Global/Diversity Learning in Chemistry: Measuring Students' Awareness, Engagement, and Transformation

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Abstract

The structure of problems in organic chemistry can seem alien to both the material covered in prerequisite courses and to the practical world. In the Global/Diversity Learning (GDL) section of Introductory Organic Chemistry, STEM students use library research to link the course to current chemical issues of global concern, such as climate change or the disposal of electronic waste. Scaffolding assignments require that students consult several different kinds of publications—such as scientific, financial, or governmental publications—and so support students' own discovery of various groups that suffer or benefit from the status quo. Reflective writing on a student's research process is assessed—not graded—using quantitative rubrics that measure growth in understanding of global issues in science. The rubrics also target each student's sense of what communities would gain or lose from a proposed response to chemical issues. Survey data demonstrated that the scaffolded procedure for research and writing both raised the quality of students' work and introduced them to previously unfamiliar resources and approaches to real-world applications of science.

A Research Paper for Global/Diversity Learning

In completing an array of scaffolding assignments that allows frequent feedback, students use diverse resources to analyze a chemical issue of environmental sustainability or global citizenship from the perspectives of multiple communities:

1. Cite a general-interest article to choose a GDL topic
2. Cite at least two more articles from, e.g., the science- and business-oriented press to identify several affected communities
3. Optionally cite an additional challenging source (e.g., book, annual report, peer-reviewed scientific literature)
4. Actively read all sources and organize an outline that links the topic to the course and gives each community's viewpoint
5. Electronically submit a complete rough draft that considers each viewpoint and advocates a policy response or compromise
6. Participate in a writing workshop on revision
7. Revise and submit a final draft in light of readers' comments
8. Optionally publicly post for collaborative discussion

Through GDL, students deepen their sense that even major issues that seem to affect everyone affect different groups differently.

Reflections and Metacognition

Students also completed two exercises in reflective writing: one after selecting a topic, and one after submitting the final draft. The reflective prompts were designed to stimulate metacognitive thinking, and students' responses captured changes in their knowledge, attitudes, and research process. The rubrics measured:

- General awareness of various local or global communities
- Sympathetic statement of and engagement with the various or conflicting viewpoints
- Metacognitive transformation in research strategies

Example Rubric: Awareness

Identify at least three different communities (local or global) affected by the issue. Be appropriately specific.

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<tr>
<th>Pre-reflection</th>
<th>Post-reflection</th>
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<td>5 points</td>
<td>9 points</td>
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Example Rubric: Engagement

For each community you identified, speculate on the consensus viewpoint towards the issue. What policy or action might members advocate?

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<td>4 points</td>
<td>8 points</td>
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Sample Reflections

Student A: Pre-reflection

The African Community is the most affected because of the lack of health care. Their view of this situation might be the world is not doing enough.

Student A: Post-reflection

My strategies for research has truly changed [as] I have never done a paper in this manner before. I found that doing a detailed outline help greatly with organizing my thoughts and information. It also open door to me using different resources at the library for the first time . . . It also help me to extract useful information from my sources compared to just writing.

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<tr>
<th>Pre-reflection</th>
<th>Post-reflection</th>
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Student B: Pre-reflection

[Po]llution is something I have issues has with having lived as a child in a community where oil companies exploited irresponsibly.

Student B: Post-reflection

My strategies for research changed immensely . . . Prior to this paper, I used to go through a hard time putting my paper together.

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Selected Topics and Assessment Results

A Ebola: +38 pts
B Pollution in Africa: +45 pts
C Microbiome and multiple sclerosis: +38 pts
D Global warming in India: +16 pts
E Alternative Energy: -3 pts
F Global warming: -22 pts
G NYC Waste Management: -71 pts

Conclusion and Future Work

- Students gather sources better than they use them.
- Effective revision remains a challenge.
- The GDL average course grade was lower (B-) than typical (B+).
- To assess GDL, reflections are necessary but not sufficient.
- Asking one reflective question at a time elicits fewer hasty responses.
- GDL can foster students' self-image as informative communicators.

Acknowledgments

Thanks to Meghmala Tarafdar and Jane E. Hindman of the Center for Excellence in Teaching and Learning for their guidance in implementing GDL.

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