Stories of Course and Curriculum Transformation

Faculty panel Provost's Seminar on Teaching October 5, 2016

Cindee Giffen

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Introduction to Ecology & Evolutionary Biology (Bio 171)

- ~600 students/semester
- Freshmen & sophomores
- Interested in bioscience majors
- One of two lecture & discussion-based courses in our majors introductory sequence
- Course redesign in Winter/Fall 2014



Motivation

- Too much content
- New instructional team with interest in best practices from literature
- Gender gap
- Desire to help all students do better & learn more



Outcomes

- Benefits of frequent quizzing & homework sets
- Better alignment
- More challenging exams with better scores
- Fewer adverse outcomes (D, E)
- TBD: Retention? Gender gap?



John Carson, Associate Professor and Director of Undergraduate Studies

History 202

Developing a New Course in a New Curriculum

Rachel Goldman, Professor of Materials Science & Engineering

MSE 250: Principles Engin Matls



http://hennig.mse.ufl.edu/wp-content/uploads/sites/30/2014/09/Materials-Science-Tetrahedron-for-2D-Materials.png
The University of Michigan
M-Write II
8

| aterials Scie | nce Curr | iculum |
|--|--|--|
| Survey Course | Basics | <u>Methodologies</u> |
| SE 250 (Principles Engineering Materials) or MSE 220 (Materials & Manufacturing) | MSE 350 (Structure of Materials) + MSE 242 (Modern Physics for MSE) | MSE 330 (Thermo-dynamics) MSE335 (Kinetics) MSE 420 (Mechanical Properties) MSE 400 (Electronic Materials) |
| | Aterials Scie Survey Course SE 250 (Principles Engineering Materials) or MSE 220 (Materials & Manufacturing) | aterials Science CurrSurvey CourseBasicsSE 250 (PrinciplesMSE 350EngineeringMSE 350Materials)(Structure of Materials)orMSE 242 (ModernMSE 220Physics for MSE)Manufacturing)MSE) |



Motivation: Increase participation of under-represented groups in STEM

Chemistry 130 SSG Enrollment by Gender





Women over-represented in Writing-to-Learn Study Groups => apply to other STEM courses! The University of Michigan______ M-Write II

Writing-to-Learn Assignments

- **Short informal assignments (<150 words)** will focus on topics presented through the readings and lectures (10 points each, ~2/week)
- **Longer assignments (350-500 words)** will focus on foundational topics of the course. For the longer assignments, you will submit multiple drafts of your work, as well as participate in peer review of the work of others (20 points each submission/revision + 20 points peer review, 3-4 total)

Developing Students' Thinking by Writing

https://tomprof.stanford.edu/posting/1472

Write to Find out What We Are Thinking and to Learn

https://tomprof.stanford.edu/posting/1486



"Exploratory Writing"

- What was the most interesting/important thing that you learned this week?
- What are the most interesting and/or challenging aspects of the upcoming chapter(s)?
- What questions do you have? What concept(s) are you still confused about?
- Relate a concept from this weeks reading to something in our everyday lives.
- Which topics on the exam did you understand well?
- How do the concepts we are covering this week relate to topics covered in your other courses?



Writing-to-Learn: Phase Diagrams



Objective:

You have been hired as a consultant for GM to determine why a Lead-Tin solder failed. This solder was chosen because it has a eutectic point at the low temperature of 183 °C. However, when GM uses the solder they find that they do not achieve total melting even at a temperature of 200 °C. Upon analyzing the solder, you determine that the wt% Sn is 50%. Using discipline specific terminology and referencing the above phase diagram, write a memo explaining to one of their CEOs why the solder didn't melt at the expected temperature. In your discussion use the lever rule to give the percent α and percent L phase of the solder at 200 °C and what temperature the solder would need to be heated to for it to melt completely.

•When we read your memo, we will play the role a CEO with minimal scientific background who is trying to understand the science behind why the solder failed.

•Describe the names of the important points, lines, and phases that are denoted in the phase diagram.

•Detail how you used the lever rule to determine the percent phase fractions of the solder.

•Include a discussion about how microstructure of the solder will affect the performance of the solder.

•External references are not required, but if they are used they should be cited using MLA format.

•Since you are trying to persuade the CEO of your credibility as a consultant, you should take care to carefully edit and proofread your memo.

•This should be a memo of between 350-500 words.



The University of Michigan M-Write II

Outcomes of Writing-to-Learn

Exploratory Writings

"I like the exploratory writing and writing to learn sets, they are like extra practice on how to use the material learned in class and apply to real-life designs."

