Assessment of Green Chemistry Knowledge in the Organic Chemistry Classroom

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Why Green Chemistry Education?

- ✓ Prepares for real world decision making
- ✓ Bridges the gap between academia and industry
- ✓ The ability to identify different factors of sustainability and their relationships

Methods

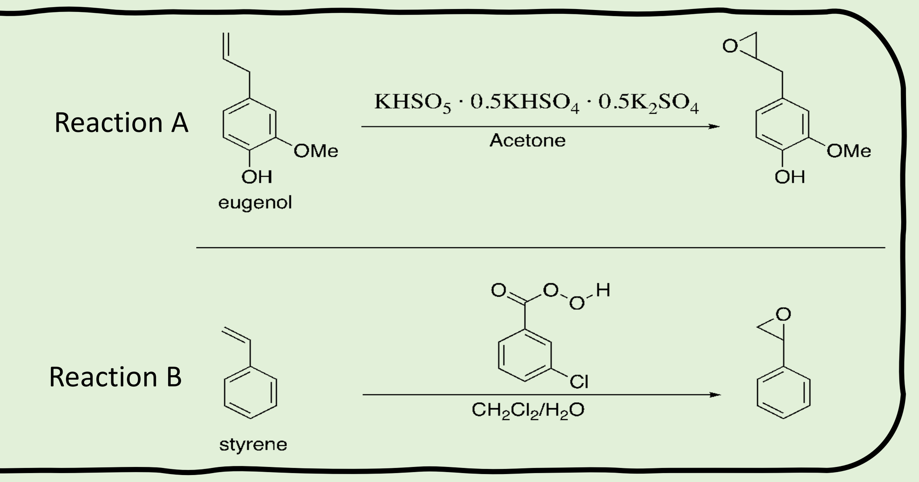
- Organic Chemistry 2 course
- 24 question true/false online survey (n=85)
  - Classical Test Theory
  - Rasch Analysis
  - Item person Map

Q. 22 “Halogenated molecules are structural features that promote facile biodegradation.” F

Q. 23 “Monitoring the progress of a reaction by analytical methods is used to measure the yield.” F

- Bonus Open Ended Exam Question (n=66)
  - Online assignment
  - Thematic Coding

Using your understanding of the Green Chemistry Principles, which of the following processes of making epoxides is more “green” and why? Explain your reasoning by listing relevant and distinct statements. Use complete sentences. Feel free to read additional sources but answer in your own words. **(+1 point for each correct, relevant, and distinct statement)**



Research Question

- How well can students apply their understanding of the 12 green chemistry principles to answer different types of assessment questions?

Acknowledgements

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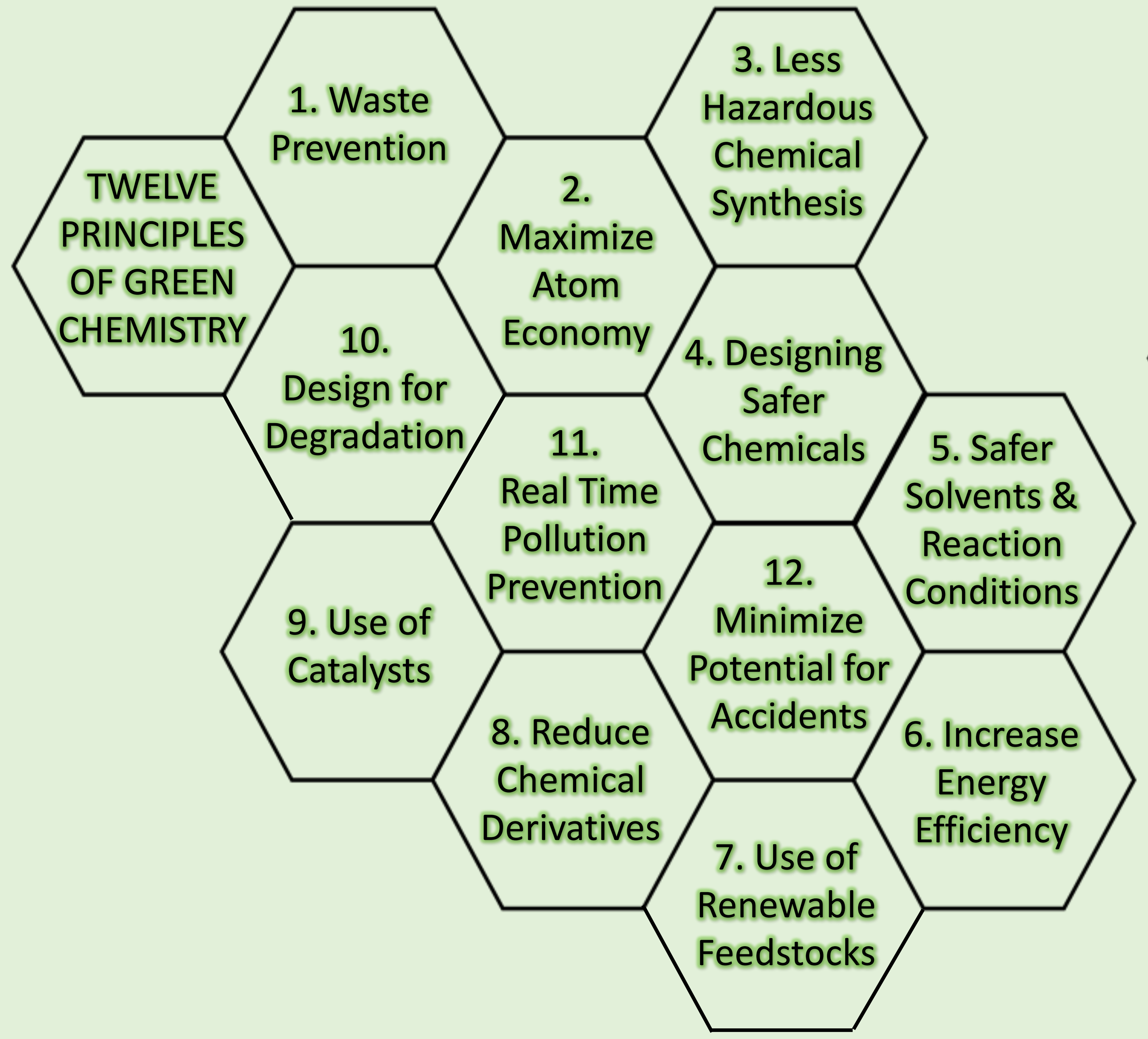
GOALS



