

Results of Student-Led incorporation of Green Chemistry into Introductory Chemistry (CHEM 1021) Course

Brinn McDowell, Jan Hu, Matt Wise, Ph.D., and Kathy Ramirez Aguilar, Ph.D.

Objectives

- 1) Incorporate Green Chemistry into the CHEM 1021 Course of benefit to providing students with an advantage when entering a variety of career paths due to increasing demand for green chemistry knowledge
- 2) Pilot student teaching assistants creating meaningful green chemistry course content
- 3) Expose CHEM 1021 students to green chemistry concepts and measure the impact
- 4) Develop an approach that is cost-effective and can be expanded to other chemistry courses and provides students teaching assistants with a unique professional development opportunity

What is Green Chemistry?

In an era of increasing attention to the human effects on the environment, green chemistry poses an opportunity to help in decarbonization efforts; however, little attention is paid to the topic matter in education institutions. **According to the EPA, "green chemistry is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances"**. CU Green Labs in collaboration with the Chemistry Department, has been working to develop an educational pilot program to implement green chemistry topics into the general chemistry curriculum.

[1] <https://www.epa.gov/greenchemistry/basics-green-chemistry#definition>

Project Description

When: Spring 2022 semester

What: 10 green chemistry modules are being introduced to CHEM 1021 Introductory Chemistry in the form of quizzes

- Posted on canvas after course lecture content taught
- Offered for a maximum of 2% extra credit
- Open for 1 week

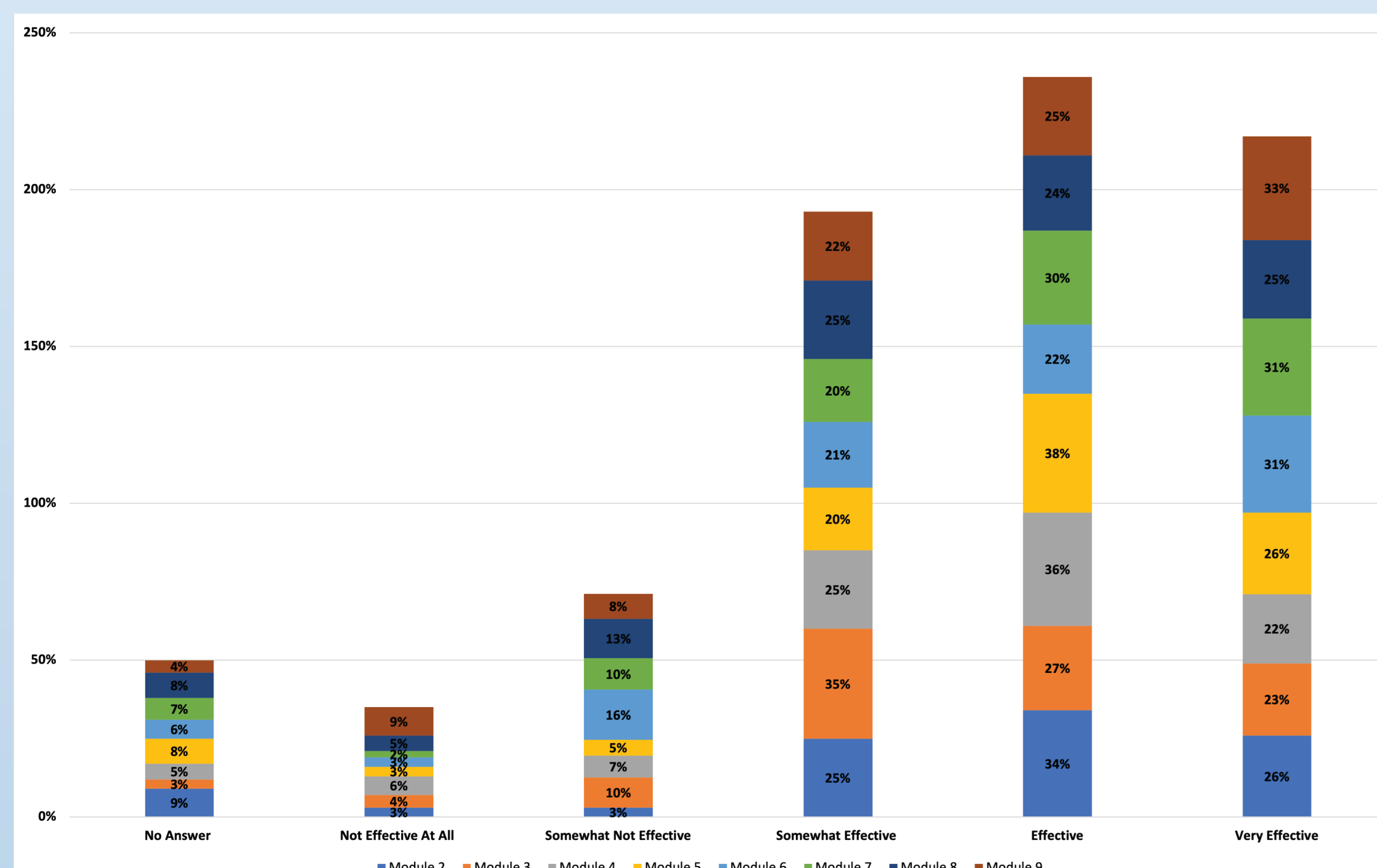
How metrics are collected to determine success:

