Student Perceptions of Abundance:
A Case Study of Two Classrooms Using the Portable Maker Workshop
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Background:
The Portable Maker Workshop (PMW):
• Is a curated set of materials and tools
• Supports functional, testable prototyping

Materials are categorized into:
• Structures, Moldables, Connectors, Utensils, Fluid Flow
• Categories drawn from existing research (Doorley, 2014; Doorley & Witthoff, 2012; Gabrielson, 2015; Martinez & Stager, 2013)
• Reusable and replenishable for engineering challenges

Research Questions:
How did students respond to the PMW, and how did these responses mediate student outcomes?

Study Context:
Two 5th Grade classrooms:
• Urban-rim community in the Northeastern US
• Second semester of an engineering outreach curricular program run by Tufts University, a private research university
• Taught by a pair of undergraduate student instructors, one of whom was the first author
• 9-week curricular unit, introducing the PMW and then centered on open-ended engineering challenges

Supplemented with Quickstart Cards:
• Visual representations of small assemblies of materials
• Paired with inquiry questions

Methods:
Case Study (Merriam, 1998)
• Microethnographic analysis techniques (Erickson, 1992)
• Methods from grounded theory (Corbin & Strauss, 2008)
• Reviewed and annotated video of student design teams
• Consulted related data (e.g. prototypes, sketches)

Initially set up as a comparative case study of both classrooms:
• Differences in group sizes and access to Quickstart Cards
• However, found no differences in our analysis
• Treated all data as from a single case study subsequently

Findings:
Students perceived a variety of abundances in the PMW, which could lead to further responses. These responses could interact with the abundances afforded by the PMW to result in different student outcomes.

Varieties of Materials
Explored in quickstart cards

Form-Function Relationships
Students attended to function while considering alternative materials, for example expressing that they needed “regular tape” not “duct tape”.

Discriminating between Materials Based on Functionality
Students also attended to functionality while discriminating between materials, for example expressing that they needed “regular tape” not “duct tape”.

Student Independence and Agency
An abundance of supplies meant that students were able to use their materials of choice freely. This access simultaneously promoted independence while limiting student-student negotiation.

Differing Task Definitions
When students had different framings, they also differed on task definitions; some students saw Quickstart Cards as what they were “supposed to make”, while others saw them as optional supports.

Elaborations and Evidence:
These findings are from explicit statements (in quotation marks), and observations/infers made from video and other data of student interactions with the PMW.

Discussion:
These are possible pathways, not definite ones, each student taking a different pathway through this model. However, within our model, each node in a pathway is dependent on experiencing earlier linked nodes.

Student Responses
Students thought “it may be easier to build, cause you don’t have just tape”, as “you have more choice to, like, different things”.

Student Perceptions of Abundance
Students had “more supplies” in the PMW, compared to the first semester where “people fought over the tape”.

Varieties of Materials
The categories emphasized one form-function relationship. However, each material evoked other relationships simultaneously; pipe cleaners were moldables and “to clean this one thing”. Students also attend to multiple relationships, like how corrugated plastic floats, is “waterproof”, and “just dries off”.

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Student Outcomes
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References: