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Improving Statistical Understanding: Using Writing in the Statistics Classroom

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I do not sit down at my desk to put into verse something that is already clear in my mind. If it were clear in my mind, I should have no incentive or need to write about it....We do not write in order to be understood; we write in order to understand.
Cecil Day-Lewis, Poet Laureate of Great Britain (and father of actor Daniel Day-Lewis)

I. Brief Introduction to Writing Across the Curriculum (WAC)

- cross-curricular educational movement dating to the 1970s in the U.S. and U.K.
- classroom and pedagogical orientation; highly idiosyncratic
- greatly influenced by research of James Britton, et. al.
- generally includes writing-to-learn *and* learning-to-write; multiple, short writing assignments; focus on writing as a process, with multiple drafts and revision; peer review; collaborative learning; active learning
- research that is highly contextualized, with mixed methodologies
- movement now toward CAC (communication across the curriculum), to include technology, speech, visual, graphics
- empirical evidence of student success in acquiring content knowledge

II. Critical thinking aspects to remember (Bean, 27-29)

- critical thinking is rooted in problems
- writing is both a *process* of doing critical thinking and a *product* communicating the results of critical thinking
- writing assignments should create cognitive dissonance for students
- writing assignments should present emerging knowledge as dialogic, not informational
- writing assignments should create opportunities for active problem solving that involve dialogue and writing

III. Advantages of problem-based assignments (Bean, 95-96)

- promote critical thinking
- deepen students' engagement with course content
- help students learn the discipline's discourse (methods of inquiry, analysis, and argumentation)

IV. Examples of problem-based writing assignments

1. Lee, Physics
2. Krawitz, Engineering
3. Jordan & Miller, Statistics (to follow)

V. Four dissertations' findings on writing in statistics classrooms

Buday (1998)	Davis (1996)
Hammett (1997)	Rojas (1992)

Designing Problem-Based Assignments to Promote Critical Thinking

adapted from Bean, John C., *Engaging Ideas: The Professor's Guide to Integrating Writing, Critical Thinking, and Active Learning in the Classroom*. (San Francisco: Jossey-Bass, 1996).

Formal Writing Assignments (Bean, 5)

"writing to communicate"

Britton's "transactional" writing

high stakes; graded

"polished" - revised & edited

audience: public, teacher, others

1- to 2-paragraph microthemes to
lengthy research papers

thesis-governed prose:

thesis-given (87)

problem-solution (88)

"generic" problem-thesis structure (89)

alternatives to thesis-governed prose:

formal exploratory essays (92)

reflection papers (93)

poem (94)

dialogue (94)

"math autobiography" (94)

role-playing exercise (95)

personal narratives (95)

Informal, Exploratory Writing (Bean, 6)

"writing to learn"

Britton's "expressive" writing

low stakes; usually ungraded

"rough" - unrevised & unedited

audience: personal, self, close peers

thinking-on-paper to discover,
develop, & clarify ideas

in-class writing:

probing a subject (105)

asking questions (105)

summing up (105)

journals:

open-ended (106)

semi-structured (107)

guided (107)

double-entry (108)

lab notebooks (109)

exam prep (109)

[for all 25, see 104-116]

A combination of formal and informal writing assignments is usually most helpful for students, who will need to be made aware of the differences between the two. Informal writing can be used as preparation for formal writing. Start your assignment design process with your course goals clearly in mind; create formal and informal assignments that reinforce overall course objectives.

Improving Statistical Understanding: Using Writing in the Classroom

Project Writing

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Meetings 2003

Outline

- Objectives
- Project Types
- Report Format
- Revision
- Statistical Language
- Grammar
- Conclusion
- References

Objectives of Project Writing

- Developing writing skills and techniques to express statistical concepts and results.
- Understanding of statistical concepts through writing.
- Gaining familiarity with “scientific” report format.

Project Types

- FULL
 - ◆ plan, collect data, analyze and interpret data, communicate results
 - ◆ semester long (checkpoints throughout)
- PARTIAL
 - ◆ available data
 - ☞ instructor-provided (all students use same data)
 - ☞ student-supplied (must be approved!)
 - ◆ analyze and interpret data, communicate results

Report Format

- Title and Abstract (summary)
- Introduction (background, objective, rationale)
- Methods (detailed description)
- Results (tables, figures)
- Discussion (interpretation)

Revision

- at least one preliminary draft
- drafts are graded, but no score recorded
- drafts receive LOTS of written comments
- if possible, discuss individually

Statistical Language

- **CONTEXT**
individual
variable
unit of measure
- **GENERAL VERSUS SPECIFIC**
General: not linked to the setting
Specific: linked to the setting

Example of context:

- The median is 200.
- The median is 200 pounds.
- The median weight is 200 pounds.
- The median weight of hockey players is 200 pounds.
- The median weight of 2002/2003 Gustavus men's varsity hockey players is 200 pounds.