"These exercises are really nice for giving reliable feedback about what students are having trouble with/ what they understand well. They seem to be more a diagnostic tool than a teaching tool but you need both and they worked great."

"Easy to complete and agree with what they strive to accomplish (reflection, looking forward on material)."

Writing-To-Learn

"These exercises were extremely useful at making long term memories of the learned material, as well as gaining an appreciation for it's understanding. They were also a refreshing change of pace from many of the quantitative problems...I think the peer review was equally useful, just seeing how another person tackled the problem, phrased it, and organized their memo's was great."

"The writing to learn assignments were my favorite part of the class because it gave me the sense of applying knowledge from class to real-world situations...This was a fun task to do and receiving and writing peer reviews also greatly improved my quality of writing."

"The longer exploratory writing problems were interesting and helpful, and I'm sure will help me retain the content long-term."

"I believe that these should be instilled in other classes. Writing for Engineers is not something required very often so it's nice to be asked to periodically. Writing about a concept for 300-500 words requires you to gain a good hold on the material."



The University of Michigan

Brenda Gunderson



Stats 250 Info

via Academic Reporting Tools

| ART 2.0 | About | Contact |
|---------|----------|------------------------------|
| STAT | S 250 |) |
| Introdu | ction to | Statistics and Data Analysis |

- Covers descriptive statistics to hypothesis testing
- Primarily Sophomores
- Psych, Econ, Business, PolySci

| Freshman | 13% |
|-----------|-----|
| Sophomore | 45% |
| Junior | 28% |
| Senior | 11% |
| Other | 1% |

| Psychology BA | 22% |
|--------------------------------|-----|
| Neuroscience BS | 13% |
| Biopsych, Cognit & Neurosci BS | 12% |
| Economics BA | 11% |
| Business Administration BBA | 10% |
| Political Science BA | 10% |
| International Studies BA | 8% |
| English BA | 5% |
| Communication BA | 4% |
| Environment BS | 4% |

Stats 250 Info

- LARGE
 ~ 1800-2000+ students
- Weekly:
 3 hours of lecture,
 1.5 hour computer lab
- Coordinated

 across 6 lectures
 of 150 to 400 students,
 ~60+ GSI led computer labs
 (of 30-35 students).

ART 2.0 About Contact
STATS 250
Introduction to Statistics and Data Analysis

Enrollment

When is it offered and how many people take it?





Welcome! This site serves random problems from past exams given in courses at the University of Michigan.



Please select your class:



Study Tool that randomly serves up past exam questions for selected topics

Currently serves 8 STEM courses across 5 departments

Began 2011 ~ Stats 250 joined 2013



Pick your Topics

Stats 250 Problem Roulette

| S | elections | Problems | My Summary | Problem Library | Student Performance | Expo | ort Problem Stats | | |
|-------------|--|--|--|---|---|--------------------------------|-------------------|-------------------------------|-----|
| S | elected Top | pics/Remainin | g Problems: 10. A | NOVA: Analysis of Va | riance: 25 / 25 11. Regress | ion: 46 | / 46 | | |
| | 3 | This problem | is in topic: 11. F | Regression | | | | | |
| | ◎ A Submit | ● B ● C | © D Skip | | | | Re | ceive past | |
| 4 | | | | | | | eva | m auastia | n |
| : | Stats 250 | Final Exam | W12 Problem 6 | ε | | | Сла | iii questio | •• |
| s s p | est scores tudents at core from erformed a | and GPA – / her small col their records. a full regressio | A college adminis lege. She took a She first examir on analysis and s | trator wished to det random sample of ned the scatterplot t ome of the output fr | ermine if standardized te 30 such students and rec o see that a general linea om R is given below. | st scor orded r relation | from | those top | ics |
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| | Signif. Residual Multiple F-statis | codes: 0 ' standard e R-squared: tic: 10.729 | ***' 0.001 '* error: 0.444 of 0.277,) on 1 and 28 (| *' 0.01 '*' 0.05 n 28 degrees of Adjusted R-sq DF, p-value: 0. | '.' 0.1 ' ' 1 freedom uared: 0.266 003 | | | | |
| T | he adminis o test the h | strator wantee _{Ny} potheses H | to test if there is $_{0:}^{\beta} {}_{1} = 0 _{H_{a:}}$ | s a significant <i>positi</i> $\beta_1 > 0_1$ | ve linear relationship betv | veen A | ACT scores and GF | PA. In other words, she wants | |
| V | Vhat is the | test statistic | and correspondir | ng p-value at the 5% | level. | | | | |
| A E C D | t = 2. t = 2. t = 2. t = 3. t = 3. t = 3. | 718; p-value = 718; p-value = 275; p-value = 275; p-value = | = 0.011 = 0.0065 = 0.003 = 0.0015 | | | | | | |

