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Modification of a junior-level capstone course to incorporate scientific writing

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Modification of a junior-level capstone course to incorporate scientific writing

Bradley M. Wile
Ohio Northern University

- Comprehensive college in rural Ada, OH
Context and motivation

• Capstone sequence split into three courses

Chem 200
• Introduction to sub-disciplines
  • Research introduction
• SciFinder
• CVs
• Ethics & safety discussion

Chem 300
• Careers in chemistry
• Point of contact as students think about REUs, grad school, internships, employment…
• Grab bag

Winter Jr.

Chem 400
Senior seminar
• 40 minute presentation
• Faculty-mentored
• “Culminating work”

Winter Soph.

Spring Sr.

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Writing component

• Summary of papers reviewed
• Writing was of poor quality
  • Motivation, timing
• Writing Seminar
• Quarters to Semesters (2011)

Chem 400
• Senior seminar
  • 40 minute presentation
  • Faculty-mentored
  • “Culminating work”
Writing component

Chem 400
- Senior seminar
  - 40 minute presentation
  - Faculty-mentored
  - “Culminating work”

Chem 3001
- Writing!
- Careers in chemistry
- Point of contact as students think about REUs, grad school, internships, employment...

- Featured element of the course
- “Move this to Chem 300…”

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Initial iteration

• Write a review paper (10-20 pages) about a topic in chemistry and biochemistry of their choice
  • Semester-long project

• SWBAT:
  • critically evaluate and interpret primary scientific literature
  • extract and compile information from the primary scientific literature
  • write professionally about chemistry
Initial challenges

• Some students floundered, despite structure

• Range of opinions about the course

• Inherited no rubrics

• Large cohort on the horizon…
On the bright side

- Freedom! (not co-taught, multi-instructor)
- Faculty and students were generally supportive
- What could go wrong?
Objectives

- Goals articulated clearly (staged)
  - Structure should bring everyone along
- Leverage resources outside my office
- Less terrifying length
The goals for this assignment are:

1. To identify and investigate in depth an area of current chemical or biochemical research. The idea here is that you will choose one area to learn more about, and using one paper as a leading reference, explain the novelty and impact of the work/area. By focusing on one area, you will get a better sense for how research topics are related to the big questions asked within a sub-discipline, as well as what techniques and methods are used to address these problems.

2. To become acquainted with the resources available at or through the ONU library. Many students will assume that the only library resources they need to make use of are the online journals and SciFinder on the web. Off-campus access to e-journals, e-books, print serial collections, and librarian assistance in searching and refining for a research project are also important skills for Chemistry and Biochemistry students. You will become acquainted with these and make use of them in the course of writing this paper.

3. To prepare high quality graphics, tables, and chemical structures for a written document. When preparing a manuscript for publication, the authors are expected to generate and submit high quality figures that enhance the text. In this assignment, you will prepare figures or schemes with molecules rendered using ChemDraw and/or recreate figures and tables presented in the text. It is expected that graphics will be legible and appear professional, so as not to distract from the text itself.

4. To hone and improve scientific writing skills. Scientific writing is somewhat different than writing for a humanities course. We will reference the course text for a complete discussion of scientific writing (purpose, practice) and make use of these skills when preparing this paper. This will include making proper notes, identifying appropriate background material, and reviewing the work of your peers. To emphasize the importance of revising, you will be asked to submit an annotated bibliography, an outline, a rough draft, and a revision plan prior to submitting the final paper.

In previous writing courses (i.e., writing seminar), you have been asked to write papers on critical analysis of rhetoric. In these papers, you have likely broken down logic or arguments by other writers/filmmakers/artists, and described your response to choices made in the preparation of the original work. In this assignment, you will conduct a similar analysis on a piece of primary scientific literature. This might at first seem daunting, but the process will be broken into components. The final paper will be the culmination of your work throughout the semester. This paper will mimic the style of a group meeting literature presentation, where one article is presented to the group, with appropriate background information to provide context. Some of you may have experience with a group meeting presentation of this type - make sure you speak with Dr. Wile before you begin if this is the case. You will choose a full paper from the recent (last ten years) primary literature, prepare an annotated bibliography, outline the paper and your thoughts, write a rough draft of the paper, receive peer and faculty comments on your draft, prepare a short plan for revision, and revise this draft before submitting your final document.

