

Tools that Lower the Floors, Widen the Walls, and Raise the Ceilings for Designing Creative Learning Experiences

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B.A. Columbia University, 2012

Submitted to the Program in Media Arts and Sciences,
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Abstract

There is a stark tension between the creative work that educators engage in and the inflexible tools they often use in their work. These tools don't support their goals, perspectives, or styles of working. In this thesis, we explore how teaching as a form of creative work can be empowered with creative tools and make the case for bringing the playful spirit of technologies for children to the design of technologies for educators.

We introduce the idea of **creative learning design tools** – tools that are more tinkerable, personal, and collaborative. We describe how educators use these tools to iteratively plan, draft ideas, prototype experiences, extend their imaginations, repurpose materials, and organize their thinking in ways that express their epistemological styles. We highlight how educators can make more of their thinking visible to themselves and others, supporting reflective practice and opening up new opportunities for collaboration. This in turn surfaces bottom-up innovations, produces work that can be readily repurposed, and encourages creative risk taking.

We explain how we repurposed existing tools as creative learning design tools and why we used one in particular (Milanote) instead of developing our own tool. Through collaborations with educators ranging from novice public high school teachers in low-resource settings to experienced university faculty teaching in open-ended contexts, we describe how a creative learning design tool can lower the floors, widen the walls, and raise the ceilings for designing creative learning experiences.

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This thesis has been reviewed and approved by the following committee members:

Advisor	Reader	Reader
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“To understand a life, you need to swallow the world.”

– Salman Rushdie, *Midnight’s Children*

As Rushdie explains, many people, moments, and experiences have brought me here – to MIT, the Media Lab, the Lifelong Kindergarten (LLK) group, and this particular research project. To thank everyone who shaped me and this work is impossible. Which is why I’ll try and focus on people who helped with this specific project.

My Committee

Mitch Resnick for cultivating a creative society in which I’ve never felt more free to pursue my own questions. Thanks for the suggestions, advice, and guidance during this project and my time at the lab. I’m looking forward to (re)mixing Mitch’s magic as I continue to explore the world of creative learning! **Bakhtiar Mikhak** for generously sharing your time, energy, and advice. I always left our interactions more motivated and with new insights and look forward to many more in the years to come. **Dayna Cunningham** for being a thought partner, someone to laugh with, and for many rich, honest conversations. You helped me synthesize my thinking and clarify these ideas for myself and others.

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In this thesis, I write in the first person “we” to acknowledge that many of the ideas presented here have been especially shaped by the following people: **Luciana Bueno** for being a partner as we traversed Boston to interview educators and for pushing my thinking on what a creative tool could

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There are many others whose work I built on or who contributed to the ideas presented here. Thank you, and if you're not mentioned, it's likely due to my forgetfulness in the late stages of thesis writing!

Tips for exploring this thesis

Play with the examples!

*"Make it your own. Take it up. Make it part of your life, your thinking, and your culture."*¹

We believe that people learn best when actively constructing ideas with digital or physical materials. You can think of the examples shared in this thesis as material for you to remix, adapt, and construct what these ideas might mean for you. This is inspired by how we facilitate learning in the Lifelong Kindergarten research group, where we favor exploration over explanation.

To make this easier, we've organized examples into a [Milanote](#) file that you can remix.²

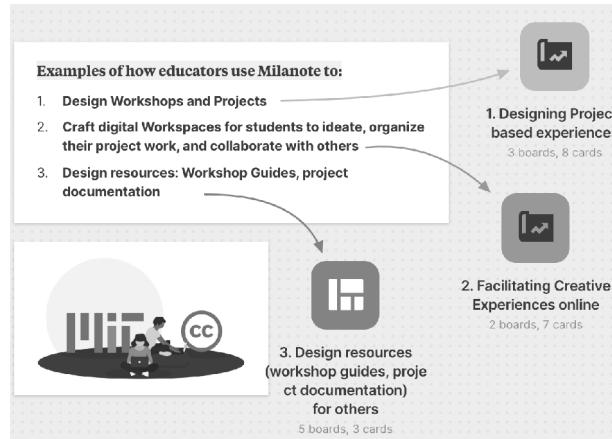


Figure 0.1. [Play with our examples here!](#)

Jump to what interests you

We've tried to include sign posts, links, and suggestions to help you navigate the thesis in a way that might be meaningful to you, the reader. When possible, we've also tried to link to full texts and brief summaries of works cited.

We, not I

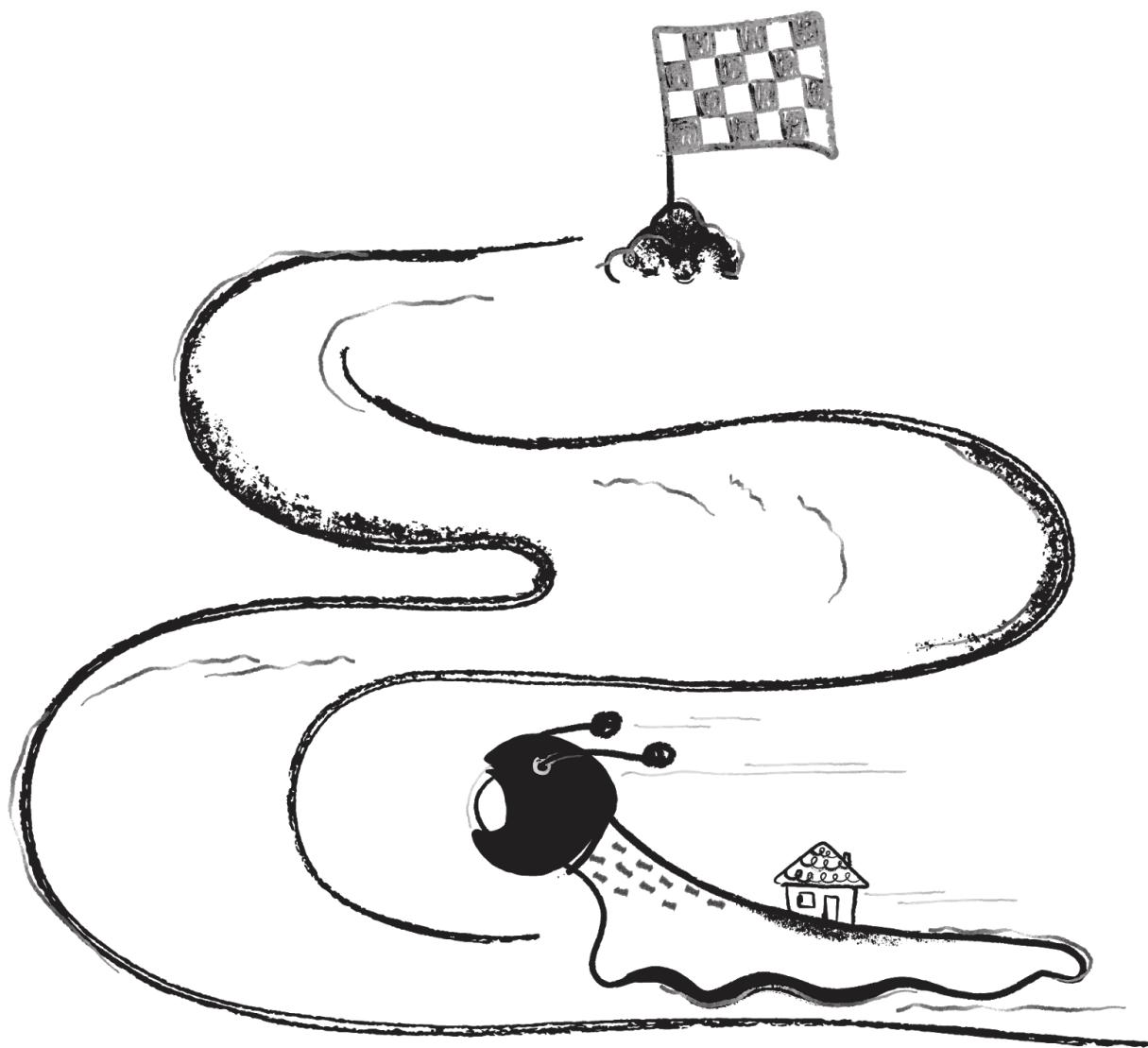
Most theses are written in the third person. I've decided to write most of this in the first person 'we' to acknowledge that this has been a collaborative process involving many of the people outlined in the acknowledgements section. That said, as the author of this document, I write from a particular position. You can read more about my perspective in [my personal theory of practice](#).

Say Hello!

These are living ideas. If you have thoughts, reactions, ideas, feedback, or just want to say hello drop me a note at yusufa@mit.edu.

¹ Papert. "[A Critique of Technocentrism in Thinking About the School of the Future](#)." In Children in the Information Age: Opportunities for Creativity, Innovation and New Activities 1988:3-18.

² Milanote is a digital design tool – think of it as a whiteboard that you can embed files in, etc.



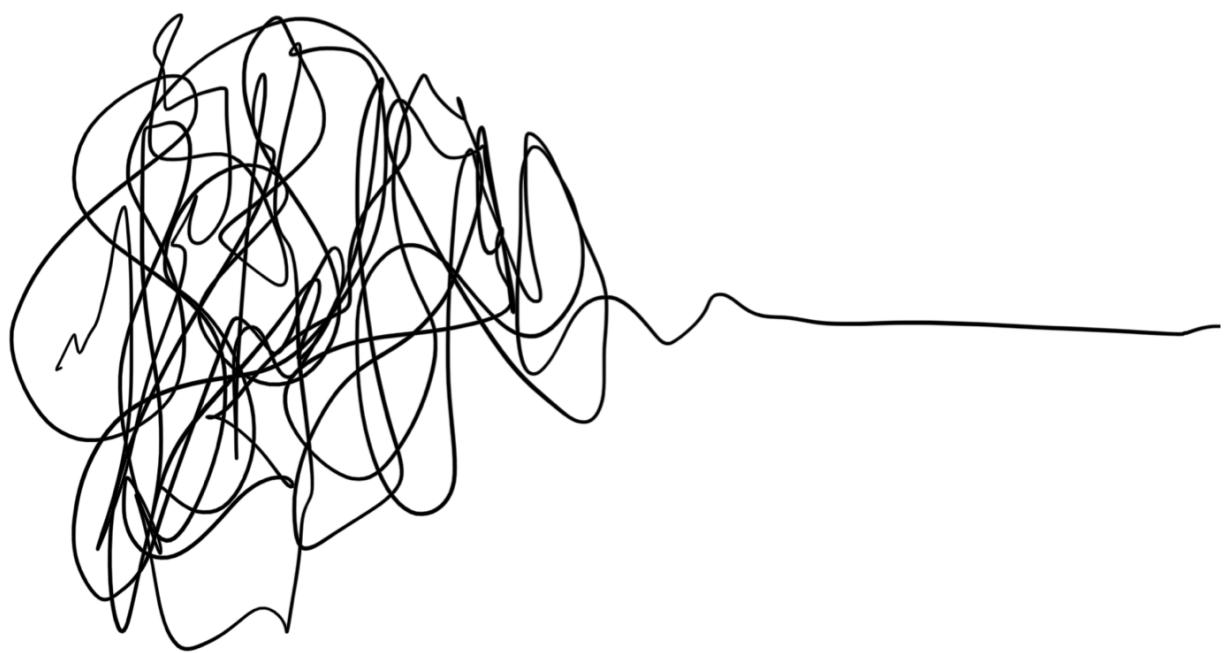
3

³ In the spirit of remixing and inspired by how many creative educators work, I've included open-source illustrations in each chapter title from Absurd Design <https://absurd.design/>.

Contents

Feel free to choose your own adventure

1. Introduction	10
2. Motivations	18
3. Related Work	37
4. Methodology and Design Process	47
5. Introduction to Case Studies	59
6. Lowering the Floors: Getting New Teachers started in Creative Learning Design	62
7. Widening the walls: Transitioning to Project-Based Approaches from Traditional Instruction	84
8. Raising the ceilings: Deepening Creative Design and Facilitation	97
9. Final Reflections	111
Appendix A: Wireframes	121
References	127



1. Introduction

“Engaged pedagogy does not seek simply to empower students. Any classroom that employs a holistic model of learning will also be a place where teachers grow, and are empowered by the process.”

- bell hooks⁴

“two complimentary fallacies... have [limited] thinking about the role of technology in education. The ‘technocentric fallacy’ is illustrated by questions like: ‘How do computers change the way children learn?’...a too-easy rebuttal leads into a complementary fallacy: the ‘just-a-tool fallacy.’ By this I mean the failure to distinguish between tools (reasonably described as ‘just tools’) that improve their users’ ability to do pre-existing jobs, and another kind of “tool”...that are more than “just tools” because of their role in the creation of a job nobody thought to do, or nobody could have done, before.”

- Seymour Papert⁵

I often find myself befuddled by the dissonance between some of the most creative educators I know and the inflexible tools used in their work. On the one hand, I see educators engaged in hard fun: playing with ideas, experimenting with activities, and iterating their strategies. While they use tools that embody this spirit with children, the tools they use to plan learning experiences (predominantly text-editors) too often remain vestiges of traditional teaching. These tools, as we’ll argue in this thesis, don’t support educators in creative work which is why we’re proposing a class of tools more in line with the values and styles of the creative educators we know and work with. We can’t just make the good stuff for the kids, right? We should make great tools for teachers too.

This section introduces the central questions, goals, and design principles of our research. It ends with a brief overview of the rest of the thesis. Before we get ahead of ourselves, we’ll start with a brief vignette.

We met JC during the course of our research. JC has taught high school math in New York City public schools, led instructional teams, coached public school teachers, and mentored candidates preparing to begin careers as educators. While JC describes teaching as rigorous intellectual and creative work, she explains that the tools educators often use to do their work – from preparing learning experiences to working with students – often don’t feel like ‘creative tools.’ They don’t feel like tools meant to support creative work or a creative profession. Rather, the tools she used in her day-to-day work often felt like bureaucratic tools, intended for reporting and narrating.⁶

⁴ bell hooks. *Teaching to Transgress: Education as the Practice of Freedom*. Routledge, 1994.

⁵ Seymour Papert’s forward in Resnick, Mitchel. *Turtles, Termites, and Traffic Jams: Explorations in Massively Parallel Microworlds*. MIT Press, 1994.

⁶ Synthesis of a conversation with a faculty member at a graduate school of teaching in January 2020.

This dilemma – the tension between traditional tools and creative practice – lies at the heart of a broader set of questions facing our education systems. As educators like JC attempt to pivot from industrial schooling to the kinds of creative learning that might prepare a generation of creative citizens, they're confronted with outdated infrastructure⁷: tools, organizational structures, cultures, paradigms, and practices rooted in what Freire might describe as a banking model of education⁸ or what Papert might describe as instructionist.⁹ These barriers are compounded by long standing equity issues and increasingly complex global crises, including the COVID-19 pandemic taking place during the writing of this thesis.

While there has been much attention paid to the importance of evolving school cultures¹⁰, teaching practices, professional development¹¹, curriculum, and content standards¹², there has been less attention directed at the tools that educators use in their day-to-day work. In this thesis, we focus on a subset of these tools: the tools educators use to design creative learning experiences.

Creative learning experiences encourage participants to work on **projects** that they're **passionate** about with **peers** in a **playful** way.¹³ We use creative learning as a more accessible way to describe a *constructionist* approach to learning.¹⁴ As Seymour Papert explains: "Constructivism is the idea that knowledge is something you build in your head. Constructionism reminds us that the best way to do that is to build something tangible – something outside your head – that is also personally meaningful."¹⁵ Creating something tangible can take many forms, ranging from a physical or digital artifact to a community organizing initiative. The point is that learners are engaged in design, iterating their ideas, testing them, and developing new skills and strategies along the way.

The below images show examples of what creative learning might look like in very different contexts: a design course at Olin College and a Family Creative Learning workshop for low-income families. In the design course, university students work on semester-long projects where they create products for particular groups of users. They dive deep into research, prototype their ideas, and refine their projects through cycles of feedback and testing. In Family Creative Learning,

⁷ For a discussion of the challenges of school reform, see Tyack and Cuban 1997, *Tinkering Toward Utopia*. For more contemporary work on the challenges to breaking from industrial learning see McGrath and Martinez, *Deeper Learning: How Eight Innovative Public Schools Are Transforming Education in the Twenty-First Century* or Fine and Mehta, *In Search of Deeper Learning*.

⁸ Freire, Paulo; Bergman Ramos, Myra;. "Pedagogy of the Oppressed." Apple Books.

⁹ See Seymour Papert's discussion of instructionism in *The Children's Machine*.

¹⁰ For example, see Valenzuela's discussion of caring teaching cultures in contrast to subtractive teaching cultures: Angela Valenzuela (1999). *Subtractive Schooling: U.S.-Mexican Youth and the Politics of Caring*. Albany: State University of New York Press. Chs. 1 and 3 (pp. 2-6, 61-113).

¹¹ See Brennan 2015 for a concise synthesis of recent constructivist professional development efforts and a description of one particular example.

¹² See Perkins 2014 for a thoughtful synthesis of competing visions for education. Perkins, D. (2014). *Future Wise: Educating our Children for a Changing World*. San Francisco: Jossey-Bass, "Introduction: Learning for Tomorrow" and "Chapter 1: Lifeworthy Learning" (pp. 1-25).

¹³ Mitchel Resnick, *Lifelong Kindergarten*. MIT Press. 2017.

¹⁴ See Aaron Falbel. [Constructionism: Tools to Build \(and Think\) With](#). LEGO DACTA, 1993.

¹⁵ Papert 1988. For more on the differences between social constructivism and constructionism, see [Ackerman 2004](#).

families participate in a series of workshops where they create personally meaningful projects using Scratch, Makey-Makey, and craft materials. Across these contexts, participants are engaged in challenging, open-ended¹⁶ projects; they develop skills while working on something meaningful; the work is often collaborative and iterative; and the process is usually playful.



Figure 1.1
Image of a student team's workspace from a design course at Olin College created by Ela Ben-Ur.

Note how the students organize their thinking in myriad forms: posters at the top with user personas that evolve as the project unfolds; post-its that they've clustered and grouped in different ways. Some represent early ideation, others visualize attempts to organize their thinking.

¹⁶ A narrow project is more prescriptive (e.g. design a bridge with X constraints). An open-ended project involves figuring out not just how to build something (e.g. a bridge under x constraints) but also what to build. Open-ended projects leave more room for student autonomy and agency.



Figure 1.2
Families making together during a Family Creative Learning workshop developed by Ricarose Roque and collaborators.

In focusing on the tools educators use to design creative learning experiences, we hope to emphasize the unique challenges facing this kind of work. Creative learning experiences are generally non-traditional: they break from the assumptions, paradigms, and practices of industrial education. As we'll examine in more depth, industrial approaches emphasize information transfer and prioritize teaching students to follow instructions and master routine tasks. An educator working under the constraints of an information-centric system might develop a fixed curriculum, work from stable lesson plans, or plan for a group. In contrast, educators who support creative learning help students think independently and nurture their creativity. These educators cultivate cultures, plan open-ended projects, prepare spaces where learners might work (these can be physical or virtual), and regularly adapt their plans and strategies in response to student explorations, interests, and changing conditions. Design for a creative educator is an unfolding process that begins well before a learning experience and continues through the experience.¹⁷

This is precisely why we use the word ‘design’ to describe how educators develop creative learning experiences. Design involves “having a conversation with the materials of a situation”¹⁸ and is deeply iterative and reflective. As a designer develops representations (e.g. plans, strategies, activities, tools), they engage in a complex making process involving a range of moves, norms, and relationships, often producing both intended and unintended consequences. Consequently, design involves reflecting-in-practice and forming new understandings and plans based on things that arise during the process.¹⁹ Even if an educator has facilitated a workshop or project before, they design for specific students and situations—and continue to adapt as things inevitably evolve. In

¹⁷ For an example of a professional development initiative that engages educators as designers, see Brennan, Karen. 2012. ScratchEd: Developing support for educators as designers. Designing with teachers: Participatory professional development in education. Edited by Erin Reilly and Ioana Literat. http://web.media.mit.edu/~kbrennan/files/Brennan_ScratchEd_Meetups.pdf

¹⁸ Schön, D. (1983). The reflective practitioner: How professionals think in action. London: Maurice Temple Smith Ltd.

¹⁹ Ibid. We've spent time explaining what we mean by design upfront because the term means so many different things to different people. We've also largely drawn on Don Schön's explication of design as it aligns strongly with how we see design as a general form of reflective practice with many local variants.

this sense, their design work is inventive and resourceful.²⁰ It is also highly personal, and leaves wide scope for each individual to approach design in distinct ways (something we'll see in our case studies). This is why we describe designing and facilitating learning as creative work.

As we'll explore more deeply in the following chapter, the tools most educators use to design learning experiences are not meant to support design-based work as described above. Consequently, there is more urgency to develop tools better suited for supporting creative teaching.

Goals

We have three principal goals in rethinking the tools educators use to design creative learning experiences:

1. **Lower the floors:** reduce barriers for designing these kinds of experiences, especially for people who are new to teaching.
2. **Widen the walls:** involve educators from backgrounds and domains often not perceived as creative (e.g. health education) as they seek to transition to more creative forms of learning and teaching.
3. **Raise the ceilings:** empower experienced educators to extend their craft.

These three goals²¹ guide our efforts to develop what we're calling creative learning design tools.

Design Principles: Tinkerable, Personal, and Collaborative

We will argue that creative learning design tools are more tinkerable, more personal, and more collaborative than traditional tools.

²⁰ This explanation of 'design' is adapted from the Stanford d.school's Starter Kit. If you're looking for a hands-on introduction to what design might mean for you, we recommend trying out their workshop with some peers: <https://dschool.stanford.edu/resources/dschool-starter-kit>.

²¹ We've adapted these goals from a formulation commonly used in the Lifelong Kindergarten group when designing creative learning technologies and activities. For a succinct explanation of designing for low floors, wide walls, and high ceilings see <https://bit.ly/MresTenTipsDesign>. For more detail, see Mitchel Resnick. *Lifelong Kindergarten*. MIT Press. 2017. It's important to note that Resnick uses this metaphor in a more complex way. For example, Resnick describes wide walls as supporting a diversity of backgrounds, interests and styles. We use the wide walls metaphor in our goals to refer to how this tool might support different backgrounds and kinds of projects.

Creative tools are **tinkerable** in that they support an iterative style of engaging by making it easy to get started, play with digital materials (images, text), get immediate feedback, and experiment with different possibilities. Tinkerable interfaces encourage low-stakes prototyping and allow users to externalize their ideas in forms they can interact with (e.g. images, spatial representations), enabling them to think through making. This in turn creates space for iterative, bottom-up planning: as one plays with possibilities and materials, one can adapt plans and strategies.²² It also makes it easier to remix and repurpose materials.

These tools are **personal** in that they support different epistemological styles — ways of thinking, organizing, and expressing ideas.²³ When people are able to work in ways that feel authentic, they're more able to engage in creative work, and in this case, creative teaching.

Finally, these tools are **collaborative** in that they offer new opportunities for collaborating from the early design of a learning experience through the end of the experience itself.

We'll revisit these ideas in greater depth in the chapters to come and describe how tools that apply these principles better empower creative teaching.

Thesis Overview

In the next section (**motivations**), we'll expand on why we're proposing the idea of a creative learning design tool. We then describe some of the **related work** that has shaped our research. This includes a discussion of approaches to designing and documenting learning experiences, challenges that educators face with current tools, and lessons from other domains that might offer inspiration for a creative learning design tool.

Next, we introduce our **methodology and design process**. This includes a discussion of how we developed the idea of a creative learning design tool, how we repurposed existing tools as creative learning design tools, and why we focused on repurposing existing tools over developing our own tool.

Finally, we jump into our **case studies**. As we explain in more depth, we have organized the cases around our three goals: lowering the floors, widening the walls, and raising the ceilings for creative learning design.

The **first case study** examines how we aimed to lower the floors to creative learning design with teacher candidates at a graduate school of education. We describe how we repurposed a range of analog and digital tools as creative learning design tools and reflect on what tools and features best supported the teacher candidates.

²² See Resnick and Rosenbaum 2013. We'll discuss their ideas in more depth in the next chapter.

²³ See Turkle and Papert 1990.

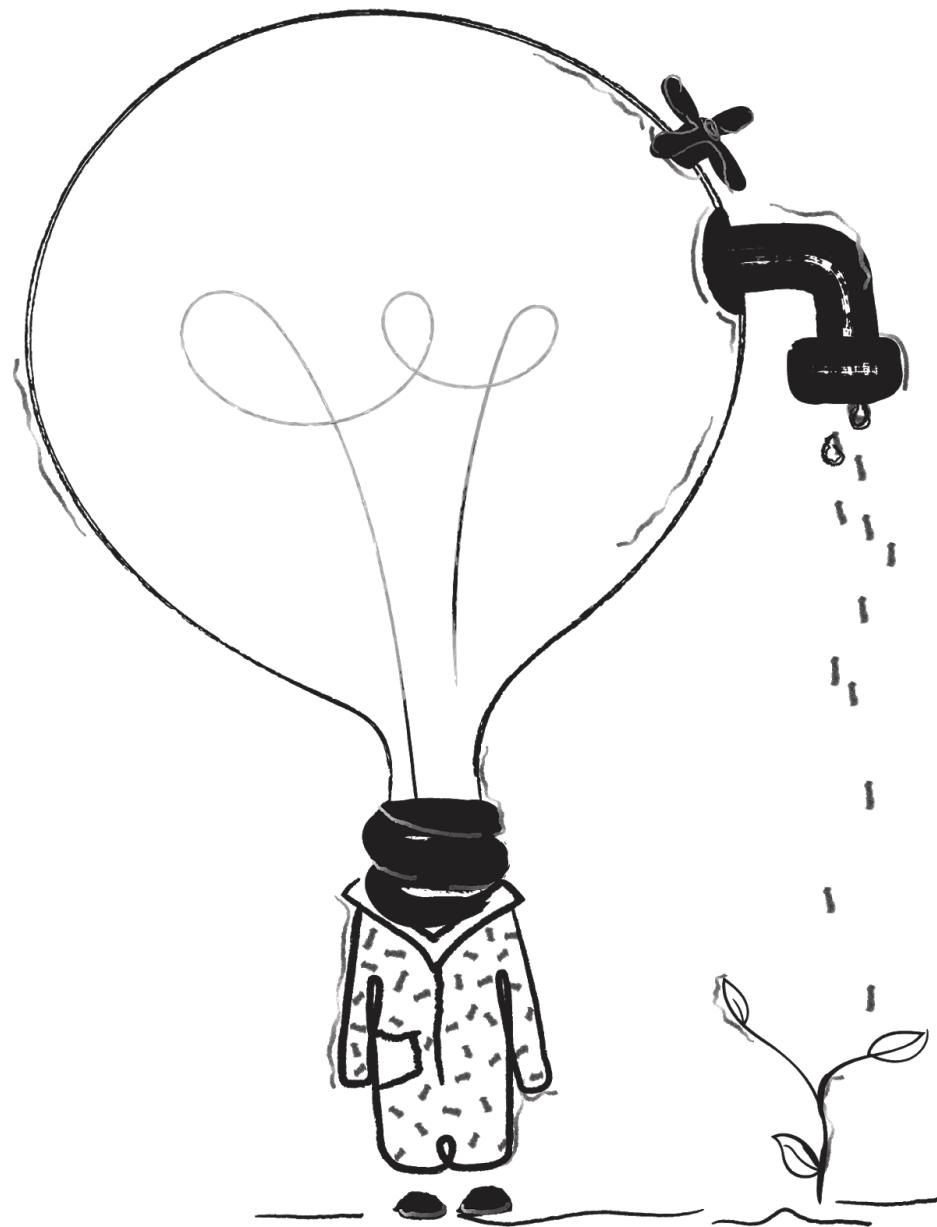
The **second case study** describes how a group of educators at a large public high school used a creative learning design tool to introduce ambitious, project-based learning experiences. We describe how we repurposed Trello and Milanote as creative learning design tools and why the latter (Milanote) better supported our goals and principles.

Our **third case study** explores how educators in low-constraint settings used Milanote as a creative learning design tool to deepen and extend their teaching practices. We illustrate how Milanote supported diverse epistemological styles, encouraged educators to tinker with ideas, and empowered iterative facilitation practices by making it easier to document and interact with open-ended student work in digital spaces.

We end the thesis with **final reflections**. This includes a discussion of general insights from the different cases; ideas for further research; and tips for those interested in developing creative tools for educators.

A Final Introductory Note

While we are passionate about the ideas and possibilities presented, we want to emphasize that we're only just beginning to explore a new terrain (creative tools for educators). Our goal in presenting concrete cases is not to suggest that we have found the best tools or strategies for creative teaching, but to rather use these examples to introduce a set of ideas and questions — questions we hope might provoke you to imagine future possibilities and experiments in this rich and emerging terrain.



Chapter 2 Motivations

2. Motivations

In this section, we elaborate on why we aim to rethink the tools educators use to design learning experiences.

In part one of this chapter, we explain how creative learning design tools might empower educators – through opening black boxes, offering tools to think with, and creating opportunities for experiential learning and iterative design. To situate how tools to think with are different from existing tools used in teaching, we unpack two paradigmatic shifts: from industrial, information-centric to creative approaches to learning and from analog to digital-first approaches to tool design.

In part two, we explain how creative learning design tools might generally impact education systems: by enhancing opportunities for bottom-up innovation and leveraging tools as a lever for changing practices and paradigms.

2.1 How Creative Learning Design Tools Might Empower Creative Teaching

Opening up the black box of creative learning design

Designing creative learning experiences is often unfamiliar territory and can be a daunting task, especially for beginners. Trying to understand how others have done this work can feel like trying to open-up a black box: you know it when you see it but it is unclear how it works.²⁴ To elaborate on what is at stake and show what I mean by opening-up black boxes for creative learning design, I've decided to share parts of my journey to creative learning.

My journey to creative learning and teaching

From 2008 to 2018, I taught in a range of contexts: from tutoring low-income youth in New York City in math to teaching at a pan-African University in Mauritius. During that time, my ideas about learning continually evolved as I learned with and from my students. I also learned through observation (seeing friends and colleagues teach was a revelation), reading (starting with practice

²⁴ We borrow the phrase 'black box' from two traditions: research at the Media Lab that sought to bring transparency to scientific tools (see Resnick et., al 2000) and research in sociology and history of science that describes how scientific work (tools, theory) can become artifacts that are taken as true in ways that congeal how they work (see Latour 1988).

focused literature such as ‘backward design’ and moving to theoretical constructivist literature), and studying “innovative” educators and institutions.

As I discovered project-based learning (through *Most Likely to Succeed*, a film on High Tech High) and browsed High Tech High’s publicly available resources (e.g. UnBoxed magazine, project based learning kits), I hoped to be able to “see inside” the underlying design decisions, rationale, and thinking behind how and why they designed and facilitated projects in particular ways, to learn about what might have worked and what didn’t in their particular context, and to hear how they might have tweaked and iterated their approaches over time – with the hope of learning from their experiments as I embarked on similar work.

My desire to ‘see inside’ particular kinds of learning experiences exploded when I discovered the work of Seymour Papert, Mitchel Resnick, and the Lifelong Kindergarten group. As I read *Mindstorms, the Children’s Machine*, preprint excerpts of *Lifelong Kindergarten*, and countless papers from the group, I longed to see examples of this work brought to life, with rich commentary on why and how experiences were designed in particular ways. This led me to join the Lifelong Kindergarten group.

During my two years in Lifelong Kindergarten, I designed, facilitated, and participated in workshops and courses with colleagues. I learned through legitimate peripheral participation, developing my understandings and intuitions about creative learning as part of a community of practice.²⁵ I created with others, reflected-in-action (during an experience, while planning), and reflected-on-action (after an experience, retrospectively).²⁶ These experiences offered me new visibility into the manifold considerations, assumptions, and perspectives that shape how the group designs everything from a two-hour workshop to an online tutorial or new creative tool.

