

Supporting Framing Agency with the Wrong Theory Protocol in a Youth Radio Camp

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Abstract: STEM instruction commonly constrains learners' agency as a means to focus attention to specific content. One consequence of this is much more research has investigated problem *solving*, rather than problem *framing*. This study investigated how learners negotiate framing agency—that is, making decisions about how to frame a design problem. Set in the context of a coding camp, learners worked with micro:bits and paper template my:Talkies to pose a community problem that could be solved via radio systems. Noticing their fixation, we guided learners through an ideation technique that prompts them to generate humiliating, harmful ideas before generating beneficial ideas, which resulted in divergent designs. Interaction and discourse analysis of video recordings highlights how learners (re)framed.

Introduction

A persistent challenge in the design of instruction is learner agency. Instruction necessarily constrains agency as a means to focus attention to specific concepts. Out-of-school settings provide an opportunity to engage learners in meaningful design, creative making, and disciplinary inquiry activities that can relax some of these constraints, shedding light on how learners negotiate agency. The goal of this research is to foster learner agency and creativity during engineering design and making activities by understanding the potential barriers to generating divergent ideas. Learners wrestle with framing and reframing design problems, in part because they have typically had few opportunities to engage these practices. Teachers and informal educators working need more strategies for facilitating generative design activities, especially in maker-oriented environments. While these environments afford a wide range of tools, materials, and possibilities, informal educators have limited guidance on facilitating problem framing processes. This paper shares an analysis of a creative engineering task in which informal educators and group of novice designers—learners in a summer STEM camp—negotiated agency while working individually and together on a problem in their community. We examine how an ideation technique supported framing agency, guided by a research question: How might an ideation technique of generating bad before beneficial ideas support learners to negotiate their agency to frame design problems?

Theoretical framework

While much research has investigated learning through *problem solving*, a key part of design comes before this, *problem framing*. Problem framing involves gathering information, including about/from stakeholders, the context and design requirements—providing abundant learning opportunities (Dorst & Cross, 2001). Problem framing is also dependent on the designer, who brings unique preferences and judgment to bear as they use what they learn to make decisions that bound the problem space (Dorst & Cross, 2001). The ability to make consequential decisions about the problem frame is termed framing agency (Svihla et al., 2021). Designers use their framing agency responsively as they consider how possible solutions meet design requirements. Thus, in addition to learning about the problem, novice designers learn how to direct their framing process. In order to shift between framing and solving a problem, designers typically generate ideas. Common techniques suggest designers should generate many ideas, yet this probabilistic argument has failed to find support in research, in part because of design fixation—inadvertent adherence to flawed solutions (Alipour et al., 2018). Because fixation creates a narrower problem space, it also limits learning. One method for overcoming fixation, the Wrong Theory Protocol (WTP), tasks designers with generating harmful and humiliating ideas prior to generating beneficial ideas (Svihla & Kachelmeier, 2022), resulting in empathetic and creative solutions.

Methodology

We report on one iteration of a design-based research (DBR) study (The Design-Based Research Collective, 2003) in a radio communication camp that positioned learners as designers capable of framing and solving a problem. Radio crafters camp is five-day, museum-hosted summer learning experience designed to introduce a socio-technical topic: radio frequency communication. They use BBC micro:bits (programmable microcontrollers (Austin et al., 2020)) to build a conceptual model of radio and use craft materials and papercraft templates (my:Talkies, (Yu et al., 2022)) to build a radio communication system model to solve a problem. The first

activities introduced radio communications and the paper my:Talkies and an initial framing of the design problem—create a system of radio communications that serves a newly-developed neighborhood west of the city, with the constraint that their solution needed to communicate with another local radio system. We prompted learners to consider problems that could be solved by having access to radio communications (contacting friends, getting announcements for the community) and to identify a list of stakeholders (kids, police or fire departments, businesses, etc.). Following the steps of the Wrong Theory Protocol (Svihla & Kachelmeier, 2022), we prompted learners, as a group and documenting their ideas on a large sheet of butcher paper, to create “the worst ideas for community radio, actively harmful.” Next, they individually imagined beneficial ideas, planning for what they wanted to design with the micro:bits and my:Talkies. The camp concluded informal design presentations.

Two girls and four boys (ages 11 to 15) participated in the camp. Four identified as Hispanic/Latinx. Two reported some prior experience with block-based programming. Sessions lasted three hours over five contiguous days in a discovery-focused museum in the American Southwest. We collected short video and audio recordings from the camp, field notes, artifacts created by learners, and documentation from whole class discussions. We initially transcribed video and audio using Otter.ai, then corrected these, adding filler words, tone, and pauses. We used two analytic techniques to examine how learners used and distributed their agency. First, interaction analysis provided a way into the data (Jordan & Henderson, 1995), with particular attention to turn-taking, participation structures, and access to space and materials. We repeatedly discussed and reviewed data to test conjectures about fixation and problem framing. We used a discourse analytic approach to characterize agency in talk (Svihla et al., 2021), with particular focus on the subject and verb types in verbal clauses. In this way, “I” denotes individual agency; “we” denotes shared; third-person subjects denote attributed agency; modal verbs such as “going to” and “could” denote tentativeness characteristic of framing agency; and modal verbs such as “can’t” and “have to” denote offloading of agency.

