Inventing Products with Design Thinking

Balancing Structure with Open-Ended Thinking

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> "I used to just let students come and tinker. One group was working on a bridge . . . but a couple of months later, I realized they hadn't made any real progress. It was a bridge to nowhere!" said a middle school librarian at a May 2016 maker workshop.

Her words struck a chord with us. After all, after years of saying that school libraries are engines of sophisticated, inquiry-oriented learning, what does a stalled bridge indicate? Those are moments when skeptical colleagues say, "If we just gave them instructions, then we'd know they had learned something. Puttering has no quality control—it's a waste of time." They're not wrong! Sure, some students will putter and learn amazing things, but others may simply zone out. Left unchecked, what will stop making from becoming a "cool thing" that widens the gap between high and low achievers?

We need a *superstructure* that gives purpose, meaning, and thinking strategies to students and simultaneously leaves the final product and its design open to student interpretation.

Enter design thinking, a flexible process for problem-solving. Working through a series of phases, students consider a problem, gather information beyond their own hunches, brainstorm potential solutions, identify a solution to pursue, create and test a prototype, and iterate until successful. It is intellectually rigorous, allows for student accountability, and gives educators a system for keeping individualization manageable. Originally conceived of by the IDEO design group, design thinking is now being applied worldwide in schools, libraries, and for-profit organizations.

Stanford's d.School (Hasso Platner School of Design, 2016) describes design thinking's phases as *empathize*, *define*, *ideate*, *prototype*, and *test*. I prefer to unpack the process further to better illuminate how we can use design thinking to connect classroom curriculum, research, thinking beyond ourselves, the ability to test potential solutions, and student-driven solutions.

IDENTIFY A PROBLEM

The maker movement has been criticized for promoting the development of silly, frivolous objects. Right off the bat in design thinking, however, we ask students to focus on a real problem. Students may identify their own challenge, but often the classroom teacher or librarian will. If it is your students' first time using design thinking, keep the experience concrete: focus on a problem that can be solved by designing a *product* or *thing*. In our workshops, we often posit to participants that no one seems to have the perfect school bag and establish as the problem, "What would the perfect bag look like?" (We intentionally choose the vague term *bag* and not a more focused word like *backpack*, *purse*, or *briefcase* for reasons that will become clear later in this article.)

RESEARCH, OBSERVE, AND INTERVIEW

Some practitioners gloss over this stage, but as librarians, this is where we connect to our information literacy and research expertise. In today's economy, no one can afford to create products or solutions that already exist or that only work for the creator. It's important to know what has already been done in the field and discern what people's genuine needs are. This is accomplished through three interlocking stages: *research*, *observe*, and *interview*. Using the "perfect bag" example, students might:

Research existing bags using traditional research skills. For example, Google Image Search is helpful for product design, as is searching Amazon.com or eBags.com. Students gather images and text for future reference.

Observe the bags teachers and students bring to school.

Where are the "pain points" or problems? Are people carrying multiple bags? What about backpacks: Do people roll them, sling them over one shoulder, both? What kinds of straps seem useful? Photographs, notes, and sketches capture these findings.

Interview users of bags, both mainstream and "extreme users" (see http://www.designkit.org/methods/45), whose bag usage seems idiosyncratic. Does someone bring an overflowing IKEA bag or metal-framed hiking backpack to school every day? Ask why they need so much storage space. What about the teacher who uses a diaper bag as a briefcase, even though you know her "baby" is now in middle school? What is it about a bag created to hold diapers and baby bottles that is meeting her professional needs now? What causes the assistant principal to eschew a purse and instead use an all-in-one wallet, keychain, and smartphone case? And what about the student who carries a teetering stack of books in his arms instead of no bag at all? In conducting interviews and recording field notes about those interviews, the students' goal is to unpack *why* people make the choices the way they do, in the *context* of how their bags are being used. (You wouldn't want to conduct an interview about school bags at the bowling alley. Talk with users when they are using the item you are researching, so their impressions are fresh, not remembered.)

This need not be too time intensive; if students work in teams, they can gain significant data rather quickly.

SYNTHESIZE AND FOCUS

Now the design team comes together with its captured artifacts, notes, photos, and other documentation. What are the patterns they see? You can use formal qualitative data analysis strategies with older students (I recommend affinity diagrams for this: http://www.balancedscorecard.org/Portals/0/PDF/affinity.pdf), or ask younger students to express hunches and point to the data that support their hunches. Have chart paper or even large pieces of butcher or bulletin board paper available, so students can scribe their thinking—this will create an additional document for their artifact collection.

In our example, students saw many kinds of bags designed for various purposes. They probably cannot design one bag that will fit everyone's needs (student, teacher, custodian, visiting district administrator, parent). Perhaps they choose to focus just on improving backpacks for soccer players. Perhaps they've looked at smartphone wallets and realized that a new kind of smart jewelry would be even better. Regardless of where their thinking takes them, they're now focused—but the areas of focus are rarely the same across the entire class, so we're still achieving the goal of student-driven, open-ended design. (This is why we used the vague word "bag" at the start of the challenge—it opens up more diverse ideas at this point.)

Students may need	So we might have available
Fabric for the body or pockets of the bag	Fabric or felt, manila folders, plastic shipping envelopes, paper or plastic grocery sacks, newspaper, second-hand clothing
Stiff material for making wallets	Manila envelopes, empty cereal boxes, corrugated cardboard, poster board
Handles or straps	Plastic hose, old belts, cardstock or heavy paper, yarn
Wheels, axles	Bottle or detergent caps, yogurt cups, wheels from discarded toys, popsicle sticks, branches, dowels
Adhesives, fasteners, tools	Needles and thread, staplers, tape, hot glue guns, scissors, wire

Figure 1: Possible prototyping materials

BRAINSTORM

Now that students have narrowed their focus, they can think of product design elements. One group may have decided to focus on book bags on wheels in the earlier stage. What kinds of wheels? How many? Where and how many pockets will there be? Will the handles be made of webbing or metal, solid or flexible? Will there also be backpack straps? Students should refer back to previous artifacts, so that their design is compatible with what they have discovered during their research (and educators can check for this via informal or formal check-ins). Sketches are a great way to capture student thinking—and they create another artifact that can be used for assessment purposes.

PROTOTYP E

With sketches in hand, it's now time to get out materials and create a prototype or rough model of the product design. For the bag challenge, they can use our ever-present box of recycled materials, but we also anticipate some of the materials that students *might* need, making sure there is a variety of potential materials. Don't constrain yourself to *exact* materials—improvising is part of the design challenge (see Figure 1). Prototypes are tools, not precious final products. Rough materials help emphasize their temporary status; if they look too perfect, then students will be reluctant to deconstruct or change them later.

TEST, ADJUST, TEST AGAIN

Next, it is time to demonstrate the prototype with target users and gather feedback. Bag prototypes can be modeled playfully with a narrated fashion show. Add feedback to the project's artifact collection, then use it to adjust and refine the prototype. Document! Repeat as time allows, but make sure students can engage in at least one revision cycle, so they understand the difference between a prototype and a product.

ASSESSMENT

Throughout, students have gathered notes, photos, and other artifacts. These serve as primary sources for student self-assessment and educator assessment. Perhaps each group keeps a blog or a Google Drive folder that contains notes, sketches, photos, and reflective writing. Perhaps they give occasional brief updates on their progress to the class or write progress memos or pitches—all gradable.

CONCLUSION

For K–12 making to be sustainable, we need to demonstrate benefits for all students. Design thinking provides a flexible structure for organizing and focusing student thinking while also allowing many opportunities to pursue, design, and defend their decisions.

REFERENCE

Hasso Platner School of Design (d.School) of Stanford University. (2016). A virtual crash course in design thinking. Retrieved October 24, 2016, from http://dschool.stanford.edu/dgift/

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