Explore **student reasoning** and **explanations** of the 12 principles of green chemistry elicited from an **open-ended question.**

Refine the true/false assessment to better suit **student vocabulary** and language use.

TRUE/FALSE ASSESSMENT RESULTS

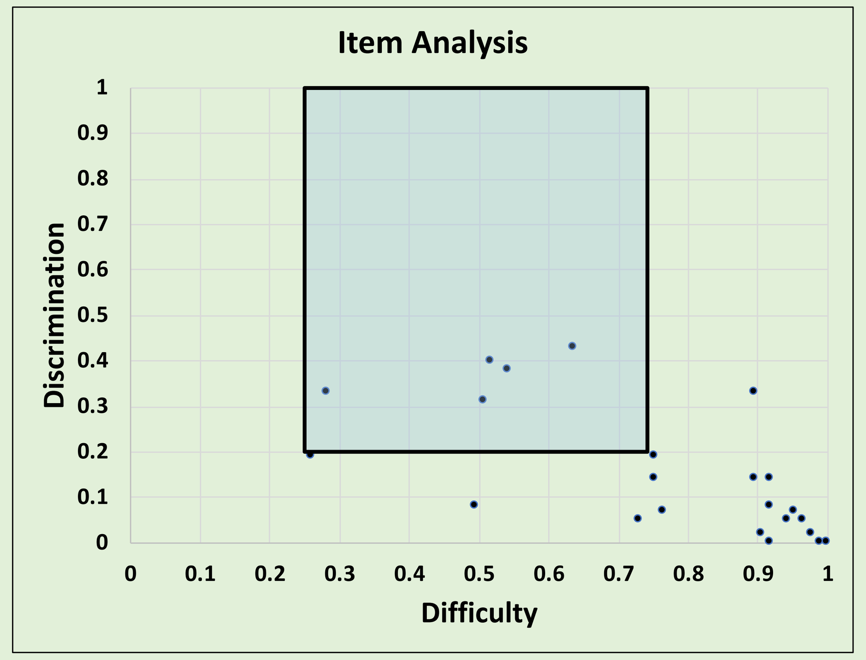


Fig 1. Item analysis of true/false assessment.

- A normal distribution was observed for the assessment scores.
- Classical test theory revealed that most items were out of the preferred range of difficulty (0.25-0.75) and discrimination (0.2-1.0).
- Because of the low item difficulty, discrimination was also low for each item.
- Classical test theory may be better suited for pre and post data of the same assessment or for a mastery assignment.

