in dynamics are taught in physics. The concept tests will involve little or no calculations in order to focus on concepts.

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[1] Steif, P.S., 'Comparison Between Performance on a Concept Inventory and Solving Multifaceted Problems', ASEE/IEEE Frontiers in Education Conference, November 5-8, 2003, Boulder, CO, USA

[2] Mazur, E., *Peer Instruction: A User's Manual*, Prentice Hall, 1997.

Analysis: The particular approach of the concept test attempted to isolate dynamic concepts from the mathematical equations, and reinforced these concepts through repetition. This reinforcement came from taking the concept test individually, then justifying their answer to a partner, and finally sharing their answer with the class. The concept tests will focus on different learning styles. The concept test will have both a reflective and active components. The reflective component consists of the students working individually on the concept tests at the beginning of class. At the end of class, the students re-take the same concept again with a partner. The active component consists of the students sharing and justifying their responses with their partner. After the students finish working on the concept together, the final active component is the large group discussion when the student responses get surveyed and a student volunteer explains why they choose their response. Once the student finishes explaining their choice, I provide the class with the correct answer and justification. In between taking the concept tests, I worked on examples problems on the board that used the concepts addressed in the concept test.

The weekly concept test had mixed results over the semester. The two items monitored were the student's correct answer and the student's confidence in their answer. From figure 1 one can see the best and worse case results from the concept tests. The results from week 7 show the best case results. In this particular example the number of students answering the question correctly increased after discussion. Also, after discussion the students' confidence in their answer increased too. However, the results from week 15 show the one of the worse case scenarios. After discussion, the vast majority of students still choose the incorrect response. Coupled with the number of incorrect response after discussion, the students reported an increased in confidence in their answers.

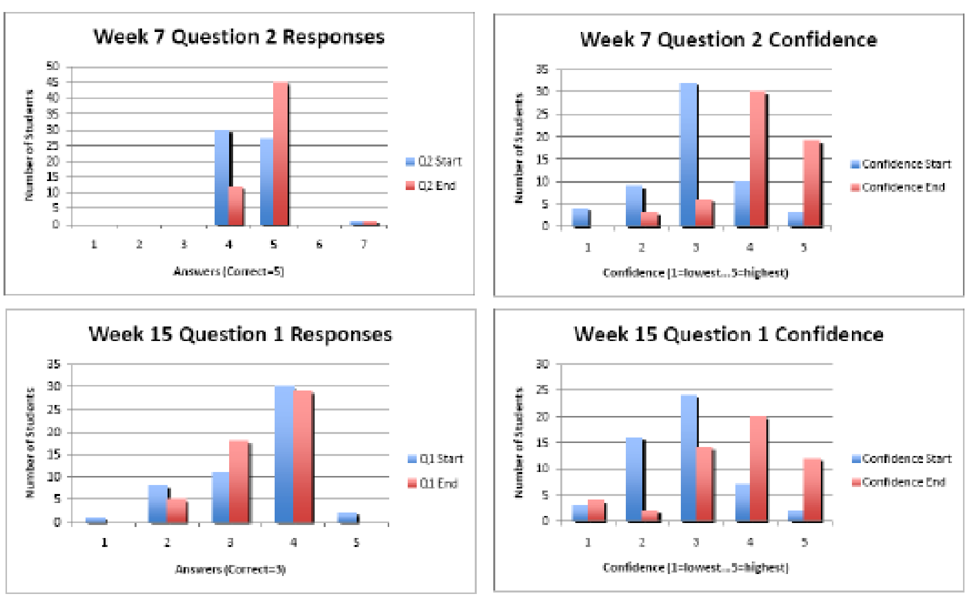


Figure 1 Examples of Students' Responses

The concept test had mixed results on final grades of the students. On the positive side, no student who took the concept tests failed the course. In addition, more students received BC and C grades compared to the students who did not take the concept test. On the negative side, the same number of students received grades of "A", "AB", and "B" regardless of taking the concept test.