However, I began to notice that the materials and tools we used to plan learning experiences – often text-editors – didn’t embody the values we advocated for in materials and tools in children. As I’ll explain in more depth, the tools we used when designing experiences weren’t tinkerable in that they made it difficult to play with digital materials (images, media), prototype experiences, spatially represent ideas, or explore parallel ideas. These tools didn’t support diverse epistemological styles as thinking needed to be shown in words. And they were limited to text-based collaboration that made it difficult to share one’s thinking or process with others.

These challenges become particularly acute when looking beyond our research group: much of the design work of our group remains a black box to those outside of it. While the group’s papers and publications outline some of the design thinking and rationale behind our work, it remains difficult to understand or learn more about our design decisions. And while our group has developed

²⁵ Lave, Jean; Wenger, Etienne (1991), *Situated Learning: Legitimate Peripheral Participation*, Cambridge University Press.

²⁶ I borrow these terms – reflection-in-action and reflection-on-action from Don Schön’s *Reflective Practitioner*.

colorful resource guides that represent some of our values and thinking, the guides are not easily remixable or appropriable.²⁷

To be fair, there is so much thinking that goes into designing and facilitating even a two-hour workshop. To unpack that is no trivial undertaking. As Deborah Ball explains in her work on discretionary spaces and micro-moments²⁸, a teacher makes hundreds of decisions in the course of a single day of teaching; these are interactions that could be overwhelming to describe when documenting even a single workshop or class. To say the least, sharing some of these considerations, both within a community and especially outside it, is a ‘wicked problem’.²⁹

This led me to find co-conspirators to explore these questions with. We scoured the landscape for examples of how other educators and researchers had tried to share their thinking with others. Some of the examples we analyzed included work from the Lifelong Kindergarten community (e.g. [Family Creative Learning](#), [Scratch Educator Guides](#), the [Playful Invention and Exploration Network](#)), efforts to open-up project based learning ([PBLWorks](#), [High Tech High](#)), and resource exchange websites and educator communities (from [ScratchEd](#) to [Instructables](#), [Teachers Pay Teachers](#), [OER Commons](#), and Curio Learning). Despite their differences, these examples generally shared resources in a similar manner: static documents (usually PDFs) that were generally text heavy, difficult to remix, and even more challenging to quickly understand both ‘what’ was being shared and the underlying design thinking behind it (the why). While there is an increasing shift to resources that can be “remixed”—that one can copy and adapt—even these resources are not very easy to adapt as we’ll discuss later.

During this time, we also began to observe a range of educators as they designed creative learning experiences (from two-hour design-thinking workshops to computing classes in a public middle school). As we watched educators design and listened to them reflect on their process, we discovered another opportunity: the tools educators used to design in aren’t well suited to the kind of work they’re doing. Although they might use post-its or paper to sketch out ideas, they usually only turned to digital tools to document their thinking so they could revisit it.

Their digital tools weren’t tools to think with.

²⁷ For an example of beautifully designed educator guides, see Scratch Educator Guides. While practical and useful for many educators, they’re not easy to change (both due to the PDF format they’re shared in and because an educator might not understand why a guide is constructed in a particular way).

²⁸ For a brief explanation of Ball’s work and an example of her analyzing a 88-second clip of teaching, see Jill Barshay 2018. “[20 judgments a teacher makes in 1 minute and 28 seconds](#).” The Hechinger Report. For her more recent work discussing the importance of collaborative documentation, see: Deborah Loewenberg Ball, Miriam Ben-Peretz & Rhonda B. Cohen (2014) Records of Practice and the Development of Collective Professional Knowledge, British Journal of Educational Studies, 62:3, 317-335, DOI: 10.1080/00071005.2014.959466.

²⁹ Many designers use the phrase ‘wicked problem’ to describe particularly complex challenges.

Tools to think (and tinker) with: Creative tools for educators

In this section, we argue why a new approach to thinking about tools for educators might unlock new possibilities for educators. Before introducing our alternative approach, we need to first unpack the paradigms that shape how many people currently think about and design education technologies. Critiquing these paradigms will then point the way for opportunities to rethink how we design tools for educators.

In the second part of this section, we explain how ‘tinkerability’ offers a powerful lens for designing contexts where educators can develop their own intuitions about learning and teaching.³⁰

Breaking from analog and industrial paradigms for thinking about education technologies

When one examines education technologies, from tools used for authoring content to tools used to support sharing and collaboration, we see legacies of both analog infrastructure and traditional ways of thinking about learning – legacies that impede efforts to develop tools to think with.

Let’s start with an analogy: factories originally began using electricity through generators installed in the factory. Machines and work were clustered around these central power sources. This organization largely remained in place after the electrical grid was introduced and equipment no longer needed to be arranged around a generator. Even when new factories were designed without a central generator and with access to the electrical grid, machines remained clustered in the same ways. It took 30 years for managers to take advantage of the electrical grid and reorganize equipment around workflow, doubling and even tripling productivity.³¹ Similarly, the first moving pictures were simply recorded plays. It took a new culture and different ways of thinking about the possibility of video for cinema to emerge.³²

We can extend these analogies to the tools educators use along paradigmatic and technological fronts.

From analog to digital-first approaches to tool design

Digital technologies used in education remain tied to the analog tools they replaced. Although the transition to digital and cloud-based tools opens up all kinds of possibilities for creative and collaborative interaction, these opportunities have largely been built on the foundation of the

³⁰ Brennan 2015 explains how constructionist professional development offers space for remodeling intuitions. Here we consider how constructionist tools might create space for similar work.

³¹ Joi Ito. “Whiplash: How to Survive Our Faster Future.” iBooks

³² Papert. “[A Critique of Technocentrism in Thinking About the School of the Future](#).” In Children in the Information Age: Opportunities for Creativity, Innovation and New Activities 1988:3-18.

analog tool a digital tool is based on. It's possible to identify at least two phases of digital design: a first stage that brings analog tools to a digital medium and a second that adds networked, collaborative capabilities. The below table outlines some examples:

Analog Version	Gen 1: Digital Versions of Analog Tools	Gen 2: Adding online collaboration
Paper / Notebook	Text-editor (MS Word)	Online Text-editor (Google Docs)
Canvas	Paint-editor	Paint-editor in the cloud
Post-its	Digital Post-its	Post-its in the cloud (Padlet, Mural)

Table 1: Evolution of tools used in learning design

As Table 1 suggests, many digital tools are designed as digital (and later networked) versions of analog tools. To be clear, the shift to digital mediums has yielded important benefits.

Browser-based text-editors have made it easier to work collaboratively and have offered important improvements on the writing experience. Similarly, digital whiteboards and post-it note applications (e.g. Padlet) have increasingly leveraged a blend of cloud-based technologies, online communities, and remixable templates to create new opportunities for collaborative work, especially when people are not in the same physical space.

However, new possibilities emerge when we begin not from analog tools but from user needs and aspirations. Collaborative thinking and planning tools like Miro, Mural, and Milanote offer an important example of what this could look like. Instead of creating digital versions of analog tools (e.g. post-its or whiteboards), the design teams at these organizations observed how people engage in creative work. This led them to design interactions that might help users do particular things. For example, Mural honed in on the challenges faced by facilitators who design and facilitate workshops online and designed features that made it easier to create space for shared conversation and ideation. While they drew inspiration from whiteboards and post-its, they didn't use analog tools as their primary departure point for design. Similarly, the Milanote team closely followed creative projects across industries and designed an interface that responded to the needs and aspirations of individuals and communities engaged in creative work.³³

³³ Interview with Ollie Campbell, one of the founders of Milanote, May 2020.

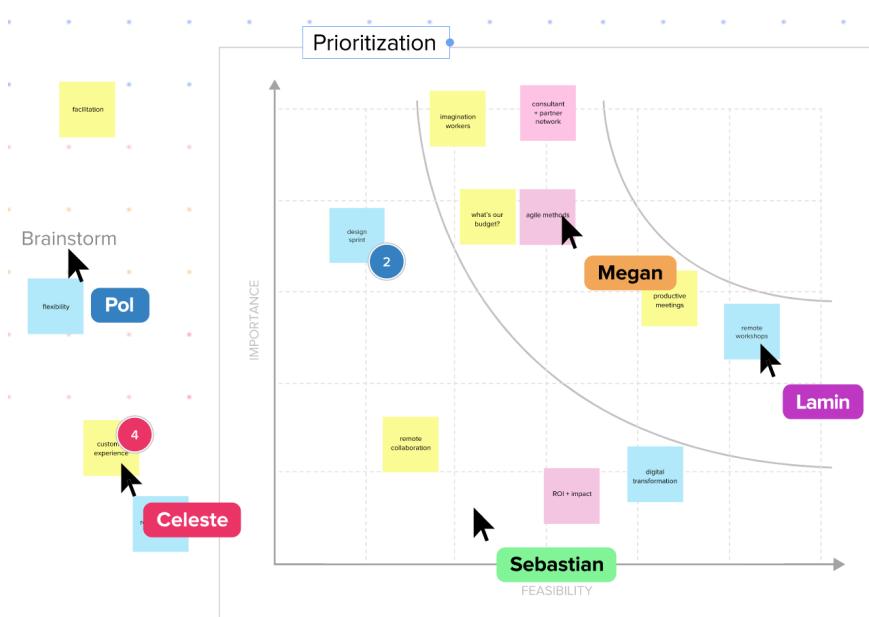


Figure 2.1

Mural, a collaborative digital workspace, draws inspiration from analog tools (post-it, whiteboards) but does significantly more because it is designed with user aspirations and needs in mind.

A needs-first approach to tool design might similarly create new opportunities to support creative learning design and facilitation. However, this requires not only thinking about the possibilities of digital and connected technologies, but also addressing the paradigms and assumptions that characterize our current generation of tools—and that shape how we think about user needs and aspirations.

Although there is increasing recognition of the need to shift to more project-based and creative forms of learning and teaching, tools continue to be designed from instructionist, content-focused paradigms. It's worth taking a moment to unpack these paradigms as they form the basis of unstated assumptions that shape how many developers and educators think about learning, teaching, and education technology. Doing so will help us understand why education tools continue to be designed and used in ways that reinforce traditional paradigms and practices.

Unpacking instructionist paradigms in education technologies and in tools used for learning design

By instructionist, we refer to an ideology that emphasizes that learning is fundamentally about knowledge and information acquisition. Although content is increasingly out of style and ‘skills’ are now in-vogue, skills are often cast in the same way as content and information were: just as content was delineated, schools now outline skills into detailed lists of competencies that students are expected to acquire in ways that resemble how they were expected to acquire content. The role of the teacher in this view is to primarily instruct students through explanation and guiding students in discrete activities. While constructivist ideas have seeped into traditional systems, the focus remains on narrow knowledge acquisition—learning fragmented skills through isolated practice and a blend of direct and indirect instruction. This might involve working on narrow

algebra problems (see below) or studying biology by reading about phenomena and at most conducting narrow, constrained experiments.

In the following polynomial, identify the terms along with the coefficient and exponent of each term.

$$3x^2 - 8x + 7$$

Terms: $3x^2$, $-8x$, 7

of each of the terms.

0:48 / 2:35

Add polynomials (intro)

CCSS Math: HSA.APR.A.1, HSA.APR.A

Google Classroom

Facebook

Twitter

Add.

Your answer should be an expanded polynomial in standard form.

$$(-2k^3 - 7k^2 + 5k) + (6k^2 + 3k) =$$

Stuck? Watch a video or use a hint.

The parts of polynomial expressions

Figure 2.2. Khan Academy's introduction to polynomials.

Math ▾ Algebra 2 ▾

A | Variable expressions

- A.1 Evaluate variable expressions involving integers
- A.2 Evaluate variable expressions involving rational numbers
- A.3 Simplify variable expressions using properties
- A.4 Sort factors of single-variable expressions
- A.5 Sort factors of multi-variable expressions

B | Equations

- B.1 Solve linear equations
- B.2 Solve linear equations: word problems
- B.3 Solve equations: complete the solution

Solve for c .

$$19 + 7c = 4c - 20$$

$c =$

$8z + 14 = -14 + 10z$

$z =$ Incorrect

The correct answer is:
 $z = 14$

Remember

To solve for a variable, use inverse operations to undo the operations in the equation. Be sure to gather like terms and to do the same operation to both sides of the equation.

Submit Got it

Figure 2.3. IXL's introduction to variable expressions.

An instructionist view isolates explanation from an educator's other roles (facilitator, collaborator, coach, connector, etc.). In other words, the teacher in an instructionist (or as Freire might describe,

a banking) perspective is seen as a vehicle for transferring (or depositing) knowledge.³⁴ Consequently, the role of technology in supporting an educator within an instructionist frame is to support the transfer of information (or of narrow, fragmented skills). Even recent efforts to support teachers often extend their ability to transfer information through enhanced analytics or auto-grading tools.

We see these ideas clearly in curriculum documents that privilege the role of explaining information over that of creating opportunities for children to construct knowledge. With the introduction of computers, educators increasingly used text-editors to prepare classes because they were organizing information that they would convey to students. As others have argued, computers were assimilated into existing school cultures and practices.³⁵

Creative educators also explain ideas and guide their students, but they do so as part of an environment where learners actively construct knowledge through working on projects. Consequently, the role of a creative educator is much more varied, and places a greater emphasis on designing cultures, materials, spaces, and opportunities for learners to construct knowledge and work on projects that are meaningful to them.

As we move from an information transfer paradigm of learning to one organized around the active construction of knowledge through construction in the world, educators have begun to develop thoughtful strategies for developing creative learning experiences. They've harnessed protean tools like Scratch and drawn on powerful peer-communities (e.g. Teachers Guild, Transcend) and networks (Expeditionary Learning) to design powerful experiences. In the process, many have hacked together approaches for tinkering with their design work (e.g. using whiteboards, post-its, or sketch pads) or repurposing tools like text-editors, spreadsheets, and virtual whiteboards for collaboratively planning creative learning experiences.

³⁴ This is inspired by Seymour Papert's discussion of instructionism in *The Children's Machine*. See also Paolo Freire's Pedagogy of the Oppressed: "A careful analysis of the teacher-student relationship at any level, inside or outside the school, reveals its fundamentally narrative character. This relationship involves a narrating Subject (the teacher) and patient, listening objects (the students). The contents, whether values or empirical dimensions of reality, tend in the process of being narrated to become lifeless and petrified. Education is suffering from narration sickness."

³⁵ See Papert 1997, "Why School Reform is Impossible."

Imagine - 10am

- Pre-start:
 - Hand out note-cards: What is one thing I'd like to learn today? (otherside for one thing I've learned).
- Intro (5 mins) (Hlengiwe)
 - Welcome
 - Icebreaker: "Act out the first letter of your name, then say your name! Everyone else follow along"
- Expectations (10 mins)
 - What is one thing you hope to learn today? (8 mins - 30secs/person) (Senzo)
 - Intro to day's activities / agenda (2 mins) (Yusuf) - Imagine, Create, Share, Reflect
- Educational context: (5 min) (Yusuf)
 - Scratch is free coding environment, around the world, 40+ languages, ages 8 and up, available offline, part of the formal curriculum roll out for next year.
 - Hear from educators who use Scratch: Why Scratch for Learning Video (2 mins)

Create - 10:20am (40 minutes)

- Create an [example](#) / demo (5 minutes): Yusuf
- Project Time (Everyone): 35 minutes
 - Animate a letter with a partner (5-10 mins)
 - Option - continue with the same partner, work alone, or join someone else (30mins)

That said, the vast-majority of educators we interviewed primarily use text-editors in designing learning experiences. And as many of them noted, there are important constraints with using tools like text-editors in creative design work. Text-editors were designed for articulating linear narratives – documents like this thesis follow a progression, from top to bottom, left to right. As you read this paragraph, it's not easy to explore another section in parallel – to do that you would need to scroll to that section or open another copy of this document in another window so you can compare ideas. In short, text-editors aren't designed to support “parallel thinking”: exploring multiple ideas, themes, or examples at once (or side by side). They're also not designed to support interactions tailored to different learners, which makes text-editors especially challenging to use when preparing or facilitating open-ended, project-based experiences where learners might move at different paces, pursue diverse interests, or struggle with varying challenges. As we'll show in the case studies, text-editors might be useful for quickly jotting down ideas, but quickly become burdensome for educators engaged in designing and facilitating project-based experiences.

Tinkerability

Some of these challenges arise because text-editors aren't the most **tinkerable** medium for designing learning experiences. As Resnick and Rosenbaum explain, “When people are tinkering, they are constantly trying out ideas, making adjustments and refinements, then experimenting with new possibilities, over and over and over.”³⁶ This explanation of tinkering echoes how many creative educators describe their work. When they design, they’re trying out ideas, adapting them for different students and situations, and experimenting with possibilities. In our interviews,

Figure 2.4

Using a text-editor to design a creative learning experience. This is from an actual workshop facilitated by Hlengiwe Mfeka, Yusuf Ahmad, and colleagues in Kwa-Zulu Natal, South Africa, March 2019.

³⁶ Resnick and Rosenbaum 2013.

creative educators described how they might prepare an experience: they would often try out the activity they had in mind with the goal of “having a conversation with the materials and experience”³⁷—a process they use to explore what to try with learners. In other words, they continually tinkered with design and facilitation. When we asked how they used tools to document or reflect on their work, they often described existing tools as feeling more like a place to document and less like a place to tinker.

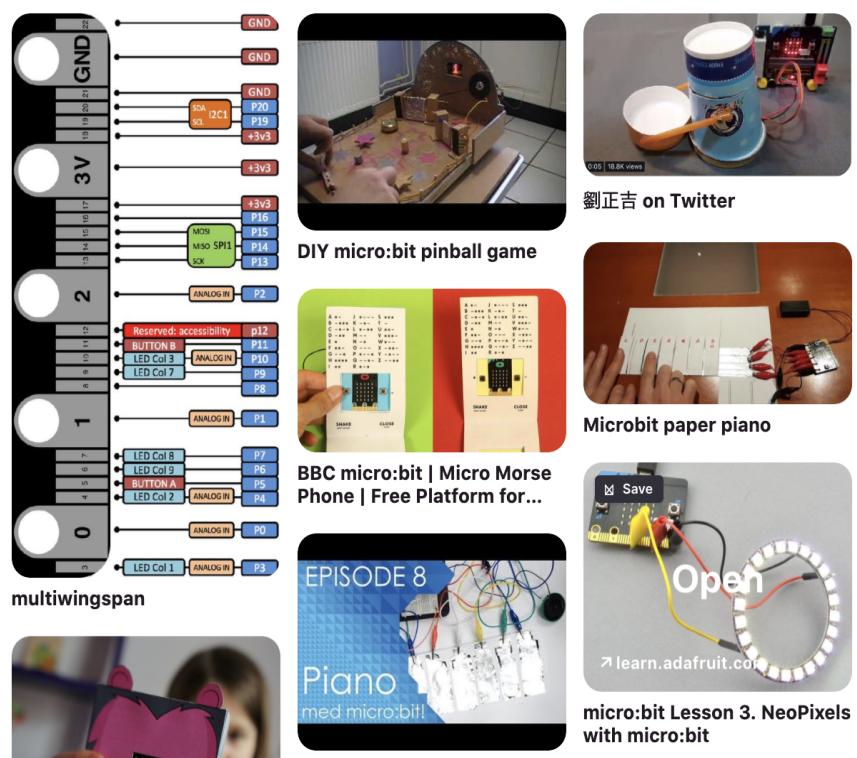
We would argue that this is partially attributable to the fact that most educators don’t use *tinkerable* tools for designing and reflecting on learning experiences. While some had discovered places to organize inspiration (Pinterest, Are.na), they often struggled to find places to think through parallel ideas or experiment with possibilities.

This contrasts starkly with other creative fields. Take for example the growing field of interface design, where designers use tools like Figma, Sketch, or Adobe XD to experiment with possibilities, organize inspiration, and sketch out ideas to try. Unlike ‘parametric tools’ where one needs to already have an understanding of a design before inputting it into a digital system, these newer design tools allow designers to think with the material: they can easily move a range of objects around on their design canvas, have access to increasingly powerful prototyping features that allow them to simulate interactions, and can in many ways organize their thinking and design work in whatever ways make sense to them *personally*. Moreover, cloud-based systems make it easier for designers to work together across the design cycle, enriching all aspects of their ‘creative spirals’. We’ll discuss what we can learn from these tools in more depth in the next section.

³⁷ Interview with an educator, October 2019.

Figure 2.5

A creative educator uses Pinterest to collect things she finds inspiring. She organizes what she finds into thematic collections that link to the original resources. ZB and other educators described Pinterest as a powerful “tool to think with” in their design process and often one of the first places they go when designing or revisiting a learning experience.



Why does tinkering matter for creative educators? And why might a tinkerable design tool help?

Creative educators design open-ended experiences. While they might design a project so students can develop particular skills (e.g. computational thinking or problem solving), the exact outcomes going into a workshop or a multi-week project aren’t known going in: they emerge as students pursue projects and ideas. Consequently, creative educators are constantly improvising, adapting, and iterating as new situations arise.³⁸

As educators and students deal with an increasingly uncertain world – especially urgent under the ongoing COVID-19 pandemic – a tinkering approach to planning, design, and facilitation is especially important to educators of all stripes. Tinkering encourages lower-stakes decision making and experimentation and offers more space to reflect on changing conditions. Moreover, a tinkering approach invites educators and students to think and design in different styles, celebrating what Turkle and Papert (1990) describe as “epistemological pluralism.”³⁹ They argue for

³⁸ This mirrors how Resnick and Rosenbaum describe tinkering in contrast to traditional planning in Resnick and Rosenbaum 2013.

³⁹ For why this is important, see Papert’s discussion of planning and tinkering approaches in Chapter 7 of *The Children’s Machine*. Also see bell hooks discussion of creating room for multiple forms of expression and identity in *Teaching to Transgress*.

the importance of both planner (top-down) and bricoleur (bottom-up) approaches to computation and construction, ideas that we hope to extend to the development of tools for educators.

Additionally, a tinkerable learning design environment might offer a context for educators to develop their intuitions for and about creative learning. In *Mindstorms*, Papert describes children as epistemologists who use programming as a context for exploring and reflecting on their own thinking. Logo in this sense was a tool for the children to think with: it encouraged children to (a) externalize intuitions when they program, making their intuitions more visible and accessible to reflection and (b) provides a context for remodeling intuitions.⁴⁰ Educators play a double role: they're both designing contexts for children to become epistemologists and reflecting on their design and support for those environments. Consequently, a tool to think with might make it easier for educators to externalize their intuitions while offering a context for remodeling those intuitions with others.

The Lifelong Kindergarten (LLK) group has applied these ideas to great effect in developing creative tools for children.⁴¹ We're interested in bringing these ideas to educators, leaving us with these questions: **How might we bring the tinkerable spirit of technologies for children to the design of technologies for educators?** How might designing learning experiences feel more like a form of hard fun? More like sketching and less like filling in a report to submit to your supervisor (which is often the role that documentation plays in educational settings)?

Moving from abstract descriptions to tinkerable building blocks

How most people currently talk about learning is often abstract, focusing on concepts without getting into how they might manifest very differently across contexts and interpretations. Different organizations can explain that they use project-based learning, but this concept level description can mask vast differences in approaches. For example, NuVu Studios (a private high school) organizes learning around two to three week-long projects that are a student's primary focus (there are no classes). Students exclusively work on their project and develop skills (e.g. they might attend a workshop or watch YouTube tutorials) in the context of working on their project. High Tech High similarly invites students to work on extended projects, but these projects are situated in disciplinary courses (e.g. English Language Arts and Physics in a project that might involve collaboration between courses). Or yet another educator (e.g. at a KIPP school) might have students work on a weeklong project at the end of a unit, once they've worked on developing certain skills or reviewing particular content. The project in this KIPP example is the dessert, not the main course.⁴²

⁴⁰ Papert 1980, 145.

⁴¹ See Resnick et., al (2009). Scratch: Programming for all. Communications of the ACM 52(11): 60–67.

⁴² For a critique of short projects at the end of a unit (the dessert), and how this is different from project-based learning as “the main course,” see John Larmer and John R. Mergendoller. “THE MAIN COURSE, NOT DESSERT: How Are Students Reaching 21st Century Goals With 21st Century Project Based Learning.” Buck Institute for Education. 2010.

These are all very different interpretations of project-based learning — differences that are lost when we remain at the concept level. In this sense, abstract descriptions and buzzwords can make it difficult to surface nuances, details, opportunities, and tensions. This can also be the case in lesson plans, where even detailed textual descriptions might not capture the essence or most critical aspects of a learning environment or activity (e.g. a lesson might describe students working on Scratch projects, but might not touch on the class's collaborative, informal culture where students feel comfortable working together, laughing out loud, and trying things out). The devil is not just in the details, but in the forms those details take.

As we'll describe in chapter three, current approaches to concretely describing learning environments (e.g. ethnographic documentation, video) can require significant time and energy for both authoring and consumption. Really capturing what one is trying to do can feel impractical, especially when up against the time constraints of most educators. Even when one might have unlimited time, there can be too much to capture, especially if one is limited to text. Moreover, current approaches can be difficult to skim or to quickly grasp the gist of an approach, and they don't readily afford remixing or "playing around" with a design.

In contrast, a tinkerable approach to learning design might make it easier to convey ideas and "to bring the philosophical down to earth"⁴³ — to oneself and to others. It also might make it easier to repurpose and modularize one's own work in ways that create building blocks for further design — and to remix the building blocks developed by others. Making it easier to think and design concretely could possibly better empower designers of creative learning experiences — while also empowering collaboration among educators within and across contexts.

Engaging educators in experiential learning

Research on teacher development emphasizes that educators engage young people based largely on their own experiences as learners.⁴⁴ As Karen Brennan explains, "teachers should have learning experiences that are comparable to their students' learning experiences, situated within a supportive community of fellow teachers."⁴⁵ Consequently, researchers have increasingly focused on developing professional development experiences that reflect the kinds of learning experiences that they want to engage learners in.⁴⁶ These experiences are more holistic: instead of isolated discussion of a topic or skill, educators are invited to develop skills and practices authentically as

⁴³ Turkle and Papert 1990.

⁴⁴ Mehta and Fine 2019.

⁴⁵ Brennan 2015.

⁴⁶ David Cohen and Carol Barnes, "Conclusion: A New Pedagogy for Policy?" in *Teaching for Understanding: Challenges for Policy and Practice*, eds. David K. Cohen, Milbrey McLaughlin and Joan Talbert. San Francisco: Jossey Bass, 1993, pp. 240-275.

part of their teaching work.⁴⁷ In a context where tinkering, remixing, and low-stakes experimentation are increasingly seen as important approaches to learning, it becomes increasingly important to support educators in practicing these approaches.

While there has been progress in professional development, ways of working (e.g. lesson study⁴⁸, implementation science⁴⁹), and in communities of practice (e.g. ScratchEd), the tools and media that educators use in their design work remains underexplored as a vehicle for enhancing experiential learning.

Creating room for experimentation and iteration

Teachers often face a lot of pressure in their work to not fail. This pressure is often both internal (I don't want to fail my students) and external (from parents, school leaders, and evaluation systems).⁵⁰ This pressure can hold educators back from taking a more iterative approach in their work as there is often fear of the repercussions of trying something that might not work – even if the status quo isn't great. Moreover, this pressure only increases during times of crisis when iterative work is especially critical.⁵¹

By creating space for educators to explore, iterate, and make their thinking visible, we hope to make it easier for them to take an iterative approach to their work as educators. An approach that not only destigmatizes failure but also moves us from a success/failure paradigm to one grounded in experimentation, iteration, and debugging. A paradigm that isn't about right and wrong and that is alternatively focused on exploring what is working, what isn't, and what one might try next.

⁴⁷ Mehta and Fine 2019. Also see John Watkins, "We Are Not Newtonian Billiard Balls! The Need for a New Approach to Adult Learning." Education Week, June 29, 2018.

http://blogs.edweek.org/edweek/learning_deepl.../we_are_not_newtonian_billiard_balls_the_need_for_a_new_approach_to_adult_learning.html.

⁴⁸ Brookings on Lesson Study in Zambia. Lesson Study in Japan.

⁴⁹ HTH research on implementation science as a critical way of working for educators to design experiences and to continually grow in their craft as designers and facilitators of learning.

⁵⁰ Interviews with educators, November 2019.

⁵¹ Educator reflections from a design workshop co-facilitated by Nidhi Hebbar, Larry Curio, and Yusuf Ahmad in July 2020. Also a consistent theme in interviews conducted with educators throughout this study. e.g. Interview with HM November 2019.

2.2 Why Creative Learning Design Tools Might Seed Systemic Change in Education

Redesigning the medium to enable different kinds of work⁵²

Research from the history and sociology of science emphasizes the importance of instruments and tools in shaping paradigms and practices in a range of scientific fields.^{53,54} We're interested in exploring how design tools shape how people think about and practice learning design and facilitation. For example, how might the tools used to plan a year-long course, multi-week project, or two-hour workshop shape how an educator actually designs that learning experience?

Focusing on the medium could be read as technocentric. By emphasizing the role of materials and tools in the design process, we're not intending to downplay the importance of social contexts or conceptual frameworks. Rather, we're emphasizing the importance of our tools within broader social and ideological contexts. In contrast, technocentric approaches often (a) see the tool as a stand alone solution and (b) seek to simply replace complex social processes (e.g. the computer as a tutor). This draws on Papert's and Brennan's critiques of technocentric views of the computer: it's not about what the computer will do to us (or for us), but how we will use the computer.⁵⁵

Similarly, we're not examining what tools will do to (or for) educators, but how educators might use different tools – and how particular tools might shape an educator's design and facilitation practice in specific ways.

Sowing the seeds for bottom-up innovations

As Papert argues in his review of Tyack and Cuban's *Tinkering Toward Utopia*, education systems persist in dynamic equilibria which are often impervious to centralized interventions.⁵⁶ These systems consist of epistemological frameworks, assumptions about learning, cultures,

⁵² This phrase is a remix of Marshall McLuhan's "The Medium is the Message."

⁵³ See Peter Galison's *Image and Logic* for a discussion of the impact of instrumentation on the evolution of ideas and practices in various physics subcultures both within and beyond the domain of instrumentation. Also see Bruno Latour, Steve Shapin, or Nadia Abu el Hajj on the relationship between the evolution of instruments, practices, and ideas in various scientific domains. The point they make is that disciplines don't simply evolve through ideological shifts as Thomas Kuhn might suggest, but rather through gradual shifts in practice and culture, which in turn are shaped by tools, social relations, etc.

⁵⁴ See Peter Galison's critique of positivist and anti-positivist views of knowledge. Positivist views argue that theory evolves through better explaining objective observations. Anti-positivists argue that shifts in theory shape what we see. This talk offers a relatively accessible exploration of these ideas:

<https://youtu.be/1sxZs-FkDfI?t=322>

⁵⁵ See Papert 1988 and Brennan 2015.

⁵⁶ Papert 1997. "Why School Reform is Impossible."

organizational structures, expectations about roles, and particular knowledge technologies. When one change is introduced – say a new technology – it's often adapted by other parts of the system.

Consequently, it's critical to design interventions and tools that support and facilitate conditions for evolution. Logo presented one such intervention – an exemplar for what a particular approach to learning might look like and a tool that educators could use to support that kind of learning. Scratch similarly facilitates emergent practice: as a protean tool, it can be used by educators and children in unexpected ways and has the power to make it easier for more people to work on projects related to their interests with peers in a playful way.

While movements like the Brazil Creative Learning Network have galvanized tens of thousands of educators, their infrastructure for sharing and spreading work remains limited. Moreover, they often run up against the challenges of translating ideas about creative learning into practice.

