

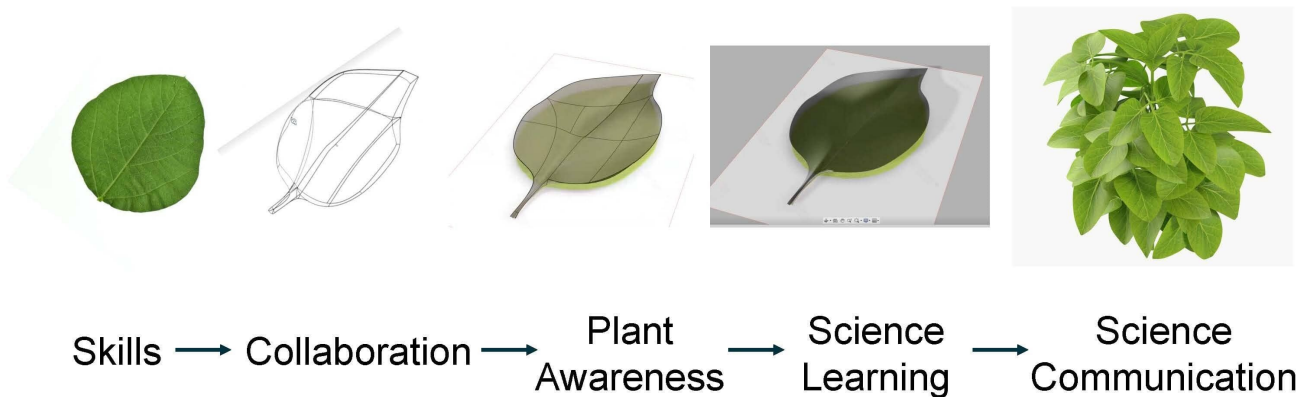
Collaboration and Science Communication Skills Support High School Project-based Learning using 3D Plant Modeling



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Introduction

Group collaboration and results dissemination in project-based STEAM learning benefits student performance, communication skills, and self-efficacy. In our project, high school students from both formal and informal learning environments work in collaborative teams to design and create 3D models of plants used in research at the Donald Danforth Plant Science Center (DDPSC) in St. Louis, MO. This STEAM project integrates science, art, design, and technology through innovative learning experiences in plant and agricultural science using emergent technologies. Students create the 3D models using Tinkercad and Fusion 360, research the plant's biology and importance, and disseminate their project results through 1-page reports and group presentations. Students learn about scientific research, the importance of plants in our society, and practice science communications skills.



Objectives

- To identify positive outcomes from collaborative project-based learning
- To promote the development of collaborative and oral and written communication skills essential for future careers

Methods

- Students work in teams of self-identified science, technophile, and art students with teachers as facilitators.
- Students use videos to self-train on how to use the 3D modeling programs (e.g., Tinkercad and Fusion 360).
- Teams create 3D models of plant parts from species under research at the DDPSC and receive scientist advice on model accuracy and research content.
- Students learn about the application of 3D models through augmented and virtual reality immersive experiences.
- Students give presentations of their projects in public/scientific events to practice their science communication skills.

To investigate the benefit of group collaboration and scientific communication in this project, we use a mixed-methods assessment approach. Seventy-eight students answered pre questions about whether they preferred to work in groups or individually and whether they had attended or presented at scientific events. Students also answered post reflection questions about how collaborating with others affected the achievement of their project goals and how their presentation experience was. The student responses are grouped by main themes.

Reflections about Collaboration

Pre-reflection Question:

Do you prefer to work individually or in groups? Why?

Of the 77 students, **45.5%** (35 students) preferred to collaborate in groups while 33.8% wanted to work individually. Six students would work either individually or in groups, but nine students said it depended on the type of project.

The most cited reasons for preferring group work is the general aspect of collaboration (10.4%), the exchange of ideas (13%), and a fun and enjoyable experience (10.4%).

The 26 students (33.8%) who preferred to work individually like having control of the project (9.1%) and found that others were unreliable (9.1%).