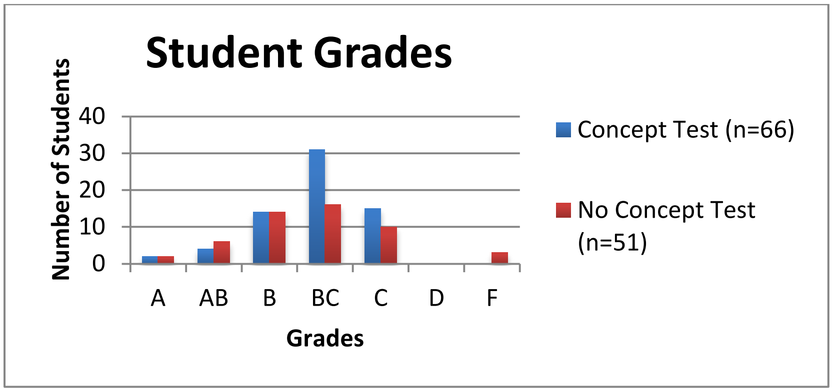


Figure 2 Student Grade Comparisons

At the end to the semester, students completed an online survey titled "Student Assessment of Learning Gains" (SALG). The survey was emailed to the students. The students were asked which class activities were most helpful to their learning on a scale from 1 (no help) to 5 (great help). Taking the concept test at the beginning of discussion had a mean value of 2.6(n=44, std dev=1.09). Justifying their concept answers to partner at the end of discussion had a mean value of 2.8(n=44, std dev=1.16). Going over the concept test with the teaching assistant at the end of class had a mean value of 3.3(n=44, std dev=1.28). The students thought the most effective activity in class was having the teaching assistant work out problems on the board, while asking for student input on the problem. This activity had a mean value of 4.2 (n=43, std dev=1.07). Overall, the concept tests had mixed reactions from the students.

One major challenge with concept tests was student involvement. Students need to share and justify their results to their peers and whole class. Some students were eager to pair up and have lively discussions about the concept tests. Other students needed encouragement to pair up. These students would quickly finish their discussion with their partner. Students were hesitant to share their answers and reasons with the whole class. Another problem was time management. Finding the right amount of time for taking and discussing the concept test was difficult. Some student groups quickly finished the concept test and other groups spent more time doing these activities.

Conclusions: Overall, the dynamics concept test had mixed results. The goal of the concept tests was to focus the student's attention on the concepts on dynamics and not the equations. The way to accomplish this is through a reflective component (student taking the test by themselves) and an active component (students discussing their choices with a partner). Another goal of the concept test was to get the students working together and generate discussion on dynamics concepts. Student feedback on concept test was also mixed. Some students had a positive attitude towards the concept tests and one wanted more concept tests. However, there were still some who had a negative attitude towards the concept test. A way to improve these concept tests is to make them on-line assignments. This would free up class time. The last way to improve the concept tests is to have the concept test questions on the exams. This has the possibility of showing the students the importance of the concepts and this would help buy into the concept test questions.

Reflection on Practice

Teaching and learning are items that must be practice in order to thrive. I do not believe anyone is born a good teacher or learner, but this comes from practicing and reflection. From practicing you can start to figure out your areas of strength and weakness. For students this practice can come in the form of reading, homework, projects, etc. For instructors, this practice comes from teaching in the classroom or attending workshops. However, one must obtain data on their teaching to reflect on. Two possible ways of obtaining data is through student evaluations {artifacts 3 and 5} or by peer evaluations {artifact 6}. These evaluations help foster learning communities. The informal student evaluation demonstrates to the students that the instructor is concern about the students learning, since the university does not require it. Also, it is important that the instructor communicates the results of these informal evaluations to show they were not done as feel good exercise for the instructor. It shows the instructor is making effort to grow and change to meet the needs of the student or provide justification for how the class is run. Peer reviews provide a support community. It is a chance for more experienced instructors to assist new instructors by providing constructive criticism in order to improve. Below is an example of how I reflected on my peer review evaluation in order to improve my future teaching.

Description: The University of Wisconsin-Rock County is a public two year university. Since it is only a two year university the student population is composed of freshmen and sophomores. The university also has a high number of returning adults. As a first semester associate instructor for Physics 201 (general physics), a professor from another UW-college is required to observe a class period. The observation visited occurs mid-semester during the first semester as an academic instructor. The professor gives the instructor notice of their upcoming visit in order to ensure that the observation does not occur during an exam or review session. After the visit the professor wrote their observations into a report. This report then was given to the dean of the University of Wisconsin-Rock County, the Department Chair of the Computer Science, Physics and Engineering, and me. As an academic instructor for UW-Rock County my responsibility was lab sections for general physics. The professor observed the Young's Modulus experiment.