This tension between aspiring to open-ended, project-based learning and more constrained, didactic realities is particularly stark when examining how Scratch is often used in the classroom. Although Scratch was designed to empower anyone to work on personally meaningful projects, it is often used in more didactic and closed ways. For example, where the Scratch team might organize a workshop around a theme and then encourage participants to create projects that interest them, classroom use of Scratch is often much more constrained, with students tasked to create a similar project (e.g. a maze game) or follow a set of programming challenges (e.g. Code.org).⁵⁷ Although the designers and facilitators of the latter environments might aspire to a project or designed based approach to learning, they often remain trapped by instructionist systems and practices. As Resnick and Rosenbaum explain, “students are making something, but the learning experience is limited. Just making things is not enough.”⁵⁸

Critiquing existing practices isn't enough. Describing an alternative isn't either. Both rely on centralized models of change and privilege ideas over practice. This privileging of ideas over practice is prevalent in our current education discourse, where discussions of project-based learning and critiques of industrial schooling often remain focused on ideas and paradigms without digging into practice details. In contrast, making it easier for educators to document and share their actual practices can play a powerful role in shaping the evolution of ideas in bottom-up, emergent ways. Creative tools might spark new forms of emergent change.

Tying it together in an educator's words

⁵⁷ See Moran Tsur's excellent critique of puzzle-based approaches to coding in “Scratch Microworlds: Introducing novices to Scratch using an interest-based, open-ended, scaffolded experience.”

<http://hdl.handle.net/1721.1/112561>

⁵⁸ Resnick, M., & Rosenbaum, E. (2013). Designing for Tinkerability. In M. Honey & D.E. Hunter (Eds.) Design, Make, Play pp. 163-181. Routledge, London. <https://perma.cc/LYN3-U9YI>.

The themes we've introduced so far – opening up the black box of creative learning design, designing tools to think *and tinker* with, considering the medium as part of the message, engaging educators in experiential learning, designing for emergence, moving from abstract descriptions to tinkerable building blocks, and creating room for iteration – provide the foundation for the work that we'll discuss in the following chapters.

These ideas come to life most clearly in a story from an educator and researcher:

RJ has worked with youth in informal and formal education settings for over a decade. In our conversations, she expressed frustration with the constraints of lesson planning: she often thinks through sketching in her notebook and has long felt constrained by the pressure to plan and design experiences using only text in a linear format. Text-based lesson planning, often in a text-editor like Google Docs or Microsoft Word can “feel too cemented. It’s not fluid and doesn’t encourage tinkering or changing things up.” In contrast, she explained that the best tools are adaptive....they allow educators to adapt to dynamic realities. To deeply know what you want for your students and be able to be agile and adjust – similar to how Schön described reflective practice above.

*This led her to adapt a practice that she discovered in the design and technology worlds: **storyboarding**. She appropriated storyboarding as a strategy for visualizing how she might design a particular learning environment to support the learners she worked with; the form encouraged her to be more concrete in her design and later in her documentation. It also encouraged her to adapt her designs regularly – both in the middle of a class and as she iterated over time. She goes on to explain:*

“with storyboarding, you can move things around and can adjust the story. It doesn’t cement the story in the way that a narrative does. You can add, delete, insert, change the order of storyboard cards – tinkerability is in the cutting and pasting aspect.”⁵⁹

RJ later shared this storyboarding approach with teacher candidates in her role as a faculty member at a graduate school for teaching and learning (see Figure 2.6). Working with her colleagues, she introduced storyboarding as an approach for designing learning experiences that would encourage teacher candidates to develop muscles for thinking about the students they designed for and to prepare to be agile and adaptive to changing needs and situations. RJ invited teacher candidates to storyboard learning experiences and challenged them to visualize how learning might look at different moments. She further challenged students to iterate on their designs both through feedback and coaching, but

⁵⁹ Interview with RJ, November 6, 2019.

also through responding to different scenarios that might require a candidate to change the order of their activities or change them entirely.

As RJ worked with the teacher candidates, she kept asking: what are they working on getting better at? And how might the tools and approaches we introduce help them?

*In this case, she found storyboarding to be a powerful **tool to think and tinker with** - one that helped teacher candidates imagine learning experiences while developing muscles for iteration. She also noted that the storyboarding approach helped candidates reflect on how different students might experience and participate in a given situation - helping them build their empathy and confidence to respond to the needs of each student.*

However, RJ also encountered resistance to the storyboarding approach among teacher candidates. A number were intimidated by the prospect of drawing or sketching a scene. Others felt that the approach involved too much effort and didn't seem practical with the other demands on a teacher. While some candidates interviewed explained that the approach had a deep impact on how they design, none of the candidates continued the practice outside of the graduate school setting. While storyboarding proved promising, important questions remain about how an alternative practice and tool for designing learning experiences might work for a variety of designers and facilitators of learning.

Superhero Science Storyboard (WW)

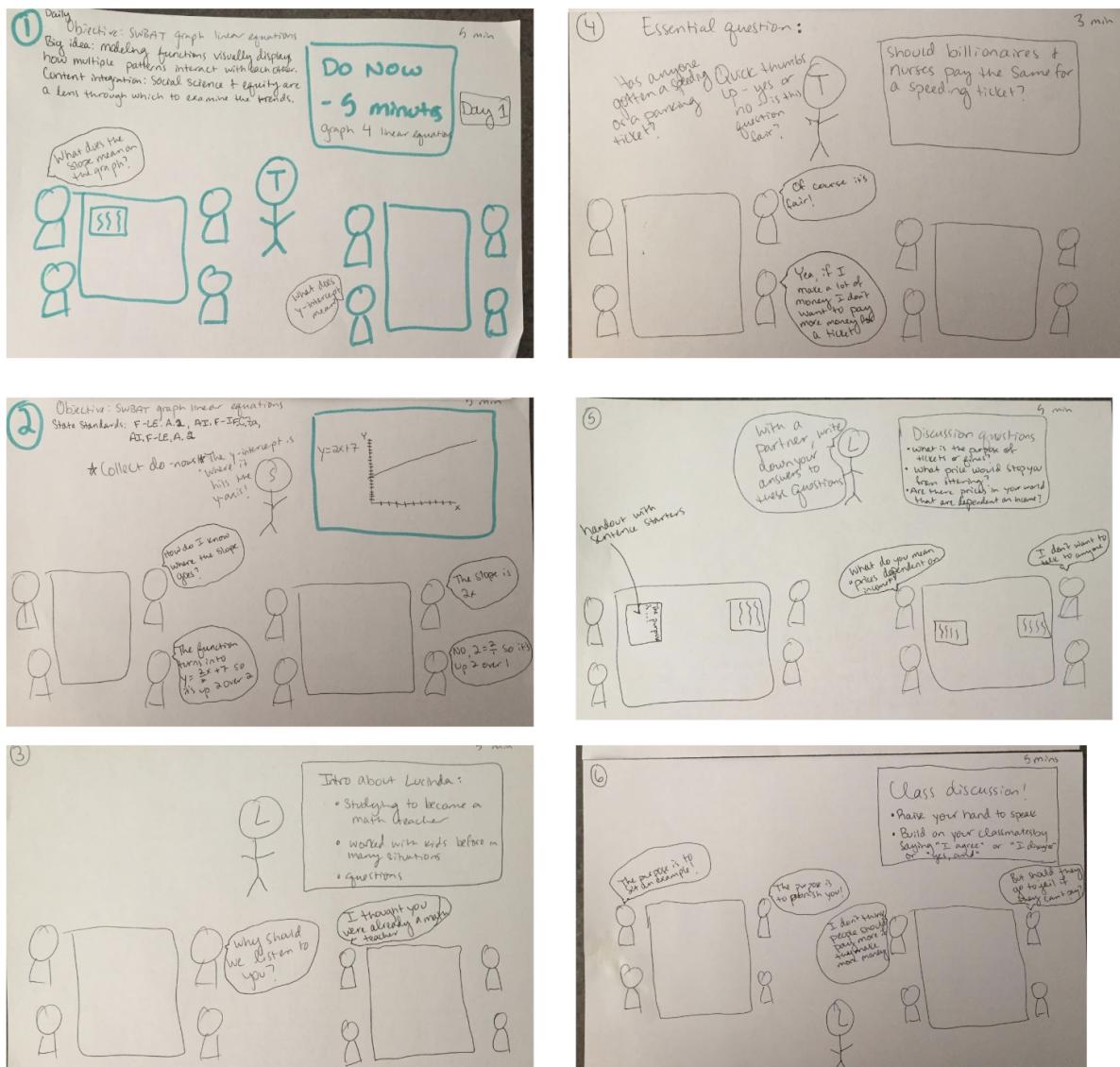
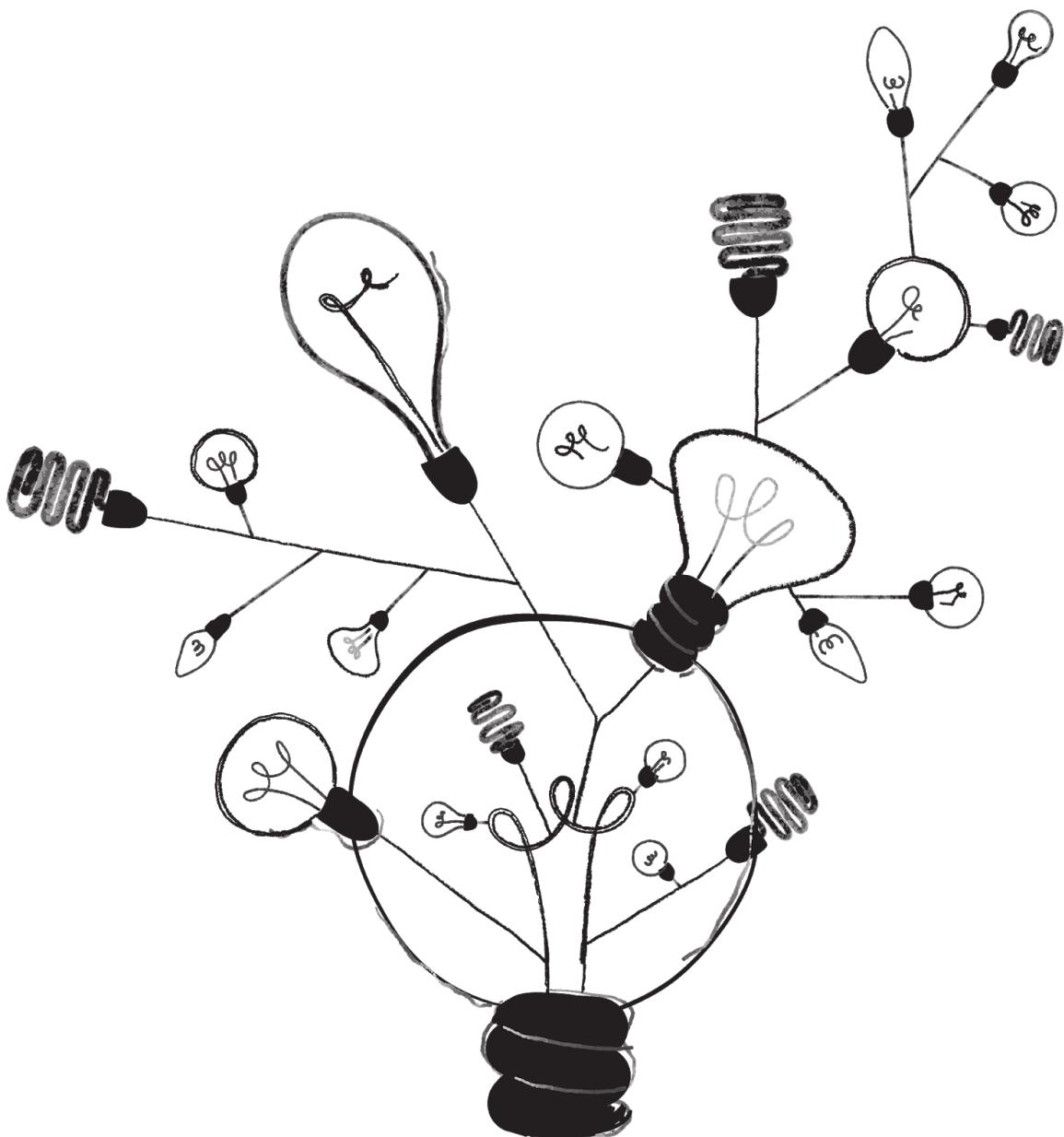


Figure 2.6. Excerpts from an example Storyboard Lesson Plan at the Graduate School where RJ worked.



Chapter 3 Related Work

3. Related Work

In this section, we discuss work that has shaped our thinking on creative learning design tools.

We first explore how Reggio educators document learning as part of their design and facilitation practice. We use this to reflect on opportunities to better support this kind of iterative, documentation-first approach to design and facilitation. We then describe the limitations of current tools many educators use when designing learning experiences. Lastly, we discuss examples from other creative disciplines, including design and developer tools, and generative computational media.

Documenting learning to support iterative design

Documentation, as we'll soon see, is central to designing and facilitating creative learning in the Reggio Emilia tradition. The approaches to documentation taken by Reggio relate to what anthropologists describe as *thick description*: styles of describing something in ways that deeply explore context. As Gilbert Ryle and Clifford Geertz explain, a thin description might describe a contraction of the eyelid. A thick description (that analyzes the situation, culture, context) helps us interpret that contraction and distinguish between a wink and a twitch.⁶⁰ In other words, thick-description helps us make sense of what we observe.

Educators in the Reggio Emilia tradition document learning through detailed narrative text, images, and video. They reflect on factors including context, space, materials, social interactions, and facilitation.⁶¹

Documentation serves multiple purposes in these environments. In one respect, it is an important part of everyday design and facilitation practice. Each day, educators carefully take note of how students pursue their questions and projects. Educators collect examples of student work, including both 'finished' and in-progress artifacts; photograph and record video of student explorations; and record quotes and conversations. These activities are essential parts of the design and facilitation process precisely because there is no predefined curriculum: the design of activities and how an educator facilitates at Reggio emerges as student work progresses. We see this in how Reggio educators describe their work as 'progettare':

⁶⁰ See [Aaron Falbel 1989](#). Friskolen 70: An Ethnographically Informed Inquiry Into the Social Context of Learning. Or Clifford Geertz 1973, "Thick Description: Toward an Interpretive Theory of Culture", *The Interpretation of Cultures: Selected Essays*, New York: Basic Books.

⁶¹ See Claudia Giudici, Carla Rinaldi, Mara Krechevsky. *Making Learning Visible: Children as Individual and Group Learners*. Reggio Children, 2011. Also see Eds Stefano Sturloni and Vea Vecchi. *Everything Has a Shadow, Except Ants*. Reggio Children, 1999.

“to design, to plan, to devise. To project (in a technical-engineering sense). The use of the noun progettazione in the educational context, at least in Reggio Emilia, is in opposition to programmazione, which implies predefined curricula, programs, stages, and so on. The concept of progettazione thus implies a more global and flexible approach in which initial hypotheses are made about classroom work (as well as about staff development and relationships with parents), but are subject to modifications and changes of direction as the actual work progresses.”⁶²

Reggio educators (described as ‘atelieristas’ to capture more of the spirit of their approach and role) document as part of their facilitation practice, but also to deepen and support student learning:

“When their learning is documented, children can revisit and thereby interpret their learning experiences and also reflect on how to develop those experiences further. Interpretation and reflection become fundamental aspects of documentation that are not only retrospective, but also are projected toward the creation of future contexts for learning. Documentation is not limited to making visible what already exists; it also makes things exist precisely because it makes them visible and therefore possible.”⁶³

Documentation in this tradition is not just for the educator, but also an empowering tool for the learner as they explore their interests and curiosities. Documentation plays multiple roles – a theme that we’ll revisit in chapter seven.

A critical part of documentation and facilitation in the Reggio tradition is listening and responding to the many languages in which children think and act. As Howard Gardner explains, “Reggio educators use the term language to describe different ways of representing, communicating, and expressing thinking in various media and symbol systems.” In describing the many languages of children, Reggio educators emphasize the importance of being attuned to the many forms in which children make sense of and organize their experience. Their role as facilitators and designers of learning, therefore, requires them to create opportunities for listening.

Eleanor Duckworth’s detailed reflections of the explorations of learners⁶⁴ are similar to Reggio in that she makes a careful effort to capture the manifold ways in which learners express themselves and make meaning of their worlds. For Duckworth, designing learning experiences involves close observation of how a child develops what she calls “wonderful ideas” and iteratively supporting their explorations based on those observations. Again, facilitation and design are deeply grounded in observation.

⁶² Ibid

⁶³ Ibid

⁶⁴ See *The Having of Wonderful Ideas* or *Tell Me More*.

Similar to Reggio, the Tinkering Studio at the Exploratorium also documents learning in progress as part of their design and facilitation practice. They also have invested significant time and effort in documenting learning as a means for supporting others in introducing similar approaches elsewhere. This has led the Tinkering Studio to explore a range of forms for documenting and describing their approach to design and facilitation through online courses, in-person workshops, Instructables, PDFs, blog posts, videos, and social media.⁶⁵

Chain Reaction playing cards

We have created a set of illustrations of inspiring elements, and turned those into a set of playing cards. Participants choose a random card and then work in small groups to create a story linking their elements together. This special deck is available for purchase from the Exploratorium store.



We put extra building materials and tools around the perimeter of the room on separate tables to allow each team to utilize their station as the place to build, test, and refine their contraption. Tool stations include a place for using hot glue, a place to cut and score materials with knives, and a place for drilling and sawing.

Finally, create an example contraption at one station, triggered by the input domino. Try to incorporate ways to demonstrate the tinfoil switch, a slow-moving motor, a ball rolling down a ramp, and ultimately something that will set off the output domino at the other end. This example should indicate possible uses for the materials and objects, but not be so complex as to intimidate learners. The ideal example immediately suggests ways in which it could be improved!

TRY IT

Getting started

The path of every participant through this activity will be unique, so it's hard to give step-by-step guidance. Be open to the inspiration that comes from the quirky movement of a particular material or to trying an idea you've always wondered about but never tested.

Give yourself plenty of time to build and experiment. In the Tinkering Studio, we set aside 2-3 hours for learners to make individual contraptions at their stations, link them together, and set them off as one collective contraption.

Get familiar with your set up and materials. When working with a large group we start by showing the example contraption and setting it off, demonstrating the use of materials, the intended use of the input and output domino blocks, and the orientation of the room in terms of where the tools and materials are located.



Other approaches to thick description include ethnographies that attempt to closely follow a learner or carefully document a learning environment. For example, Sarah Fine and Jal Mehta⁶⁶ closely describe learning environments at four different high schools in the US — describing both what they see and reflecting on the underlying paradigms, practices, cultures, and structures. Where a Reggio *atelierista* might document learning as part of a day-to-day facilitation practice,

Figure 3.1. Chain Reaction Activity Guide. Created after the fact – and through multiple iterations – for other educators to use when designing and facilitating this activity. Although this is different from our use case (we're looking at what educators use when designing), it offers an example of a starting point (what an educator might remix or adapt) and an example of how an organization fluent in creative learning design (the *Tinkering Studio*) has aimed to share an activity with other educators.

⁶⁵ Based on conversations with members of the Tinkering Studio, including Karen Wilkinson. Also see Karen Wilkinson and Mike Petrich, *The Art of Tinkering*. Weldon Owen. 2014.

⁶⁶ Jal Mehta and Sarah Fine. *In Search of Deeper Learning. The Quest to Remake the American High School*. Harvard University Press, 2019.

Mehta and Fine are focused on surfacing what ‘deeper learning’ might look like in different contexts to inform conversations on school reform and educational practice.

While these different approaches to thick description make learning and the design of a learning environment more visible, they are often very difficult to create. In the case of Fine and Mehta, they spent over seven years engaged in the research that led to their book. In the case of Reggio educators, their *craft* is developed over time as part of a particular culture and environment.

All that said, there are some limitations with the above approaches to documentation. Namely, they’re shared in forms that are often difficult to adapt or repurpose. In particular, for those without deep contextual knowledge, the design choices, rationale, or the process behind design and facilitation choices often remains obscure. These approaches to thick description can also be limited to what is observable in a given context. As more learning moves to digital media, observation and what an educator can document becomes increasingly limited by the tools available to them. This challenge is especially acute in remote learning situations, an urgent concern given COVID-19. New environments for making in-progress thinking and work visible become more pressing under these conditions.

For the purposes of this thesis, we draw inspiration from how Reggio and the Tinkering studio document learning as part of their design and facilitation practice – and are curious how a creative learning design tool might better support this kind of iterative, documentation-first approach to design and facilitation.

Resource platforms and collections

We’ve included platforms where educators share and discover resources (lesson plans, activities, projects, other content) as they offer valuable visibility into some of the broad patterns characterizing how educators create, document, and share learning experiences. This in turn offers us insight into their creative process and the challenges they face.

From OER Commons to Teachers Pay Teachers, there are a host of platforms that enable educators to share their work with others – and to find content, activities, and lessons. Many of these have reached significant scale. For example, 5 million teachers, largely in the US, have used Teachers Pay Teachers to explore a library of 3 million resources and to download over 1 billion resources. 86% of English Language and Math elementary teachers and 63% of secondary teachers use Pinterest.⁶⁷ And these are just two of the many tools that educators use to discover and share work. This signals the interest and importance of sharing and discovering resources as part of how educators engage in their day-to-day work as teachers.

⁶⁷ [Opfer et al.](#). Implementation of K-12 State Standards for Mathematics and English Language Arts and Literacy: Findings from the American Teacher Panel. Santa Monica, CA: RAND Corporation, 2016.

The screenshot shows the Teachers Pay Teachers homepage with a search bar for 'Nonfiction: Tone and Bias in the Media Coverage of Jack the Ripper'. The search results page displays various educational resources, including a main product thumbnail for 'Jack the Ripper: Analyzing Tone + Bias in Non-fiction' and a sidebar for 'Explore High School Resources'.

Figure 3.2. Teacher Pay Teachers website and resource library (left). An example resource on Teacher's Pay Teachers (right).

The screenshot shows the Instructables website with a search result for 'Tinkering With LEGO: Art Machines' by tinkeringstudio. The page includes a thumbnail image, author information, project details, and a preview of the project content.

Figure 3.3. Instructables educator search page (left). An example resource (right).

As educators we spoke to explained, when they use these platforms, they're looking for inspiration, new ideas, things that might help them get 'unstuck', examples, or lessons that they can either remix or simply 'plug and play' with little adaptation. Although teaching can sometimes feel like an isolated experience, most educators we spoke with prefer to work collaboratively, learning from others and sharing what works for them with their peers. The widespread use of these platforms signals a strong interest in collaboration, but also points to a number of barriers.

In our interviews with educators from contexts ranging from low-resourced public schools to after school programs and university settings, we observed a host of challenges. Educators explained that the format and quality of what is shared on these platforms is highly uneven. It generally is hard to really understand context, to quickly understand the gist of a resource, and to adapt resources found on these sites to one's own context. As one educator explained, context matters – without understanding the culture or environment an activity or project was used in, it can sometimes be difficult to ascertain what parts she needs to change. Another pointed out what she finds on these sites often excludes the most important parts of designing a project-based learning experience:

"Looking at another educator's lesson doesn't help me.... All the magic that you bring to things usually isn't present in a lesson plan. The ethereal things that an educator brings to teaching - the most important parts of teaching aren't recognized in a lesson plan.... For example, you might include some of these important elements as notes (e.g. classroom set-up, facilitation moves, etc.) to speak to the moves in a room... magical things get lost, especially with project based learning...."⁶⁸

These challenges in understanding context or 'the magical parts' of a project-based experience formed part of a broader problem: being able to find the 'signal' (content that might be helpful) amid 'all of the noise.'

Expeditionary Learning, the Buck Institute, High Tech High, and a number of other parties curate resources for educators. Some of these include video and images. Others are more minimalist and include high-level descriptions. Many have tried to address the challenges of 'too-much information' with more carefully curated collections.

While some of these efforts have introduced novel materials for learning design (e.g. PBLWork's Project Cards⁶⁹ or High Tech High's Unboxed⁷⁰ resources), they remain difficult to reconstruct or to meaningfully explore. Educators described that while they were more helpful than 'the average resource,' these curated collections still presented significant barriers to reuse and appropriation.

⁶⁸ Interview with a former public school art and engineering teacher, November 2019.

⁶⁹ Formerly the Buck Institute, see PBLWorks Project cards and gallery:

https://my.pblworks.org/projects?gclid=EA1aIQobChM1zMfTp2c6wIVzf_jBx21UA5_EAAVASAEgINh_D_BwE.

⁷⁰ See https://hthgse.edu/professional_learning/unboxed/.

The challenges educators described when discussing these resource platforms and curated resource collections hint at a deeper problem, one that creating simply another platform for sharing resources won't solve: the resources on these sites are for the most part static pdfs or linear text-documents. While some resources are designed in adaptable forms (e.g. Google Slides that can be copied like the Stanford d.school's design thinking "Starter Kit"⁷¹), they largely fall into the traps described above: it can be challenging to parse context, what worked or didn't, the 'magical parts' of an experience, and to grasp both details and the gist. Even the files that are editable can be tedious to change. In short, there are issues with both form and content.

Ultimately, interacting with teacher resource platforms and curated teaching material collections highlights a recurring problem: many educators seem constrained by the tools they're using to design learning experiences. While there has been lots of attention paid to sharing resources through curation or platforms, there has been much less investment in rethinking the tools educators use to design or document their design of learning experiences.

Explorable media

Traditions of explorable media offer insights into developing interactive content that could reshape how we think about learning design tools. This includes Alan Kay's writing on dynamic media,⁷² Mitch Resnick and Brian Silverman's active essay experiments in the 1990s,⁷³ and [Nicky Case](#)'s and the Communications Design Group's work (Bret Victor, [Glen C.](#)) on explorable explanations. These traditions explore the affordances of digital media to make specific ideas more interactive: instead of passively reading text, a user of one of these tools can fluidly change parameters to see how they might impact a situation in which an idea is expressed.

That said, the rules that underlie many of these projects can't be manipulated (even though surface level features can) and they are not very reconstructable or easy to repurpose for different tasks. Moreover, many of these ideas have not been brought to bear on how we think about tools for designing and facilitating learning.

Generative computational media

Our explorations in this thesis are heavily indebted to the Lifelong Kindergarten Group's work on [Scratch](#). Technologies like Scratch lower the floors, widen the walls, and raise the ceilings to creating meaningful projects. Instead of focusing on the technology or skills as the ultimate end, Scratch positions powerful ideas, skills, and tools with respect to and as a means for creating things that are personally meaningful. The interface is playful, encourages experimentation, and

⁷¹ See d.school Starter Kit: <https://bit.ly/dschoolStarterKit>.

⁷² Kay, Alan. "[Afterward: What is a Dynabook?](#)." VPRI Paper for Historical Context.

⁷³ See Mitchel Resnick and Brian Silverman. [Exploring Emergence](#). 1996.

invites collaboration. There is no one right way to create projects; rather, Scratch invites a wide variety of outcomes and ways of making.⁷⁴

Moreover, Scratch is much more than a creative tool; it is also a creative community that exists online (on the Scratch website and other domains) and in a variety of in-person settings (through a host of meet-ups and networks). The online community offers a social context organized around sharing and remixing work – emphasizing creative spirals that are not just individual or atomistic, but connected and shared.⁷⁵ Where Logo lacked a literature, Scratch offers a diverse literature that is easily adaptable and connections to others who share interests or who might offer support, examples, or other forms of collaboration.

We're interested in bringing the ideas behind Scratch to how we think about creative learning design tools. What might a "Scratch" for designing learning experiences feel like or make possible?

Design and developer tools

There are a host of developer and digital design tools that support creative practices. Tools including [Glitch](#), [Codepen](#), [Codesandbox](#), and [Repl.it](#) lower the floors to creating computationally by making coding more tinkerable. For example, many of these tools make it easier to repurpose code from other projects and support immediate feedback: one can immediately see how changes to one's code are reflected in a project. This emphasis on tinkerability is not accidental, but the result of a culture that prioritizes rapid prototyping and learning through quick experiments.

We especially draw inspiration from tools like [Figma](#), [Sketch](#), and [Adobe XD](#) that make it easier for designers to tinker with possibilities, explore ideas, organize inspiration, and collaborate across multidisciplinary teams. These tools allow designers to work with digital materials in ways that resemble how they might use physical craft materials: they can develop an idea, reflect on what they've created, and then decide what to try next—an iterative design process where they can 'think with materials'.⁷⁶ As these systems have opened up and become more cloud-based, they continue to become more robust in empowering creative projects. For example, plug-ins for Figma and Sketch magnify a designer's efforts in new and continually evolving directions: plug-ins encourage re-use and remixing, amplify prototyping abilities, and offer more materials to think with (e.g. photo or icon search). Moreover, there is a whole ecosystem of tools, sites, and online communities (such as [Muz.li](#), [Pinterest](#), or [dribbble](#)) that make it easier for designers to share their projects, find inspiration, or organize content that might be helpful to them.

⁷⁴ Resnick et., al 2009.

⁷⁵ See Monroy-Hernandez 2012 for a discussion of how the Scratch online community was designed around remixing.

⁷⁶ This is very similar to how Don Schön describes how tinkerer might work. See Schön, D. (1983). The reflective practitioner: How professionals think in action. London: Maurice Temple Smith Ltd.

Critically, the tools described above are intended for what are perceived to be creative work – in this case, computation and design. Work that is often extended, open-ended, highly collaborative, and that involves bringing one's own unique style and perspectives to the creative process.

However, these domains, especially computation, have not always been seen as creative, artistic domains – and in many respects still are not seen this way.⁷⁷ This allows us to see how reframing computation as a form of creative work can lead to fundamentally different tools. Because the developers of this new class of tools designed with a different frame (they set out to support creative activities), they developed environments that were more tinkerable and personal than traditional computational tools. This new class of creative computing tools (from Scratch to tools like Glitch) in turn empowers more people to create with computation.

The designers of these tools didn't make their decisions in a vacuum. They were shaped by cultures and communities that increasingly emphasized rapid prototyping, creativity, and bringing artistic sensibilities and ways of creating into computation.

We'd like to emphasize a few lessons from these creative tools for computing and design:

First, if we were to reframe learning design and facilitation as forms of creative work, how might that change how we design tools for educators? What might creative tools for educators look like and what lessons could we borrow from creative tools for other kinds of creative work?

Second, the breakthroughs seen with these computational tools are supported by cultural changes in how certain communities see computing. As we reflect on introducing creative tools for educators, how might we draw on cultures and communities engaged in similar work to empower educators as creatives?

Third, there are a number of specific design choices and features from these tools that inspired how we thought about creative learning design tools. For example, Sketch and Figma inspired how we thought about components and building blocks. They also offered general inspiration for how a creative tool might look and feel. Computing tools that encourage immediate feedback made us reflect on how we might create opportunities for immediate feedback – especially because educators would be working with something that they wouldn't have actual feedback on until they began facilitating.

Finally, it is important to note that there are important differences between the work that design and developer tools support and the kinds of work that educators engage in. What we're proposing is to draw lessons from the above tools when thinking about the quite different context of developing creative tools for educators.

⁷⁷ Much of this groundwork was laid with research by the Logo lab and that Seymour Papert, Sherry Turkle, and many others have described.



Chapter 4

Methodology and Design Process

4. Methodology and Design Process

This chapter introduces the methods that we used to partner with educators, prototype ideas, develop our idea of a creative learning design tool, and evaluate these tools. We drew on design-based research, semi-structured interviews, and participatory action research. After describing our research methods, we outline the design principles that guided our research.

We also describe the design process we followed, including a discussion of why we chose to repurpose existing tools as creative learning design tools instead of developing our own tool. We describe how we tested these tools with educators and eventually converged on a particular tool (Milanote).

