The Struggle is Real: Navigating Interdisciplinary Design Making in the Middle School Classroom

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Topics: Interdisciplinary (Science, Humanities, English/Language Arts), Problem, Project, and Place-Based Learning (P3)

Summary

Struggling is an important part of learning experiences, but facilitators often have difficulties balancing instruction while allowing students to struggle through complex learning tasks. This research brief explores the structure of an interdisciplinary Problem, Project and Place-Based Learning (P3) experience. Striking a balance between making, scaffolded guidance, and assessment is important when implementing P3 learning experiences. While the class design of this project can be applied to other multidisciplinary learning experiences, this research brief provides one, science-based example of this type of experience.

Background

Research occurred at a locally-chartered public school. This school focuses on individualized learning experiences while creating learning opportunities that encompass social justice and environmental sustainability. Students answered the question: *What do sustainable and resilient food systems look like?* by designing a self-sustaining, closed-loop aquaponic farming system that would simultaneously grow food and sustain fish. Researchers investigated the scaffolding needed to facilitate P3 learning experiences while also exploring the impact of connecting the learning experience in an effort to issues in local and global communities.

Research Design

This was a design research study where 60 middle school students (grades 7 and 8) participated in a year-long P3 investigation. Two educators were primary facilitators with support from Indiana University research partners. The investigation included an exploration of sustainable food systems and aquaponic farming.

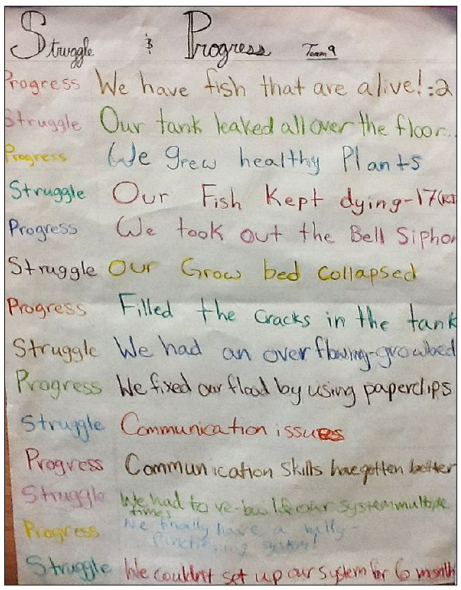
Class Design

This design project developed along two tracks. All students engaged with the learning experience through both tracks.

	Track 1 (Science)	Track 2 (English / Language Arts ELA) & Humanities)
Academic Standards	• Understand the interaction of complex systems within living things • Observe and explain the process of photosynthesis central to the energy cycle of animal ecosystems • Develop a basic understanding of chemistry	<u>English / Language Arts (ELA)</u> • Text analysis • Write for different purposes <u>Humanities</u> • Examine food systems (issues, cause/effect relationships) • Understand the connection between food supply and labor rights
Teams and Roles	• 10 teams of four to six students each • Divided into roles based on student interests and strengths. • Roles included team leader (manage/organize), historian (capture the learning experience), and project-specific roles (create/monitor).	• Collaborative teams of 3 to 4 students • No specific roles assigned
Tasks	Students completed design tasks including developing multiple design iterations with sketching, conceptual models, technical drawings, and fabrication of working systems.	Students explored pertinent historical resources through close reading, discussion and micro-research projects. Students connected resources with the overall project by providing background knowledge and real-world examples.

Findings

Researchers found that balancing struggle with scaffolded guidance is an important aspect of P3 investigations. For example, students struggled when they were asked to perform new tasks relating to unfamiliar equipment (sensors/actuators and coding). Providing an explicit foundation for students through structured guidelines while also allowing opportunities for student discovery and failure allows participants to be decision makers as they are guided toward specific learning goals. Students felt that the frequent reflection and decision-making opportunities were imperative to their engagement and learning within the investigation. Students also valued opportunities to



problem-solve without explicit assistance from facilitators. Failure experienced during these opportunities fostered further investigation and learning. Researchers also found that the authentic community connection within a P3 learning experience fosters student interest and engagement.

Implications

One implication from this research is the positive value of open-ended challenges. Facilitators continuously balanced scaffolding instruction while also allowing for failure along the way. Facilitators aimed to strike a balance between student struggle/failure and providing needed just-in-time guidance to achieve instructional goals. A second implication is that interdependent and collaboratively structured learning experiences are most meaningful when students can connect their learning to the outside world.

"We actually did something real, and I think that was really important to a lot of people in our class. P3 teaches us that we can make a difference" (Wallace et al., 2017).

While experiences such as the aquaponics systems are not always feasible due to financial constrictions, the model of P3 and the allowance for failure fostered meaningful connections to learning. This model, P3, can be adapted to other learning experiences using the interdependent, track-based structure as seen in this project.

Source

Wallace, S., Banks, T., Sedas, M., Glazewski, K., Brush, T. A., & McKay, C. (2017). What Will Keep the Fish Alive? Exploring Intersections of Designing, Making, and Inquiry Among Middle School Learners. *International Journal of Designs for Learning, 8*(1). https://doi.org/10.14434/ijdl.v8i1.22668

Additional Resources

Small-scale aquaponic food production
http://www.aquacultuurvlaanderen.be/sites/aquacultuurvlaanderen.be/files/public/aquaponics_fao.pdf