Results and discussion

In early pre-ideation activities, we saw evidence of fixation from the learners. One created a version of the Titanic (which was part of the initial framing of the camp about possible disasters of radio communication) while others mirrored the examples—a rabbit and a duck—creating Pikachu, a swamp monster, and a panda (Figure 1).

Figure 1

(a) Example of my:Talkie presented to the learners; designs subsequently made by learners: (b) a panda and (c) Pikachu



Thus, the learners seemed influenced by prior solutions, suggesting design fixation was at play and could limit the creative learning opportunities (Alipour et al., 2018) by limiting their framing agency. Responsive to indications of fixation, we implemented the Wrong Theory Protocol. We prompted learners to generate harmful and humiliating ideas related to the problem. Although the facilitators attempted to bring them back to the more specific problem space (radio communication), the learners framed the problem much more broadly as the “worst place to live,” a framing that served as fertile ground for their problems and designing. After an initial period of tentativeness, one learner came up with the idea of faulty wiring causing electric shock and fire. They revisited the idea of fire throughout the whole session. At one point in the discussion, learners discussed a “nuclear football” (delivered to the president via faulty Amazon drone delivery) that would lead to nuclear holocaust, but decided there would be nothing left to harm nor humiliate, so they returned to fire again. As the learners developed more dystopian ideas on the large shared paper, they went back to scribble red marks over them to depict objects in the community, trees, and buildings catching on fire. This focus on fire is particularly important as during the camp, wildfires raged across the state, leading to smoke in the air.

Learners also drew on locally-salient societal issues. They considered ways Amazon could be used to facilitate specific harm, including delivering unwanted packages by drone and providing harmful working conditions, a local concern considering an Amazon distribution center had recently been built in the community they were designing for. Olivia suggested, “everyone has the same rights as an Amazon worker” and Liam showed

his understanding of issues Amazon workers might face, adding “They don’t ins—install toilets in houses anymore.” Building on this, Damian and Liam discussed monopolies and removing regulations (Figure 2). In response, Ms. Y, a facilitator, suggested a dictator. However, Liam showed high individual agency over his evaluation that a dictator did not fit their dystopian vision, then shared agency with his peers over the framing. Damian then tentatively shared new direction—making Taco Bell “the only place to eat,” and restricting envisioned community members’ agency, a storyline picked up by his peers. This interaction illustrates how students drew upon their understandings of localized issues like wildfires and worker rights, using their agency to reject an idea as out of frame, before more playfully exploring a topic they may have suspected the facilitator would not be able to contribute to. In a classroom, such a shift in focus may have been discouraged or labeled “off task,” but we interpret it in this context as a display of framing agency.

Figure 2

Vignette 1: Framing a harmful, humiliating design of an Amazon monopoly, determining that the idea of a dictator raised by the facilitator doesn’t fit.

Damian: Everything is just a monopoly. Every single industry is monopolized.
 Liam: There are no corporate regulations. No minimum wages
 Ms. Y: And one dictator decides everything?
 Liam: I guess. We don’t- We’re just making the worst place to live
 Damian: At this point we should make it so that the only place to eat is just Taco Bell. You can’t eat anywhere else.
 Olivia: Except it’s vegan.
 Damian: Yes
 Liam: Oh
 Damian: All the meat is vegan as well.
 Liam: What if there’s no
 Olivia: Oh and there’s only the Dorito um, the Dorito shell. And every worker- And every worker is required to lick it first
 Liam: What?

High agency marker. First person singular subject
Shared agency marker. First person plural subject
Framing agency marker. Verbs show potential control
Low agency marker. External person/object subject
Low agency marker. Verb indicates lack of control

After generating terrible ideas, learners generated ideas individually and developed these into their projects, which were diverse, empathetic solutions. Damian’s smart lake showed empathy for community members’ needs and varied uses of a lake. He emphasized the importance for privacy for someone who is unsheltered (and who had a need for bathing in the lake), respect for a family on an outing (who would be alerted if the lake was occupied), and solace for people who come to the lake to feed ducks when they are sad. The smart lake had the capability to take care of itself, monitoring sewage and the fish’s home. Damian, in explaining his final project (Figure 3), demonstrated framing agency through his use of potential control verbs, like “could” and “would,” demonstrating how he continued to consider possibilities. This reflects how designers treat their early solutions as tentative and as revealing much about the problem and whether needs have been met (Dorst & Cross, 2001). When a facilitator made a suggestion, he considered it but did not automatically take it up, indicating that while he was willing to take other ideas into account, he retained control over his design and the problem he had framed.