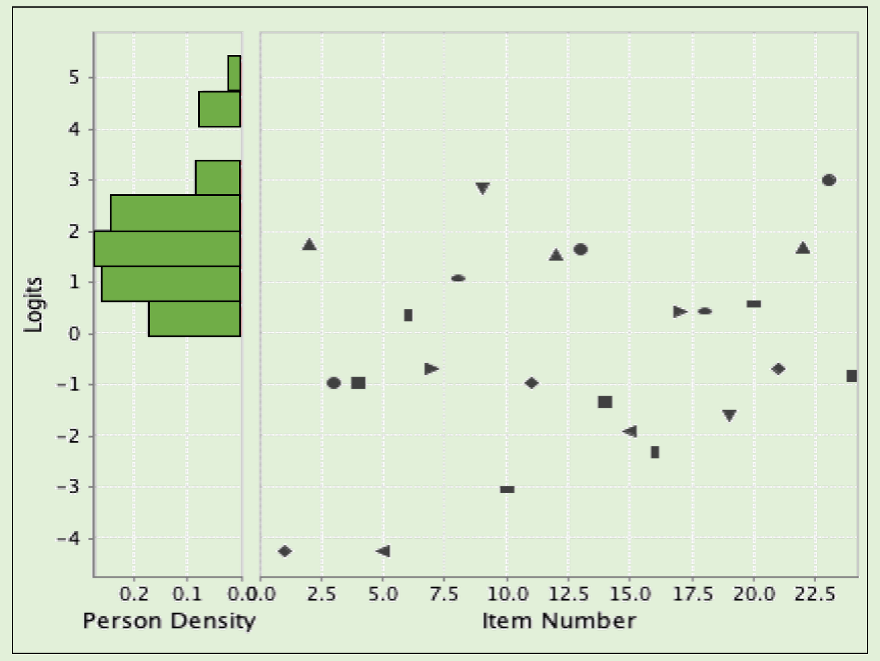


Fig 2. Wright Map displaying item difficulty and person ability.

- Rasch analysis in jMetrik was used to analyze student scores.
- Item difficulty and person ability increases up the y-axis.
- More ability is required for items that are higher up in order to answer them correctly.
- Item 9 & 23 are the furthest up, showing students had the most difficultly with these items. The language of these items is under revision.

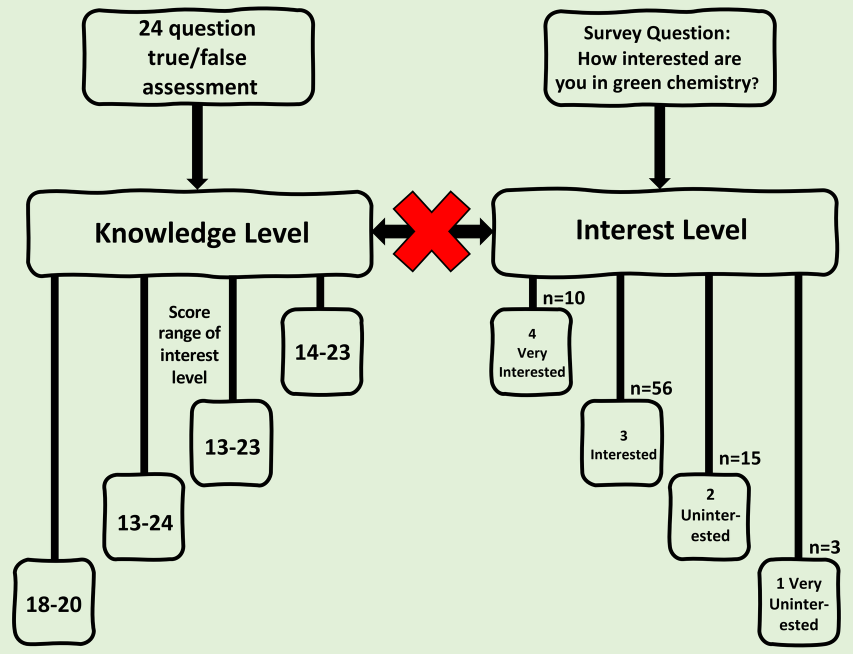


Fig 3. The correlation between constructs of knowledge and interest level.

- Students completed a 1 question survey following the true/false assessment pertaining to their interest level of green chemistry.
- The responses were on a Likert scale from 1-4, as seen in **Fig 3.**
- Kendall’s Tau = -0.009
- Sig. (2 tailed) = 0.923
- No correlation or significance was found between student interest level and student exam score.