Please consider the following points when writing your paper:

- Extended discussion about goals
- Ties to writing seminar
- Annotated bibliography
- Revision plan
- Guided reading

<table>
<thead>
<tr>
<th>Week # – starting:</th>
<th>Monday</th>
<th>Wednesday</th>
</tr>
</thead>
</table>
| 1 – Jan 16, 2017  | *Martin Luther King Jr. Day*  
Syllabus, structure of class  
Homework: Choose topics for final paper and discuss with peers/group  
Reading: Chapter 2 | *No class meeting*  
Due: Assignment 1 (CV) |
| 2 – Jan 23, 2017  | CV preparation and difference from a resume  
Beginning the research process (at the Library)  
Reading: Chapter 1 | *No class meeting*  
Due: Annotated Bibliography for final paper |
| 3 – Jan 30, 2017  | Conducting a job or graduate school search  
Reading: Chapter 13 | *No class meeting*  
Due: Assignment 1 (CV) |
| 4 – Feb 6, 2017   | MS vs. PhD, and research in the Academic Sector (Guest)  
Reading: Chapter 3 | *No class meeting*  
Due: Annotated Bibliography for final paper |
| 5 – Feb 13, 2017  | Guided discussion of a review paper  
Writing and developing a thesis  
Reading: Chapter 9 | *No class meeting* |
| 6 – Feb 20, 2017  | Open class meeting – Q & A about anything in the course/life/chemistry!  
Due: Outline of final paper | *No class meeting* |
| 7 – Feb 27, 2017  | Senior Capstone Seminar  
Due: Sign up for meeting times at Dr. Wile’s office | Senior Capstone Seminar  
Reading: Chapter 8  
Sign up for meeting times at Dr. Wile’s office |
| Mar 6, 2017       | *Spring Break* | *Spring Break* |
| 8 – Mar 13, 2017  | Individual meetings to discuss outlines (no class meeting) | Individual meetings to discuss outlines (no class meeting)  
Due: Summary of review article (Assignment 2) |
| 9 – Mar 20, 2017  | Senior Capstone Seminar | Senior Capstone Seminar |
| 10 – Mar 27, 2017 | Senior Capstone Seminar | Senior Capstone Seminar |
| 11 – Apr 3, 2017  | No class meeting (ACS Meeting)  
Reading: Chapter 14 | No class meeting (ACS Meeting)  
Due: Rough draft of final paper |
| 12 – Apr 10, 2017 | Group-led review paper discussion  
Objectives of peer review and revisions  
Due: Be prepared to participate! | Peer review of final paper rough drafts  
Reading: Chapter 4  
Due: Peer Review Spreadsheet |
| 13 – Apr 17, 2017 | *Easter Break* | Senior Capstone Seminar |
| 14 – Apr 24, 2017 | Senior Capstone Seminar  
Due: Revision plan | *No class meeting*  
Due: Assignments 3 & 4 |
| 15 – May 1, 2017  | *No class meeting*  
Due: Work on your final paper | Discussion of this semester’s seminars |
| 16 – May 8, 2017  | *Finals Week – Final paper due by 4:00 pm Monday, May 8*, 2017 | *Finals Week – Final paper due by 4:00 pm Monday, May 8*, 2017 |
Annotated bibliography

- Lead reference + two others
- ACS format for references

Choice of Topic/ Annotated Bibliography
Student has addressed the questions “Why this topic?” and “What is your interest?” ______ / 1
The lead paper has been selected; and ______ / 1
... is of appropriate quality (journal impact, etc.), length, and format (i.e. 1°) ______ / 1
References (lead and two supporting) are provided; and ______ / 1
... context/summary is provided for each ______ / 1

