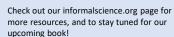
The Productive Struggle Design Framework

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This poster is based on work supported by the National Science Foundation under Grant No. DRL-1612577. Any opinions, findings, and conclusions or recommendations expressed in this presentation are those of the authors and do not necessarily reflect the views of the Foundation.



INVITE

Use clear design to v/elcome all intended learners to the activity

DISRUPT

Facilitate disequilibrium by challenging norms or expectations

SUPPORT

Provide options for persisting through disequilibrium and feeling productive.

Do all of these:

Minimize barriers to entry:

Provide easy orientation

Demonstrate clear objectives

Allow visitors to preview

Make it obvious how to reset or continue

Present a compelling task

Maximize relevance, value, and authenticity

Prioritize accessible design for all:

Design physically inclusive interactions Incorporate multisensory features Avoid reliance on pre-existing skills and specialized knowledge Provide for varied emotional preferences and skills

Do at least one:

Craft novelty

Challenge expectations
Embed surprising phenomena, experiences, or events
Include unfamiliar information

Leverage uncertainty

Limit available information Force decision-making Challenge fine or gross motor skills

Introduce social unease

Invite competition Break social norms Embrace interpersonal differences Offer a performative element

Do as many as possible:

Offer feedback

Indicate progress or success Include mini-wins (throughout) and final rewards Integrate hints and scaffolding Encourage trying again

Give choices

Offer more than one level of challenge Create pathways for social and solo interaction Design for multiple goals Allow repeated attempts Include the option to do less/more

Support self-regulation

Acknowledge the challenge Normalize feelings of disequilibrium Invite reflection on disequilibrium

About our project This work comes out of a

This work comes out of an NSF-funded Research in Service to Practice project (DRL-1612577). The project used a design-based research approach to develop the research-based design framework shown here, which shares strategies for designing science exhibits that foster productive struggle.

What is productive struggle?

During productive struggle:

- a learner confronts an impasse, obstacle, or social unease and feels disequilibrium (confusion, frustration, surprise, unease, etc.),
- 2. the exhibit supports the learner to persist
- the learner overcomes the obstacle, feeling a positive resolution or satisfaction with their effort

Why productive struggle?

Our research shows productive struggle is a *valuable* experience that can enhance *learning, and engagement*. Designing for productive struggle can also support *emotional accessibility,* making science learning available to a broader audience.

Our process

Our design-based research gathered data from over 450 people as we iteratively developed, tested, and refined our design framework. Our data collection included observations, interviews, surveys, stimulated recall, eye tracking, and galvanic skin response.