Analysis: Professor Obi Otu is a professor of physics at University of Wisconsin- Waukesha. He has performed multiple observation visits during his tenure. He does not have any involvement with the physics program at UW-Rock County. Before the observation Professor Obi Out never had any contact with me other than emails to set-up the observation date. Therefore his observation report should be unbiased. As a physics professor he has knowledge of the material being taught and can comment on how I am presenting the material. From his observation report {artifact 6}, he thought I had a good rapport with the students in the class. He pointed out that all the students in the class seemed very comfortable asking me questions when they were struggling with an aspect of the lab. In addition, as physics professor he reported that he was pleased with the quality of my responses to their questions. Another positive aspect of my observation report was my movement. He reported that he like the fact that I walking around to every group and checked on their progress. This movement made the students more comfortable asking me questions. Overall, the observation report portrayed my teaching in a positive light. However, this observation report was based on only one laboratory period. Another important aspect was not addressed in the report was the quality of the students results. He could not conclude if the students obtained reasonable results for the Young's Modulus. Another important observation is even though he does not know the quality of their results he believes the students were comfortable in analyzing the data after the whole class discussion on the lab.

Conclusions: Having impartial observer come to a lab was a very beneficial experience. The observer allows me to see the classroom experience with a different set of eyes. This observation report gave me the opportunity to compare what I observed going on in the classroom to what some else saw. What makes the observation report so useful was the fact the observer had teaching experience and this experience was in physics. So his comments can really shed light on helping me improve the classroom experience.

One of the goals of mine is to have an open classroom. I want the students to feel comfortable asking me questions. Based on the observation report and my personal experience in the lab, it seems that I have accomplished this goal. The students were comfortable working with each other and me. It seems that a way to create this open classroom is to move around to the different students. I think this is an effective method because it gives the individual attention to the students. As a student I preferred to ask my instructors questions after class because I did not want to ask my question during class. Going around to the different groups allows them the chance to ask questions which they might think are "dumb" questions which they do not want their peers to hear.

Artifact {1} Lab: Energy in Gasoline

Goal: To analyze some easily obtained data to determine the efficiency of your car. For the experiment, the efficiency is defined as:

ε = (energy going into moving your car) ÷ (energy available in a gallon of gas)

General procedure:

1) You will need to determine the force acting on your automobile when operating at highway speeds. By knowing the mass of the car and measuring the acceleration due to the net external force, we can use Newton's second law to determine the force. Some additional calculations will be required to determine energies and work.

   Procedure to determine the acceleration is as follows.

   At all times, the driver should realize that <u>**SAFETY**</u> is absolutely critical. All measurements should be made by the passenger while the driver watches the road and/or other traffic. Be aware of all legal restrictions and any other traffic headed in all directions.

   If you don't feel comfortable driving, then partner with someone so you can be the passenger and data recorder.

   A) Find a section of flat level and straight section of highway.
   B) Obtain a constant and legally allowed speed.
   C) Take your foot completely off the accelerator while your lab partner times how long it takes to slow down approximately 10 mph. <u>Do not put the car in neutral</u>. If you have questions, please ask before heading out to take data.
   D) Repeat this 5 or 6 times taking data in both directions to account for any slight hill and/or wind that may be present. You should average over your data when performing your final calculations.

2) You will also need to determine or research the following information.
   A) The amount of energy in a gallon of gas
   B) The number of miles per gallon your car achieves.
   C) The mass of you car.

3) Internal combustion engines are incredibly inefficient in converting the chemical energy in the gasoline into kinetic energy required to move your car. You should find that your car's efficiency is about 10% - 20%. About 10% of the energy from the gas is required to operate the car and goes into the various pumps, fans, radio, power steering, etc. The

large majority (~70%) of the energy is lost due to friction and heat from the radiator and/or through your tailpipe in the form of hot gases.

Questions:

1) Imagine if an auto repair shop could increase the efficiency of your engine so that it became three percent more energy was converted into moving the car. (ε =18% instead of ε=15% for example). With this added efficiency, how many miles per gallon would your car achieve? Determine the percentage increase in your mpg that comes from a 3% increase in engine efficiency.

2) If the current price of gas is $3.50 per gallon, determine the cost of one Joule of energy. How much energy could you get for a penny?