Figure 3

Damian retained framing agency as he considered possible changes

Damian: This is the smart lake of the future. Right here alerts it, like, it could sense if someone’s in here. [...] Like it can sense if there’s fire or sewage either near or by the lake. As you can see, it’s setting fire, fire, fire. And, if you press the upper one. Sewage. You know, pretty much it’s a smart lake that could help with the lake, the fish in the lake. Sad people could go by, feed the ducks. I don’t know.
 Dr. H: If you had more time and resources, what would you add? Or change?
 Damian: I’d probably fix this that I actually could talk with the swamp creature. But, other than that, that’s pretty much it.
 Ms. Y: Or do you want to connect other characters over here?
 Damian: Hmm. I never really thought about connecting it to someone else’s. But it would be nice to connect it to one of the fire department people just in case of fire button.

Olivia created a system for alerting the community for needed food donations and availability of food for distribution. In describing it (Figure 4), she showed high individual agency over the problem, which she situated as an existing problem. When asked about design features, Olivia offloaded her agency, a shift that speaks

to her disappointment in not fully delivering what she envisioned. Rather than suggesting she lacked framing agency here, we interpret this as an indication that she maintained a clear frame, but because of time spent troubleshooting, did not develop the solution she aimed to make. Concern about failure in ambitiously-framed problems can prompt educators to limit learner agency. Allowing learners to envision and tackle ambitious problems means being prepared to coach them through failures, positioning problems and learning as more important. Dr. H's response shifted attention away from what was not, to what Olivia accomplished—a positioning Olivia took up as she displayed high individual agency (“I did...”).

Figure 4

Olivia showed high agency in describing her creation

Olivia: I made a food delivery system slash, just like managing food because a lot of donation systems is that people who are needing food don't know when to go when there's a supply and don't know when they go and get food, which was actually a problem, a lot of like, uh universities ran into when a big gift gets delivered. So none of the faculty and none of the students would know there was food. So instead of cameras which alerted people when there was food that had been delivered, so everyone knew when to go and get them.

Dr. H: Tell me about the design features that you had in your project.

Olivia: I wasn't able to do everything I wanted to. But when you point it at different places, like here, it'll show that which is FULL, and this one is EMPTY means there's nothing inside. And processing means that it's, that's the process of being donated to or it's getting resources.

Dr. H: If you have more time and resources, what would you add to your project.

Olivia: Individual products like vegetable, meat, uh grains, carbs, dairy. But because of like the small display with numbers, I wasn't able to do that.

Dr. H: Tell me about the programming that you did to make it work.

Olivia: um I did the sensor programming, which took me a very long time to troubleshoot. And as well as uh programming that would play for the number in a specific range, it would uh show the number on the LED system here. um And I did that for all three of the numbers and then troubleshooted it more and then found out my LEDs on the microchip were broken. So I got a new microchip and had to download everything, and figure out something was broken, so I troubleshooted again, So we spent a lot of time troubleshooting.

Conclusions and limitations

We find support for using WTP to mitigate the impacts of fixation and help learners use their agency to (re)frame problems—itsself a learning process. WTP opened space for learners to draw upon their assets and understanding, sharing their awareness of everyday events and experiences, in turn shaping a broad problem space—far broader than the radio systems context that the facilitators envisioned. The learners' broad problem space served as fertile ground for them to frame diverse problems with empathy. When the facilitators tried to alter the scope, the learners displayed ownership over the problem space. We also identified examples of learners displaying framing agency as they reflected on their work, both as they treated their solutions as tentative.

References

- Alipour, L., Faizi, M., Moradi, A. M., & Akrami, G. (2018). A review of design fixation: Research directions and key factors. *International Journal of Design Creativity and Innovation*, 6(1-2), 22-35.
- Austin, J., Baker, H., Ball, T., Devine, J., Finney, J., De Halleux, P., Hodges, S., Moskal, M., & Stockdale, G. (2020). The BBC micro: bit: From the UK to the world. *Communications of the ACM*, 63(3), 62-69.
- Dorst, K., & Cross, N. (2001). Creativity in the design process: Co-evolution of problem-solution. *Design Studies*, 22(5), 425-437.
- Jordan, B., & Henderson, A. (1995). Interaction Analysis: Foundations and Practice. *Journal of the Learning Sciences*, 4(1), 39-103.
- Svihla, V., & Kachelmeier, L. (2022). Latent value in humiliation: A design thinking tool to enhance empathy in creative ideation. *International Journal of Design Creativity and Innovation*, 10(1), 51-68.
- Svihla, V., Peele-Eady, T. B., & Gallup, A. (2021). Exploring agency in capstone design problem framing. *Studies in Engineering Education*, 2(2), 96-119. <https://doi.org/10.21061/see.69>
- The Design-Based Research Collective. (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*, 32(1), 5-8.
- Yu, J., Hsi, S., Van Doren, S., & Oh, H. (2022). MyTalkies: Designing a craft kit to support learning about communication devices through making. *Interaction Design and Children*, 442-447.

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