February 3, 2021

Creating STEAM by Design: Beyond STEM and Arts Integration
Who we are

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Foundations of design and design thinking

What design thinking is

Design thinking and STEAM

Teaching, STEAM and design thinking

Wrap up

Q & A
Design Thinking
Design
We live in a
Designed world
We live in a Designed world
We live in a Designed world
99% invisible
<table>
<thead>
<tr>
<th>What to study?</th>
<th>Sciences</th>
<th>Arts</th>
<th>Design</th>
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<td><strong>What we care about? (Values)</strong></td>
<td>Objectivity, rationality, neutrality, universalism, organized skepticism, and a concern for ‘truth’</td>
<td>Subjectivity, creativity, commitment, imagination, a concern for “justice”</td>
<td>Practicality, empathy, ingenuity and an emphasis on the “particular”</td>
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Derived and modified from Nigel Cross, Designerly Ways of Knowing (London: Springer Verlag, 2006), DOI: [https://doi.org/10.1007/1-84628-301-9](https://doi.org/10.1007/1-84628-301-9).
The proper study of mankind is the science of design
- Herbert Simon
What is design
Defining design

Structure adapted to a purpose ~ David Perkins
Defining design

Structure adapted to a purpose ~ David Perkins
Who designs?
Everyone designs who devises courses of action aimed at changing existing situations into preferred ones ~ Herb Simon

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Life can be much broader once you discover one simple fact: **Everything around you was made up by people that were no smarter than you and you can change it, you can influence it, you can build your own things that other people can use.**

Once you learn that, you'll never be the same again  
~ Steve Jobs
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~ Steve Jobs
Every aspect of education is made up
Every aspect of education is designed
Teachers are designers
Teachers are designers of activities
Teachers are designers of lesson plans.
Teachers are designers of curricula
Teachers are designers of learning experiences
The belief that all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative – John Dewey
Dewey’s 4 impulses for learning

- Inquiry: Finding things out
- Construction: Making or building things
- Communication: Interacting with others
- Expression: The artistic touch
Creative, interdisciplinary, human-centered problem solving
What is design thinking?
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What is design thinking?

Design thinking refers to the cognitive, strategic and practical processes by which design concepts are developed.

~ Wikipedia
What is design thinking?

Design thinking is an iterative process seeking to understand the user, challenge assumptions, and redefine problems in an attempt to identify alternative strategies and solutions that might not be instantly apparent with our initial level of understanding.

~ Interaction Design Foundation, 2020
1. Understand the problem
2. Develop possible solutions
3. Prototype, test, & refine
4. Implement
So many design thinking models...
So many design thinking models...

...but most are really similar
Stanford d.school Design Thinking Process

**Empathize**
- Interviews
- Shadowing
- Seek to understand
- Non-judgmental

**Define**
- Personas
- Role objectives
- Decisions
- Challenges
- Pain Points

**Ideate**
- Share ideas
- All ideas worthy
- Diverge/Converge
- “Yes and” thinking
- Prioritize

**Prototype**
- Mockups
- Storyboards
- Keep it simple
- Fail fast
- Iterate quickly

**Test**
- Understand impediments
- What works?
- Role play
- Iterate quickly

[https://dschool.stanford.edu](https://dschool.stanford.edu)
EMPATHIZE

DEFINE
Why design thinking and STEAM?
Dewey’s 4 impulses for learning

Inquiry
Finding things out

Construction
Making or building things

Communication
Interacting with others

Expression
The artistic touch
Why design thinking is STEAM?
Design thinking

An purposeful, analytic and creative process that engages a person to experiment, create and prototype models, gather feedback, and redesign… Goes beyond disciplinary boundaries
Design melds STEAM together and provides a framework for re-thinking STEAM curriculum.
Beyond simple connections and surface-level combinations of subjects...
Creative, interdisciplinary, human-centered problem solving
What does it mean for educators and learners to be designers?
Educators as designers
Educators as designers

- Engage with authentic, interdisciplinary and real-world projects
- Build resiliency and problem-solving ability
- Cultivate an open-minded and creative approach
- Develop a deeper understanding of self, others, and the task at hand (through empathy and inquiry)
- Contribute to a culture of creative problem-solving
- Develop a designerly identity (& sense of agency in the world)
Learners as designers
Learners as designers

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Teachers are designers of learning experiences
Design snapshot: *Blending disciplines in a real-world shoe design project*
Disciplinary integrations: 4th grade students

- “Fancy feet” project
- STEM and aesthetics come together in shoe design
- Developed with ideas from the Teach Engineering website
- 9-year-olds explored the roles of designers and engineers in shoe manufacture, experimented with materials, and then designed and constructed their own pairs of shoes.
Disciplinary integrations: 4th grade students

- Students posed their own statistical questions to investigate their feet and shoes, and those of their peers
- Learned about “natural and processed” materials
Disciplinary integrations: 4th grade students

Students (a) **identified a design need** (problem/challenge); (b) **identified properties of common materials** for shoe design; (c) applied design processes including **generating ideas**, planning, and designing desired shoes (d) **selected appropriate materials** for creating their shoes; (e) **constructed an initial model**, taking into account given constraints; and (g) **tested, evaluated, and suggested ways to improve** their product.
Disciplinary integrations: 4th grade students

Students go through these phases or modes of design...but that’s not all they are doing.

The teacher designed the project to ensure that opportunities to gather information and knowledge were embedded along the way.

Before designing their shoes, kids answered prepared questions to scaffold their thinking. Questions should be open-ended to allow them to generate ideas.
All the blue additions were for beauty, the added support was for support.

- Added blue rose and ribbon
- Added rose - blue
- Blue ribbon in the middle
2nd design

put plastic around the bowl thing.

we could make it taller

10 cm taller

side view

sand paper

23.6 cm long

to make it pretty

kurd bord to make it stronger
Toward “Informed Design”

- Getting kids to learn while designing.
- Bigger picture projects over time
- Multiple disciplines connect in real-world types of tasks
Design snapshot: *Breaking traditions in Spanish and going to the real world*
Katherine: 4th grade teacher

- Teaching elementary level Spanish lessons to introduce students to new vocabulary
- Seeking more interdisciplinary, engaging and creative lessons
- She worked through the design process to develop a creative STEAM project to teach the subject matter...and much more.
Design Thinking

Creative Thinking

Problem Solving
Design Processes for the Teacher’s Thinking

- **Empathy** - Informal interviews/surveys to understand student motivations and interests
- **Define** - Let kids spend time with issues to make connections between school and their world
- **Ideate** - Brainstorm on an idea with several fellow teachers
- **Prototype** - Come up with a lesson plan for first run of project
- **Test** - Try it with kids, take notes and observe what works
Clean water issues in Spanish speaking countries

**Initial goal:** A better Spanish vocabulary lesson

**Outcome:** Interdisciplinary STEAM project where students researched the scientific dimensions of water usage, and considered problems that happen in Spanish speaking countries, learning about the water cycle, and brainstorming to teach other students about the intersection of these issues.
Task

You are responsible for teaching other students in the school about the water crisis in a Spanish speaking country. You will be researching information about a chosen country and designing a solution to their water problem.
Clean and Dirty Water Board Game

- Provided kids with clean and dirty water tokens
- Dirty water tokens exceeded the clean water tokens
- Rationing water
- Using empathy, helping if someone ran out
“Learning about design thinking came at a great moment in my teaching career. It allowed me to feel like a designer. I believe this process of design promotes creative thinking, collaboration, student ownership and responsibility of learning...you could take many different paths through and modify this process as needed.

Without it, I would have struggled creating this project for my students. As a designer, it was exciting to see the development and changes from start to end.”

~ Katherine
Design Thinking in Teacher Education
Design Thinking in Teacher Education
Major Themes

Becoming Open to Uncertainty

Valuing Empathy

Seeing Teaching as Design
Becoming Open to Uncertainty

“We think we know why problems occur. We think we have the answers. So often we skip empathizing and understanding and defining and jump right into a solution. We struggle to look at all the factors, reframe the problem, or be okay with the uncertainty. Fortunately, I see it now.”
Valuing Empathy

“Understanding the people impacted by the design helps a teacher understand how to create a successful product. As I interviewed my class my students waved their hands in the air enthusiastically wanting their voice to be heard. In the past, I would turn to my mentor teacher for advice. In the empathize phase I learned the importance of the student or user voice…What I thought my class was thinking was not necessarily what they were actually thinking.”
Seeing Teaching as Design

“I no longer see myself only as a teacher, but as a designer. After taking this class I realized misconceptions I had about design. I had always thought a design was based on an idea that popped into your head. I always thought people that came up with excellent design ideas were the people that just naturally had great ideas. This work has taught me that everyone can be a designer and that there is a process. Teaching is design… I was a designer without even realizing it.”
To sum up…
Every aspect of education is designed
Teachers are designers
Everyone designs who devises courses of action aimed at changing existing situations into preferred ones ~ Herb Simon

Teachers & Students
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Thank you!

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