Methods

Design-Based Research

Design-based research involves an iterative process that cycles between design, observation, testing, reflection, and analysis.⁷⁸ We used this approach to support divergent explorations (what is possible instead of just what is immediately apparent) and to actively involve diverse perspectives. Moreover, we favored careful observation of how people used our prototypes and other tools over A/B testing. As Resnick explains:

“It has become common for designers to run A/B tests to figure out the preferences and habits of users. They show version A of a design to some users, version B to others, and see how they all respond. This approach works well for figuring out simple interface issues, such as the best location or color for a button on a web page. But to support creative learning experiences, it’s important to gain a deeper understanding of how people will engage with (and make sense of) new tools and activities. We’ve found it most productive to watch people using our prototypes, carefully observing what they do (and don’t do), and then modify our prototypes accordingly. It’s not enough to ask people what they think or what they want, you also need to watch what they do.”⁷⁹

We pursued depth along a few dimensions: we worked with some of the educators involved in this research for over six months, getting to know how they worked, designed, and taught. We reflected with them on their aspirations and frustrations and carefully observed how they used different tools to pursue their goals. When possible, we collected artifacts, recorded

⁷⁸ Barab, S., & Squire, K. (2004). Design-based research: Putting a stake in the ground. *The Journal of the Learning Sciences*, 13(1), 1–14.

⁷⁹ Mitchel Resnick. *Lifelong Kindergarten: Cultivating Creativity through Project, Passion, Peers, and Play*. MIT Press. 2017. 177.

conversations, and recorded videos of educators working with our prototypes so that we could revisit actual behaviors and interactions.

The process began at a participatory workshop in October 2019 held at the Connected Learning Summit and extended through observations, interviews, shadowing, ethnographic research, low-fidelity prototyping, design workshops, and collaborations with educators from October 2019 to July 2020.

As part of this design based approach, we analyzed:

- The artifacts that users created and how those artifacts evolved over time.
- The reflections of the users on how tools shaped their practices, awareness of the kinds of artifacts they make, how they see themselves, and how they design and facilitate.
- Observations of learning experiences crafted in this process and of the design process.
- The experiences of learners through interviews, observations, and examining their projects.
Due to the pandemic, this was only possible for the third case study.

Semi-Structured Interviews

In addition to observation and informal conversations, we also conducted semi-structured interviews with designers, educators, and learners. Over the course of our research, we conducted over thirty interviews to better understand how designers and educators design learning experiences. We especially examined how they use, explore, and remix other materials, and capture and share their designs and process with others.

As we tested prototypes and tools with educators, we reflected on how they used the tools to:

- Experiment, iterate, and adapt learning experiences before, during, and after implementation
- Reflect on their growth as designers and facilitators
- Collaborate and share their thinking with others

Participatory Action Research

Participatory Action Research (PAR) traditions offered guidance on how we might involve educators as partners in the design process while helping us (the design team) negotiate power dynamics and our own identities and perspectives as we engaged in this work. PAR research recommends naming and addressing power-imbalances between different people involved in a research project. In this case, this included the research team, educators, school leaders, and students we worked with. We attempted to redistribute power and share credit in this work through myriad forms, including: co-authoring blog posts with educators, being clear about our

intentions in conversations with students (and making sure they retained voice in how we used their contributions), and positioning our work within an organization's or educator's broader goals.

We also actively involved educators in articulating their needs when designing and facilitating creative learning experiences – to understand what *workable* tools might look like. We coupled these principles with our own observations and design principles to make design decisions about which tools to introduce or how to prepare tools (with examples and templates). As Greenwood and Levin explain, Action Research offered an approach for navigating power dynamics in the design process while encouraging context-bound problem solving:

“It is important to emphasize that in an [Action Research] process, the knowledge is generated through conscious attempts to solve practical problems. The workability of these solutions will accordingly create the platform upon which new knowledge can be constructed.”⁸⁰

This led us to evaluate our designs to the extent that they solved problems for the particular educators we worked with. We developed a set of design principles to guide this.

Design principles

The principles we used to guide our design and evaluate *workability* for a creative learning design tool are outlined below:

1. Tinkerable:

- Easily get started, even if I'm not comfortable jumping into new tools
- Reuse, remix, and ‘play’ around with digital materials of various sorts (e.g. text, images, links)
- Can fluidly iterate and change my work

2. Personal and Appropriate:

- Organize my thinking and work however I would like
- Express myself in ways that feel comfortable to me
- Able to make this my own and be myself when using it
- Can externalize my ideas and assumptions in ways that allow me to better imagine the kinds of learning experiences I'd like to design
- Represent and design for the needs and interests of different learners

⁸⁰ Greenwood and Levin. *Introduction to Action Research, Second Edition*. Sage Publications. 2007. 108.

3. Collaborative:

- Makes it easier for others to understand my ideas and how I'm thinking about an experience
- Can easily invite others to collaborate with me (for feedback, to co-develop ideas, share resources, etc.) throughout the design and facilitation of a learning experience

Further Design Requirements

A few design requirements cut across the principles above. These included

Media: Is it easy to include images, links, videos, and other media (slides, docs, etc.)? Once added, can media be easily annotated? Labeled? And organized in relationship to other objects (text, media, etc.)?

Allowing for diverse forms of media to serve as ‘building blocks’ for educators to play with was inspired by our observations and conversations with educators: we noted that they often wanted to express their ideas and visions for learning in different ways – being able to quickly add an excerpt from a student project, a photo of student work, or a link to a nice activity (often with an associated image) could go a long way in both making their design process easier while enabling new ways for them to express and make connections between ideas, observations, and inspiration.

Organization: what kinds of organization might a tool allow? Are there multiple ways to organize ideas and content? We experimented with tools with more rigid organization as we felt this might ease both getting started in a tool and readability among diverse users. We also tried tools that were much more flexible in the kinds of organizations they allowed, but that also ran the risk of being more difficult to get started with or to ‘follow’ another person’s thinking in.

That said, it’s important to note that these principles evolved throughout the project, informed by our iterative design process and ongoing collaborations. They also varied across settings. The teacher candidates and educators who were new to project-based approaches were most interested in using creative learning design tools to think through their initial design of a learning experience. The more experienced creative educators we’ll meet in our third case study (chapter 7: raising the ceilings) were most interested in using these tools as another avenue for seeing student thinking and engaging with students’ in-progress work.

We used these principles to evaluate a host of tools and to wireframe our own ideas.

Design process

This section describes our design process – how we used the methodologies and principles described above to repurpose existing tools as creative learning design tools and why we focused on repurposing existing tools over developing our own tool.

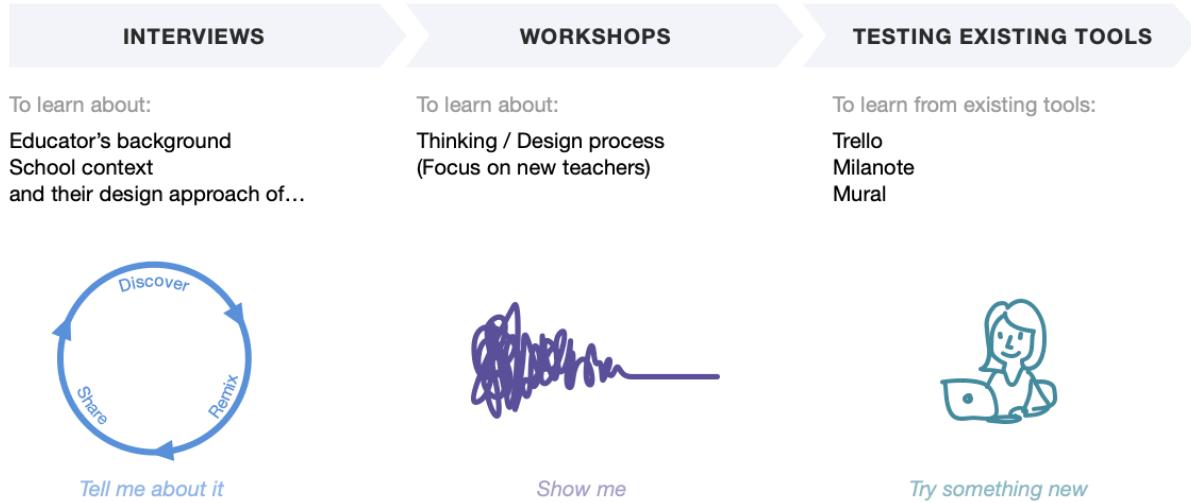


Figure 4.1. Overview of our design process. Developed by Luciana Bueno.

Our design process began in the summer of 2019 with extensive interviews, ethnographic research (observing how educators design with existing tools), and analysis of existing tools that educators use to design and facilitate learning experiences. Our goal was to deeply understand how educators currently design creative learning experiences and to surface some of the challenges and tensions in this work, many of which we've described in our motivations section.

To aid in this design research, we began facilitating workshops to observe how educators used tools to design learning experiences. This included a workshop at the Creative Learning Summit in October 2019 and continued through early 2020. We describe some of these workshops in the case studies that follow. During these workshops, we also introduced creative learning design tools for educators to use in their design work. These included analog tools (post-its, paper) and digital tools (including storyboarding software, Trello, and Milanote).

We extended this kind of activity (introducing a tool to educators and observing them craft a learning experience using the tool) to informal and semi-structured one-on-one and small group interactions. Our aim during these interactions was to closely observe how educators worked with creative learning design tools – to listen to them as they talked through their process, reflect on what they experienced and noticed, and to take note of the things that they actually did, aspired to, and struggled with. During our interactions with educators, we also paid close attention to how their use of a tool might change over time.

While working with educators, we also began wireframing and prototyping our own creative learning design tool. This was inspired by what we learned from how educators used existing tools (both analog and digital). Our designs were originally inspired by a combination of how educators used post-its, paper, Trello, and storyboarding tools to design learning experiences – and in some cases to manage and reflect on learning experiences that they facilitated. You can view our wireframes in [Appendix A](#).

However, as we neared completion of our first prototype, we noticed that educators were increasingly thriving with one of the tools that we had decided to repurpose: Milanote. We observed how Milanote felt more tinkerable, more personal, and more collaborative than other tools that we had tested – and in many respects seemed more flexible and personal than the tool that we were in the process of developing. This led us to pause our development efforts in April 2020 and focus exclusively on testing Milanote as a creative learning design tool.

In the case studies that follow, we describe how we repurposed existing tools as creative learning design tools to lower the floors, widen the walls, and raise the ceilings for creative learning design and facilitation. We reflect on how educators used different tools to support their work and on what this might tell us about what features characterize a particularly powerful creative learning design tool.

In our final reflections, we'll synthesize some of our findings and share some of the wireframes that we developed in May 2020 based on what we learned from our design research.

Repurposing existing tools as creative learning design tools

This section introduces the tools that we considered repurposing as creative learning design tools. We briefly describe how we evaluated these tools and why we chose to focus our efforts on understanding how educators might use Trello and Milanote.

Tools we considered

As we reflected on our design principles, we developed a list of tools from other domains that embodied some of these principles. A representative, but not comprehensive, list of tools we considered include:

Table 4.1. Tools We Considered

Category	Examples	Why we included these
Text-editing	Google Docs, Microsoft Word	Most educators currently use these to plan learning experiences
Presentation	Google Slides, Powerpoint, Canva	Already used by most educators for other purposes, more visual than text-editors
Agile project management	Trello, Taiga	Modular, encourage chunking, easy to move parts around and adapt on the go
Modular organization & notes	Notion, Coda, Airtable	Modular tools, allow for rich media, support automation, can view the same content in multiple forms
Interface design	Figma, Sketch, AdobeXD	Visual, tinkerable, allow for diverse thinking styles, modular
Mindmapping	Omnigraffle	Visually organize ideas
Storyboarding	Storyboarder, StoryBoardThat, Boord	Designed for representing scenes and moments visually
Visual thinking + organizing creative work	Padlet, Mural, Miro, Milanote	Widely used for online facilitation, ideation, and organizing work in design-based and creative professions

We didn't include tools designed only for tablets (e.g. iPads) as most of the educators we worked with didn't have access to them. We're noting this, as we do feel it might be worth exploring how using a tablet and pencil might support particular kinds of learning design work, especially for educators who are comfortable using these kinds of tools.

How we narrowed our focus to Trello and Milanote

We tested most of the above tools ourselves (e.g. we designed workshops in these tools⁸¹) and with the educators we worked with—some of which we have profiled in the case studies.

As we tested and evaluated tools, we applied the design principles outlined above (tinkerable, personal, and collaborative). For example a tool like Storyboarder only supported those who were comfortable with drawing which made it easy to rule out. Others like StoryBoardThat required too much effort to represent an idea (e.g. one would need to visualize and cast characters for an entire scene) and therefore didn't encourage quick, low-stakes drafting.

We also invited educators we worked with to try out tools independently and share their findings with us. We were most surprised when two educators attempted to use Scratch (a block-based programming language used to create games, animations, and other digital media) to think through and visualize a learning experience. One had used Scratch for years (including teaching workshops with Scratch) while the other was completely new to Scratch⁸². They both explained that visualizing what they wanted their learning environments to look like was helpful and appreciated the ability to animate their vision. However, they found that it took them too long to represent their ideas in Scratch – while it was a great tool to tinker with when considering how students might use it or to inform how they might craft a prompt, it wasn't intended to support them in tinkering about their design of a learning experience.

Ultimately, we began to focus our testing around a few different sets of tools: project management tools like Trello; visual thinking and organization tools like Miro, Mural, and Milanote; and interface design tools like Figma.

We quickly ruled out interface design tools such as Figma because they were too high-floor and have steep learning curves: many educators we shared these with felt intimidated to use them for the purpose of learning experience design. Moreover, even educators fluent in using these tools didn't feel comfortable repurposing them as a tool to think with when crafting a learning experience.⁸³ This is partially because there are too many options in these tools, leading one to focus more on look over the design of an experience; text-editing isn't as fluid as it is in some other tools; and projects can become overwhelming as they grow in complexity.

We ultimately decided to focus our efforts on evaluating two tools: Trello and Milanote.

⁸¹ Example of a workshop we designed and documented in Trello: <https://trello.com/b/oIIoIfrl>.

⁸² Example of how one used Scratch to visualize a lesson: <https://scratch.mit.edu/projects/360567289>.

⁸³ For more on how one researcher tried to address Figma's barrier to entry as a tool for design. documentation see Tiffany Tseng. "A Figma Library for Design Documentation." Medium. March 26, 2020. <https://medium.com/@scientific/a-figma-library-for-design-documentation-db0fc2121479>.

[Trello](#) is a project management tool designed to support agile ways of working. We felt that Trello's emphasis on iteration, chunking work into cards, and allowing for embedded media might allow us to test ideas around fluid creation, experimentation, and constrained structure. We hoped that limited space for text would encourage users to be concise and to use images and other media to express ideas. We also hoped that this concision might support them in moving between the big picture and particular details as they drafted their plans.

The Trello board is organized into several columns:

- Objectives, Goals and Standards:**
 - How does this lesson fit with the overall unit?
 - BI: The shape of a structure can sometimes have an effect on its function
 - LO: Engaging in Argument from Evidence
 - Objective & Big Idea
 - SWBAT
 - Content Standards
 - What do students produce?
 - Goal: Students should know:
 - HS-LS1-1 Construct a model of transcription and translation to explain the roles of DNA and RNA that code for proteins to regulate and carry out essential functions of life.
 - Mastery Objective: Students will be able to:
 - Articulate how DNA builds a protein that causes a genetic disease by designing a Google presentation that will have all relevant criteria according to the rubric and shared in Google Classroom.
 - Student Outcome: Students will demonstrate
 - Goals from unit plan
- Warm-up (10 min):**
 - Warm-Up
 - Label the diagram complete vocabulary terms only please.
 - A. Chromatin fibers (decondensed chromatin)
 - B. Chromosomes (condensed chromatin)
 - C. Nucleolus
 - D. Nucleoplasm
 - E. Chromosome (condensed chromatin)
 - F. Nucleus envelope
 - G. Nucleus
 - H. Centromeres
 - Warm up(vocabulary review)
 - Watch video - Mitosis Rap
 - Blooms Taxonomy Levels 1 & 2
- Notice and Wonder (15 min):**
 - Chromatin and Condensed Chromosome structure
 - Figure 1
 - Notice and Wonder
 - Teacher moves
 - Students need to articulate and build a coherent idea.
 - Blooms Taxonomy Levels 2, 3, & 4
- Classwork (45 min):**
 - Conservative, Semiconservative, Dispersive
 - Parental DNA
 - First Replication
 - Second Replication
 - Classwork for students
 - Blooms Taxonomy Level 5
 - + Add another card

Figure 4.2. A novice teacher using Trello to design a class. We'll revisit her work in chapter 6.

[Milanote](#) functions through “boards” – the pages where work happens. Objects—text-notes, images, links with image previews, or file embeds—can easily be added anywhere on a board. The objects can be structured into columns (that can be made to look and feel like a Kanban board) or can be organized using arrows or clustering methods. Moreover, a user can nest a board anywhere within another board, making it possible to organize ideas while managing a project’s complexity. There are frustrating aspects to Milanote: the arrows can be tricky to use, zooming out is not intuitive, and the open-ended flexibility of the boards can be overwhelming. Nevertheless, the organizational and expressive possibilities are balanced with enough constraints to allow for both

novices and more advanced students to dive into design. In the sections that follow, we will unpack how faculty and students used these features to support collaboration and creativity.⁸⁴

Figure 4.3. An educator using Milanote to design a workshop. We'll revisit her work in chapter 8.

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We found that Milanote stood out from other tools (especially Mural, Miro, and Notion) because it was more tinkerable (it was easier for educators to get started; quickly draft ideas with text, images, links, and other media; and to fluidly experiment with ideas and spatial relationships); it was more personal in that it supported very different styles (from column heavy usage that approximated Kanban boards like Trello to mind maps or mood boards) and allowed for *spatial* organization of ideas along three-dimensions (across a board or through nesting boards within boards); and it was more collaborative in that people could work together in the same board using different styles. That said, the similarities between Milanote and other tools suggest that those tools could be repurposed for creative learning design.⁸⁵

For reasons we'll explore below, we felt that Trello and Milanote represented aspects of our core design principles *and* approximated some of the features we intended to include in the tool we originally planned on designing. Our goal when we set out was to test Milanote and Trello with

⁸⁴ This description of Milanote is adapted from Rosa Weinberg, Yusuf Ahmad, David Alsdorf. Designing Workspaces for Digital Creativity and Collaboration. MIT Media Lab.

<https://www.media.mit.edu/posts/designing-digital-workspaces-for-creativity-and-collaboration-in-online-project-based-courses/>

⁸⁵ Our collaborators at the Stanford d.school were particularly taken by Mural while some at MIT prefer Miro.

educators to inform later development efforts of our own tool. However, we noticed that educators were so taken with Milanote that we opted to focus our efforts on understanding how they were using it and why they found the tool to be so helpful.

In the case studies that follow, we'll explore how educators used Trello and especially Milanote as creative learning design tools. However, because the research in Chapter 6 at the graduate school of education took place early in our project, we'll also describe how teacher candidates used other tools as well.



Chapter 5

Introduction to our Case Studies

5. Introduction to our Case Studies

This section introduces our three case studies for exploring how a creative learning design tool might better support the design and facilitation of creative learning experiences. We share context on why we chose to partner with particular communities and on our reasoning for organizing these cases into three parts: lowering the floors, widening the walls, and raising the ceilings for creative learning design.

How we chose communities to work with

“But a tool itself cannot dictate how it is used in a particular environment, despite the intentions of the tool’s designer.”⁸⁶

We chose to work with communities that were actively seeking to support creative learning as described in the introduction. While these communities differ in significant ways, they offered supportive environments for examining how a creative learning design tool might be used and how such a tool might impact how educators design and facilitate. We made this decision – to work with educators that were broadly aligned with our vision for learning – because a tool does not exist in a vacuum. It is shaped by the cultures in which it enters and the aspirations and practices of people creating that culture.

However, we also wanted to have some diversity in our case studies to see how a creative learning tool might be appropriated by educators working in different contexts and in different phases of their journey as creative educators.

Our design partners

We ultimately decided to work closely with educators in a few communities:

- A new graduate school intended to prepare STEM teachers
- A large comprehensive public high school
- Two innovative private, project-based middle and high schools
- A “pilot” public school serving grades 6–12 that is transitioning to project-based learning
- Two design-based graduate courses at two private universities

⁸⁶ Brennan 2015 citing Scardamalia M. & Bereiter C. (1991) Higher levels of agency for children in knowledge building: A challenge for the design of new knowledge media. *Journal of the Learning Sciences* 1(1): 37–68.

Framing our collaborations

We've organized our research around the three goals that we laid out at the start of this thesis: lowering the floors, widening the walls, and raising the ceilings for creative learning design⁸⁷.

The first case study on lowering the floors to creative learning design is primarily grounded in research with the Mans et Manus Graduate School for Teaching and Learning,⁸⁸ where we were immersed for over two months. The second case represents research with a large comprehensive public high school that was cut short due to the pandemic. The third case involved a number of collaborators and took place almost entirely remotely under the conditions of the pandemic.

Case One: Lowering the floors

Our work at the graduate school for teacher candidates focused on strategies for lowering the floors for creative learning design. The teacher candidates we worked with were very early in their journey as educators and their goals and contexts differed in important ways from our other case studies. The teacher candidates also happened to work in the most constrained setting we engaged during this research: most taught in public schools under the supervision of another teacher so had relatively less scope for experimentation than our other partners.

Case Two: Widening the walls

Our research with a large, comprehensive high school offered a context for exploring how a creative learning design tool might widen the walls for creative learning design and facilitation. A group of teachers, in domains often considered to be content focused, sought to make the transition to project-based learning. Consequently, this case offers useful insights on how a creative learning design tool might support educators in making that transition.

Case Three: Raising the ceilings

Finally, we describe how a creative learning design tool extends and magnifies the efforts of educators who have the freedom and space to experiment. We worked with educators involved in two university design courses, a robotics course at a private middle school, and a project-based engineering course at a public 'pilot' school

⁸⁷ Although the educators we partnered with used phrases such as 'student-centered', 'open-ended', 'project-based', or 'design-driven' to describe their approach to teaching, they embraced a common set of ideas and goals captured in Resnick's articulation of creative learning and in Papert's description of constructionism.

⁸⁸ This is a pseudonym.



Chapter 6

Lowering the Floors to Creative Learning Design for Teacher Candidates

6. Lowering the Floors to Creative Learning Design for Teacher Candidates

Central question

How might we support teacher candidates in developing as designers and facilitators of creative learning? Might particular tools make it easier for candidates to tinker with possibilities, visualize learning, and facilitate more creatively?

Overview

This chapter discusses our research at the Mans et Manus Graduate School for Teaching and Learning. We worked with the faculty team at Mans et Manus to explore how a creative learning design tool might lower the floors for ten teacher candidates as they began designing student-centered learning experiences.

From January to March 2020, we facilitated three workshops and a number of small group and one-on-one sessions with teacher candidates to support their work. During these interactions, we co-designed with teacher candidates, observed how they used different tools, and examined how they imagined, iterated, and discussed their plans with others.

We'll start with some context on Mans et Manus before discussing our work testing creative learning design tools with the teacher candidates. We will describe how tools and features supported or inhibited their efforts, sometimes in unexpected ways.

Background on Mens et Manus

Mens et Manus is a new graduate school that aspires to reinvent teacher preparation. The founders of the school aimed to place a greater emphasis on competencies over content, teaching for equity, and preparing teachers for the kinds of active learning they might support in the 21st century. There is also an emphasis on thinking like a designer, exemplified in the ubiquitous use of the [Innovator's Compass](#)⁸⁹ for reflection and planning. The current president of the school describes it as an operational innovation lab that pilots new approaches to teacher preparation.

The school launched with a “design year” in 2017, during which a cohort of ten “design fellows” (who planned on becoming teachers and the school’s first students) co-designed, tested, and

⁸⁹ A tool developed by Ela Ben-Ur that helps people think like a designer: <http://innovatorscompass.org/>.

refined core aspects of the school's programs. The fellows then enrolled as part of the graduate school's inaugural cohort in September 2018. After joining the program, the candidates are grouped by area of focus: either math or science (chemistry and biology). The candidates generally participate in the same experiences, with some divergence into subject area groups.

The program consists of a series of design challenges that range in length from a couple of weeks to months. Each challenge focuses on a particular set of competencies. Challenges are supplemented with clinical placements, mainly in public schools in Somerville, Cambridge, and Boston. While the teacher candidates start off together, they are encouraged to move through the program at their own pace.

The candidates split their time between placement work under the mentorship of a lead teacher and the graduate school where they worked on challenges. In this sense, the candidates both had freedom to focus on their own development while navigating relatively constrained settings: most taught in public schools under the supervision of another teacher so had less scope for experimentation than our other partners.

The graduate school's experimental culture and aspirations to reimagine teacher preparation provided a rich context for exploring new strategies and tools to prepare teachers to develop as designers and facilitators of open-ended learning.

Context for this project: Making Big Ideas Real

Our collaboration with the graduate school focused on one particular challenge: Making Big Ideas Real (MBIR). The challenge kicked off in January 2020, with workshops lasting through the end of February. That said, teacher candidates continued to work on MBIR well into the summer of 2020 as they moved at their own paces.

The challenge consisted of three parts:

1. Learning across the year (January): The teacher candidates selected two "big ideas" (one focused on content, another on practices) and showed how students might engage with these big ideas at three different points in the year. In the process, they articulated what big ideas mean to them, how they might introduce big ideas this within curricular constraints (e.g. standards, the constraints of their schools), and imagined how student engagement with big ideas might concretely look by describing a specific interaction or moment of an activity.

2. A Unit of learning (Early February): After completing part one, teacher candidates then translated those ideas into a unit plan (how learning might look across a few weeks). They considered both the kinds of engagement they'd like to see with big ideas and how to navigate the

constraints in their particular school. We did not explicitly work with the teacher candidates on this part of the challenge.

3. Design a lesson (Mid-February to March): Finally, the candidates designed a specific lesson or workshop (these ranged from 45 minutes to two hours, depending on the context the candidate worked in). They were tasked with revising their plan twice and facilitating it at least once.

Our work with the candidates focused on parts one and three of the challenge as both required candidates to design for specific experiences and moments.⁹⁰ We decided that the broader focus of part two (mapping out how learning might look over a few weeks) was out of scope for our work — although, as our second case study will show, creative learning design tools can better empower iterative design over extended periods of time (weeks and months).

As mentioned previously, we facilitated three workshops with teacher candidates:

- A brief introduction to thinking about the tools we use to design learning experiences and more broadly on our process for designing learning experiences (what we consider, questions we ask, assumptions we make, etc.). This took place as part of the formal introduction to the Making Big Ideas Real challenge in early January 2020.
- A workshop where teacher candidates used Trello to design a learning experience. They worked in groups and workshopped their plans and facilitated a part of it with peers (early February).
- A workshop where teacher candidates were invited to use any medium to design a learning experience and then workshop it with their peers (late February).

These were supplemented with small group sessions and one-on-ones with teacher candidates. We used these interactions to talk through their design process, observe them as they designed, design with them, and to reflect on how their practices evolved over time.

Our questions

We examined how teacher candidates used creative learning design tools to:

- Experiment, iterate, facilitate, document, and reflect on learning experiences they design
- Collaborate with others (ideating, remixing, sharing, soliciting feedback, co-design)
- Reflect on their development as educators and reflective practitioners

⁹⁰ It's useful to note that there are important differences between challenge one and three. Illustrating one moment and connecting it to other moments at different parts of the year (challenge one) is different than developing a lesson that consists of a series of moments that sequentially fit together. Despite these differences, both activities involve thinking about specific moments, a muscle that we sought to support through creative learning design tools.

At our core, we were interested in whether particular kinds of tools might better support teacher candidates in designing creative learning experiences – and developing as designers.

Exploring tools to think (and tinker) with

Tools we tested with the teacher candidates

As we described previously, we considered a number of tools that we might repurpose or use to design learning experiences with the teacher candidates. We invited teacher candidates to use whatever tools that might help them plan learning experiences in ways that encouraged them to think *concretely* (e.g. be specific about activities, interactions, and to use images when possible to represent what they mean). Some of the tools teacher candidates tried included:

- **Text-editing:** Google Docs, Microsoft Word
- **Presentation:** Google Slides, Powerpoint, Canva
- **Project management (especially Kanban boards):** Trello
- **Visual design:** Figma
- **Modular note taking and organization:** Notion
- **Storyboarding:** Storyboarder, StoryBoardThat, Boord
- **Organizing creative work:** Padlet, Milanote
- **Digital Media:** Scratch

Focusing on storyboard, Trello, and an “anything goes” workshop

While the candidates tried a number of tools, we will focus our discussion on three explorations: (a) storyboard, as this was the status quo when we started; (b) Trello, as it approximated aspects of what we felt a creative learning design tool might look like and (c) a workshop where we invited candidates to use whatever tool they would like to try—and where most chose paper or post-its and one chose to use Milanote.

As we evaluated how the teacher candidates used these tools, we considered our design principles:

1. Tinkerable: Did the tool make it easier for teacher candidates to draft ideas? To easily rearrange, repurpose, and think with objects (e.g. text, images, links, media)? How easy is it to get started with? Is it suited to quickly drafting ideas in ways that feel low-stakes or more suited for high-fidelity design?

2. Personal: Did the tools encourage diverse ways of expressing oneself and organizing one's thoughts? For example, might this support someone who prefers to use more text when planning and someone who thinks through images? Different approaches to organization and structure?

3. Collaborative: What kinds of interactions with others did the tools afford? Could they be useful for early stages of the design process? Or only later interactions? How easy is it to repurpose something someone else has done?

Storyboards: Collaborative, but not tinkerable and personal enough

In the first year of operation, the graduate school introduced storyboarding as a strategy for helping candidates develop their learning experience design skills. As RJ explained in the introduction, storyboarding was designed to help candidates visualize what a learning experience could look like and to center student perspective. JS, the current clinical director for the graduate program explains:

"Traditional lesson plans are often a material supply list and a script for the teacher. They tell the teacher what to say, provide, etc. A storyboard as an alternative shifts the focus to the student. To what they're saying, doing, feeling. The storyboard helps because it is made of frames. Each frame is time boxed: how long do you expect it to take? When do you make a new frame? This is critical, because it encourages an educator to think like a designer, to consider transitions between parts of an experience, to imagine different kinds of activities. To reflect on the flow. If one frame has too much happening in it, students will likely experience it in that way. In that sense, creating storyboard 'frames' helps teacher candidates break their lesson up into different parts."⁹¹

Teacher candidates created storyboards using a range of tools. Some used paper to sketch their storyboards (see Figure 2.6) while others used digital tools (mainly Google Slides with some using storyboarding software such as StoryBoardThat). The below images show examples of digital storyboards.

⁹¹ Interview with Clinical Director for Mens et Manus Graduate School.

