A hands-on ecology experiment at home: the benefits of a take-home experiment post-pandemic

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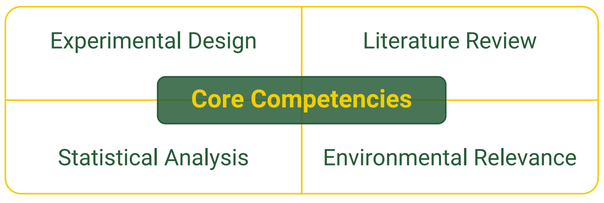
Abstract

Online learning became the staple during the Covid-19 pandemic, reducing the opportunity for hands-on learning that enhances students' engagement, curiosity, and critical thinking. This motivated us to redesign a simple and fairly inexpensive ecology abiotic factors experiment that students could complete safely at home. The new design had students study the effect of three experimental groups and a control group on *Raphanus sativus var. longipinnatus*, a commercially available Daikon variety of radishes. Students were responsible for choosing the general theme of their project according to their individual interests and the supplies readily available at home. Their experimental design was submitted for evaluation via a detailed research proposal where instructors assessed the feasibility and the safety of the project. Before starting the procedures and manipulations at home, the students had to complete a full hazard assessment of their experiment and complete a short quiz that confirmed and acknowledged that the experiment would be safely conducted and completed under the conditions mentioned in an institutional legal document and their research proposal. Germination and stem length were the main quantitative observations that were compiled but leaf color, root length, and stem tonus were also frequently observed. Students presented their findings in a scientific poster on a forum of our course management system. The originality of the projects were found to be far superior than the ones usually completed in the lab, as the students were not limited by a fixed temperature, light cycle, and water uptake.

Introduction

The COVID-19 pandemic caused dramatic pedagogical changes to post-secondary education, as balancing learning outcomes and general safety proved to be particularly challenging for science teaching laboratories where core skills cannot fully be developed or assessed via virtual tools. While simulations and videos allow students to visualize fundamental concepts, limited access to lab facilities does not provide students with flexible hands-on opportunities, thorough application of the scientific method or peer-to-peer connections (Noel et al, 2020 Anderton et al, 2021).



A lab exercise was therefore redesigned for students to be able to complete an individual investigation at home using *Raphanus sativus var. longipinnatus* on an environmental theme of their choice during the course of BIOLE208 : Principes de l'écologie at University of Alberta Faculté Saint-Jean, Alberta.

Learning outcomes and objectives

Learning Outcome

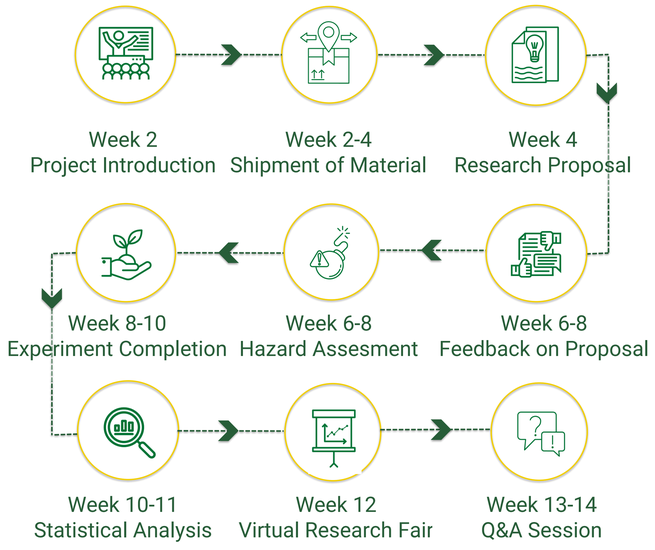
Investigate the effect of different abiotic factors on the germination and growth of *R. sativus* seedlings

Learning Objectives

- Develop a research question and hypothesis based on literature review
- Clearly explain why the theme of the project is relevant in an environmental or biological context
- Design an experiment that can test the hypothesis
- Determine appropriate negative and/or positive control groups
- Chose the best statistical tests to analyze data sets
- Effectively communicate relevant findings in a poster presentation
- Interact in a professional and cordial manner with peers during virtual Q & A session

Experiment

Overview and timeline of the experiment



Research Proposal

Detailed plan of the project to evaluate 1) general pertinence 2) feasibility and 3) safety while conducting the experiment outside of a lab facility. Proposals including potential hazards had to be modified and resubmitted for approval.

