Supporting conceptual learning and disciplinary thinking in chemistry through peer review and revision

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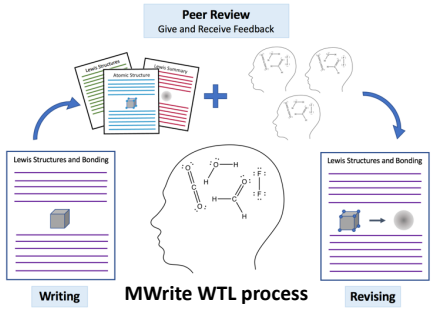
Introduction

Writing-to-Learn

- Writing-to-Learn (WTL) can support conceptual learning and critical thinking in STEM[1]
- MWrite works with faculty to develop and implement WTL assignments in introductory STEM courses[2]
  - Context and audience to situate the content about which students are writing
  - Peer review and revision to support learning through revisiting knowledge

Peer review and revision

- Feedback is a powerful tool for supporting student learning, especially when students are actively engaged with the process and are provided opportunities to use the feedback they receive[3-5]
- Peer review and revision are ways to involve students in the feedback process and support use of feedback[5]



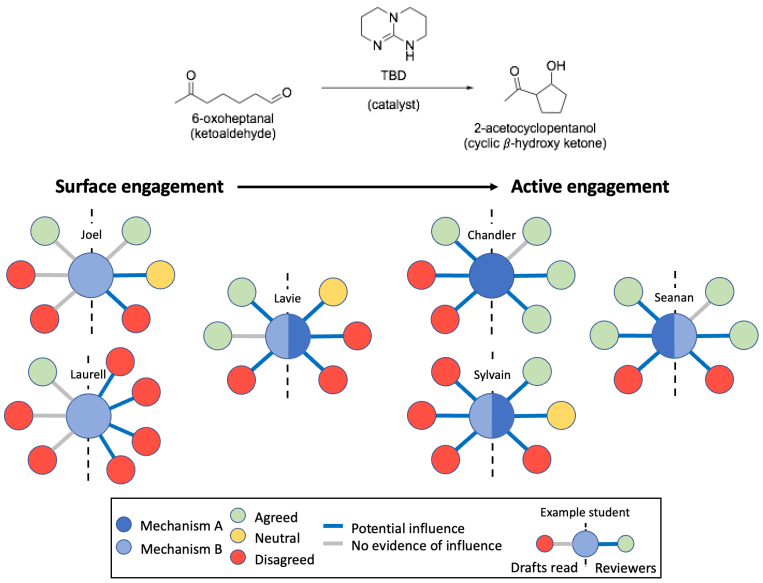
Research Objectives:

1. Expand the research base on how peer review and revision can support students' development of conceptual knowledge and disciplinary thinking, with an emphasis on the role it plays in WTL in chemistry
2. Implement and assess interventions within chemistry courses to support student engagement with peer review and revision processes in alignment with the learning objectives of WTL

Case study of student revisions from peer interactions[6]

Background and methodology:

- Analyzed student artifacts from a WTL assignment in an organic chemistry II lab
  - Students described two reaction mechanisms
  - Selected which would be more likely to occur
- Selected six students based on the peer interactions and mechanism choice



Findings

Students engage with peer review and revision to different extents, ranging from primarily providing positive peer feedback to providing constructive feedback and making substantive, content-focused revisions.

When revising, students can draw information from the drafts they read. However, they appear to do this more readily for lower order features of reasoning.

As instructors we can consider how to support students better engage with all elements of the peer review process, thus enhancing its benefits.

Role of assignment design and peer review on student revisions[7]

Background and methodology:

- Analyzed student artifacts from two versions of a WTL assignment in an organic chemistry II lab
  - Students proposed an analog to thalidomide and described its reactivity
- Examined responses from 632 students using machine learning and statistical analyses

Linear regression analysis of the influence of peer review on revision

Dependent variable		Revised draft – charges coeff. (st. err.)	Revised draft – implicit properties coeff. (st. err.)
Independent variables	Prompt	-0.0985 (0.165)	-0.1458 (0.133)
	Initial draft - charges	0.7579 (0.028) ***	-0.0036 (0.022)
	Peer feedback - charges	0.0991 (0.099)	-0.0540 (0.079)
	Drafts read - charges	0.3827 (0.110) **	0.0900 (0.088)
	Initial draft – implicit properties	-0.0218 (0.037)	0.7806 (0.029) ***
	Peer feedback - implicit properties	-0.0023 (0.089)	-0.0461 (0.071)
	Drafts read - implicit properties	-0.1294 (0.108)	-0.0005 (0.087)
	Intercept	1.3770 (0.305) ***	0.7923 (0.245) **
	R-squared	0.585	0.576

*p < 0.05, **p < 0.01, ***p ≤ 0.001

References and Acknowledgements

1) Gere et al, *Written Communication*, **2019**, 36(1), 99-135.
2) Finkenstaedt-Quinn et al, *Journal of Chemical Education*, **2021**, 98(5), 1548-155.
3) Boud & Molloy, *Assessment & Evaluation in Higher Education*, **2013**, 38(6), 698-712.
4) Hattie, & Timperley, *Review of Educational Research*, **2007**, 77(1), 81-112.
5) Topping, *Theory Into Practice*, **2009**, 48(1), 20-27.
6) Finkenstaedt-Quinn et al, *Assessing Writing*, **2024**, 59, 100808
7) Watts et al, *Chemistry Education Research and Practice*, **2024**, Advance Article.

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