Comments:
Revision plan

- How does the student respond to peer review?
  - Select → prioritize → reflect

- Template provided

<table>
<thead>
<tr>
<th>Priority</th>
<th>Selected Comment</th>
<th>My Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Some discussion of key reactions could add some depth to the paper.</td>
<td>Look at the synthetic schemes again to decide which reactions are important in forming the indenoisoquinolines and should be explained in depth. (Maybe reactions for addition of nitro and hydroxyl groups).</td>
</tr>
<tr>
<td>2</td>
<td>Add more background about the importance of Topoisomerase I and relegation to relate this research to more people.</td>
<td>Talked about Topoisomerase I when discussing camptothecin and its mechanism of action. Could add another paragraph there to explain relegation (and its inhibition) more, though.</td>
</tr>
<tr>
<td>3</td>
<td>Usually R groups are labeled as superscripts rather than subscripts.</td>
<td>Oops, this is an easy fix. Go through and make sure all substituents are labeled as superscripts in discussion of important locations on compound.</td>
</tr>
<tr>
<td>4</td>
<td>There is a brief discussion of GI_{50}, but no values are ever shown.</td>
<td>Actual GI_{50} values were not given in the paper—presented relevant to camptothecin activity as (+), (++), (+++), (++++) Explain this better in the paper and maybe show criteria for each classification.</td>
</tr>
<tr>
<td>5</td>
<td>Expand on some your own thoughts. Expand points to answer “why is this relevant?” Organic chemists typically do not like synthetic schemes cut from a paper using the original paper’s numbering scheme. Plus, these schemes are blurry, and so the reagents are hard to see.</td>
<td>Create the synthetic schemes using ChemDraw to make them easier to see and eliminate the use of the paper’s synthetic schemes. Talk more in conclusion about the implications of this paper’s findings (future anticancer agents) to explain why these findings are so impactful for pharmaceutical development.</td>
</tr>
<tr>
<td><strong>Background and Scientific Rigor</strong></td>
<td><strong>Exemplary (3)</strong></td>
<td><strong>Strong (2)</strong></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Previous work by this group or in the chosen field is described, and is sufficiently comprehensive.</td>
<td>Some background is given, and leads the reader into the following paper. Some areas could be expanded or improved.</td>
<td>Little or no background material is presented. The reader is not given context for the discussion to follow.</td>
</tr>
<tr>
<td>The paper contains no notable scientific inaccuracies.</td>
<td>Some aspects of the discussion could be clarified, but the writing is generally clear and accurate.</td>
<td>The paper contains notable scientific inaccuracies. Statements are obscured by errors or misinterpretations of the data.</td>
</tr>
<tr>
<td>The scientific content is in depth, and details are presented where appropriate.</td>
<td>The paper addresses some aspects of the work but misses some important points. More depth would enhance the paper.</td>
<td>The scientific content is shallow or is not described in detail. The treatment of the paper comes off as superficial.</td>
</tr>
<tr>
<td>The references cited in the paper are from appropriate journals (at least 2 from ACS or other approved), and of high scientific merit. The papers all focus on a theme, as identified clearly in the paper.</td>
<td>An appropriate number of articles are referenced, though some links between the work could be stronger.</td>
<td>Not enough articles are cited, or the articles are of poor quality. The articles are not clearly related, or the link is not clearly described in the text.</td>
</tr>
<tr>
<td>The writing is clear and concise. Few to no errors in the text (typo or grammatical).</td>
<td>The writing is adequate, with only occasional typographical and grammatical errors.</td>
<td>The writing is unclear, and does not clearly communicate the student’s ideas.</td>
</tr>
<tr>
<td>The paper is between 5 and 10 pages (double spaced), not counting large figures, tables, or references.</td>
<td>The paper is one to two pages too long.</td>
<td>The paper is too short, or more than two pages too long.</td>
</tr>
<tr>
<td>References are formatted using ACS style</td>
<td>Reference format needs minor adjustment</td>
<td>References are missing or formatting is far from ACS format</td>
</tr>
<tr>
<td>Schemes and figures are of high quality and enhance the discussion. No instances in which the reader must interpret text without a scheme or figure.</td>
<td>Schemes and figures are present throughout the document. Quality could be higher (i.e. pixelated, poor rendering of structures), but those present enhance the text.</td>
<td>Schemes and figures are sparse or not helpful. Greater quantity and quality of figures would enhance the paper.</td>
</tr>
<tr>
<td>All required sections are present and sufficiently detailed.</td>
<td>All required sections are present, though some may be terse of in need of revision.</td>
<td>Some sections are missing or notably incomplete.</td>
</tr>
<tr>
<td>The paper has been thoroughly edited from the rough draft, following the student’s revision plan.</td>
<td>The paper shows signs of editing and revision, though some errors remain, or comments could be addressed.</td>
<td>The paper has been poorly edited, or not edited sufficiently.</td>
</tr>
<tr>
<td>A clear, concise conclusion is made at the end of the paper. The student draws meaningful conclusions.</td>
<td>A conclusion is present, but may be too verbose or too superficial.</td>
<td>Conclusion in not present, or demonstrates little understanding of the importance of the cited work.</td>
</tr>
</tbody>
</table>
Assessment data

Avergae Faculty Evaluation

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Conclusions and progress

• Anecdotally - much improved from previous course

• Challenges in dealing with data from non-normed group of faculty/students

Chem 400
• Senior seminar
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Chem 3001
• Writing!
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Remaining questions

• Two year delay between first year writing seminar and this course

• How do we fairly assess student writing in all degree programs? (BS vs. BA)

• What are the student attitudes about writing?

• Five years in - can I “stick the dismount?”
Acknowledgements

- Trilisa Perrine (Chemistry)
- Students in Chem 3001 Spring 2013 - present
- Kathleen Baril (Director, Heterick Memorial Library)
- Justine Neiderhiser (Director, ONU Writing Center)
- Ohio Northern University Getty College of Arts & Sciences