- Students are surveyed for their familiarity and interest in green chemistry topics at the beginning and end of the semester.
- In addition to grading each module/quiz, the 10th question for quizzes #2 through #9 measures the student's opinion of the effectiveness of the green chemistry module/quiz on a numerical scale.
- Quizzes #1 & #10 allow the students to write in their opinions and evaluations in short answer or essay form.

Why choose CHEM 1021:

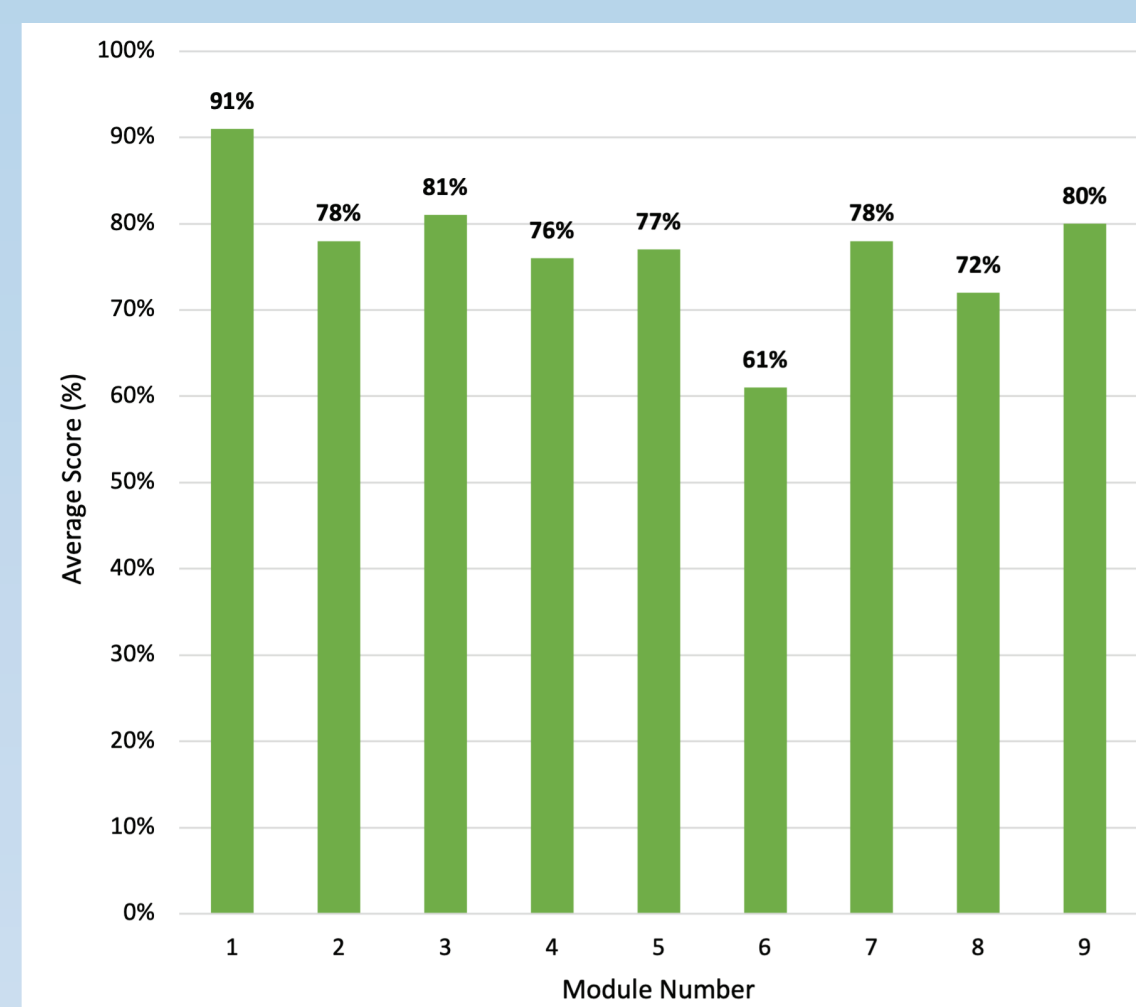
- The course reached 217 students with a wide variety of majors.
- The laboratory course and lecture course are integrated into one section encouraging easier adaptation into course material.
- There is one professor for the course, which avoids the variation between instructors' teaching styles and content.

Results Effectiveness of Module



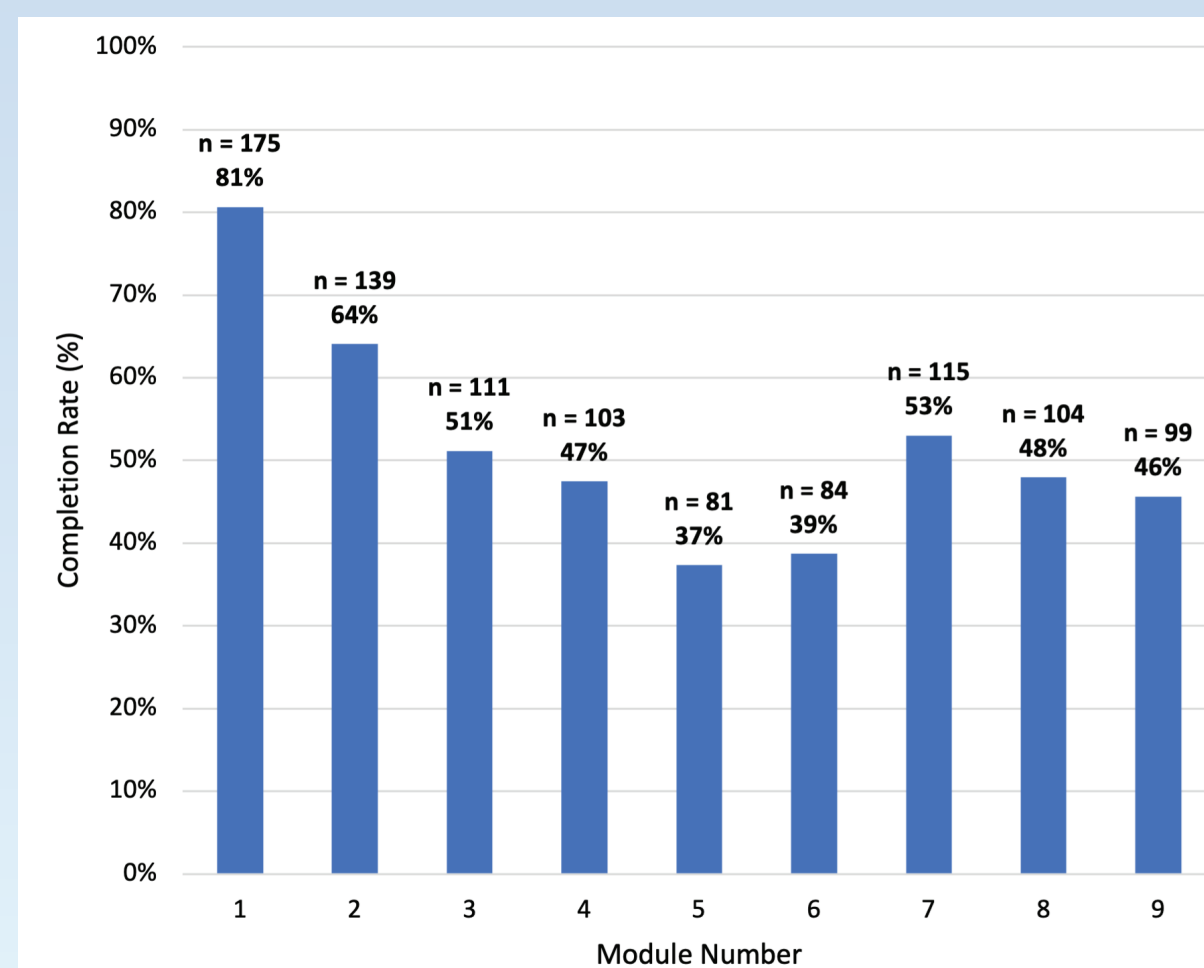
Graph 1. For Modules 2 -9, students rated the effectiveness of the quiz. This data shows that the majority of students feel the lessons were either somewhat effective, effective, or very effective.

Average Score Per Module



Graph 2. This graph displays the average score per quiz.

Completion Rate Per Module



Graph 3. This graph displays the completion rate of each quiz. The number of students who participated in the modules was divided by the total number of students in the course.

Quotes from Quiz 1*

"This lesson was really good. I rate it a 5/5 and would love to see more of this"

"This was pretty informative. I have a much better understanding of green chemistry. I did not know anything about it when starting!!"

"Very informative as an introductory quiz can be. Most of the questions aligned with what we are learning in class as well."

* No comments were left on Quiz 1 that rated it lowly

Conclusion

Students, teaching assistants, and the course instructor found this to be a successful way to implement green chemistry into higher education curricula.

• **The majority of students rated the modules to be effective in teaching green chemistry topics.** This indicates that...

- student teaching assistants, with education in chemistry, have the skills and knowledge to successfully research and create meaningful green chemistry content for chemistry courses
- this pilot, led by student assistants, is successful in providing students with an opportunity to learn green chemistry principles

• **Success with the pilot's approach of utilizing student teaching assistants to create and upload green chemistry modules/quizzes into Canvas** has shown to be a method that:

- integrates green chemistry into the curriculum with limited interference to classroom instruction
- requires minimal time on the part of faculty instructors
- is cost-efficient
- provides student teaching assistants' with a beneficial leadership and professional development opportunity

Funding is needed to continue and grow the success of this pilot:

- To hire graduate student teaching assistants
- To expand into other chemistry courses
- To improve and enhance green chemistry content in courses

If this pilot could be expanded into the general and organic chemistry courses, then the annual number of CU Boulder students with access to green chemistry education would grow from hundreds to thousands of students.

Resources and Acknowledgements

In Collaboration with CU General Chemistry and CU Green Labs



Check out more information on
Green Chemistry Education
at CU Boulder
by scanning the QR code!