Hazard Assessment and Safety Agreement

Students had to review institutional legal documentation, a detailed Hazard Assessment and an acknowledgement via a quiz on our laboratory learning management system.

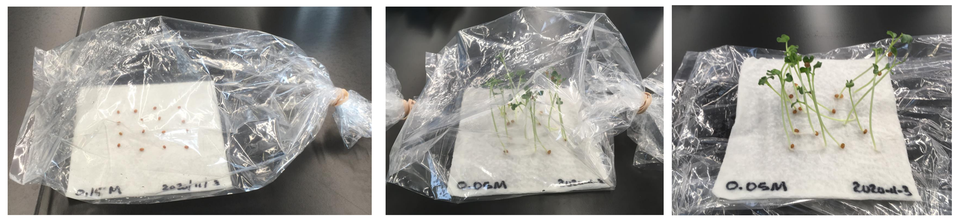
Click on all applicable components :

- [ ] a. I read and understood the protocol of this activity.
- [ ] b. I have in my possession all the necessary material (provided by FSJ lab team and at home) to complete the experiment.
- [ ] c. I know what to do and who to contact if an injury occurs during the completion of this experiment.
- [ ] d. I will respect every sanitary requirements related to the COVID-19 pandemic if I need to leave my house to complete this laboratory activity, including social distanciation, gloves and/or masks requirements, etc.
- [ ] e. Necessary personal protective equipment is available if needed.
- [ ] f. I commit to complete this experiment at home in consideration of the available information provided to and approved by the instructor in my research proposal for the Experiment 3 of BIOLE208 LAB Fall 2021.

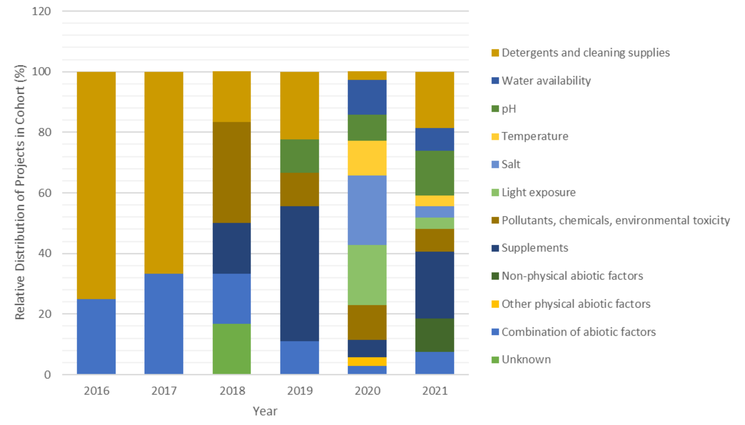
Experiment

Material

Seeds germinated in an enclosed growth chamber on four sheets of paper towels to support the seedlings. Each growth surface were soaked with 30 mL of water or treatment solution depending of the frequency of treatment stated in the research proposal. Plastic bags were inflated and closed using an elastic bands to maintain an appropriate humidity level in the chamber; every chamber was briefly opened daily for air exchange and observed for seven days.



Students were encourage to note daily observations (germination, seedlings mortality) but only measured parameters needing an active manipulation of the seedlings at the end of the experiment (stem length, roots structure). Date were statistically analyzed and presented during a virtual research fair hosted via a forum on our learning management system.



Advantages

- Project diversity
- Active participation of students
- New emerging themes
- Improved question cohesion
- Faster experimental turnaround
- Timeline flexibility
- Statistical relevance

Disadvantages

- Shipping costs
- Increased workload
- Decreased teamwork
- Less opportunities of oral scientific communication

The take-home experiment showed to be a great alternative for students to implement the scientific method in a real experimental context as we navigated the COVID-19 pandemic. The data also suggest ways to improve our usual abiotic factors and plant physiology activity, as students thrived with the timeline and flexibility of the modified project. Modifications will be necessary before implementation in a normal activity schedule to mitigate the effects of the increased workload and allow students to practice oral communication.

References

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