Post-reflection Question:

Describe your relationships with your peers, instructors, and mentors. Did these help you achieve your goals? If so, how? Did these hinder your achievement of goals? If so, how?

Theme	Number of Students	% of Students*
Achieved project goals		
Divide tasks	9	11.5
Exchange ideas	13	16.7
Helpful and supportive	17	21.8
Work well together	21	26.9
Good communication	7	9
Good experience	14	17.9
Somewhat helpful teammates	2	2.6

Hindered achievement of project goals

Little interaction and poor communication	8	8.8
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*Percentage are calculated with respect to a total of 78 students. Percentages per column do not add to one hundred since some students provided responses for more than one theme.

"All of my peers and instructors were very supportive and helpful when it came to creating the model. It helped to be able to bounce ideas off of each other, and they all helped me achieve my goals."

Reflections about Communication

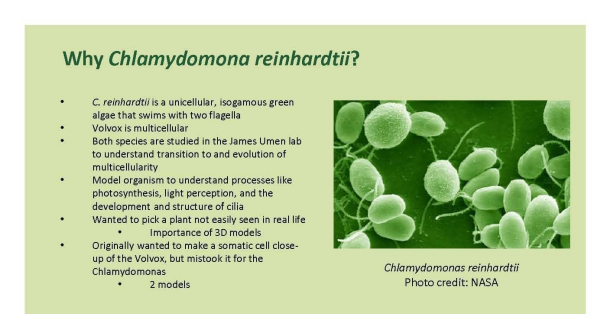
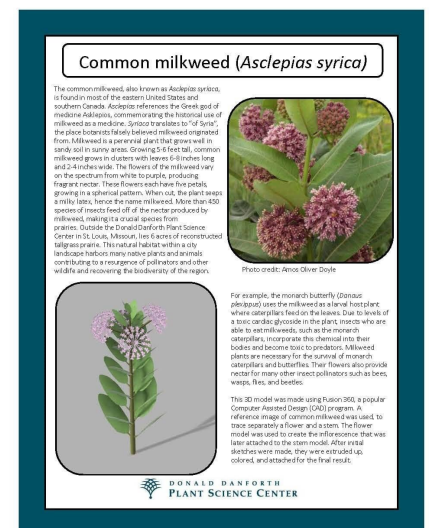
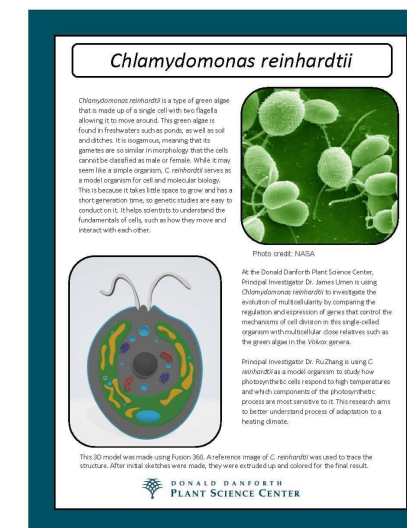
Post-reflection Question:

How was your experience presenting?

Theme	Number of Students	% of Students*
Good, fun, positive experience	48	78.7
Nervous, low confidence	4	6.6
Difficulties	3	4.9
Not a good experience	6	9.8

*Percentage are calculated with respect to a total of 61 students.

Examples of Student Presentations and Reports



"I had a great time presenting. I felt confident in our work and knew I had team members and mentors willing to aid me if an issue popped up. I enjoyed having researchers and other guests asking questions."

Summary

- Some benefits of working in groups included an exchange of ideas and new perspectives, growth of relationships, help in solving problems, and increased project efficiency.
- Student reported that disseminating results showed the work that was completed and their gain in confidence for communicating results.
- Many students also mentioned that teamwork skills and communication were relevant to future jobs later in life.

What is Next

- Data collection from more schools including rural schools.
- Analysis comparing pre and post responses across schools.

Acknowledgments

We thank the teachers and students that have participated in this project. Several members from the Education Research and Outreach Lab at the DDPSC have supported this project during trainings and student visits to DDPSC.