Findings from the Building Computational Thinkers Research Project

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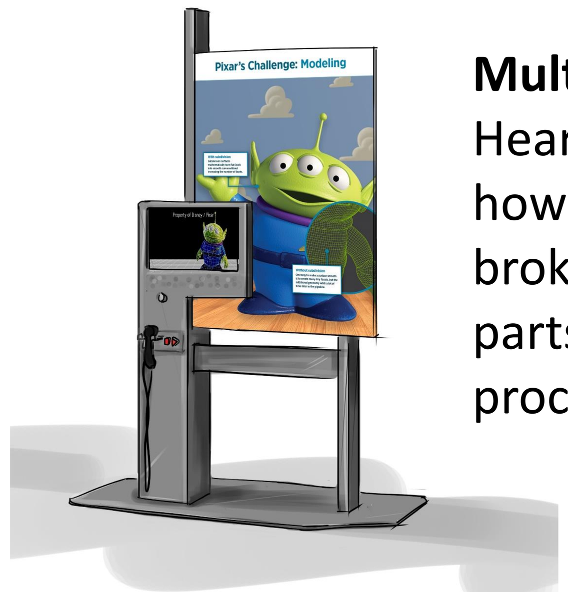
About the Exhibition

- ***The Science Behind Pixar (SBP)*** is a 13,000 sq. ft. exhibition.
- Collaborative creation by the Museum of Science, Boston, Pixar Animation Studios, and the Science Museum Exhibit Collaborative.
- Designed to increase knowledge, skills, and interest in science, math, and computer science.

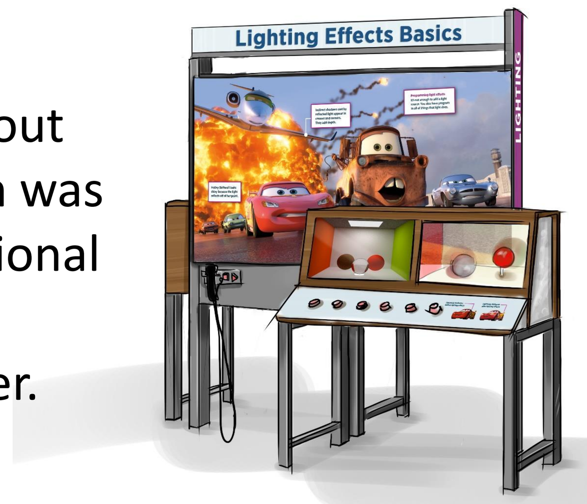
Exhibition floorplan
Boston

Exhibit Design Approaches



Multimedia narratives
Hear from an expert about how a complex problem was broken down into functional parts that could be processed by a computer.

Essential elements: An authentic story, personal connections, & a cohesive explanation



Solution explorations
Adjust activity variables to learn how an expert's solution to a complex problem means breaking it down or building it up from its functional elements.

Essential elements: Authentic context, guided exploration, & well-defined tasks

Creative design activities
Design a creative solution to a complex problem by assembling an algorithm from its functional parts.

Essential elements: Authentic context, open-ended exploration, & learner-defined goals

About the Research

Computational thinking (CT) is the "thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent" (Wing, 2011).

Focus on problem decomposition (PD): Visitors will be able to systematically approach complex problems and challenges by breaking them down into manageable parts.

Study goals: 1) Develop exhibits that convey CT content 2) Explore differences in how experts and novices think about exhibits conveying CT 3) Create scaffolds that mediate novice use and understanding of CT tools and approaches in exhibits, & 4) Understand impacts of different exhibit design strategies for developing CT capacity in youth related to aspects of learner identity.

Phase 1 explored how experts and novices make sense of complex, creative challenges to inform the development of effective scaffolds for CT learning environments.