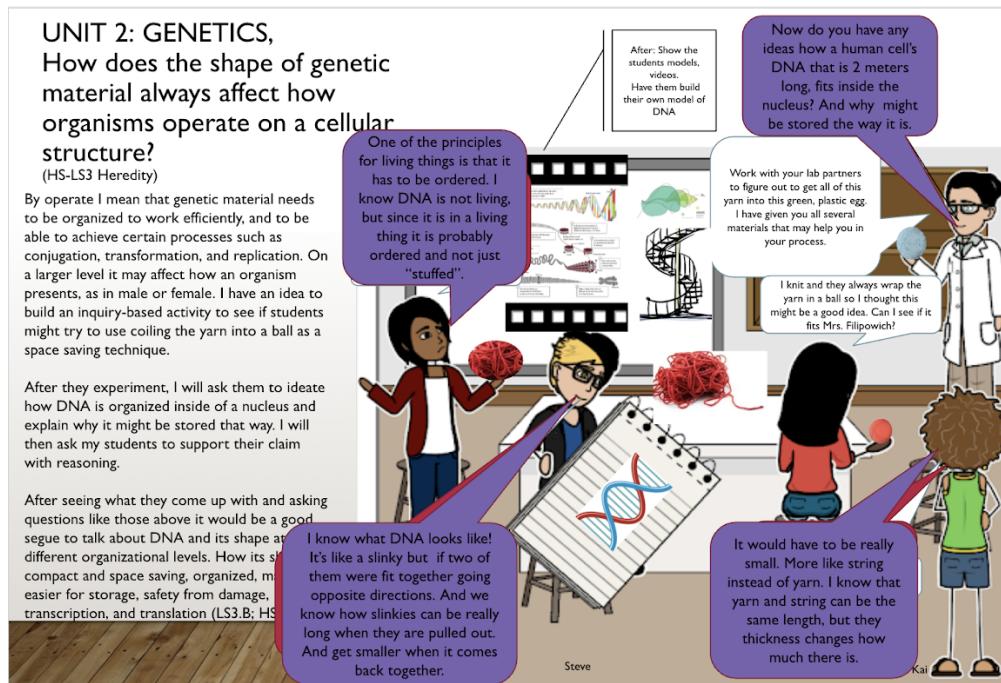


Figure 6.1.
 Example storyboard. The scene in the right part of the image was created in StoryBoardThat and then placed in Google Slides where the teacher candidate added annotations and text. The example shown is a screenshot of the final storyboard in Google Slides.

4 About that second to last part (in the dotted box)?

1 So, the slope of the tangent line at P is $2ax+ah+b$, but what do we do the h?

2 Can h be zero?

3 Well, we want h to be really small because it makes the two points really close.

5 If h is zero, then we are dividing by zero, which would make a black hole in math.

6 So we want h to be infinitesimal.

7 Isn't that what a limit does? We could have it for when $h \neq 0$.

Note: Board color coding does not match what students spoke, but is there to help students

Figure 6.2
 Another storyboard created in Google Slides. This is one “frame” from the storyboard.

Faculty at the Graduate School explained that a storyboard was much easier to offer feedback on than a traditional text-based lesson plan (**more collaborative**): a storyboard made it easier to quickly get the gist of the lesson, to see how a teacher candidate broke it into frames, how they imagined student experience (through the images they included and associated annotations), and how they might interact with students at different moments. Assumptions about learning can be easier to surface visually (e.g. a teacher standing in front of the room and explaining a particular kind of problem in figure 6.2), allowing for a richer conversation between a faculty coach and a

teacher candidate.⁹² However, faculty also noted that storyboards could sometimes be overwhelming to read when candidates used too much text.

While the storyboard offered a powerful visual medium for teacher candidates to express what a learning experience might look like and for them to think through how they might structure and design that experience, it also posed significant challenges. First, even candidates who were comfortable with drawing or storyboarding from prior experiences didn't continue storyboarding after the challenge ended. They explained that it took too long to make a storyboard and that the practice didn't quite fit into their workflows in public schools (i.e. they would need to make a text-based lesson plan to share with a colleague or to submit to a supervisor). While storyboards helped candidates develop in the context of the Graduate School, they required too much effort to become a sustainable practice outside of it.

As we reflected on tools to introduce in January 2020, we observed in our initial 1:1s with candidates that storyboards did not seem **tinkerable** enough *for most* candidates. Although storyboards were highly visual, and could be made to be somewhat modular (e.g. if a candidate used individual notecards or pages for each 'frame', they could rearrange and adapt their workshop more easily), storyboards generally required significant work to create and to change. Consequently, we noticed candidates retreated to text-editors or notebooks where they could quickly jot down or sketch ideas.

⁹² This is reminiscent of Don Schön's description of how an architecture professor engages in reflective design with a student. In Schön's example, the professor and student use the shared visual language of an architectural design to try out new ideas and talk through ideas and feedback. The visual storyboard offers similar possibilities for a teacher candidate and a faculty coach. See Don Schön (1983). *The reflective practitioner: How professionals think in action*. London: Maurice Temple Smith Ltd.

Trello: When a tool is too constraining to think with

As we considered tinkerability, we decided to playtest Trello with teacher candidates. Although we had never seen Trello used as a learning design tool, we felt that it met some of our design requirements in an interesting way:

- It has powerful collaboration features (commenting, tagging, can easily share or remix Trello boards or create templates).
- Cards can easily be edited with text or images and can be rearranged with little effort. Editing here is a low-production affair.
- Limited formatting: after observing candidates often spend more time on formatting than on thinking through their designs, we felt that limiting formatting might actually be a generative constraint and encourage candidates to focus on substance over form.

However, Trello's features also presented a few challenging constraints: the layout was rigidly tied to a grid; images were not always easy to see without opening a card (which presented a significant tradeoff with storyboards). Information was either completely hidden inside a card or crammed on the face of a card. And the ceiling for personal expression felt much lower than in other tools we considered.

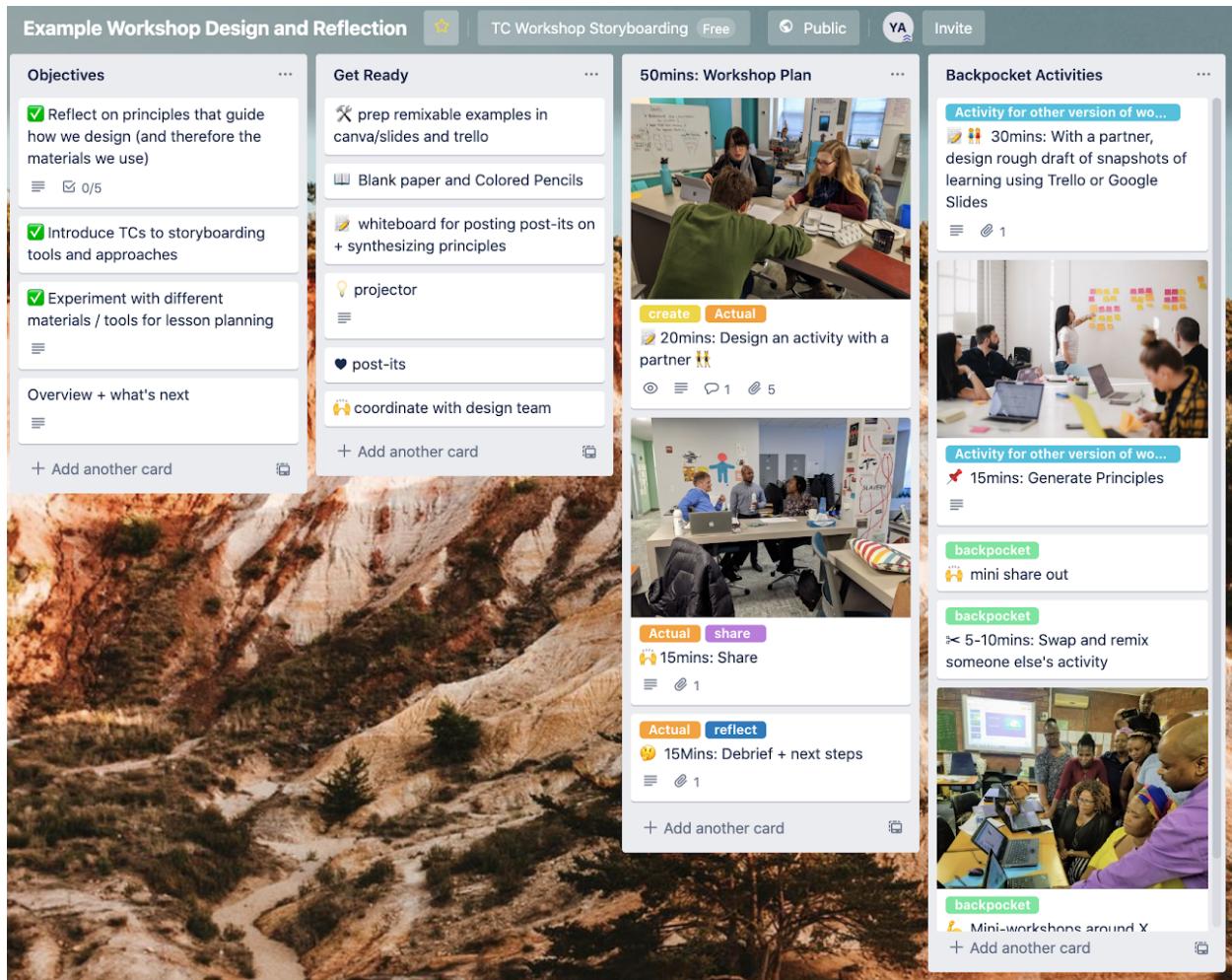


Figure 6.3. An example workshop guide that we created in Trello.

Although Trello empowered design in some aspects, we ultimately found it to be too constraining of a tool for candidates to think with as they designed learning experiences.

On the positive end, we noted that teacher candidates used the ‘cards’ and ‘columns’ in Trello to quickly break down their learning design into intelligible chunks. They tended to use the columns as activities or ‘frames’ that the lesson consisted of (e.g. a warm-up, main activity, debrief, etc.). The cards within each column offered details including objectives, the intention for each frame, activity prompts, and images of students learning to visualize how things might look. Some candidates went so far as to explain that using Trello encouraged them to break down their lesson into different pieces. And that it encouraged them to iterate and adapt ideas more than they otherwise might have.

The below images offer a glimpse at how this played out. They show Trello made it easier for candidates to collaboratively design than Google Docs (which they had been using previously): they could explore ideas in parallel (different columns), point to images, and chunk their ideas, and easily move things around.

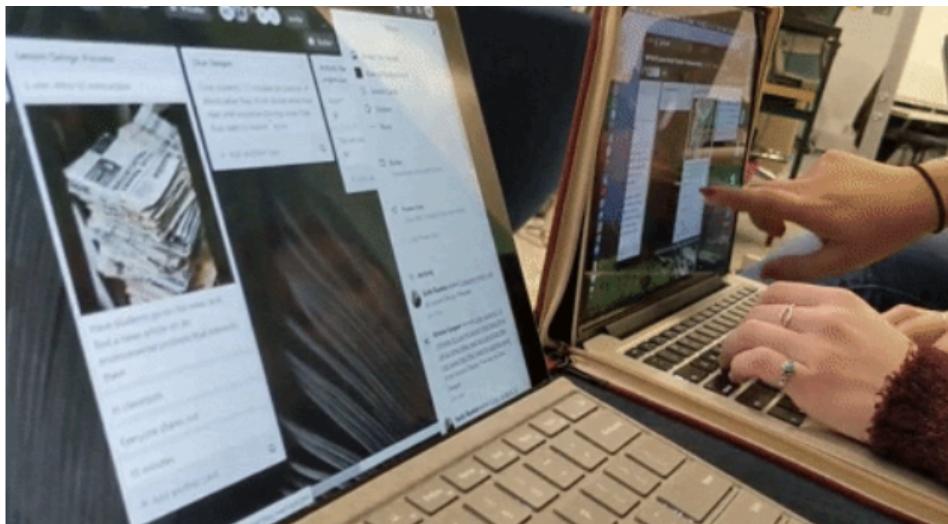


Figure 6.4

3 teacher candidates collaboratively design a biology lesson. They each have Trello pulled up on their computers and move between working on different parts at the same time to talking through a specific idea or situation.

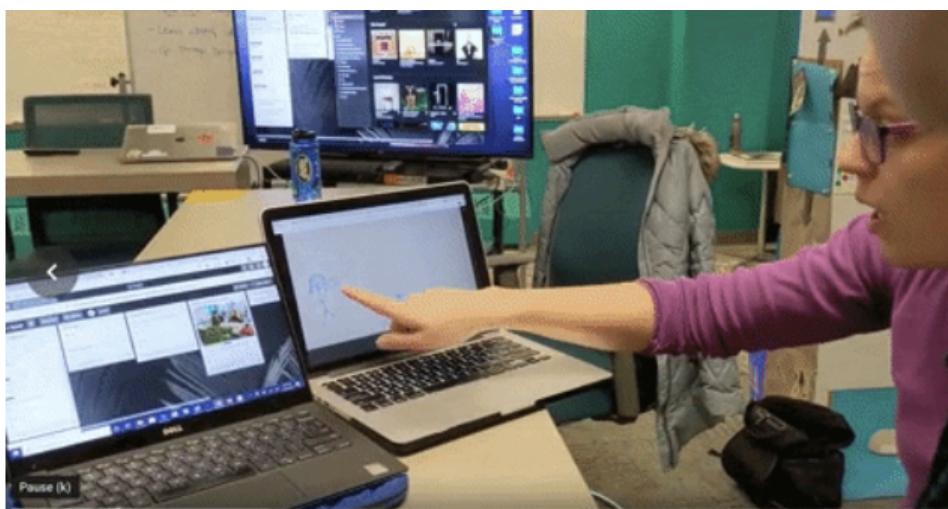


Figure 6.5

Alli, a Math teacher candidate, explaining her ideas to her peers. You can see her move between pointing at her neighbors Trello, her own Trello, and moving to a whiteboard with her peers in the next photo.

The columns made it easier to jump between different ideas or parts of a lesson. Easily embedded images offered her something to point to — and in turn made it easier for her partner to act out the activity.





Figure 6.6

Teacher candidates ‘test’ part of their lesson at the end of a lesson design session – which they then used to reflect on how their prep helped them get ready for this activity.

Big Ideas	Start of Year	Mid Year	End of Year
Our representation of relationships affects our understanding of them.	<p>Content Standard: Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and compare different situations where the rate of change is the same (positive).</p> <p>Measurable Objective: Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., linear, quadratic, exponential) by observing its key features. Sketch a graph that exhibits the qualitative features of a function that has been described verbally.</p> <p>Content Standard: <input checked="" type="radio"/> 1</p> <p>Measurable Objective: <input checked="" type="radio"/></p> <p>How this shows the Big Ideas, and Connection to Beginning of the Year (Please click)</p> <p>Content Standard: <input checked="" type="radio"/> 1</p> <p>Measurable Objective (Please click)</p> <p>How this shows the Big Ideas (Please click)</p> <p>Students collect data about change vs time</p>	<p>Content Standard: Create equations and inequalities in one variable and use them to solve problems, including those arising in real-world applications, focusing on linear and exponential functions.</p> <p>Measurable Objective: Interpret expressions that represent a quantity in terms of its context.</p> <p>Content Standard: <input checked="" type="radio"/> 1</p> <p>Measurable Objective: <input checked="" type="radio"/></p> <p>How this shows the Big Ideas, and Connection to Beginning of the Year (Please click)</p> <p>Content Standard: <input checked="" type="radio"/> 1</p> <p>Measurable Objective (Please click)</p> <p>How this shows the Big Ideas (Please click)</p> <p>***Iteration 2: Content connection (Please click)</p>	<p>Content Standard: CCSS.M.HSN.Q.B.4.a Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p> <p>Measurable Objective: CCSS.M.HSN.Q.B.4.b Interpret parts of an expression, such as terms, factors, and coefficients.</p> <p>Content Standard: <input checked="" type="radio"/> 1</p> <p>Measurable Objective (Please click)</p> <p>How this shows the Big Ideas (Please click)</p> <p>***Iteration 2: Content connection (Please click)</p> <p>"You have 30 seconds to draw yourself throwing a snowball!" "Now, add the flight of the snowball to your drawing -- all the way from</p>

Figure 6.7

A teacher candidate using Trello to plan how students might engage with a big idea at three moments during the year.

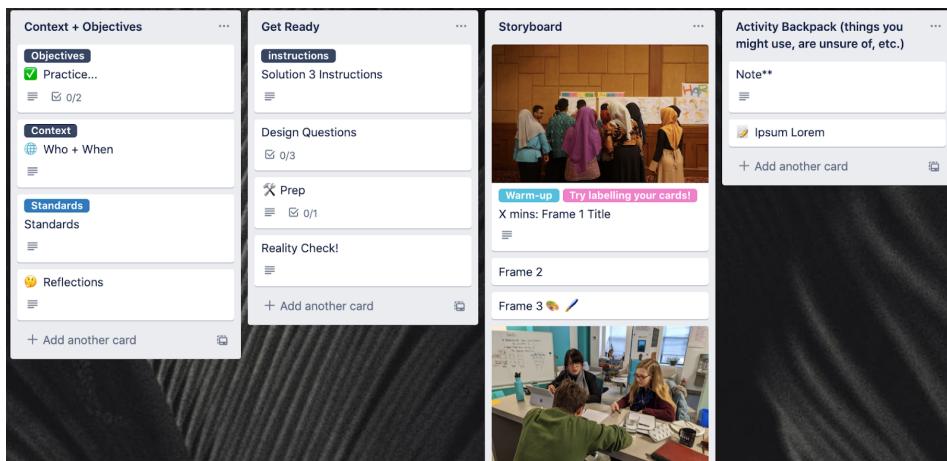


Figure 6.8

One of the Trello templates that we created for teacher candidates. We invited candidates to remix these templates or to create their own.

However, Trello also had important shortcomings for many of the teacher candidates and for coaches who hoped to offer them feedback.

Not personal enough: The rigid layout didn't afford diverse forms of thinking or organization – while some candidates who liked this layout thrived, others found it increasingly frustrating, describing that they felt 'boxed-in' and unable to organize or visually represent ideas how they might otherwise like to. For example, they couldn't change the size of cards and were limited in visual cues for distinguishing or connecting ideas.

Not tinkerable enough: Although some candidates felt this medium was more tinkerable than others they had tried, other candidates felt that Trello required more thought on where to put things. Some tried creating a column for 'unsorted' activities, but that still required pasting information or jotting down ideas in ways that quickly became confusing for them to work with later. Moreover, while nesting information inside cards helped manage complexity, it also meant that making changes took slightly more work – one needed to open a card (and remember which card to open) in order to access text or images to change.

Not collaborative enough: While Trello made it easier for candidates to play with multiple ideas or parts of a lesson in parallel (see Figures 6.3 to 6.6), it presented a number of challenges to candidates. First, when candidates are next to each other they could point to where they were working or where they might be talking about an idea, but when working remotely this became more challenging – there was no option to follow someone else's cursor. Second, candidates had very different preferences for how to use and organize their Trello boards, sometimes causing friction in how to work together. In other words, the tool didn't seem to afford multiple styles or ways of organizing one's thinking in the same board.

Our experiments with Trello led us to open up and explore more tools. The below reflections describe excerpts from our February 18, 2020 workshop with candidates. They also draw on interviews and one-on-ones that extended before and after the workshop.

Hannah: Looking for a visual tool that suits her style

Hannah tried a few different tools for designing her lessons. She had considered Trello but preferred not to use it because it felt 'too limiting'. The boxes felt narrow, the image library wanting, and she didn't like scrolling to information that was not in front of her.

She also didn't find StoryBoardThat (**Figure H1**) all that helpful to her design process. For example, it constrained how characters were positioned (they all faced the same direction, instead of being able to face each other to highlight peer interactions or other activity) and didn't allow her to place text next to an image. She instead found herself using lots of text on a follow-up slide - which wasn't as helpful for her as a designer. Moreover, storyboarding using StoryBoardThat was a high-production affair: it required a lot of effort and time to design even a single activity.

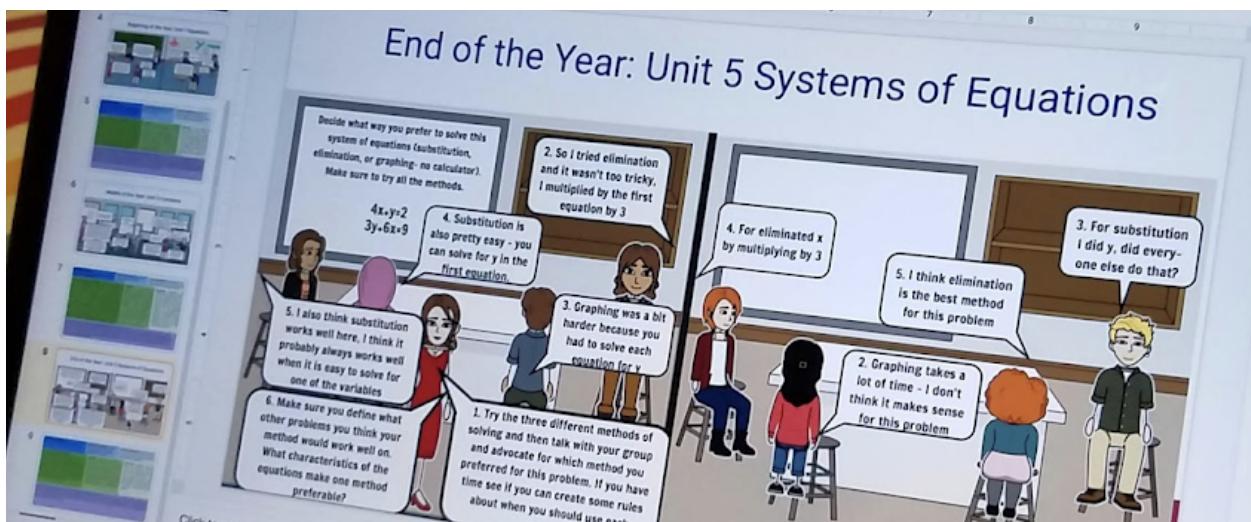


Figure H1. Hannah's storyboarding a lesson. She used [StoryboardThat](#), a storyboarding software, to create each scene, which she then pasted into Google Slides.

In looking for a tool, Hannah desired something that could help her visualize how learning might actually happen in her classroom. She also wanted something that allowed her to focus on designing the lesson, not on formatting how her lesson plan looked. Although the storyboarding approach was visual, it required what felt to her like painstaking attention to detail.

These concerns and aspirations led her to try designing in Milanote. She appreciated the flexibility of the authoring environment – how she could add images and text where she wanted, easily move things around, all while

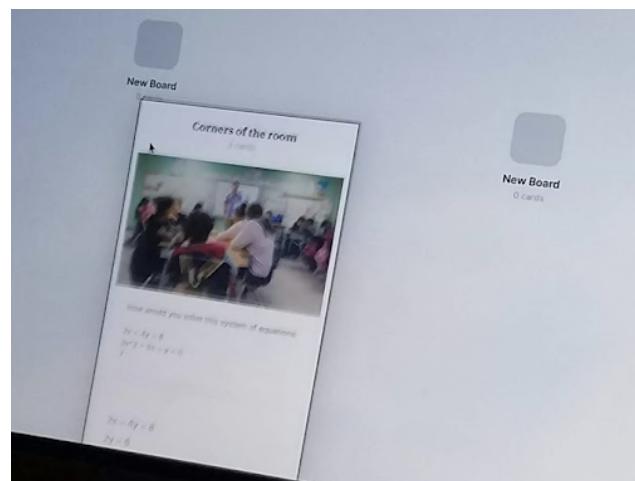


Figure H2. Hannah drafting a lesson in [Milanote](#).

staying organized and seeing everything 'at a glance.'

As Hannah began planning, she first added in a quick warm-up that she wanted students to work on. She started by searching for a photo on Unsplash that conveyed what she wanted the room and activity to feel like. She then added the problem she would share with students below the image (see Figure H2). As she elaborated on the activity, she renamed it from 'corners of the room' to 'warm-up hook' to convey where it fit within the lesson.

Next, she added a new column for her next part of the lesson: "group activity." Again, she decided to start by searching for an image that conveyed what she hoped to do. As Hannah searched, she explained her frustrations with the stock images she was finding, explaining that they didn't quite convey what she was trying to do in her classroom. She only used them because she preferred searching for something over drawing, both to save time and because she didn't feel comfortable sketching on the computer.

In response to her frustrations, we shared our library of 20 sketches that represented different kinds of learner interactions (e.g. small group work, students working at tables, etc.). When she saw our library of sketches, she quickly found a sketch that conveyed what she wanted the activity to 'feel like.'

She also remixed a panel from an example storyboard that we had shared, suggesting that being able to draw on a small library of images and remixable examples might be useful.

As Hannah progressed, she used columns in Milanote to separate each activity and place them next to each other, allowing her to dive into the details of one activity while stepping back to see how her whole lesson plan evolved (Figure H4). She could easily change the order of activities, move elements from one activity to another, or "park" activities in a different part of the board if she wasn't sure what to do with them.

Figure H3. Hannah adding a sketch as she starts to design her second activity.

Figure H4. The version that Hannah ended up sharing at the end of the workshop.

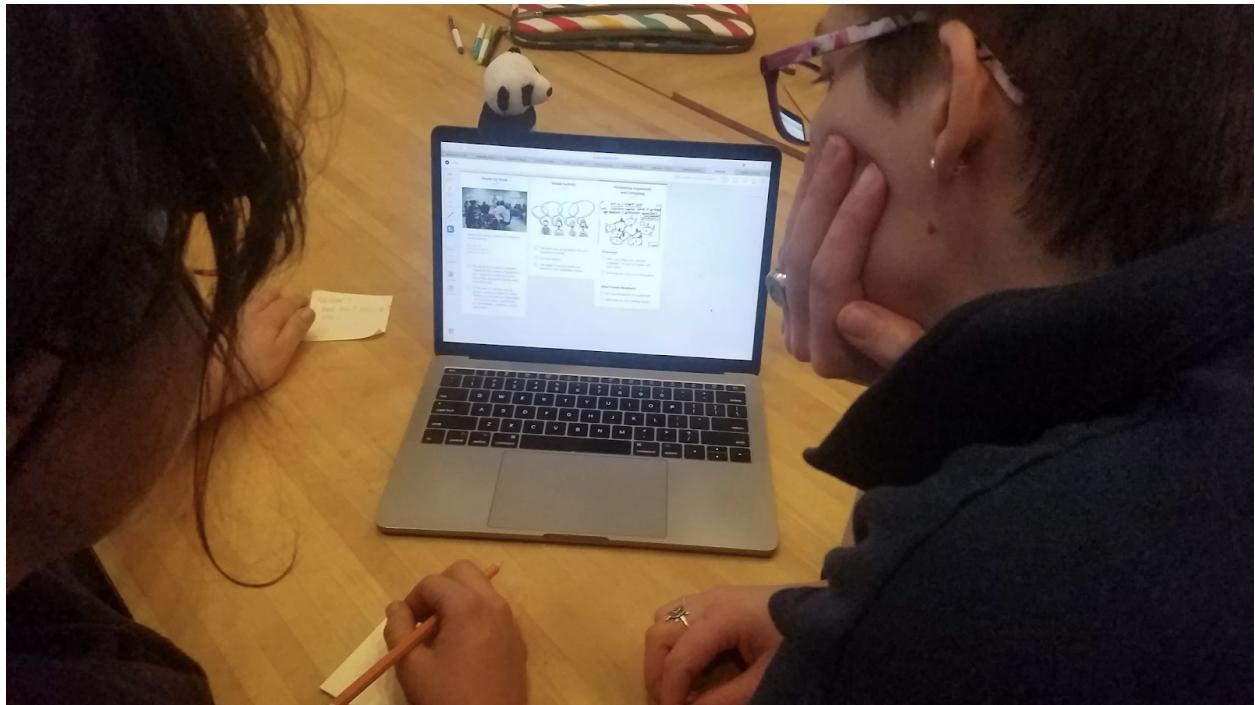


Figure H5. Alli and Kristin discuss Hannah's design. [See this video](#) (beginning at 1.30') for more on Alli and Kristin's discussion of Hannah's plan.

As other teacher candidates 'read' Hannah's plan, they were able to quickly get the gist of her lesson and each component activity – even though this was a quick prototype that she had drafted in about an hour. As Alli explained: "This is really clean. I can get the most important information really easily and there is a lot of depth of information as well." They read the headings at the top of each column and intuitively grasped that each column represented an independent activity. As they puzzled through the third activity (in the third column in Figure H5), they clicked on the image to zoom in, talking through the diagram to make sense of the movement and activity. In the process, they discovered much more about the activity than they would have if Hannah had just used text.

The candidates explained that this made it easier to share actionable feedback with Hannah and to get 'into the meat' of her design without needing to jumble through lots of text to figure out what she was trying to do.

Alli: Paper prototyping approaches to thinking through a lesson

Alli is a teacher candidate with a background in computer science. Prior to joining the teacher preparation program, she had taught in Southeast Asia. The following story shows how she grappled with approaches for thinking through her process for learning design; and how she might experiment with different analog and digital tools to support her design process.

Although she had used exclusively digital tools in her prior work, she explained that "I left programming because I didn't want to be in front of computers all day, and now find myself spending all this time on computers." In contrast, she prefers being with and around people and thinks better when she moves her thinking off screen to a medium where she can draft ideas.

During our design session, she started with what she called 'prototype 1' (**Figure A1**): this was her first stab at thinking through her lesson plan. In it, she outlines what she would like students to do or consider during different phases of the lesson. While this was helpful for articulating broad goals, she wanted to get more granular.

This led her to elaborate her plan in what she called 'prototype 2' (Figure A2). In this version, Alli "sketched" what the students might create (in this activity, students draw a figure throwing a snowball). She also "sketched" what she feels students should take away from different parts of the activity to be able to move on to the next part of the lesson and takes note of possible student reactions and observations.

While this level of detail was helpful for her as she thinks through her lesson design, it also quickly became "messy" and "difficult to follow." For example, she described how prompts and student work become blurred with student observations and her own hopes for what they needed to get to in order to move on to the next activity. Visually, the different ideas are indistinguishable and appear simply as bullets next to her main headline and image for each activity.

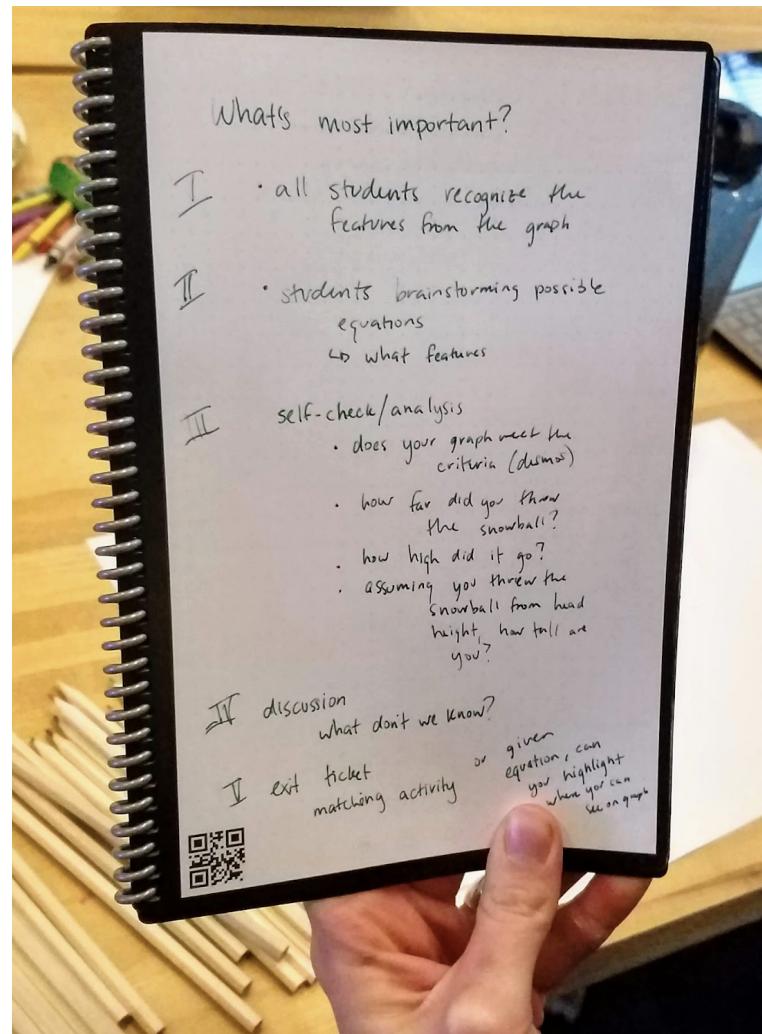


Figure A1. "Prototype 1" – Alli's first attempt to think through how to design her lesson, using her notebook.