3) A mid-sized car (A Grand-Am @ 3500 lbs and 32 mpg), a full sized car (like a Buick La Saber @ 4500 lbs and 30 mpg), and a pickup truck (like a F-150 @ 5000 lbs and 18 mpg) are all about 18% efficient in converting the energy in gas into motion of the car. Why do they have such different mpgs?

Write-up:

As always, you need to prove to me that you understand how to use your measurements to complete the analysis throughout the experiment. It should be obvious how and why you included the equations that you used. Simply writing the equations and plugging in the numbers is unacceptable. You need to include statements/sentences so your audience can follow your analysis.

You should also include a Free Body Diagram (FBD) and a very short procedure section to explain what you have done.

You are being given more than enough time to complete this task and finish your report today. If you choose to leave early, that's your decision but the time to ask questions is now. Don't expect me to be receptive of questions if you skip out of lab early today and expect me to answer any questions next week.

Artifact {2} Lab Report Grade sheet

Name ____________________

Experiment ___________________

Procedure: **____/3**

Did you include figures, a brief description, and/or detailed description when required?

Data: **____/3**

Is you data neatly organized in a table, sketch and/or graph? Did you include units with your measurements? Is the data labeled so it's apparent what it represents?

Analysis: **____/4**

Is it easy to follow or are you jumping around on a page? Can it be understood by a reader who didn't do the lab? Did you include comments about what you're calculating? Did you remember units?

Comments: **____/2**

Did the results match what you expected? Did you calculate percent differences as requested? What improvements would you make to this experiment?

Questions: **____/3**

Are your answers in complete sentences? Does your answer make it apparent what the question was?

TOTAL **____/15**

Artifact {3} Student Lab Comments

Things I like about lab:

1) I like that we are given more than enough time to complete the labs and that we are given until the next lab to hand in our reports.
2) The material is well taught and easy to understand
3) I like the labs, they keep me interested and are never similar to one another
4) The labs are fun and interesting
5) Putting equations w/actual gathered data
6) I like how we've been able to leave early so far and I like the clear statements of the lab procedure
7) I like the projects we've done so far. They're interesting and applicable
8) I enjoy the varying differences each lab is. We go from recording video to driving cars, and I enjoy that
9) I enjoy the work that caries from week to week
10) Lab procedures are clear and understandable
11) I like working in groups of 3
12) Instructions are clear and lab makes sense
13) I like the fact that Physics lab involved experiments involving real life situations, that you can relate to out of class
14) I like the flexible timing – I can have when I need to but still get stuff done
15) I like that the labs go quickly, can get done what needed and still get out is a reasonable amount of time, which is nice if one has to work afterwards
16) We perform interesting activities, such as today's lab. Finding how inefficient our cars are.
17) Using the different computer programs
18) I like working on problems and not listening to a lecture
19) One thing I like about this lab sections is we do some real life experiments that allow us to stay interested and involved.

Things I don't like about lab

1) Nothing
2) Change to use a different computer lab
3) I dislike the procedure part of the lab write ups
4) Everything seems fine

5) Better instructions that I understand and aren't at grad school terminology
6) I really wish we could leave earlier but I also understand that we can't learn/experience very mush without dedicated time to lab
7) I don't see anything that requires changing at this time.
8) I would say that a brief intro on the computer programs would ease the lab process
9) I do not like my stupid computer its DERP !
10) Larsef groups *(sorry, Tom, I can't read the first word ☺)*
11) I don't like answering the same question over and over. Working in groups of 3 would be nice.
12) Groups of 3
13) I dislike that well…. Really nothing, its all interesting
14) I would like to see more example work with the equations we are supposed to use
15) I would like to see more/better examples of some calculations that are needed for the lab so a person is sure they're doing what is expected
16) Sometimes the lab reports take many hours to complete. I dislike this but I'm aware its college so it won't change
17) Printing is a problem, not all computers are hooked up to the printers.
18) I like it as it is
19) One think I would change is have labs done during lab with lab notebooks and worksheets

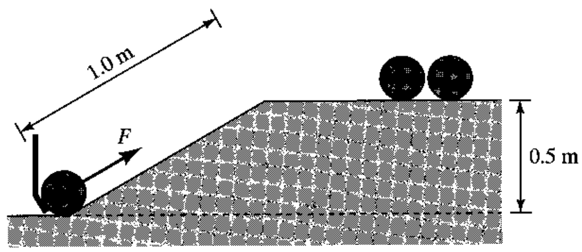
Other thoughts:

1) I like Physics labs much better than chemistry
2) I enjoy this lab course
3) Overall, it's a very effective lab and gets what needs to be done, done
4) Less time between class and lab
5) Good !
6) Why do some mountains look like presidents?
7) Good lab lessons
8) A&W is awesome
9) Overall, I think the labs help learning material
10) A little more direction in labs could help make understanding less complicated
11) I like the fact that the labs tell you what must be done, usually step by step.
12) I enjoy taking this class. So far, it's been one of my favorites
13) I like the lab instructions, they are easy to follow.