- Data collection: Background interview and survey, video recorded group interaction, post-exhibit interview, & cued retrospective stimulated recall

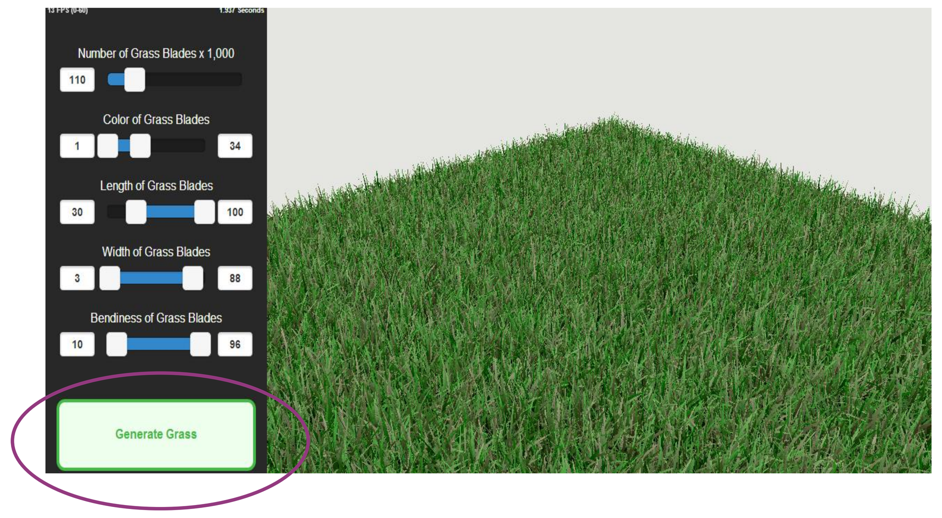
Phase 2 explored the outcomes of engaging middle and high school youth in each of the three exhibit approaches to PD.

- Data collection: Pre-survey and PD task, time and tracking, mid-experience reflection, immediate-post survey and PD task, & extended-post survey

Phase 1 and Phase 2 Findings

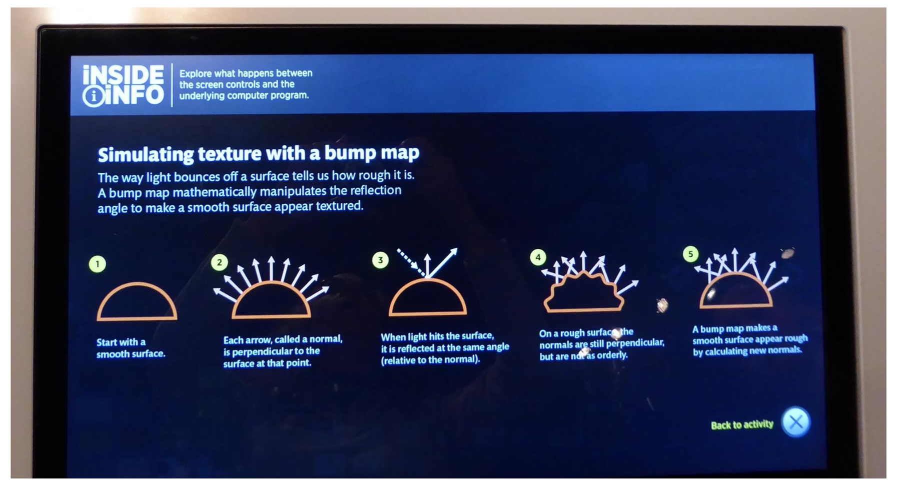
Phase 1 led to the development of embedded supports in exhibits that **revealed authentic connections** between the programming process and necessary computational thinking skills.

Authentic context and process was emphasized to support novice recognition of programming, as well as their agency and identity around doing this type of work.



Authentic language related to programming was added, which encouraged novices to associate the exhibit's process or task with programming or math.

Opening the black box entailed revealing underlying mechanisms or the algorithms behind an exhibit's program without overwhelming novices.



Phase 2 investigated the affordances and impacts of the three exhibit design approaches to build problem decomposition capacity, efficacy beliefs, and interests in novice learners.

Affordances of using any combination of CT focused exhibits

- Youth **interest** in learning about and **self-efficacy** for doing computer programming increased.
- Youth **perceptions of problem decomposition** in computer programming became more sophisticated.
- Youth **perceptions of creativity** in computer programming increased, especially in females.

Impacts of individual CT focused exhibits

- **Multimedia narratives** can be effective for increasing youth understanding and level of sophistication of PD, especially for females.
- **Solution explorations**, that guide an individual through an expert's solution to complex problem, can work well in raising interest in CT, particularly to engage and heighten interest in females. Girls spent significantly more time at these activities than males and rated them "very interesting" significantly more frequently than males.

If you have questions or comments, please contact us at:
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Museum of Science.

The Science Behind PIXAR

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