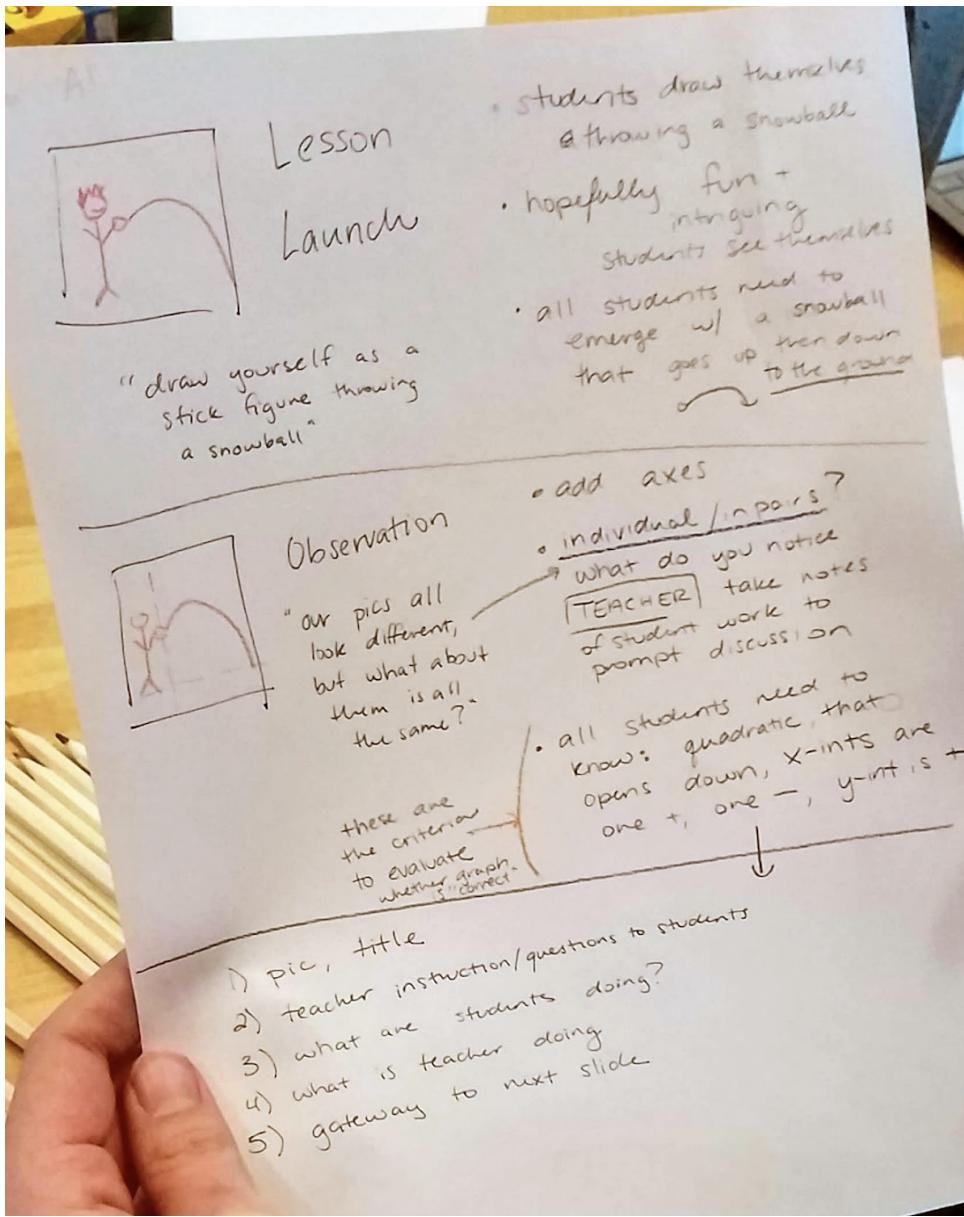


Figure A2. "Prototype 2"

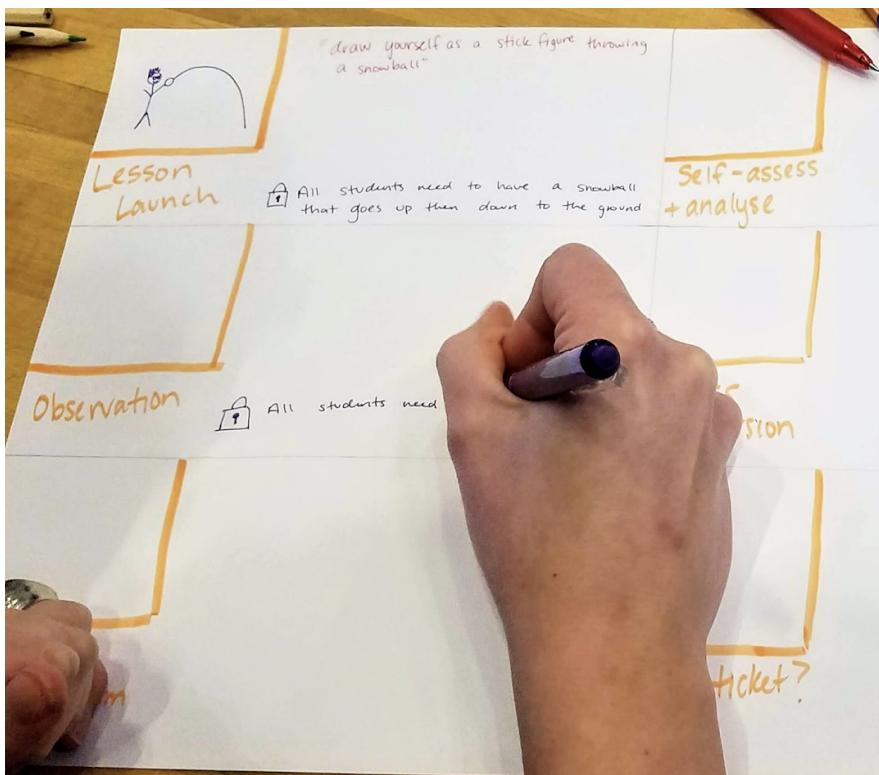
Alli used this second prototype to think through her design. However, she found this version too messy and hard to follow. It was difficult for her to organize different branches of thinking while being able to move between details and the big picture.

This led her to outline a few components for what might constitute an activity “chunk”: a title, an image showing the activity, prompts she would share with students, a brief explanation of student and teacher actions in each scene, and what needs to happen to move on to the next activity. She then used these activity chunks as the basis for her third approach for thinking through an activity (and using paper to visualize and think through her plan).

In “Prototype 3” (**Figure A3**), Alli color coded the ‘activity chunks’ - and proceeded to fill in each chunk sequentially. When I took this photo, she had just finished drawing the title for each activity chunk. She had started to draw out prompts, but quickly shifted to what she called “gateways” - things she wanted to happen for the students to move on from one activity to the next. As she worked, she explained that this version made it easier for her to move from the big picture to implementation details while still keeping track of her narrative arc for the overall lesson.

Figure A3. "Prototype 3"

[Video A1](#): Alli walks me through her first two prototypes for documenting her lesson design.



Sarah in her own words:

Below are notes that one of the teacher candidates shared with us as she reflected on the tools she used to think and tinker with her design of a learning experience.

"So I really liked the idea of trello, but I struggled using it in my design process because of how it hides information in the top view; I really like to see all my ideas and think at once. So I decided to make this "trello" out of sticky notes! So now I have a very rough first draft of a full lesson."

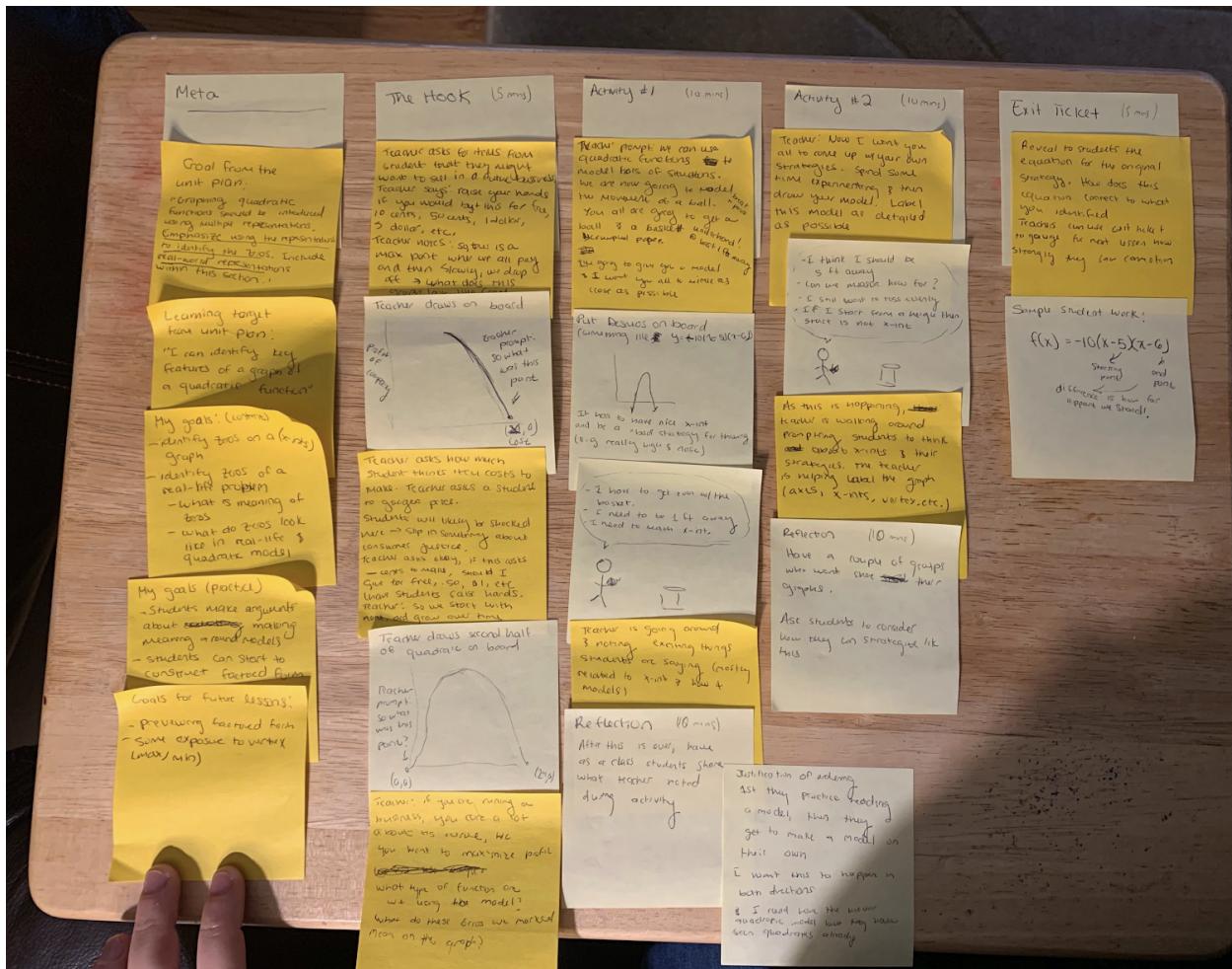


Figure S1. Sarah uses post-its to plan a lesson.

"So kind of the way I went about doing this was mostly linearly, but then going back and revising previous cards once I had developed future ones. When I started, I first wrote down the unit goals and then my goals. Then for each of the activities I would write down an opening, and then add other stickies that showed different parts of the lesson as I moved through the activity. One of the things that helped me with this (besides needing to be able to see everything at once) was my ability to quickly draw small doodles. *This helped me more concretely visualize what I was*

imagining what the teacher is saying, and drawing what the board might look like, and then drawing a student and what they might be thinking/doing. So, for example, when I was drawing what the board might look like for the hook, when I finished the first board drawing, I actually went back and revised what the teacher should say. And then when I went to draw the second board, I went back and revised the first board (I added in axes and labeled them). When I drew the doodles of students thinking, this helped me both narrow in on what kind of thoughts I want students to be having, and also prompted me to be creative about what students might be thinking and then how the teacher might respond to all different kinds of thoughts."

"One thing that I also added in a little bit was some thoughts on justification for the ordering of activities 1 and 2. I needed to write that down because I went back and forth between what order I wanted students to be learning things. Do I want them to discover this quadratic arc/model for themselves, or do I want the teacher to model it first so that the students can then do some deeper thinking on their own? I decided on the latter in part because I was thinking through what kind of insights I want students to make, what they already have exposure to, and how I want them to engage. (And also I wrote all of this out with the understanding that in my "trello" I could easily flip the order if I decide I didn't like it, but once I had it written down I felt a little more certain that this was the better way to do it.)"

Reflections: Pulling it all together

In our work with teacher candidates, we noted that the tools they used while designing did matter, but sometimes in ways we didn't quite expect.

Although Trello proved to be a powerful tool for some of the teacher candidates during the first part of Making Big Ideas Real, it ultimately proved to be too constrained relative to other possibilities.

On the one hand, a number of the teacher candidates explained that Trello helped them organize their designs into 'chunks'; made it easier to visualize options through built-in image search or to easily attach images; and encouraged them to adapt their designs and explore possibilities. Moreover, it empowered conversations between faculty coaches and teacher candidates. As one faculty member explained, "this is helping my coaching in that we are working on shared visual space."⁹³

On the other hand, tinkerability requires more than being able to move pieces around. While Trello cards felt like LEGO bricks, Trello offered a very limited set of LEGO bricks that could only be used in certain ways. For example, the rigid grid structure in Trello didn't allow space for candidates to discard ideas or to have unsorted cards that they could revisit later. During the debrief to one of our workshops, teacher candidates explained that working in Trello felt too final, like they needed to have already thought through their ideas beforehand. In contrast, paper allowed them to quickly

⁹³ Conversation with a faculty coach at the Graduate School.

sketch out ideas and possibilities.⁹⁴ Our experiences with the teacher candidates led us to explore other creative learning design tools and ultimately to experiment with Milanote in the following case studies.

Despite these constraints, the creative learning design tools that we experimented with – from storyboarding tools to Trello and Milanote – lowered the floors for teacher candidates as they began designing creative learning experiences. Moreover, we found that creative tools didn't simply lower the floors; these tools also raised the ceilings for conversation and design, making it easier for candidates to push further in their work. As coaches explained, it made it easier for candidates to 'chunk' ideas, visualize their thinking, and concretely represent their ideas. These tools also helped teacher candidates design with the students at the center of their experience.

Finally, we noted a strong desire for tools that allow for low-stakes drafting of ideas. This comes across most clearly in how all but one of the teacher candidates used paper instead of a digital tool during one of our design workshops. Although working with analog tools added work for them (they would need to move their work to a digital medium for sharing with colleagues), they felt that doing so better empowered their creative process. Especially in the early stages of their planning process, they felt they could be more free, take more risks, and "mess around" with ideas in a way that they felt they couldn't when working in a digital tool. This low-stakes, 'drafty' aspect is often missing from digital tools that educators use – and led us to introduce Milanote in our subsequent case studies as a low-stakes, creative learning design tool.

Hannah's work with Milanote showed some of the promise of a digital tool that can also afford low-stakes prototyping. A digital medium offered new possibilities for scaffolding her work: she was able to repurpose sketches that we shared with her and elements from other workshops. She was also able to find images that represent her beliefs about learning (in contrast, the images and icons she found online represented more traditional approaches to learning as most showed a teacher speaking to a large group).

We concluded our work with the graduate school with this insight: for a creative learning design tool to meaningfully lower the floors to design, it needs to afford low-stakes, drafting of ideas (tinkerability) and allow for more personal forms of expression and organization.

⁹⁴ Feedback from our group debrief during the Feb 18 Design workshop.



Chapter 7

Widening the Walls:

Transitioning to Project-Based Learning

7. Widening the Walls: Transitioning to Project-Based Learning

Central question

Might a creative learning design tool support educators at large public high schools in transitioning to more open-ended, project-based approaches to learning?

Overview

In this chapter, we describe our work with a group of educators at a large urban public high school as they introduced extended, project-based learning experiences in their courses. Most of the educators in this setting worked in domains that are not considered “creative” or ripe for project-based approaches. Consequently, these explorations show how a creative learning design tool might support a transition to ambitious, project-based learning from more traditional, instructional approaches.

Background

Riordan High is a large, comprehensive public high school located in a major urban area. Just under 2,000 students attend the school. Since 2005, students have followed a four-by-four block schedule with four 84-minute periods each day and two 90-day semesters each year. The longer class sessions aimed to make the school day easier and more impactful for both students and educators. For the purposes of our research, Riordan High offered a unique opportunity: most public high schools don’t have enough uninterrupted time-blocks to cultivate deep and extended learning opportunities. Riordan High’s extended block schedule offered educators an opportunity to experiment with project-based approaches.

Our collaboration began with the school’s two technology coordinators. In addition to generally supporting educators across the school in using technology to support learning, the pair took a keen interest in introducing technology in ways that might support more creative, project-based approaches to learning. They pursued these goals through one-on-one interactions with teachers, professional development workshops, collaborative teaching with teachers, and workshops and events for students and families.

In exploring how a creative learning design tool might support a diverse group of educators in designing creative and project-based experiences, we focused on a few moments: working with

the coordinators to try these tools out with educators in collaborative teaching settings; and as part of a the health department teaching team's transition to project-based learning. Our research with Riordan High educators began in January 2020 and was largely paused with the onset of the pandemic and transition to remote learning in mid-March 2020. Of note, a planned workshop with the health educators was canceled as was a workshop as part of a project-based learning course for educators at the school.

For the purposes of brevity, we've focused this case study on our work helping the health team transition to project-based learning and a brief discussion of one collaborative teaching effort.

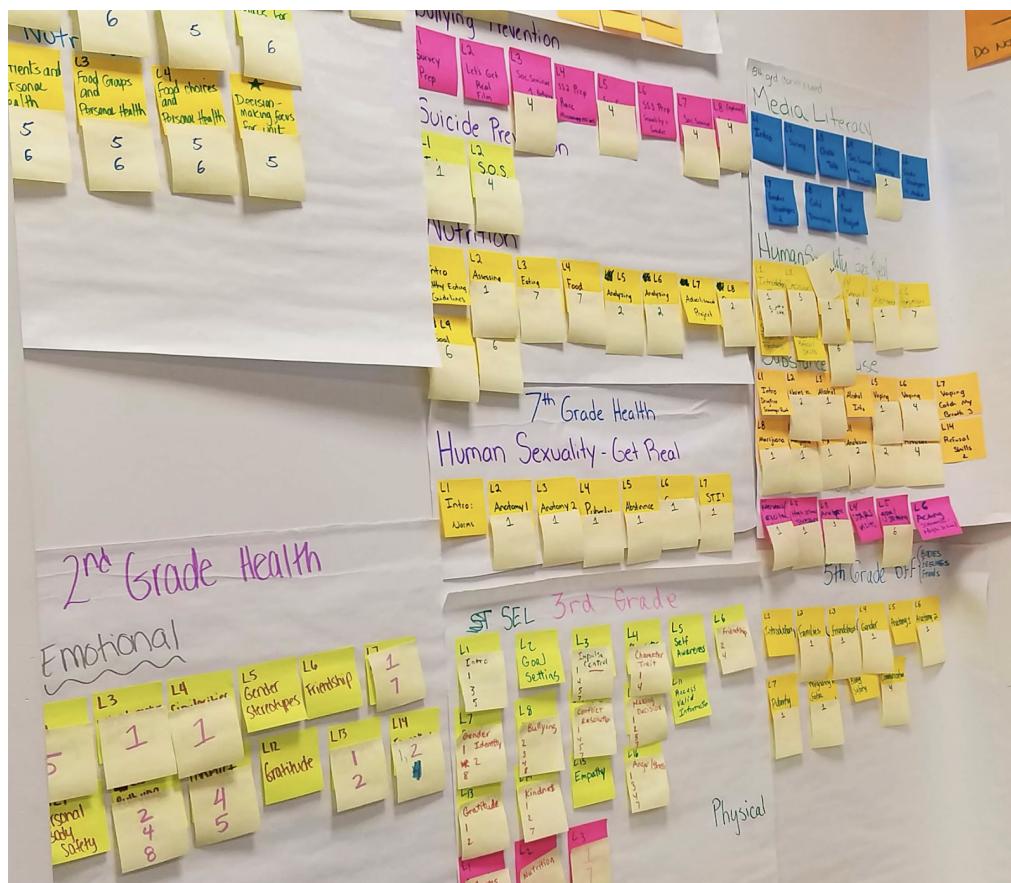
Transitioning the health team to project-based learning

The health teaching team, led by PK, had recently started the process of transitioning from what they described as a content-focused curriculum to one focused on skills and grounded in projects. The shift was part of a broader district-wide redesign of the health curriculum – an important detail as it meant that the team had support from the school and district in making radical changes to how they taught. They also had professional development support from within the school and from a nearby university's STEAM Learning Lab.

The team kicked-off their process in February. They started by first mapping the overall curriculum with a high level focus on content and skills. They visualized this work using large sheets of paper and sticky notes. PK, the health team's lead teacher, explained that using post-its and large sheets of paper in a single room allowed them to really see the kind of changes that they wanted to make and to move between the big picture and specific details. It also made it easy for them to make changes and experiment with different possibilities, all while supporting a shared conversation grounded in the shared artifacts (in this case, a room filled with post-its and large-sheets of flip-chart paper). They could move things around and could orient themselves spatially to where things were posted on the walls.



Figure 7.1
The Health team's mapping of their new project and skills based 10th grade health curriculum.



However, the team needed a way to document their thinking digitally so that they could continue to collaborate while not in the same space; and so that they could begin building out learning experiences and updated courses based on their initial visioning work. This would include developing resources for students, lesson plans and slide decks for classes, and project prompts and rubrics. This would also involve finding, curating, and repurposing a range of digital materials. They needed a digital medium to manage this growing complexity.

As they looked to digital tools, their options felt limiting. The health team's lead teacher, as part of a project-based learning professional development series held at the school, had already introduced project-based learning into a ninth grade health class. To do this, he built on a template that the professional development team shared with him from PBLWorks (see Figure 7.2). While the template made it easier to think of the different parts of a project or to see what might go into it, he explained that it was a difficult tool to work with. The boxes in the Google Docs based template were too constrained and as he filled it in it quickly became overwhelming (see Figure 7.3). The document became cumbersome to read and even more difficult to make changes to. It was clear that it wasn't an ideal place to play with possibilities: what might happen if he moved an activity to a different session? Inserted a prompt here? Added a back-up activity there? In a more tinkerable interface, it would be easy to play with these possibilities – to think not just in one's head but through and with another medium. With the text-based plans, this became difficult.

Figure 7.2.

Project planner from PBLWorks (formerly the Buck Institute for Education).

1. Project Overview

Project Title	Public Product (Individual or Team)
Driving Question	
Grade Level / Subject	
Time Frame	
Project Summary	

2. Learning Goals

Standards	Literacy Skills
Key Vocabulary	Success Skills
	Rubric

3. Project Milestones

Directions: Use this section to create a high-level overview of your project. Think of this as the broad outline of the story, with milestones representing the significant ‘moments’ or ‘stages’ within the story. As you develop these, consider how the students will demonstrate learning and what learning will take place. The Project Calendar (Section 4) will allow you to build out the milestones in greater detail.

Milestone #1	Milestone #2	Milestone #3	Milestone #4	Milestone #5	Milestone #6
Entry Event (2 days)	(4 days)	(3 days)	(3 days)	(4 days)	Public Product (3 days)
Key Student Questions					
Formative Assessments	Summative Assessment				

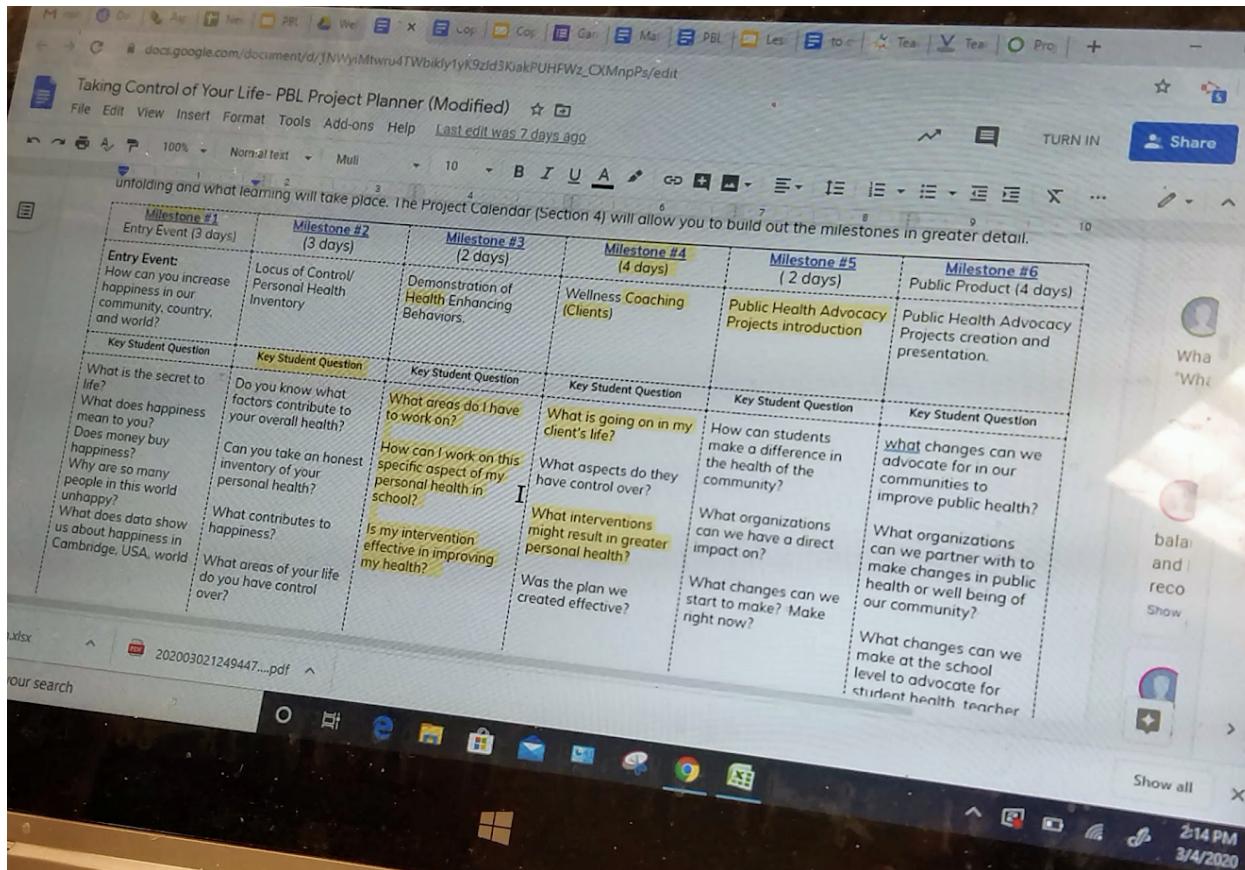


Figure 7.3. PK using the project planner to design and facilitate a project.

These concerns were echoed by other educators at Riordan High. They explained that while the planning template helped them understand what might go into a project design (e.g. milestones, student questions), the template wasn't a great planning tool: it was difficult to play with possibilities, to flesh out one's ideas without getting overwhelmed with information, and to dance between the details of a specific part of the project (e.g. a particular milestone or activity) and the overarching whole. Moreover, once a project kicks off, it becomes even more difficult to make adaptations or changes to the project plan. Some educators explained that the template feels overwhelming before you even get started, and as you add to it, you're quickly flooded with text.

The health team lead and the technology coordinators we worked with reiterated these concerns: it's difficult to parse the big picture from the details; to add rich media (photos, videos, embeds, etc.); to show and not just tell (e.g. include examples of projects that inspired you, previous student projects that reflect their interests); and to reconfigure things once you've created a version (want to swap milestone 2 and 3? Surprisingly burdensome!).

In response to these challenges, we began experimenting with other tools that educators might use when designing their projects.

We first adapted the PBLWorks Planner into Trello. We felt that might make it easier to plan than the Google Doc: users could nest information inside cards, move cards between columns (which could be helpful both when playing with possibilities and once a project goes live as things evolve...), and add in all kinds of attachments that could help an educator plan or that they or students might actually use in the course of the project. Which makes sense – Trello was designed as an *agile* project management tool – for projects where iteration and movement is the norm. Trello also had a similar feel to the post-its that some of the educators had been using in their other planning work — a familiarity we hoped would encourage them to jump right in.

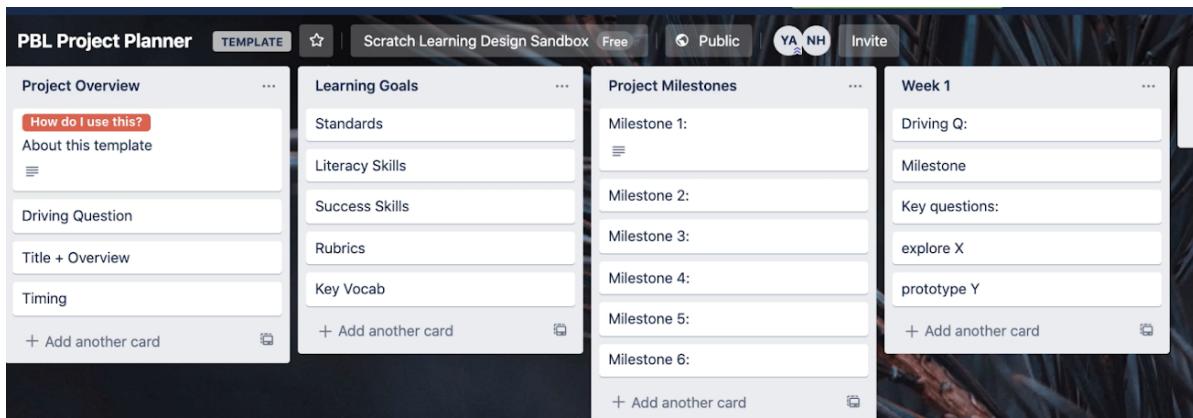


Figure 7.4. Example of the project planner remixed into Trello. Video of the Trello template in action: <https://vimeo.com/450191779>

One could even imagine making a version of this board visible to students. For example, students could use Trello to track their own learning and development through a project, to collaborate with peers, and to document their work – which in turn helps prepare them for project work and directing their own learning outside of school. This might even further empower the work of an educator, something we'll see in the next chapter. Some learning communities (e.g. Agile Learning Centers) already do this.⁹⁵

In addition to the Trello prototype, we prepared another version of the PBLWorks Project Planner in Milanote. While the Trello version might be easier for some people to use,⁹⁶ Milanote felt better suited as a creative design tool because it generally felt more tinkerable, more personal, and more collaborative as we'll explain below.

For example, in Milanote we can create a Kanban board (columns with cards) similar to Trello, but can also embed videos, GIFs, and other content *wherever* we would like – we're not constrained to columns. We can also choose whether to expand or change the size of cards (so we can see everything at a glance) or to hide information into a 'nested' view. Moreover, one can easily export

⁹⁵ See <https://agilelearningcenters.org/>.

⁹⁶ More people are familiar with Trello, you can do more with a free account, it's more constrained so you have fewer decisions to make.

a Milanote board as a Word document, PDF, PNG, etc. It's also easy to save content using a Chrome extension or drop images from other websites or documents directly into your board. Most importantly, in our limited testing both at CRLS and in other contexts, we noted that Milanote was easier to get started with. Typically, we found that educators were able to find their way around the tool to do what they wanted to do. They would bring their own styles and ways of thinking to bear, manifesting in very different uses of the tool.

PBL Template

Invit

How do I use this?