Artifact {4} Example Concept Test Question[3]

1.

At the bowling alley, the ball-feeder mechanism must exert a force to push the bowling balls up a 1.0-m long ramp. The ramp leads the balls to a chute 0.5 m above the base of the ramp. Approximately how much force must be exerted on a 5.0-kg bowling ball?



1. 200 N
2. 50 N
3. 25 N
4. 5.0 N
5. impossible to determine

Start of Class Answer:

Rank Your Confidence in Your Answer (1=lowest…5=highest)

1 2 3 4 5

End of Class Answer:

Rank Your Confidence in Your Answer (1=lowest…5=highest)

1 2 3 4 5

[3] Mazur, E., *Peer Instruction: A User's Manual*, Prentice Hall, 1997.

Artifact {5} SALG Questions and Results

Number	Question	N	Mean	Std dev
	The Class Overall			
1	HOW MUCH did the following aspects of the class HELP YOUR LEARNING?			
1.1	The instructional approach taken in this class	44	3.5	1.00
1.2	How the class topics, activities, reading and assignments fit together	44	3.7	0.91
1.3	The pace of the class	44	3.1	0.87
1.4	Please comment on how the INSTRUCTIONAL APPROACH to this class helped your learning.	28		
1.5	How has this class CHANGED THE WAYS YOU LEARN/STUDY?	25		
	Class Activities	**N**	**Mean**	**Std dev**
2	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?			
2.1	Attending lectures	44	3.9	1.10
2.2	Attending discussion sections	44	4.0	1.10
2.3	Specific Discussion Activities			
2.3.1	Taking the concept test at the beginning of discussion	44	2.6	1.09
2.3.2	Justifying your concept test answer to a partner at the end of class	44	2.8	1.16
2.3.3	Going over the concept test with the teaching assistant at the end of class	44	3.3	1.28
2.3.4	Working on the handout problems with a partner	44	3.6	0.95

2.3.5	Having the teaching assistant work out a problem on the board, while asking the class for input	43	4.2	1.07

	Assignments, graded activities and tests	**N**	**Mean**	**Std dev**
3	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?			
3.1	Graded assignments (overall) in this class	44	3.6	0.92
3.2	Opportunities for in-class review (given by the instructor or TA)	41	3.7	1.15
3.3	The number and spacing of tests	44	3.4	0.92
3.4	The fit between class content and tests	44	2.9	0.95
3.5	The mental stretch required by tests	43	2.6	0.93
3.6	The way the grading system helped me understand what I needed to work on	44	2.8	1.11
3.7	The feedback on my work received after tests or assignments	44	2.6	1.19

	Class Resources	**N**	**Mean**	**Std dev**
4	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?			
4.1	The primary textbook	44	3.8	1.03
4.2	Visual resources used in class (i.e. PowerPoint, slides, models, demonstrations)	43	3.3	0.97

	The information you were given			
5	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?	**N**	**Mean**	**Std dev**
5.1	Explanation of how the class activities, reading and assignments related to each other	43	3.2	1.05
5.2	Explanation given by instructor of how to learn or study the materials	44	3.0	1.13
5.3	Explanation of why the class focused on the topics presented	43	3.0	1.05
5.4	Please comment on HOW the INFORMATION YOU RECEIVED about the class helped your learning.	21		
	Support for you as an individual learner	**N**	**Mean**	**Std dev**
6	HOW MUCH did each of the following aspects of the class HELP YOUR LEARNING?			
6.1	Interacting with the instructor during class	38	2.9	1.02
6.2	Interacting with the instructor during office hours	16	3.4	1.20
6.3	Working with teaching assistants during class	38	3.5	1.08
6.4	Working with teaching assistants outside of class	21	3.4	1.29
6.5	Working with peers during class	44	3.4	1.04
6.6	Working with peers outside of class	38	3.9	0.84