Examples of general versus specific:

- The data are skewed.
VS The distribution of weights of 2002/2003 Gustavus men's varsity hockey players is skewed toward high values.
- A t-test was done.
VS The mean heart rates for the two exercise methods were compared using a two-sample t-test.
- The t-test is significant.
VS There is strong statistical evidence that the mean heart rate differs for the two exercise methods ($t=3.6$, $df=20$, $p=0.0018$).

Grammar and Style

- Tense: present or past?
(Past: methods, results)
- Voice: active or passive?
Encourage active, particularly in discussion.
- Person: first or third?
Encourage first person.

Conclusion

- Project writing is one tool for enhancing student understanding of statistical concepts.
- In project writing, students focus on expressing concepts specifically in context.
- Students are exposed to the “scientific” report format found in journals.

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- Spurrier, J.D., Edwards, D., and Thombs, L.A. (1995) *Elementary Statistics Laboratory Manual*, Duxbury: Pacific Grove, CA. (Appendix 1: Technical Report Writing and Appendix 2: Technical Report Writing Checklist)

Improving Statistical Understanding: Using Writing in the Statistics Classroom

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Jackie's Thoughts on Teaching Writing at Drury University

- Description of the Alpha Seminar
 - Challenges
 - Lack of training in teaching and grading writing (and in developing assignments)
 - Students' assumptions that they are already strong writers
 - Students turning in first drafts as final drafts
 - Even faced with the challenges, it was a positive and worthwhile experience
 - Connection to statistics
 - Interpretation is key in statistics
 - Writing about statistics helps students learn statistics
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Joy's Thoughts on Teaching Writing at Lawrence University

- Description of Freshman Studies
 - Creating Assignments
 - Revision
 - Students do not fully understand the revision process (see, for example, Bean, 2001, or Sommers, 1980)
 - Discuss frequently with students what revision is and what it isn't
 - Think carefully about the comments written on student papers (see, for example, Bean or Sommers, 1982)
 - Grading writing in the statistics classroom
 - Style and content are often intertwined (i.e., can't ignore style)
 - Statistics teachers are capable of teaching and grading writing
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Example Microtheme Writing Assignment for the Introductory Statistics Classroom

Suppose you receive the following letter from your dad:

Hey Kiddo,

I am worried about Grandma. Remember that she was diagnosed with high blood pressure? Well, she's currently taking the medication Makemewell to lower her blood pressure. At the time of Grandma's diagnosis, her doctor said that a randomized, double-blind experiment had been conducted and that Makemewell was shown more effective in lowering blood pressure than a placebo. To be honest, I have no idea what any of that means, but I believed and trusted the doctor. Now I've heard two stories that make me think differently. Larry, our next-door-neighbor, was taking Makemewell and he got a terrible fever that put him in the hospital. Also, my co-worker, Sally, actually had her blood pressure go up while she was taking Makemewell! I'm now very suspicious of this medication.

I know that you're taking a statistics course at college. Based on the information I've given you, do you think Grandma should stop taking her medication? Whatever your opinion, will you please explain yourself thoroughly and clearly? (I will draw on your responses when I talk with the doctor.) And please don't use any statistics mumbo-jumbo that I won't understand. I really appreciate your help with this.

Love, Dad

Your assignment is to type a 1-2 page letter (single-spaced, 12-pt. font) responding to your dad.

Grading Rubric (Given to the students with the assignment)

Grading Criteria (25 points possible)

_____ The explanation to your dad convinces me (your teacher) that you understand the following: what a randomized, double-blind experiment is; what anecdotal evidence is; and which of these data collection methods is appropriate for decision making. (10 points)

_____ The explanation to your dad is thorough, well organized, and clear. (5 points)

_____ The explanation to your dad is presented in non-technical terms that he will understand. (5 points)

_____ You successfully paid attention to accepted conventions of language use (syntax, spelling, grammar, readability, etc.) (5 points)

“RAFT” heuristic

R role

Student/offspring explaining a statistical concept he/she is currently studying

A audience

Student's father, who isn't sure about the doctor's prescription for Grandma's high blood pressure

F format

Informal letter

T task/theme/topic

Explain the following in a way a layperson can understand: 1) what a randomized, double-blind experiment is; 2) what anecdotal evidence is; and 3) which of these data collection methods is appropriate for decision making

Classroom Research – Preliminary Plans

- Research questions
 - Do writing assignments aid student understanding of statistical concepts?
 - If so, to what extent does this happen?
 - To what degree are students aware that writing in a statistics course helps them better understand concepts (and become better writers)?
 - Mixed methodology
 - Quantitative measures (e.g., quiz, followed by a writing assignment, followed by an exam)
 - Qualitative measures (e.g., minute papers, interviews)
 - Stay tuned!
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Suggestions of Where to Start

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Writing to learn (general)

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