- This is a tool for you to think with!
- You can add notes, images, and other attachments (videos, embeds, etc.)
- Adapted from this.

Learning Goals
3 cards

Standards
Next Generation Science Standards

- HS-PS1-2: Construct and revise an explanation for the outcome of a simple chemical reaction based on patterns of reactivity, and tests the proposed explanation by collecting evidence for each of the predicted phenomena.

Skills
Ipsum Lorem....

Essential Questions
Ipsum Lorem???

Project Milestones
2 cards

Milestone 1
Ipsum Lorem

Milestone 2
Ipsum Lorem....

Week 1
5 cards

Driving Question

Milestone

Key Question

Explore X....

Prototype kjaifjlkf

Week 2
0 cards

Week 3
5 cards

Driving Question

Milestone

Key Question

Explore X....

Prototype kjaifjlkf

Inspiration

https://www.youtube.com/watch?v=v0E_GYead
Water Quality Project

<https://my.pblworks.org/project/theres-whats-in-my-water>
There's WHAT in My Water?

Students identify and research harmful chemicals in their community and propose solutions to minimize the impact of these chemicals. They partner with local or regional environmental stewardship organizations to discuss the most pressing environmental issues and the chemicals associated with them. These examples are largely from food supply, water and air quality, brownfields and chemical hazards—you may wish to provide students with a short list of locally relevant issues, and identify ways to address those issues within the local community.

Professionals working in water testing or who can

Figure 7.5. Early iteration of our project planner in Milanote. Video of the Milanote board in action: <https://vimeo.com/450192329>

We introduced both the Trello and Milanote prototypes to the educators at Riordan High. Despite the fact that a couple of the educators were already familiar with Trello and had even begun experimenting with it for learning design and for project managing learning experiences, the group jumped to try Milanote.

The consensus was quickly clear: Milanote felt more like a tool to think with. The interface encouraged **tinkering**: educators could easily drag and drop text, images, videos, and links. They could move things around and rearrange them. They could have organized parts of their workspaces and less organized parts. And they could nest or hide information so things didn't become too overwhelming.

Milanote was also more **personal**: each educator could organize their boards in unique ways. Some relied more on columns, others nested information in boards. They could be more visual, textual, rely on embedded information (e.g. slides). Although one could expect diversity of expression could impact readability, it actually helped educators better convey their ideas with others and to see how peers were thinking.

This led educators to intentionally use Milanote to empower **collaboration**: instead of sharing information and ideas on email, some began using this as a place for organizing slide decks, resources, and to-do lists – all uses that we did not anticipate going into this project. As one educator put it, she no longer needed to search her email endlessly for files or links or what a collaborator had agreed to if she was co-teaching. Instead, she could just drop into her Milanote board and continue the conversation there. As we pushed to ask why they used Milanote to collaborate, we observed that educators seemed drawn to both the tinkerability of the interface, the organizational possibilities (columns, the ability to nest a new board or workspace inside another one, to-do lists, and the ability to easily embed links and all kinds of files without needing to worry where a file was in a folder), and the spatial interface (just like one might remember where something is in a room, educators explained that it was easier to remember where something was spatially on a Milanote board.)

These ideas emerge clearly in two examples.

Project Overview

Title: Taking Control of Your Life

Summary: Students will analyze factors that contribute to their overall health

Driving Question: How can people increase happiness? How can we increase happiness in our community, country, and world?

9th Grade Health
Timeframe: 17 Classes

Public Products

- Develop a personal portfolio of self care
- Work with clients within the community to develop plans for self care as personalized wellness coaches
- Develop a wellness plan/initiative for a company, school, organization, or government and pitch their ideas.

Learning Goals

Standards
NHES (6): Students will demonstrate the ability to use goal-setting skills to promote health

Skills

- analyzing data
- interviewing
- public speaking
- communication skills

Key Vocab

- locus of control

Rubrics
TBD: based on formative and summative assessments as well as learning experiences.

PROJECT MILESTONES

Milestone 1

1 Milestone 1 Details
3 days

Entry Event
How can you increase happiness in our community, country, and world?

Key Student Question
What is happiness? Are people happy? Why or why not? What type of data do we have to back that up?

Formative Assessment
Elevator Pitch

Elevator Pitch Assignment and Rubric.pdf
Download - Open in browser - 62 KB

Milestone 2

2 Milestone 2 Details
3 days

Entry Event
Locus of Control / Personal Health Inventory

Key Student Question
Do you know what factors contribute to your overall health?
Can you take an honest inventory of your personal health?
What contributes to happiness?
What areas of your life do you have control over?
What modifications will you make to your life to address your own personal health?

Formative Assessment
Holistic Goal Setting Plan

Figure 7.6. PK's project plan in Milanote. The static image above doesn't capture how much easier this version is to work with than the original project-planner.

First, PK's health curriculum in Milanote is much easier to read and explore. Instead of being overwhelmed by information, one can more easily move between implementation details and the bigger picture of the project. From a design perspective, PK might embed his slides in here in a way that makes this helpful not only for planning, but for facilitating and *iterating* on the project. Although PK's example is still largely limited to text and columns, the interface allows him to play with possibilities and spatially organize his ideas. It also allows him to include details that matter (e.g. curriculum standards), while hiding them from view so that he can only see them – or export them – when he needs to.

WeVideo PSA

 Comr

Day 1 - Tues, 3/3	Day 2 - Weds, 3/4	Day 3 - Thurs, 3/5
9 cards	5 cards	4 cards
1:10-1:50 <ul style="list-style-type: none"> • TECHNICAL HOW TO'S LESSON 10 min Stations <ul style="list-style-type: none"> • Station 1: Nicole - SchoolCam • Station 2: Kendall - Google Drive uploading on cellphone • Station 3: Paige - Taking pictures and videos on the Chromebook <div style="border: 1px solid #ccc; padding: 5px;">  Nicole 5 Mar 2020 <p>Something amazing we learned: make sure the student shuts off their data plan, otherwise SchoolCam will try to connect during the uploading process and the student will receive an error message!</p> Reply </div> 1:50-2:30 <ul style="list-style-type: none"> • SET CLASS UP WITH WEVIDEO <ul style="list-style-type: none"> • Have student "Log in" with correct codes • Video editing vocab • Walk them through WeVideo essentials • Introduce the "Express Yourself" Project 1 	1:10-1:50 <p>WHAT IS A PSA?</p> <ul style="list-style-type: none"> • Watch PSAs • What makes a good PSA? • What was the tone? • Who was the audience? <p>What elements/visuals were used?</p> <div style="text-align: center;">  <p>Single Sign On Please enter your user name and password</p> <p>User name: <input type="text"/></p> <p>G https://docs.google.com/document/d/1blI7tPSAexamples</p> </div>	1:10-1:50 <ul style="list-style-type: none"> • Work on Express Yourself Video • Gallery Walk 1:50-2:30 <p>STORYBOARD!</p> <ul style="list-style-type: none"> • Define Storyboard • Tone, Audience, Musical Elements, Videos <div style="text-align: center;">  <p>Single Sign On Please enter your user name and password</p> <p>User name: <input type="text"/></p> <p>G https://docs.google.com/document/d/1Hn2STORYBOARD</p> </div> <p>To do:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Make Storyboard vocab definitions <input type="checkbox"/> Make Storyboard Handout (Modify the Dream Podcast one)

Figure 7.7. Two educators using Milanote to collaboratively design and facilitate a project-based experience where students make public service announcements. Her class slides are hidden with a Media Lab Log-in page.

In our second example, we see two educators use Milanote to organize their thinking, planning, and examples all in one place. They're able to sketch out their goals for the extended project they've planned; translate those goals into concrete activities and plans; and share to-do lists with each other. They've also embedded all of their slide decks for each teaching day – and have used the slides for the details of each session. Finally, they embedded an example video that they planned on sharing with students in their Milanote.

Reflections: Pulling it all together

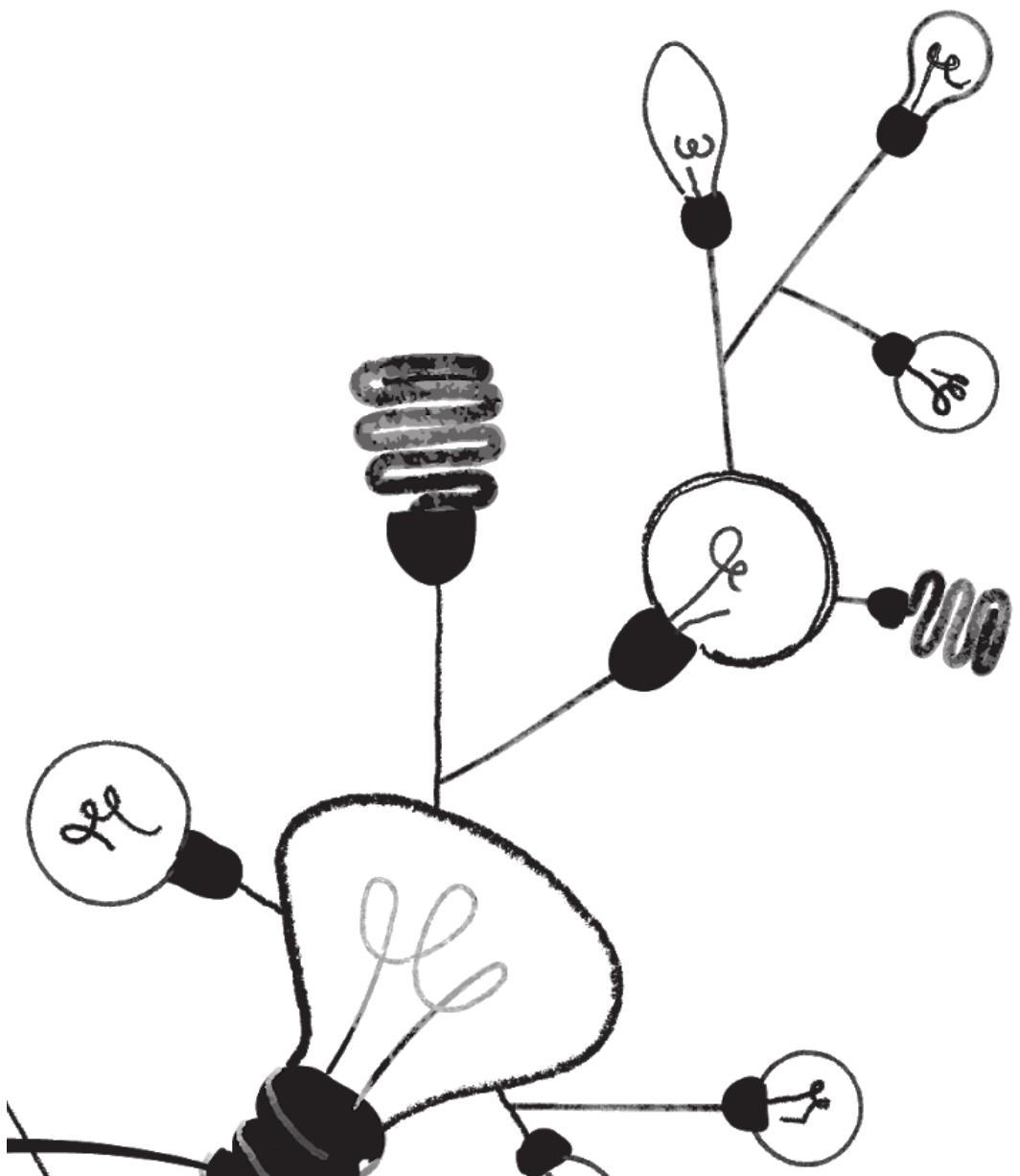
Creative learning design tools can make trying new things less scary

Because our work with educators at Riordan High was abruptly cut off due to the pandemic, these reflections are early *impressions* of our work. We didn't get to see educators use these tools over extended periods of time as we did in the first and third case studies.

Although our work with Riordan High was limited, we noted that a creative learning design tool made it easier for educators to engage in a more tinkerable approach to designing learning experiences. This is nontrivial: a tinkerable approach made design feel more intuitive, less scary, and offered freedom "to try out different ways of doing things."

In our interviews with educators (at Riordan High and elsewhere), we consistently heard that educators felt immense pressure to "not fail" and to "do good by my students." This pressure to be perfect, we found, often stifled creative energy and thinking. By making it easier for educators to play with possibilities, visualize learning, and spatially represent their ideas, Milanote (and to a lesser degree Trello) lowered the barrier to entry for a greater diversity of educators: especially ones who might otherwise have dismissed or felt intimidated by open-ended, creative approaches to learning and teaching.

As a creative learning design tool, Milanote also widened the forms of expression used to describe and visualize learning. It might offer a better medium for educators like PK to push the ceilings of creative design work, sparking new possibilities for him and his students.



Chapter 8

Raising the Ceilings: Deepening Creative Learning Design and Facilitation

8. Raising the ceilings: Deepening Creative Learning Design and Facilitation

Central question

How might creative learning design tools shape how educators design and facilitate creative learning experiences in contexts where open-ended, creative learning is already the norm?

Overview

We describe how experienced educators used Milanote as a creative learning design tool to deepen and extend their practices. Across four very different contexts, these educators used Milanote to tinker with their plans, organize their thinking, express ideas, and collaborate with peers. They also moved in an unexpected direction, using Milanote to create a digital space for students to show their explorations and ongoing project work. The educators did this so that they could see student-thinking in its myriad forms and in turn respond to and support students as they engaged in open-ended project work.

Background

"All new technologies go through the same pattern of development. Their first uses are to do in a new way what was already being done; for example, the earliest movies were "photographed theater," and many of today's ideas about using computers in education simply see school's old methods through a computerized lens. It takes time for a new culture to emerge with new categories of people—in the case of cinema, the great directors, stars, and special-effects wizards—performing functions that were unimagined and largely unimaginable. The richest route to anticipating the analogous development in education is to look closely at the emerging new educators"⁹⁷

This chapter examines our work with "the emerging new educators" who champion new cultures of creative learning. We explore how these educators used a creative learning design tool to develop and plan learning experiences and as a means for supporting ongoing, iterative planning that responded to evolving student projects, needs, and aspirations.

⁹⁷ Seymour Papert's forward in Resnick, Mitchel. *Turtles, Termites, and Traffic Jams: Explorations in Massively Parallel Worlds*. MIT Press, 1994.

From early February through July 2020, we worked with a number of creative educators in formal and informal settings. The case study presented here focuses on the first two of these collaborations:

- A graduate product design course at Harvard University.
- A design course at the Stanford d.school.
- A middle school robotics course at a private school in the Boston area.
- And a public high school in Boston focused on project-based learning.

The educators profiled here worked in cultures that support open-ended learning and offer educators wide latitude in designing their courses: they were not limited by defined curricula or information-centric learning cultures. These educators saw their roles not as creating curricula or lessons, but as designing environments and projects for students to engage in and continue to iteratively design further experiences and interactions as they support student learning.

There were also important differences between these contexts. Some involved older students and fewer restrictions (the university courses). Others, including the public high school we worked with, grappled with resource constraints (faculty:student ratio, resources available to students).

These cases offer us a unique window into how creative educators might extend and deepen their practices when they have creative tools at their disposal. The below stories focus on selections from these explorations that highlight some of the insights from our work.⁹⁸

On finding tools to express oneself and extend one's imagination

AM has designed and facilitated play-based and creative learning experiences for children and adults for over a decade. She has facilitated creative computing workshops in refugee camps in East Africa and advised governments in their efforts to support creative learning practices at scale. In her current role, she develops tools and resources for educators and teaches courses on using design thinking approaches to develop learning tools, resources, and experiences.

When designing learning experiences, AM usually starts with whiteboards or post-its to think through her ideas and explore possibilities. She appreciates how they offer space to quickly draft ideas, play with possibilities, and arrange her thoughts spatially. As her work becomes more refined, she transitions to digital tools like Padlet or Mural. She does this to both involve others in

⁹⁸ You can learn more about our other case studies by exploring our Milanote file or reading reflections from educators. For example, an educator from the Boston Public School transitioning to Project Based Learning shared some of his reflections here:

<https://www.media.mit.edu/posts/dystopian-engineering-piloting-a-remote-high-school-engineering-course/>.

her work and because it becomes easier to further build out an experience in a digital medium (add links, images, media, organize ideas, etc.).

Of the digital tools she used to design learning experiences and resources, she preferred Padlet because of its simplicity, visual emphasis, and adaptability: she could generally use it to express ideas visually in her own epistemological style. However, she also noted that Padlet had serious limitations, especially as projects grew in complexity. Mural offered similar challenges – while it was useful when facilitating a brief activity, it also became overwhelming to use when projects grew in complexity.

Responding to these concerns, we invited her to try using Milanote as a creative learning design tool. She quickly jumped in, using it to (a) design a workshop and associated facilitation materials on machine learning and ethics and (b) to design and facilitate the *Designing for Digital Agency* course that she co-taught at the Stanford d.school.

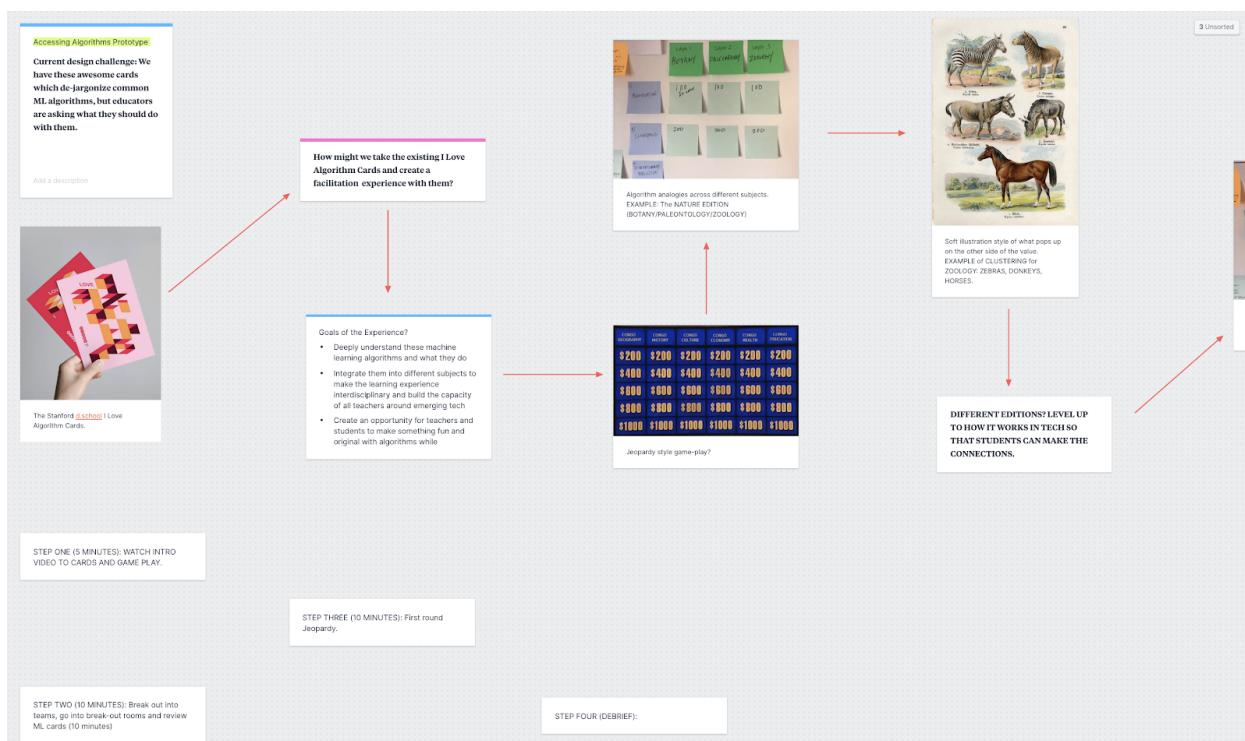


Figure 8.1. Ariam ‘mapping out’ her ideas for a learning resource that she was prototyping. You can play with and remix the example here: <https://app.milanote.com/1lopS21eqYeT3x>.

The personal nature of Milanote became even more immediate and powerful for AM because of how tinkerable the interface was. Instead of needing to think about her thoughts before personalizing them, she was able to quickly draft ideas and thoughts. AM explains:

"I'm not just seeing this as documenting my work and creating a workflow or learning experience, but also a way of communicating to others I'm working with and a way to express my thoughts. And that's why it's important – being able to do some of those things. Some of the Adobe tools can be so overwhelming because there is so much that you can do that it becomes distracting.

For example, for class I have an iPad and Apple Pencil and have been using Adobe Draw. Would never use this for what we're doing [designing learning experiences, resources, and facilitation materials]. Would only use [Adobe] to create assets, but not to create learning experiences or to express my thoughts because it has so many features and functionality and even though they have templates, the learning curve is too high, not something you'll use. Have to be comfortable with other tools in their suite or take hours of training to understand how to use the functionality to achieve a goal. If you need to collaborate with others, that is too much of a learning curve."

She was able to use Milanote as a creative learning design tool precisely because of a unique balance of personalization and tinkerability: it offered her enough expressive freedom and possibility without overwhelming her with options (as more robust design tools like Adobe XD or Figma might). This allowed her to focus on developing her ideas. Moreover, because creating, iterating, and extending ideas felt as easy as moving LEGO bricks, she could do so in ways that encouraged her to experiment and play with possibilities – without getting bogged down with formatting.

AM describes this tension and what it unlocked for her:

"If you're not thinking about how you use technology, you're missing opportunities to express yourself – and to get to the core of what you're trying to do. When I have a great tool that helps me express myself, I'm doing my best work honestly. Because I can be fully who I am. Everything I want to get out there, I'm able to do through the things that exist in the technology. When those things don't exist, they're not being transmitted through my brain. Google docs doesn't do that for me [which is why] I'm not doing my best work [there]...I'd always rather have open-ended tools like post-it's and a whiteboard, because at least I can draw my ideas and have no constraints vs. being forced to use Google Docs for visual work and feel constrained and repressed."

In our discussions, and in examining and observing how AM used Milanote to design, it became clear that it offered her a tool to think with. She thought as she tinkered with digital materials (text, images, spatial arrangements) and in the process discovered new ideas and possibilities for how she might design a learning experience. For AM, using a creative learning design tool offered a medium that helped her extend her imagination.

She brought these experiences to bear in her *Designing for Digital Agency* course: a 12-week, design studio course based at the Stanford d.school. Due to the COVID-19 pandemic, the course

was facilitated purely online. Consequently, students needed to find spaces to collaborate and to *make their thinking visible* to the teaching them. As a *responsive facilitator*, AM saw her role as designing an environment, and then iterating and continuing to design based on where students took their work. Consequently, she used Milanote and another creative design tool, Mural⁹⁹, to support students in making their thinking visible and to encourage collaboration and reflection in practice – as ideas and projects were being developed.

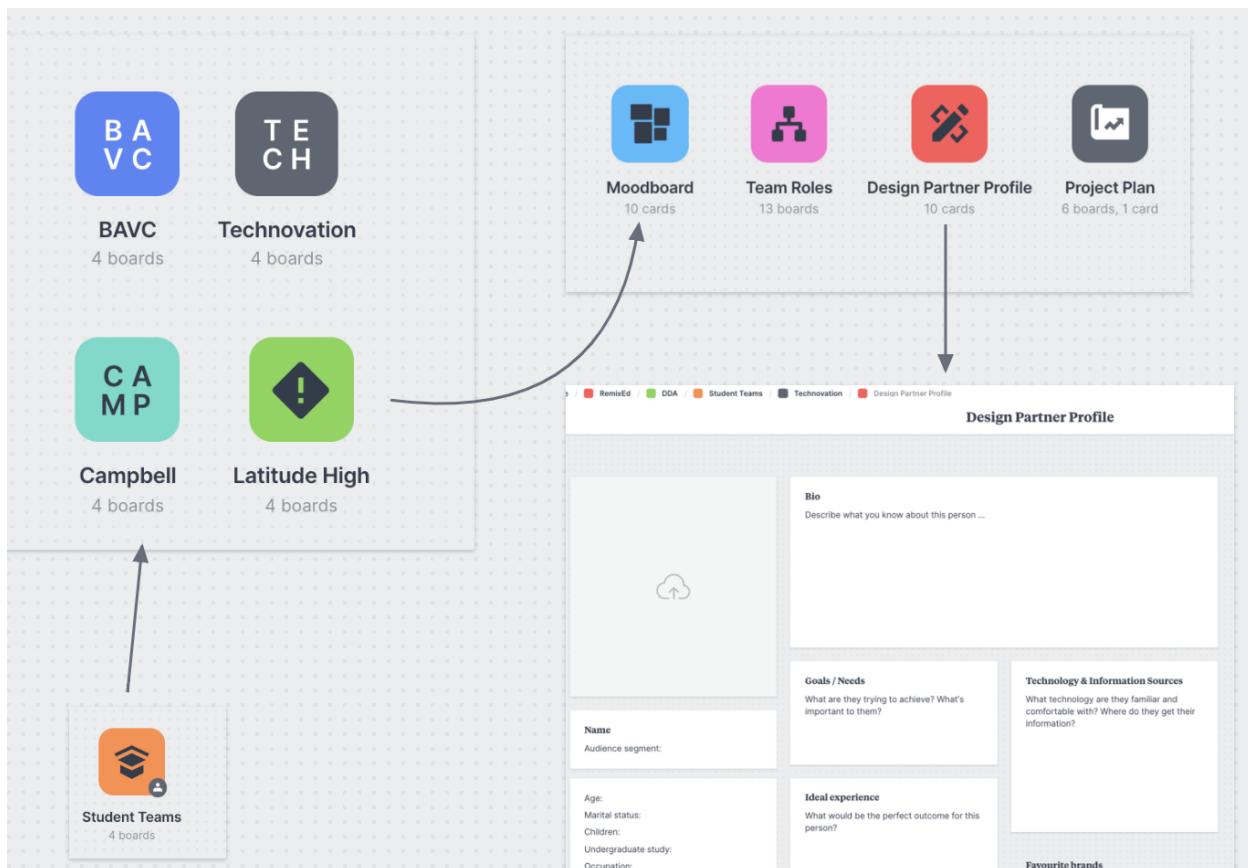


Figure 8.2. How AM set-up Milanote boards for her course. Each student team was given a board where they could share their design research and thinking.

In using Mural and Milanote to design and facilitate her course, AM resembled the Reggio *atelieristas* we described earlier: she created an environment where she could document and see student thinking and exploration – so that she could then respond to what she saw and design in iterative ways. For AM, creative design and facilitation were not sequential activities, but formed a part of her *creative teaching spiral* as she moved fluidly between design and facilitation – a pattern we'll see in our next story as well.

⁹⁹ She chose to use Mural in this setting because students were more familiar with Mural as many of them had used it in other courses.

Drafting learning experiences and creating spaces for responsive design and facilitation

RW is a practicing designer and artist and was trained as an architect — training and experience that shape how she designs and facilitates learning experiences. She teaches at an innovative, project-based high school (instead of classes, students work on 2-3 week long extended projects called ‘studios’ organized around a theme, and are not batched by age or ability). She was also part of the teaching team for a product and experience design course at Harvard led by Beth Altringer.

We were particularly interested in her perspective because of her experience (she has six years of experience teaching in an ambitious, open-ended context) and because, as director of studio development, she was responsible for helping other educators at her school develop their ability to plan and facilitate open-ended learning experiences.

To better understand the role of a creative learning design tool in RW’s work, it could be helpful to start by taking a closer look at how she designs learning experiences. RW described how she finds and organizes inspiration when developing a ‘studio’ (open-ended design-based learning experiences); how she refines her ideas (e.g. would a studio topic be generative enough? Relevant? Would the students find it interesting? Did she have access to the required expertise?); and how she evolves those ideas as they come to life in her courses. From talking to her, we discerned two reasons why she didn’t document the process she went through when planning a studio: first, she had taught almost sixty studios and much of the work she was able to do in her head acting as a critic for her own ideas; secondly, the tools she had on hand did not facilitate the type of thinking she needed to do. Which is why when we shared Milanote with her, we weren’t surprised that she soon took it up as a tool for designing learning experiences, but also as a general tool for organizing creative work. At first she used it to think through some writing she was doing but after the switch to virtual learning she sought to use Milanote in completely new ways for her teaching.

Reword!

Studio Brief: Designing for Perception
2 cards

Brief: create a physical device or wearable that actively interacts with the body and affects your perception of the physical world, society, the city etc or yourself. It can be mounted to you or something in the world, or be an object in-between. Look beyond the a simple mask!

What is a device? a thing made or adapted for a particular purpose, especially a piece of mechanical or electronic equipment.

What is a wearable?

How do you make something more effectively communicate intended identity signaling.

- Say you're single, how could you communicate that better? Clothing or gesture?
- Seen as someone who investors should take a chance on, how do you communicate that I'm trustworthy and high potential.
- For Men there's a lot of status watch communication going on, most status watches are really expensive. Some people in that category are playing with the idea of status watch. There's a status bag communication.
- Imagine a future where the same pace of clothing is attached to the body in different ways or can shape shift.
- Remake your clothes as you grow.
- How would a robot present itself in a certain

148 words

Lens: Perception
2 cards

What is Perception?

- [Article on LinkedIn](#), Perception in Design: the ability to see, hear, or become aware of something through the senses. A way of regarding, understanding , or interpreting something; a mental impression.
- [Gestalt Theory](#)
- [Wikipedia](#)
- [Perception and Consciousness](#): Is consciousness a battle between your beliefs and perceptions?
- [What affects our perception?](#)

What are examples of things that are perceived?

- [Intelligence and Fashion](#)
- [Clothing and Stereotypes](#)
- [How perceptions of cleanliness affects customers?](#)
- [Clutter and anxiety](#)
- [Body Image](#)
- [Our perception of robots](#)
- [What makes a beautiful day?](#)
- [What makes cute things cute?](#)
- [Different types of maps and the Map is not the territory](#)

Random thoughts....

- What does it mean to alter perception? Is this about seeing beyond initial perceptions? Or about moving beyond

Project Examples
5 cards



<http://briankane.net/art/#>
[Art | Brian Kane](#)

Please see this page for video, images, and documentation. "Healing Tool" is a site-specific installation and visual realignment by media artist Brian Kane. As part of his ongoing series "Art for Commuters", this installation introduces a poetically enhanced digital image on a giant billboard in order to restore and realign the surrounding landscape.

IRIS VAN HERPEN

<https://www.irisvanherpen.com>
[Iris van Herpen](#)

Thank you for an incredible night and surprise DJ performance at Le Guess Who. Björk embodied the black laquer leather 'Synesthesia' dress, wearing custom glass-blown 'Shift Souls' face jewelry, created in collaboration with Philip Beesley.



Figure 8.3. RW's using Milanote to organize inspiration and draft ideas for a design-brief that would provide the basis for a project-based learning experience.

Using a creative learning design tool to develop open-ended projects for a graduate course

RW used Milanote as a creative learning design tool for the graduate course on product and experience design. The course is organized around a series of design challenges in which student teams create digital or physical prototypes. Projects students worked on ranged from redesigning public spaces at their university to developing virtual reality projects using Unity. This particular version of the course ran during the spring 2020 semester and we began working with RW just before the course transitioned online due to COVID-19.

Prior to using Milanote, RW had primarily used Google docs to document her thinking and collaborate with the teaching team. Although RW is fluent in AdobeXD and has deep experience with a range of design tools, she found more advanced design tools to either have “too many features” (one gets overwhelmed with formatting options in ways that distract from ideas) or to be “too parametric”: they require one to already have formed ideas before entering them into a

software.¹⁰⁰ For the purposes of designing learning experiences, these design tools were not helpful.