	Your understanding of class content	N	Mean	Std dev
7	As a result of your work in this class, what GAINS DID YOU MAKE in your UNDERSTANDING of each of the following?			
7.1	The main concepts explored in this class	44	3.8	0.87
7.2	The relationships between the main concepts	44	3.7	0.86
7.3	The following concepts that have been explored in this class			
7.3.1	Kinetics of a particle - force and acceleration	44	3.9	0.99
7.3.2	Kinetics of a particle - work and energy	44	3.7	0.93
7.3.3	Kinetics of a particle - impulse and momentum	44	3.4	1.01
7.3.4	Planar kinetics of a rigid body - force and acceleration	44	3.6	0.84
7.3.5	Planar kinetics of a rigid body - work and energy	44	3.6	0.81
7.3.6	Planar kinetics of a rigid body - impulse and momentum	44	3.3	0.98
7.3.7	Kinematics of particles	44	3.6	0.92
7.3.8	Planar kinematics of a rigid body - force and acceleration	44	3.6	0.90
7.4	How ideas from this class relate to ideas encountered in other classes within this subject area	44	3.3	1.00
7.5	How ideas from this class relate to ideas encountered in classes outside of this subject area	44	3.1	1.01
7.6	How studying this subject area helps people address real world issues	44	3.1	0.97

	Increases in your skills	N	Mean	Std dev
8	As a result of your work in this class, what GAINS DID YOU MAKE in the following SKILLS?			
8.1	Working effectively with others	44	3.2	0.99

	Class impact on your attitudes	N	Mean	Std dev
9	As a result of your work in this class, what GAINS DID YOU MAKE in the following?			
9.1	Enthusiasm for the subject	44	2.6	1.08

Number	Question	N	Mean	Std dev
9.2	Interest in discussing the subject area with friends or family	44	2.5	1.15
9.3	Interest in taking or planning to take additional classes in this subject	44	2.6	1.37
9.4	Confidence that you understand the material	44	3.1	1.05
9.5	Confidence that you can do this subject area	44	2.9	1.13
9.6	Your comfort level in working with complex ideas	44	3.2	0.99
9.7	Willingness to seek help from others (teacher, peers, TA) when working on academic problems	44	3.2	1.14

Integration of your learning

		N	Mean	Std dev
10	As a result of your work in this class, what GAINS DID YOU MAKE in INTEGRATING the following?			
10.1	Connecting key class ideas with other knowledge	44	3.0	0.81
10.2	Applying what I learned in this class in other situations	44	2.9	1.00
10.3	Using systematic reasoning in my approach to problems	44	3.3	0.88
10.4	Using a critical approach to analyzing data and arguments in my daily life	44	3.2	0.94
10.5	What will you CARRY WITH YOU into other classes or other aspects of your life?	23		

Artifact {6} Class Visit Observation

Class Visitation Report: Thomas Carstens - Physics 201 Lab. Nov. 16, 2009.

The class started a little bit earlier than 2:30 pm. I got there by 2:20 pm and Tom had already given the students the lab hand outs, discussed how to do the lab, and put the students in groups of four. They were five groups in all. The experiment was to determine Young's Modulus.

Tom showed the students how to read a micrometer screw gauge they were to use to make some measurements. They used the micrometer screw gauge to measure the radius of the wire used for the Young's experiment. He moved around to make sure every group did the right thing. The experiment was quite involved especially when the students had to adjust the mirror to align the laser beam so that the reflected beam was horizontal. Tom kept moving around to make sure that every group was doing the right thing. Some students asked questions that he answered very well. The groups were done taking data within the first one hour. Tom expected them to derive the equation to use to plot the graph and determine the slope from which Young's modulus can be calculated. After about thirty minutes, Tom went to the board to explain how to obtain the equation using simple geometry and the laws of reflection. The students were more comfortable at this point to use their data to plot the graph and use it to obtain the value of Young's modulus. I do not know if the students got reasonable relative errors given that the experiment is quite difficult to perform.

Tom had a great rapport with the student. They did not hesitate to ask for help when they needed it. I liked the fact that Tom was frequently moving around and thereby readily making himself available and approachable. He is doing a great job.

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Copy to: Bill Bultman, Chair, CSEPA, UW-Fox Valley
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Tom Carstens, UW-Rock