Stats 250 Problem Roulette



Stats 250 Problem Roulette

| bkg's Summary | | | | | | |
|--|---------------------------------------|------------|------------------------|--------|---------|----|
| Filter by Course: Statistics 250 • | Filter by Topic (must select course): | All Topics | | | • | |
| You have attempted 36 problems and you go Your accuracy is 55.6%. Your average time per problem is 23.7 secon Show: All | ot 20 right. nds. | | | Your | Correct | |
| Name • | Topic | ٠ | Date | Answer | Answer | \$ |
| Stats 250 Final Exam W12 Problem 6E | 11. Regression | | 2015-12-06 19:56:52 | D | D | |
| Stats 250 Exam 1 W13 Problem 7A | 4. Random Variables | | 2015-10-06 | В | A | |

Nice Summary Tab

Filter for list of those missed so can review and productively struggle with them more and bring these to office hours

PR Generates Lots of Interesting Data: Stats 250 PR Usage F15



Many other analyses conducted and ongoing...

- * 0.1–0.3 final grade point boost for regular users
- * reduced gender bias (relative to final grade)
- * A-students: 1-day earlier, ~50% more problems than non-A

PR Generates Lots of Interesting Data

Overachievers did ~25% more problems than underachievers



Stats 250 PR: How did we get started?

| LSA INSTRUCTIONAL SUPPORT SERVICES | | Search Q All News Workshops and Events People | Stats Joined ECoach | | | |
|--|---|---|---|---------------|--|--|
| for Resources Support and Services * SUPPORT AND SERVICES FUNDING AND G SUPPORT AND SERVICES | Classroom Information Equipment Loan & Reservation M RANTS Funding and Grants Learning Technologies and Consulting Group is available to explore of | Iedia Center MClassrooms Database | $\rightarrow \text{Heard about PR} \\ \rightarrow \text{Level 1 Fac Grant}$ | | | |
| BlueCorps Classroom Support Digitization | technology projects, including assistance in identifying and applying for open to all instructional staff in the College of Literature, Science and Arbor. Some of the grant opportunities include: | Statistics Problem Roulette | | | | |
| Funding and Grants Learning Technologies and Consulting | Faculty Project Grants Level One grants of up to \$5,000 are available to individual faculty mu effort to use instructional technologies in teaching undergraduate cou | | | | | |
| Lecture Capture Media Productions Special Events Support Videoconferencing | Level Two grants of up to \$15,000 are available to faculty to carry out undergraduate curricular developments that take advantage of new in New Initiatives/New Infrastructure (NINI Grants) Over the past five years, an average of five proposals have been funde \$45,000 per proposal. NINI grant proposals should seek to improve te innovative use of information technology. | Faculty Developer: Brenda Gunderson Position: Senior Lecturer | Grant Level: Telepho Level I 734-763- Department: Statistics | one: -3519 | | |
| | Technology grants can be used to fund: • Hourly wages for graduate media assistants | Target Course: Statistics 250 Target Course Description and History: | | | | |

Personnel Support Needed:

Support for Graduate student in Statistics to be trained on the program, to create/convert content, enter the content (questions and solutions and images), test the system, analyze data resulting from the use of the system.

Support for the Physics Problem Roulette Consultant Michael Mills <mcmills@umich.edu>

Stats 250 E²Coach PR advice from past student

A story: A good addition



Using Problem Roulette for Exam 1

First, I went over concepts from lecture that were confusing or reviewed multiple times in lecture. I watched a few videos, went through the coursepack, and looked over some problems again.

Second, I did **all the problem roulette problems without any notes**. This was the first time I was doing problems without relying on the notes, which allowed me to really assess how well I knew the concepts.

Next, I did one of the two practice exams (also without my notes), after I had done every problem in Problem Roulette that I could do, I went to GSI office hours to talk about any of my weaknesses — whether that was

a problem roulette problem that I just couldn't get or an overall topic that I needed more help with.

Last, I took the second practice exam. At that point I just looked over HW problems and confirm that I was comfortable with everything.

~ Former student, Fall 2015

Back-up Slides



The University of Michigan_ M-Write II



The University of Michigan M-Write II

MSE 220 & 250: 2010-2015

MSE 220: Materials & Manufacturing



IOE 33% ChemE 24% NERS, MSE 5% IOE 4% EE, AERO, CSE 2% The University of Michigan M-Write II

MSE 250: Principles of Engineering Materials



 BME 49%

 ChemE 18%
 MSE 13%

 IOE 5%
 NERS 4%

 EE, AERO 3%
 ME 1%