OPEN ENDED ASSESSMENT RESULTS

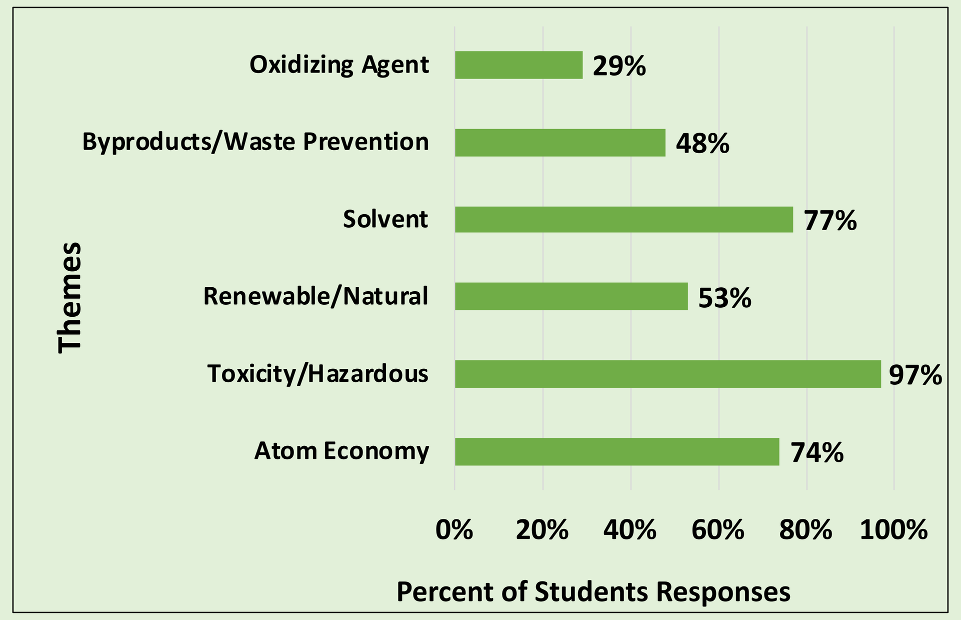


Fig 4. Most prevalent student response themes.

- Student responses were coded according to **Fig 4**.
- Also included in student responses:
  - 83% chose Reaction A
  - 32% directly stated a green chemistry principle
  - 58% of students directly used a list in their response

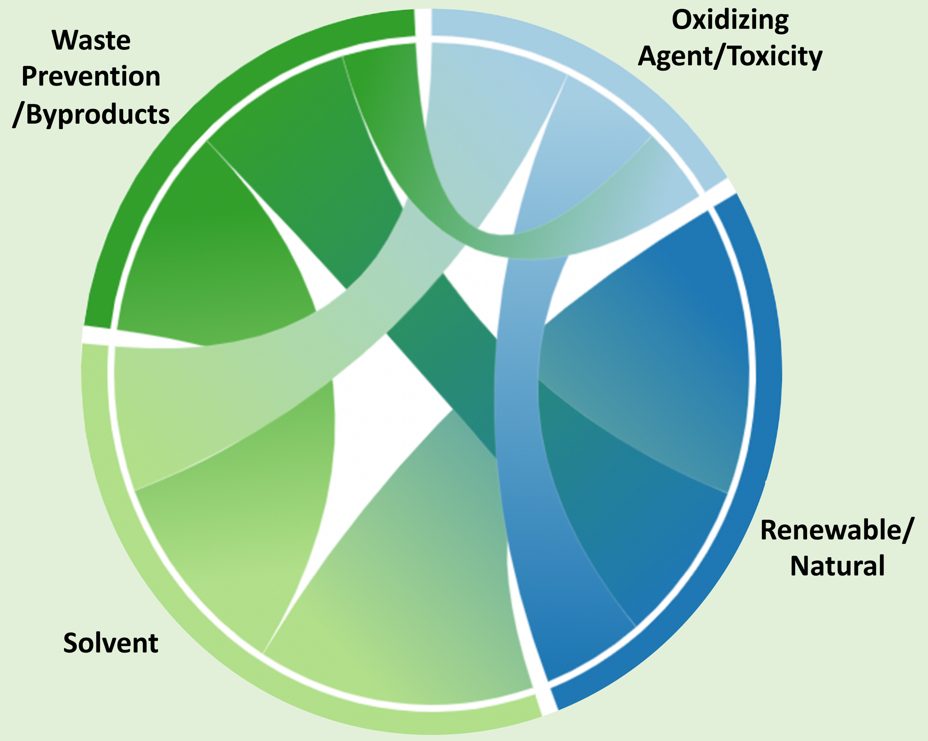


Fig 5. Connections between student response themes.

- **Fig 5**. is a visual display of student responses that had overlapping themes.
- The thicker the chord is, the more overlap observed between those two categories.
- Atom economy is not included on this graph due to students not justifying their answers regarding atom economy.
- Oxidizing Agent and Toxicity were combined due to the complete cross over of categories- that is students always mentioned the safer, less hazardous oxidizing agent used in Reaction A.

DISCUSSION

- Students indicated the terms “ambient,” “facile degradation,” and “halogenated molecules” were unfamiliar terms in the true/false assessment. Further refinement of test questions is needed.
- Open ended format of two alternatives is sufficient in eliciting student reasoning and knowledge.
- The green chemistry interest scale will be changed to better interpret student interest levels.

FUTURE DIRECTION

- Analyze student responses to the new true/false survey
- Create an assessment for Organic Chemistry 1
- Compare knowledge level in Organic Chemistry 1 & 2
- Investigate differences between majors & non-majors

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