Replacing the Traditional Graduate Chemistry Literature Seminar with a Chemical Information Literacy Course

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The Graduate Literature Seminar

Department seminars are a common requirement of PhD graduate chemistry programs [1]. Hard for students! Requires mastery of many skills:

- Organized
- Data Interpretation
- Clear Hypotheses
- Subject Knowledge
- Chemical Information
- Alternative Hypotheses
- Engaging Delivery
- Communication
- Critical Analysis
- Appropriate pace
- Visual Aids
- Outlooks

Chemical Information Community Very Active Teaching Skills...

Librarians and Chemists have long history of teaching graduate students chemical information, critical analysis, communication and other skills needed for successful seminars [1]. Two major challenges:

Navigating and retrieving Chemical Literature

Evaluating and Communicating Chemical Literature

“Chemical Research Literacy” [2]

Many great examples of teaching these skills in literature, a few examples:


Chemistry Literature Seminar required for all second year graduate students:

1. 30 minute public seminar, 10 page research paper on chemistry topic outside of study area.

2. Paired with a Literature Seminar Advisor for support and advice. No other formal instruction provided. **Largely an independent exercise.**

3. Results? Large variability. Major issue was presenting a survey of the literature, a “book report”, instead of a thoughtful original critical analysis of the topic.

Time to Revamp our Literature Seminar Program

Worked very closely with Chemistry Graduate Director, Stephen Woski, and Graduate Committee to develop:

**CH584 – Literature and Communication in Graduate Chemistry**

16 week course, 3 credit *required* class, Vincent Scalfani (myself as primary instructor), Stephen Woski or Patrick Frantom (co-instructor).

Formal instruction and guidance on 10 page paper, 20 minute seminar.

**Topics**

(1) Chemical information resources, (2) evaluation/critical analysis of the literature, (3) scientific writing, (4) scientific presentations, and (5) peer-review.

N.B. Course focuses on evaluating and communicating chemical information

**Introduction**
Expectations, course overview, tentative schedule.
Discussion of good past student seminars.

**Grading**
40 % research paper, 40 % seminar, 20 % participation.
*RUBRICS given out first day, no surprises!*

**Research Library**
Overview of modern libraries, organization of information, access at UA Libraries

**Chemical Information**
We cover the major resources: SciFinder, Reaxys, Web of Science and our LibGuide.

http://guides.lib.ua.edu/CHEM

We spend a lot of time discussing the Scientific Method (multiple hypotheses, disproof, and Ockham’s Razor). **Students need to understand how science works in order to evaluate science!** Main discussion readings:


Weeks 2–3: Critical Analysis of the Literature

We critically analyze 4 papers together as a class. 2 good, 2 bad... See: Epstein, M. S., Using Bad Science To Teach Good Chemistry. *J. Chem. Educ.* **1998**, **75** (11), 1399.


1. Locate and write down the author’s main hypothesis
2. Find and write down the main evidence in support of the hypothesis
3. List all alternative hypotheses (from authors and you)
4. List what additional experiments or controls are needed/missing
5. Write down what conclusions can be made from steps 1–4
6. List any other comments/questions you have

Critical analysis lectures were adapted from Prof. Rick Finke C793 Lectures at Colorado State University
Weeks 4–5: Student Critical Analysis Lightning Talks

Research Advisors select a primary article for their students to focus on for the remainder of course (research paper and seminar).

Each student must critically read the article applying previous 6 step reading method. Then present a 5 minute lightning talk on:

1. The main hypothesis
2. The main evidence
3. Alternative hypotheses and conclusions.

My favorite activity because it shows students what they don’t understand about their topic during week 4, not week 16!

Weeks 6–7: Scientific Writing

Major Topics

Plagiarism, research paper structure, cover letters, typography, scientific writing principles and guidelines.

Approach

Introduce a writing concept such as using precise/simple words, placing old information before new, subject-verb agreement, etc.

Then in-class time to work through the excellent practice exercises in Hofmann text and/or student’s personal scientific writing.

#### Major Topics

Classic “Do’s and Don’ts” [1]

Seminar organization, content, style, **software skills** (chemical structures, formatting slides, drawing simple cartoons, editing figures) and seminar delivery.

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**Main Hypothesis:**

The origin of negative thermal expansion (NTE) in $M^{II}Pt^{IV}(CN)_6$ Prussian blue analogues is a result of the vibrational flexibility in the $M^{II}$–NC linkage.

Weeks 9–15: Peer-Review

Peer-Review of Research Papers and Presentations

We make good use of the detailed rubrics and create guided peer review questions.

Each student receives peer-review on research paper, seminar slides, and a practice seminar from students and instructors. Two-rounds!

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<thead>
<tr>
<th>Critical Analysis of Data</th>
<th>Exemplary (4)</th>
<th>Competent (3)</th>
<th>Developing (2)</th>
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<tbody>
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<td>□ Main hypotheses are clearly interpreted and well communicated.</td>
<td>□ Main hypotheses are partially interpreted and are somewhat unclear.</td>
<td>□ Main hypotheses are not interpreted and not well communicated.</td>
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<tr>
<td>□ Main data is accurately interpreted and well communicated.</td>
<td>□ Main data is partially interpreted with satisfactory communication.</td>
<td>□ Main data is not interpreted and not communicated clearly.</td>
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Week 16: Presentations and Evaluation

Official Literature Seminars

One day, 15–20 minute talks grouped by chemistry area (e.g. Inorganic). All chemistry faculty invited. Fun day with lunch. :)

Grading

For seminars, all faculty participate (using rubrics and comment sheets). Student’s participate too, their scores are averaged as one faculty member.

Final research papers are graded by instructors and selected chemistry faculty.
Results

Positive response from students and faculty. Students in CH584 produced higher quality research papers and oral seminars compared to students prior to 2013 with no course. Faculty support, class will continue!

Feedback to Improve CH584

Faculty: (1) increase seminar introductory material; (2) create divisional student practice groups for outside of class peer-review.

Students: (1) Enjoyed critical analysis lectures but critical analysis/scientific method readings were too challenging (heavy on philosophy)**; (2) more peer-review from chemistry faculty on research papers.

Conclusions and Outlooks

• At the University of Alabama, we successfully replaced our chemistry graduate literature seminar with a full semester course (CH584: Literature and Communication in Graduate Chemistry) covering chemical information, evaluation/critical analysis of the literature, scientific writing, scientific presentations, and peer-review.

• Course was well-received over past 2 years. Have some specific changes to add in this year such as emphasizing more seminar introductory material and using different critical analysis/scientific method readings.

• Course content has now expanded into Chemical & Biological Engineering. We are piloting a similar course this fall for the Chemical Engineers (CHE 591: Research Methods).

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