A Model for Teaching Scientific Writing in an Undergraduate Curriculum

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Scientific Writing

Outline

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Scientific Writing
Background

• UWSP tries to hire teachers with “real life” agency experience, presumably to give students “real life” classroom experience.

• UWSP hired me at least partly for my mix of private sector, state agency, and federal agency experience.

• Therefore, I teach my senior-level courses using “real life” examples (illustrations) and “real life” exercises (no exams).
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Context
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Context - Professional

- AFS Certification Program:
  - Communications: 9 semester hours, of which 3 may be communication intensive courses:
    Courses whose primary subject matter is not communications, but which have intensive communications requirements and are officially designated as such by the university.
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Context - University

• UWSP General Degree Requirement:
  - Verbal Skills: 6 credits (English 101 + 102)
  - Writing Emphasis: 6 credits:

  Courses designed to provide instruction needed to develop skills for appropriate and successful writing within a discipline or profession.
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Context - Major

• Fisheries Major Degree Requirement:
  - Fisheries Sciences:
    • NRES 250 – Introduction to Fishery, Forestry and Wildlife Resources (4 cr.)
    • BIOL 374 – Ichthyology (4 cr.)
    • BIOL 375 – Fish Ecology (3 cr.)
    • WATR 353-354 – Wildlife & Fish Population Dynamics (4 cr.)
    • WATR 483 – Fishery Research (3 cr.) WE
    • WATR 484 – Fishery Management (3 cr.)
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Context - Course

- Water 483: Fishery Research; 3 credits = 2 lecture hours + 2 lab hours per week:
  - A scientific paper written in the format of the North American Journal of Fisheries Management (40% of total grade);
  - An oral presentation in the format of a meeting of the American Fisheries Society (30% of total grade); and
  - An oral defense of the research to mimic a thesis defense (10% of total grade).
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Context - Course Objective

- The course will introduce students to the scientific research process, including:
  - formulating a hypothesis,
  - designing and conducting a study,
  - writing a scientific paper,
  - giving an oral presentation, and
  - providing an oral defense of the project.
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Context - Course Objective

• The student will become familiar with
  - principles of what makes a hypothesis testable,
  - how to design a study to address the hypothesis,
  - how to organize and write a scientific paper,
  - how to plan, deliver, and defend a scientific presentation.
Scientific Writing
Premise
Scientific Writing
Premise

• Writing is not easy or natural for most of us, so must be learned and then practiced.
• Writing style must conform to a selected audience (all styles are not appropriate).
• Scientific writing is a particular form of writing aimed at a scientific audience.
• Scientific writing must focus on accuracy and precision, so “style” is unimportant.
Scientific Writing

Model
Scientific Writing
Model

• Introductory lectures.
• Laboratory discussion.
• Feedback on writing.
Scientific Writing Model

• Introductory lectures:
  - The research process (7 steps).
  - Writing a scientific paper (overview).
  - Presenting science to peers (examples).
  - Defending your work (thesis defense).

• Remaining lectures cover topics in *Fisheries Techniques* textbook.
Scientific Writing
Model

• Discussions (1\textsuperscript{st} half of lab periods).
  - Overall concepts of clarity and content.
  - Critique recent publications (examples).
  - Writing is rarely perfect.
  - We all make mistakes that cloud clarity.

• Labs (2\textsuperscript{nd} half of lab periods) cover exercises in fishery data analysis.
Scientific Writing
Example - Clarity

• *Do all parts of the manuscript build consistently from one to another?*

  Word choices ➔

  Sentence structure ➔

  Paragraph organization ➔

  Section organization ➔

  Manuscript order
Scientific Writing
Example - Word Choices

• Accuracy - Use definitive nouns, rather than ambiguous pronouns:
  - Pronouns form very weak openings to sentences.
  - Never begin a sentence or phrase with “it” or “there” (English 101).
    • “It” obscures the subject of the sentence.
    • “There” invariably results in an inverted sentence.
  - Avoid jargon (e.g. “aged” and “aging” do not mean what you intend!)
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Example - Sentence Structure

• **Order** - Hiding the subject at the end, not the beginning, of the sentence (inverted = *Yoda Speak!*).
  
  - **Bad** - There was no significant difference in growth of largemouth bass after imposition of the minimum length limit in West Blue Lake.
  
  - **Good** - Growth of largemouth bass did not change significantly after imposition of the minimum length limit in West Blue Lake.
Scientific Writing
Example - Content

- Title
- Abstract
- Introduction
- Methods
- Results
- Discussion
- Tables
- Figures
Scientific Writing
Example - Title

• The title is read by more individuals than any other part of the manuscript, so must be carefully crafted (short and sweet).

• Write the title first, and then review each word for precision and accuracy:
  - Does the title accurately reflect the focus and content of the paper?
  - Is the title stated precisely, preferably in 12 words or less?
Scientific Writing Example - Title

  - 109 Titles
    - 73 Articles
    - 36 Management Briefs
  - 29% of Titles ≤ 12 Words
    - 27% for Articles
    - 33% for Briefs
Scientific Writing
Example - Title

• Longest original title = 27 words:
  - A Bayesian Analysis of Biological Uncertainty for a Whole-Lake Fertilization Experiment for Sockeye Salmon in Chilko Lake, British Columbia, and Implications for the Benefit-Cost Ratio
Scientific Writing Example - Title

• Longest original title = 27 words:
  - A Bayesian Analysis of Biological Uncertainty for a Whole-Lake Fertilization Experiment for Sockeye Salmon in Chilko Lake, British Columbia, and Implications for the Benefit-Cost Ratio

• Revised title = 12 words:
  - Biological Uncertainty of Fertilization for Sockeye Salmon in Chilko Lake, British Columbia
Scientific Writing Model

• Feedback on writing:
  - Research project (summer experience).
  - Research objective (face-to-face, email).
  - Manuscript parts (one/week, free pass).
  - Manuscript critique (written, graded).
Scientific Writing
Conclusions
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Conclusions

• Time-consuming to teach because of time spent critiquing papers.
• Students mostly react favorably to the class (student evaluations).
• Many students later claim this course was their best course in college.