Professional development for undergraduate science students:

Teaching and assessing professional scientific writing

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Background About Seattle University

Seattle University

- a 4-year comprehensive university
- chemistry department offers BA & BS degrees

Writing in 1st year core

Lab reports in all laboratory courses

Occasional papers in upper-level courses

Professional style senior thesis
Our Central Issues: Problems with Senior Theses

What were problems with professional competencies?

- Non-professional style and/or format
- Inadequate background, theory, context
- Unclear statement of aim
- Unclear target audience
- Illogical presentation of data
- No persuasive, logical argument
- Not thinking like a chemist

Some possible reasons why...

- Students have not been trained to write in a professional style
- Students inadequately connect what they are doing with what they’re writing
- Students do not know how to process data
- Students do not know how to form or communicate logical arguments
Integrating Writing and Knowing

“WID developed as a response to the recognition that different disciplines are characterized by distinct ways of writing and knowing. Thus, a specialized conception of disciplinary knowledge is integrated with a specialized conception of writing.” --Michael Carter, CCC 58:3 / February 2007

• This made us realize that the distinct ways in which chemists write are linked to the distinct ways in which chemists think

• Our students are writing poorly, in part, because they are not thinking like chemists, and vice versa

• Our new goal: we want our graduates to write, to think, and to behave like professional chemists
How do other chemists elicit professional thinking & professional writing?

Articles fell into two categories:

- **learning to write**
- **writing to learn**

- based on our objectives we realized that neither of these would be sufficient
- we need to integrate ‘learning to write’ and ‘writing to learn’
Reflecting on Our Curriculum

**Things we are doing well:**
- 1\textsuperscript{st} year core prepares students for WID
- finishing with a senior thesis

**Things that need improvement:**
- our curriculum fails to meet students where they are at the end of 1\textsuperscript{st} year core
- the middle of our curriculum fails to build skills in writing and thinking

**Why is the middle of our curriculum flawed?**
- assigning writing is not the same as teaching writing (it is ineffective)
- assigning “lab reports” is actually destructive
What is Wrong with Lab Reports?

What “lab reports” do:
• teach non-professional writing habits that students must later unlearn (the “lab report” is a pseudo-academic genre)
• “lab report” implies a professor-student relationship
• therefore students think and write like students
• In summary, a lack of professional dispositions

What we want our assignments to do:
• to teach professional writing habits
• to imply a collegial relationship between writer and reader
• to reward students for thinking and writing like professionals

Conclusion:
• we want to integrate “scientific papers” into courses in the middle of our curriculum
• in order to do this, we need to reverse engineer our curriculum to teach students early how to write a scientific paper
Reverse Engineering our Curriculum

To write a professional quality thesis in their senior year...

...students need to practice writing scientific papers in their junior year.

A foundation for junior year writing practice is focused instruction in the sophomore year...

...after freshman core courses.

• Teaching students to write scientific papers is *integrated* into all sophomore courses, not relegated to a separate course
• Writing practice and instruction is *embedded* into subsequent (Jr. and Sr.) courses
Organic chemistry is:
- a year-long course
- taken by all chemistry sophomore students
- thus an ideal course for integrated writing instruction
Program Design

- We address each section of a scientific paper separately
  (Introduction, Experimental, Data/Results, Discussion, Conclusion, References)
- Matches writing assignments with course content

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- Students find experimental and references sections straightforward
- In many ways, the discussion is the most difficult section for students
- Only at the end do students have enough experience to write an introduction

- **Final writing assignments** are cumulative
- Revision is required for student learning
1. Student writing seems to improve dramatically over the course of the year of instruction.

2. Students display attitudes and behavior in the lab that are more professional…Why?
   - Moving from pseudo-academic to professional writing
   - Using investigative rather than “cookbook” experiments

Our Anecdotal Observations
The central questions we are exploring are:

1. To what extent does student writing improve from novice toward professional during the year of instruction?

2. To what extent are learning gains transferred to upper level writing assignments?

3. What impact does our writing program have on affecting the transformation of student behaviors from that of a subordinate student to a scholarly colleague?
Progress and Remaining Issues

• Question 1 - Writing Improvement:
  • Progress: We have developed **rubrics**
    – to indicate the basis for evaluation & assessment, and:
    – to provide clear guidance to students at the planning and writing stages
    – to enable practical self-assessment by students
    – to allow rapid evaluation by the instructor
  • Remaining Issues: What do we use as the baseline for this assessment?

• Question 2 - Transfer of Learning:
  • Progress: We have identified faculty interested in collaborating
  • Remaining Issues: How do we assess transfer to upper-level courses?

• Question 3 - New Dispositions:
  • Progress: We are beginning to think and articulate what professional dispositions look like.
  • Remaining Issues: How do we assess changes in disposition?
Acknowledgements

Collaborators in English
- Prof. John Bean
- Prof. Larry Nichols

Collaborators in Chemistry
- Prof. Jennifer Loertscher
- Prof. Ryan McLaughlin

Critical Feedback
- Prof. Brian Coppola - University of Michigan, Chemistry
- Prof. Therese Huston - Seattle University, Psychology
- Prof. David Green - Seattle University, International Studies

Funding and Support
- Teagle Foundation
- Carnegie Academy for the Scholarship of Teaching and Learning
- Seattle University Center for Excellence in Teaching and Learning
- Seattle University Office of the Provost
- Seattle University Office of the Dean of Science and Engineering