In contrast, RW explained that she was able to use Milanote to quickly draft ideas, organize inspiration, and flesh out her thinking. Although Milanote didn't have the same visceral 'feel' as paper and pen, the medium still felt "drafty" and "comfortable" - her ideas didn't need to feel final to be drafted in Milanote. In fact, it made it easier for her to draft and parallel prototype ideas. This idea of parallel prototyping was especially important to RW: when she designs an experience, she likes to explore multiple ideas and threads in parallel. Milanote allowed her to move her ideas around, to make sense of them as she organized them spatially and visually.

As she dived deeper into planning a design brief, she was able to show (instead of telling) what she meant by including links and images, and make connections that otherwise might have been more difficult to make if she had just been using her notebook — we saw this especially when comparing notes she quickly drafted on paper with thoughts that she drafted in Milanote in Figure 8.3. Although Milanote didn't support sketching, it allowed for some of the spatial representations she could make in a notebook while making it easier to add images and a third-dimension to how she organized ideas: instead of just organizing her thoughts spatially in two dimensions, she could nest information inside a sub-board. All of these features furthered her work in planning a project-based learning experience.

Crafting a virtual 'studio space' for seeing and supporting digital project-based work

With the onset of the pandemic, the teaching team for the Harvard course quickly expanded how they used Milanote to support creative learning: to create a virtual 'studio space' for students to *draft* ideas and share their *draft* thinking with each other and the teaching team.

Creating this virtual 'studio space' was vital. When RW teaches in-person courses that involve physical making, she uses the in-person studio setting to observe work-in progress (artifacts, students at work); this allows her to offer both project and process feedback. Seeing student thinking and student's working is especially critical early in open-ended projects where students are still finding their way. Without this visibility, it becomes difficult to coach students or give meaningful *process feedback*, which she sees as essential to design-based learning.¹⁰¹ Her focus on listening and observation echoes goals shared by AM and the Reggio *atelieristas* we described earlier.

¹⁰⁰ Educators we spoke to from many different contexts raise this critique generally about the digital tools they might use to plan learning experiences — of tools feeling too 'parametric' or 'as if one needs to have their ideas fleshed out before moving into a digital medium'.

¹⁰¹ For more on the differences between project and process feedback, and why process feedback is especially critical to design-based learning, see Rosa Weinberg. "What should design students do with our feedback? A few thoughts on student agency." Medium. August 2020.

<https://medium.com/@rosaweinberg/what-should-design-students-do-with-our-feedback-32aa215c53f7>

RW also explained that it can be more difficult to observe the process for a digital project — a growing challenge as creative work shifts to digital mediums. While RW could circulate a studio space and have students point to ongoing digital work on their computers, her visibility into digital making isn't quite the same as it is with physical making. These challenges are compounded under remote conditions, which the course was forced into in March 2020 due to COVID-19.

To respond to these challenges, RW and the teaching team used Milanote as a digital 'studio space' to observe student thinking and process. They also used it to give feedback on projects and process, and to adapt their teaching to student needs as their project work unfolded.

Similar to the other examples, the tinkerable, personal, and collaborative nature of a creative learning design tool like Milanote facilitated both RW's teaching and the creative work of her students. It offered a shared space for idea development and for sharing one's thinking while one iterates and develops ideas and project work. The tinkerable interface meant that students could easily get started on the tool, use it to quickly draft ideas using text, links, or images, and make changes on the fly.

Moreover, because the *personal aspects* of the tool supported diverse epistemological styles, students were inclined to share more of their process, and to engage more fully in creative work. As one undergraduate explained, "When I'm writing things out I especially tend to be very self-critical and I edit myself a lot... [Milanote] makes me edit myself less."¹⁰² As another put it, starting to work in this medium helped her feel "like I had more to contribute."¹⁰³ Students felt more comfortable expressing themselves authentically — empowering their own learning and the teaching team's ability to support them.

A creative design tool can create new possibilities for listening to and understanding students — and therefore for creative teaching. As bell hooks explains:

"As a classroom community, our capacity to generate excitement is deeply affected by our interest in one another, in hearing one another's voices, in recognizing one another's presence. Since the vast majority of students learn through conservative, traditional educational practices and concern themselves only with the presence of the professor, any radical pedagogy must insist that everyone's presence is acknowledged. That insistence can not be simply stated. It has to be demonstrated through pedagogical practices."¹⁰⁴

By using a creative tool — in this case Milanote — as a place for students to document their thinking, RW created new opportunities for listening: for her to listen to her students and for students to acknowledge and listen to one another. As one student explained, seeing an image or how another student had arranged a board helped her understand a point the student was making that she

¹⁰² Interview with undergraduate student, April 2020.

¹⁰³ Interview with undergraduate student, April 2020.

¹⁰⁴ Excerpt From: bell hooks. "Teaching To Transgress." Apple Books.

otherwise wasn't able to glean from their conversation. By creating room for more understanding, they also made critique more humane: RW and her students explained that their use of Milanote made it possible to take time to look at a student's work *before* engaging in critique; it also made it easier to elevate voices and perspectives that are often not heard within many learning spaces.

This use evolved across the phases of a project and was especially vital for early idea development. As RW explains:

"The most important time to see students' thinking is during the divergent phase when they are trying to figure out the form and function of their project. When a project is more figured out, Milanote's use switches to being a place to agglomerate iterations and prototypes, while still allowing for divergent thinking and parallel prototyping when necessary."

While some of this work (i.e. aggregating iterations and organizing prototypes) could happen in other tools, another member of the teaching team explained that Milanote actually made it easier relative to other tools to stay organized and support student learning at even later stages in the design process:

"Normally you have this fragmentation of stuff. Milanote enables students to cleanly organize their work, like a front page for their work. Easy for us to see where everything is, which makes it easy for us to see things [across files and cloud systems]... Spatially oriented in useful ways which makes it easier for me to remember where things are so I can spend more time on the conversation and less time looking for their work."¹⁰⁵

While these concerns are generally relevant for digital projects, they become essential when supporting remote learning and group work as many have been forced to do during the current pandemic.

Across RW's experience using Milanote as a creative learning design tool, we can see how creative teaching and creative learning are better empowered by tools that allow students and educators to prototype ideas, express themselves in personalized ways, and to easily collaborate across the various phases of a creative project — from early idea development to refining, implementing, and iterating a developed project.

Supporting nondominant styles of thinking

DA teaches middle school students at a private school near Boston, MA. In his Spring 2020 robotics and humanities course, participants (ranging in age from 10-13) explored questions related to wayfinding (philosophical, pedagogical, personal) and design robots inspired by their philosophical discussions. As they transitioned to remote learning, DA and his students used

¹⁰⁵ Interview with Beth Altringer, April 2020.

Milanote as a collaborative tool for organizing the class's work and for sharing project work, documentation, reflections, and other explorations. For example, their reflection journals were originally conceived in more linear formats such as Google Docs. In the more dynamic medium of Milanote, students were able to create non-linear, visual, and multi-dimensional representations of their ideas and feelings.

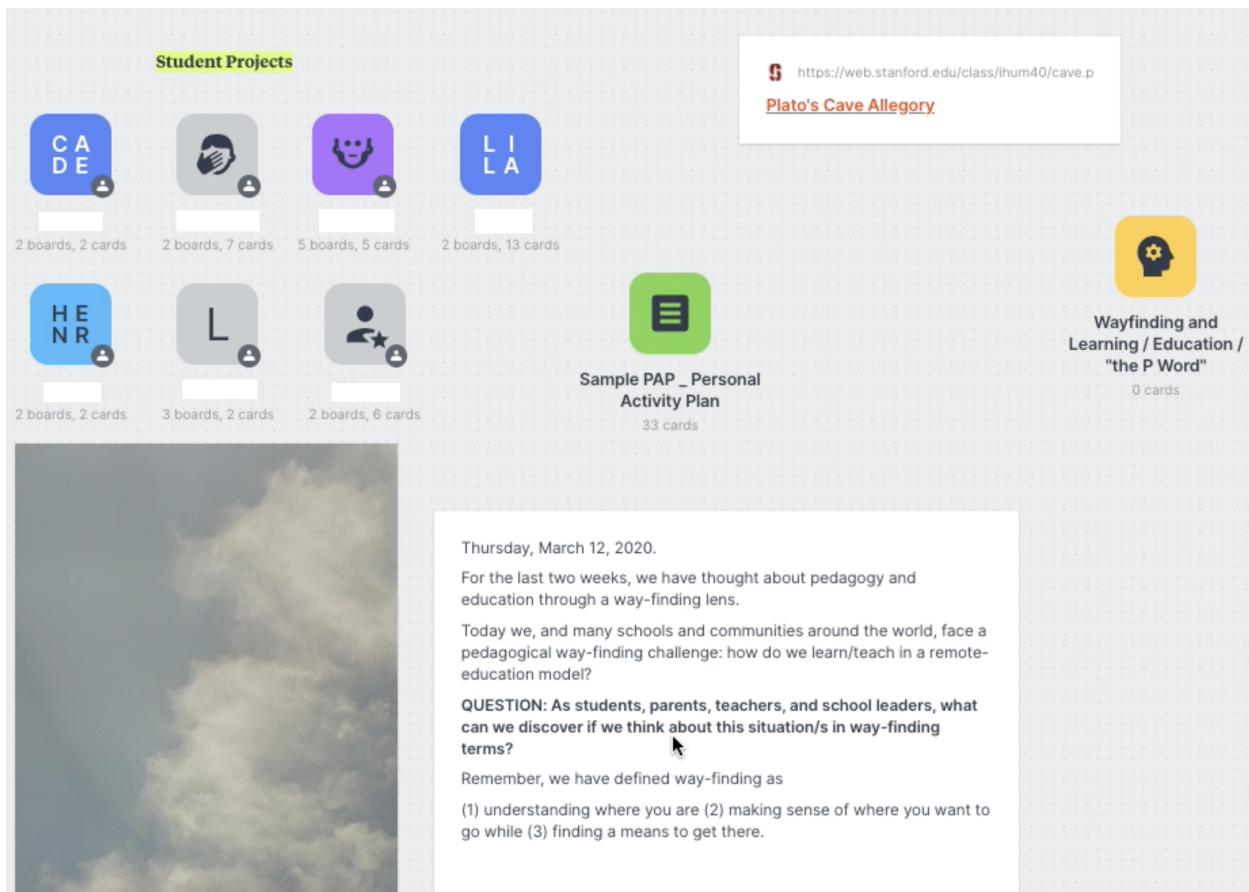


Figure 8.4. The Wayfinding class's digital workspace. In other writing, we describe how DA used this space to empower creative work and collaboration among his students. For the purpose of our argument here, we'd like to draw attention to how DA used this workspace to observe and document student thinking – both intermediate artifacts and how they worked – so that he could iteratively design and teach.

These opportunities especially supported nondominant epistemological styles. DA noted that one particular student was able to express himself and to feel heard in ways that he hadn't beforehand. Using Milanote empowered this student to develop his ideas and made it more accessible for others to see his thinking. This empowered DA's teaching because he was able to see not only the particular prompts or projects a student was engaged in, but the different ways in which the student organized his project work or structured his explorations.

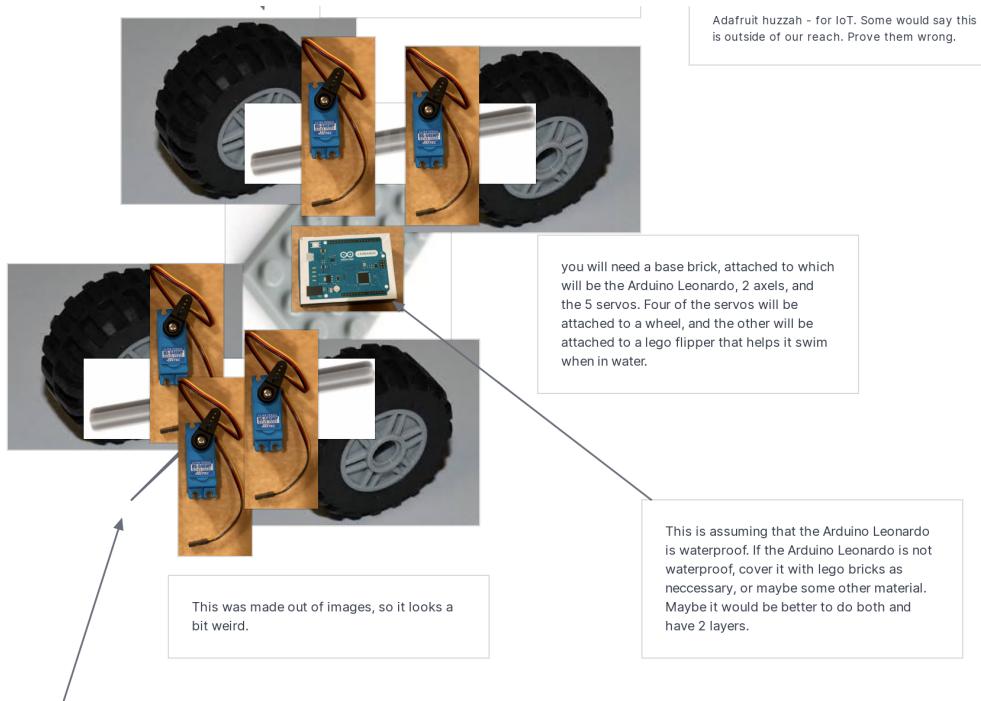


Figure 8.5. Example of how a student shared his process with DA. DA can then use this space to offer feedback, etc.

While we noticed that some students with dominant epistemological styles (e.g. they felt comfortable working in text-only formats) didn't take advantage of the new medium with the same excitement as some of their non-dominant peers, they were still able to express ideas just as they might have in a more traditional medium. In this sense, we saw how Milantoe as a creative learning tool, not only supports different styles, but especially makes space for people who didn't have the space or tools to express themselves. This visibility better empowers the iterative design and teaching work of someone like DA — who can better understand and engage with students over the course of open-ended project work.

Reflections: Pulling it all together

In this final set of examples, our collaborators demonstrated how a creative learning design tool might advance creative learning and teaching in multiple directions. At one level, a creative learning design tool offers a more tinkerable, more personal, and more collaborative medium for developing learning experiences. At another, it offers a space for making student-thinking and process visible, especially for projects that involve digital work or that take place in remote-learning situations. In the process, these tools create space for non-dominant epistemological styles, inviting more students and educators to be themselves and more fully participate in creative work.

In this sense, we used a creative learning design tool to break down the divide between planning and facilitation: a creative learning design tool better enabled educators like RW and AM to structure and shape educational experiences as they evolve, not just beforehand. As Sergio Spaggiari explains, “the most important ability of a teacher is knowing how to capture those vital and significant events, as they appear, around which the teacher’s intervention should be organized; the teacher is therefore called to structure the educational experience primarily as it evolves, not just beforehand.”¹⁰⁶

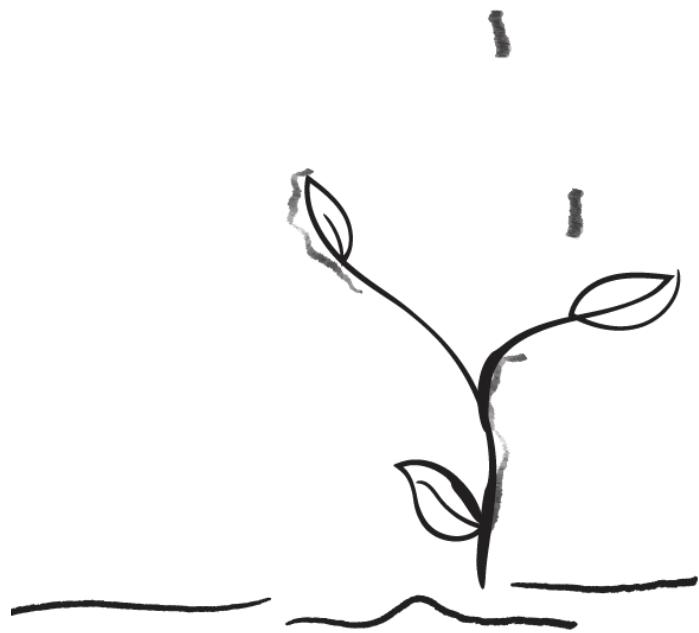
The educators we worked with crafted digital environments for students to make their thinking visible before the learning experiences began and continued to iterate with the design of these environments as the experiences progressed. For example, they would iterate on how they organized the Milanote environment, trying out different templates for students to use to document their work, dropping different questions into student workspaces, and suggesting various kinds of peer interactions.

Moreover, the educators then used these environments and what they observed students doing to continue to evolve and adapt their facilitation strategies and the design of subsequent activities and projects. As Karen Brennan explains, “Understanding and supporting learning necessarily means creating opportunities to make sense of the individual, personal connections that learners form to what they are learning.”¹⁰⁷ Experienced constructionist and design-based educators are constantly iterating on their designs based on what they observe learners tinkering with and pursuing in their open ended projects. Consequently, part of the design work for these educators involves developing strategies for making thinking visible – so that a student can more easily reflect on their own process and invite others – peers and educators – into that process as well.

As work and learning become more virtual, we need more environments like this: virtual spaces that resemble some of what is possible in a physical studio environment while harnessing the affordances of digital and computational tools.

¹⁰⁶ Also see Eds Stefano Sturloni and Vea Vecchi. *Everything Has a Shadow, Except Ants*. Reggio Children, 1999. p. 8.

¹⁰⁷ Brennan 2015.



Chapter 9

Final Reflections

9. Final Reflections

“Writing speaks over distance and time. But what’s powerful about writing was unsuspected. It changes how we think. It is not just a transliteration of oral modes of thought. It creates, co-creates, new modes of thought. The powerful idea about that is we should be able to invent more powerful idea vehicles.... Our languages are made to share categories we already understand in common. We need to touch, see, make, etc. – and talk a little too – to build an understanding of something new.”

– Alan Kay¹⁰⁸

These are early explorations in what offers to be a promising domain: creative tools to unlock the creative powers of educators and the students they work with.

As we've seen across our case studies, a creative learning design tool can lower the floors, widen the walls, and raise the ceilings for educators who are interested in designing and facilitating creative learning experiences. This is largely because creative learning design tools are more tinkerable, more personal, and more collaborative than traditional tools: creative tools encourage educators to play with possibilities, extend their imaginations, and draft ideas in ways that express their unique voices and epistemological styles.

Teaching, like other forms of creative work, is deeply personal. Each of us has our own ways of thinking and working. In our examples, educators and students used creative learning design tools to represent ideas and think through projects in distinct ways. Some used columns, others created mindmaps, some developed spaces that felt more like mood-boards – and others swam between forms of expression depending on what they were working on. Allowing for different forms of expression – what we might describe as a form of wide walls – better enables users to personalize a tool to their own uses and preferences – and to engage in more meaningful creative work.

Educators were much more able to express their individual styles in a tinkerable medium. Throughout our case studies, we observed how educators are more easily able to organize inspiration, remix ideas and resources from other sources, and externalize their ideas in images, text, embedded media, and spatial representations – that they can then see and more easily manipulate. In the process, educators can make more of their thinking visible to themselves and others, opening up new opportunities for collaboration.

As more educators and education systems seek to support creative learning, creative learning design tools – and creative tools for educators more broadly – might offer an important means for lowering the barrier to entry. As we saw with the teacher candidates, these tools offer a space

¹⁰⁸ Alan Kay. [Thinking about Thinking about Seymour](#). January 26, 2017.

where people new to this work can grow and develop as creative educators. They also make it easier for people who come from more traditional, information-centric approaches to transition to creative approaches to learning and teaching as we observed with the teachers at the large public high school.

Moreover, as outlined in our final case study, creative learning design tools are better suited for the kinds of iterative design and facilitation that creative educators seek to engage in. Design doesn't stop when learning begins: rather, much of the design work continues as educators observe, listen, and respond to student explorations. Creative learning design tools offered new avenues for listening to students and making their thinking visible. These tools also offered shared space for students and educators to play with ideas, possibilities, and ways of interacting with one another, breaking the conventional divide between educator and student and advancing the work of even the most experienced creative educators.

This worked because a more tinkerable and more personal medium created new possibilities for students and educators to express themselves: they took advantage of text, images, embedded links, and the freedom to spatially organize and represent their ideas in ways often not allowed by more constrained tools – better empowering epistemological pluralism.¹⁰⁹ While we saw how this provided educators new insights into how many of their students think, it might also help inject much needed diversity and concreteness into education debates.¹¹⁰ As bell hooks explains, "The scholarly field of writing on critical pedagogy and / or feminist pedagogy continues to be primarily a discourse engaged by white women and men."¹¹¹

One possible implication of this work is that it might create discursive space for new ways for talking about and *showing* learning. Educators often don't have the time or resources to share the research and creative work they engage in everyday. A creative learning design tool might make sharing their work more viable, surfacing up bottom-up innovations and challenging the researcher-educator divide.¹¹² This in turn could offer new possibilities for co-creating knowledge and research on education. It also might provide opportunities for those on the margins to share their perspectives and experiences in ways that can transcend the written word.

¹⁰⁹ Sherry Turkle and Seymour Papert. "Epistemological Pluralism and the Revaluation of the Concrete." Versions of this article appeared in the Journal of Mathematical Behavior, Vol. 11, No.1, in March, 1992, pp. 3-33; Constructionism, I. Harel & S. Papert, Eds. (Ablex Publishing Corporation, 1991), pp.161-191; and SIGNS: Journal of Women in Culture and Society, Autumn 1990, Vol. 16 (1).

¹¹⁰ For analysis of 14 recent articles on equity in maker-education, see Peter J. Woods. "(Re)making Whiteness. A Critical Discourse Analysis of Equity-Based Maker Literature." Proceedings of the 2019 Connected Learning Summit. 189-197. 24. https://electionlab.org/CLS_Proceedings_2019.pdf

¹¹¹ Excerpt From: bell hooks. "Teaching To Transgress." Apple Books.

¹¹² Many of our collaborators explained that they often feel researchers "drop-in" from elite-institutions and write about their work in ways that often further that particular researcher's career without necessarily benefiting the educators who actually engaged in teaching – or acknowledging the role teacher's play as researchers. In contrast, our collaborators described their teaching work as a form of research, even if they didn't use the 'r' word.

That said, we also noticed a tension between personalization and tinkerability. In our research, tools like Adobe XD, Figma, and Sketch can be vastly more personalized than Milanote — however, they often have significantly higher floors for beginners and can distract advanced users with formatting questions that take away from idea development work.

However, personalization and tinkerability are not always in opposition. A tinkerable, simple interface can make it easier for more people to personalize a tool to their own purposes. Post-its and paper can be appropriated to support many different epistemological styles with little friction to getting started. It took us time and experimentation to find the best tool in our work (Milanote) and the most impactful practices and scaffolds (templates, examples, getting started workshops) to help our partners negotiate personalization and tinkerability.

What next?

Although we began prototyping our own creative learning design tool, we opted to focus our research on repurposing existing tools that met our criteria: hacking them through templates and examples that encouraged educators and students to use them in personally meaningful ways. While this approach enabled us to see how educators might use a creative learning design tool, the tools we opted to use did have certain limitations.

In further research, it could be worth exploring what a bespoke creative learning design tool might look like – and how that might further support creative learning design and facilitation. We've outlined some of our initial ideas and wireframes in [Appendix A](#).

Finally, our research was still relatively limited in scope. While we worked closely with 20 educators in very different settings, our interactions were time-limited and largely self-selected. We predominantly worked with educators who might identify more with a 'soft approach' as described by Papert and Turkle: they prefer bottom-up exploration, flexible and nonhierarchical approaches, and developing a "feel" for objects, people, and tools¹¹³. While there were certainly planners among the educators we worked with who might prefer different approaches to design, we generally noted that they also benefited from the flexibility and personal nature of creative learning design tools. Some 'planners' experimented with bottom-up approaches and were more open to new ways of thinking. Further research could explore these patterns in more depth and gauge how a creative learning design tool might support different epistemological styles.

¹¹³ Turkle and Papert 1990.

What now?

How might you bring these ideas to life in your context?¹¹⁴

We've included questions for designers and developers below. We also invite you to play with the examples that we shared in our Milanote file at the start of this thesis and on our website: remixed.media.mit.edu. These include artifacts you can adapt and make your own.

We invite you to engage with these examples and the questions that follow as objects and tools to think and tinker with.

¹¹⁴ Our invitation for you to *appropriate* our research is inspired by a few traditions:

- *Participatory Action Research* encourages reflecting on how findings from one context might be adapted in other contexts. Unlike replicability in other fields, there is more *flexibility* here – the intention is to not to apply lessons from these case studies carte blanche to another environment, but to *explore* how these might shape how one works in another setting.
- *Constructionist* communities, including the Lifelong Kindergarten group and many of our collaborators, invite people to learn through hands-on exploration.

Questions for people developing creative tools for educators

How to use this

These questions synthesize principles that shaped how we developed, repurposed, and evaluated creative learning design tools. We're sharing them for others interested in helping educators unleash their creative superpowers. They're adapted from Mitchel Resnick's tips for designers and developers of creative technologies and activities for children.¹¹⁵

We've shared questions instead of tips because we believe that people learn best when actively constructing ideas for themselves. The questions are intended to spark reflection and to support you in actively constructing how these principles might come to life in your own world. You can use these before embarking on a project (e.g. to clarify your beliefs and goals) or revisit them anytime during the development process (e.g. during a design review).

The Tips

Beliefs and goals

1. What are your key assumptions and beliefs about learning?
2. What do you hope to help someone do – and get better at?

Design principles

3. Is your tool tinkerable?
4. Can a user make it their own?
5. Is it collaborative?

Designing for low floors, wide walls, and high ceilings

6. How might you make it easy to get started *while* supporting people as they deepen and extend their craft?

Tying it all together: Encourage hard fun

¹¹⁵ You can find Resnick's original tips for designers and developers here: <https://bit.ly/MresTenTipsDesign>. We also recommend his tips for [parents and educators](#), and [learners](#).

Beliefs and Goals

1. Beliefs: What are your key assumptions and beliefs about learning? And how can you test them?

As we discussed in the introduction, there are many ways to think about learning. These ideas inevitably shape how you design tools for educators. Being explicit about your beliefs might help you surface assumptions and interrogate ideas. It also opens room for conversation with others and makes it easier to reflect on how your ideas might manifest.

We also recommend trying out your ideas — as a learner and as a facilitator of learning. Reflecting on your own learning can be a powerful window into how to support the learning of others. Actually trying to support the learning of others can deepen and extend your perspectives. If you're looking for ideas, our research group often hosts a particularly fun activity: try teaching something to a friend, learning something from them, and then reflecting on your experiences.¹¹⁶

If you're interested in diving deeper, we recommend trying activities from Karen Brennan's *Designing for Learning by Creating*.¹¹⁷

2. Goals: What do you hope to help someone do - and get better at?

We borrowed this tip from RJ, one of the educators and researchers we worked with. Make a list of the concrete behaviors, perspectives, and skills that you hope a user of your tool might improve in. Then prioritize and shorten that list.

For example, when RJ designed storyboards as a tool for lesson design, she hoped that teacher candidates would use storyboards to get better at iterative design and at putting students at the center of an experience. Anchoring in these goals helped her evaluate her tool, to iterate on it, and to create add-on activities (such as a “reality check game” that shared scenarios with teacher candidates that they would then need to adapt their designs in response to).

¹¹⁶ If you're looking for some inspiration, we recommend Seymour Papert's *The Children's Machine*. In the book, he reflects on his own learning and on his efforts supporting and observing how children learn.

¹¹⁷ See Karen Brennan's Harvard Graduate School of Education course on “Designing for Learning by Creating.” The syllabus from the 2017 version of the course can be found here:

https://www.dropbox.com/s/xk013xx96399p0d/T550_2017_Syllabus.pdf?dl=0

Design Principles

3. Is your tool tinkerable?

Creative work, as we've argued in this thesis, requires space for exploration, experimentation, and iteration. This often works best when educators can play with ideas and possibilities. A tinkerable tool allows educators to prototype, get feedback on, and iterate on their ideas. It doesn't get in the way of creating and actually makes it easier to 'think with material.' This works especially well when educators can externalize and visualize their thinking in ways that feel light and easy – both when initially "jotting down" ideas or "dropping-in" media (links, etc.) and when playing around with ideas (moving objects around, being able to reconfigure how ideas might feel or look).

The following questions might help you design for tinkerability¹¹⁸:

- Can a user engage in quick experimentation that offers immediate feedback on what they're working on (both product and process)?
- Does experimentation feel fluid? Is it easy to get started and to connect different parts?
- How might you support open exploration?

4. Can a user make it their own?

Creative work is deeply personal. We visualize our ideas, organize our thoughts, and make sense of the world in different ways. Allowing for multiple forms of expression enables users to personalize a tool to their own uses and preferences – and to engage in more meaningful creative work.

For example, although both Milanote and Trello were tinkerable (easy to get started, fluidly move text and images, encouraged experimentation), we found Milanote to be more personal: in Trello educators were confined to a rigid grid format. In Milanote, educators could represent ideas however they liked. Some stuck to columns and Kanban boards that resembled Trello's format while others organized their ideas in moodboards, clusters, or maps. The key idea is that Milanote supported diverse forms of expression and thinking, which in turn shaped how comfortable educators were in developing and sharing their ideas.

Designing for many styles doesn't mean overwhelming users with options: our research showed that tools with too many options and features actually turn many people away, and support fewer epistemological styles. In contrast, some of the simplest tools, including Post-its and paper, can be appropriated to support many different epistemological styles with little friction to getting started.

¹¹⁸ These are adapted from Resnick, M., & Rosenbaum, E. (2013). Designing for Tinkerability. In M. Honey & D.E. Hunter (Eds.) Design, Make, Play pp. 163-181. Routledge, London. <https://perma.cc/LYN3-U9YJ>.

You'll need to figure out the most appropriate balance for your context, problem, and the users you're designing with and for.

One strategy we used to design for diverse epistemological styles was to work closely with very different educators. Mitchel Resnick advised us to pick three different contexts at the start of our work — this offered us some diversity while not overwhelming our research. In each of these contexts, we asked ourselves if users were able to appropriate a tool to support their own thinking styles.

5. Is it collaborative?

Creative work is usually highly collaborative. As you consider ways to support educators in creative design and facilitation, what kinds of collaboration might you encourage? How might a tool fit into current practices and interactions? Aspirational practices?

In understanding how educators collaborate, we found it helpful to shadow them as they worked on individual work *and* as they engaged in various forms of collaboration (synchronous and asynchronous). This led us to some unexpected ideas. For example, we found that making it easier for educators to engage in deep, individual work in ways that made it easy to share their thinking with others empowered collaboration in new ways.

Designing for low floors, wide walls, and high ceilings

6. How might you make it easy to get started *while* supporting people as they deepen and extend their craft?

To design an inclusive experience or tool that has low barriers to entry, offers diverse possibilities, and has room for complex projects, consider the following:

- Lower the floors: How easy is it for someone to get started? What barriers might exist to beginners from different backgrounds or with different goals?
- Widen the walls: What kinds of diversity — in forms of expression, epistemological approaches,¹¹⁹ ways of organizing, interests or content areas — does your tool encourage? How do people from different backgrounds use your tool? Is there space for a user to explore — and do unexpected things?

¹¹⁹ For more on epistemological approaches, we strongly recommend Turkle and Papert 1990's description of bricoleur and planning approaches to learning and creating. You can find a brief summary, excerpts, and a link to the full text here:

<https://www.notion.so/yusufa/Epistemological-Pluralism-8a5161172d8246cc95e2a3e14092954a>.

- Raise the ceilings: How might someone use your tool over time? Is there space for them to stretch and work with sophisticated ideas?
-

Tying it all together: Encourage *hard fun!*¹²⁰

We hope these tips and principles help in your work developing creative tools for educators. The journey of developing these kinds of tools is inherently an iterative one. It involves deep listening and careful observation; tinkering with possibilities; and trying new things — exactly the kinds of things you might hope to encourage and support in the tool or activity that you're designing!

We end with one last piece of advice. As you stitch together these principles in developing a tool that is tinkerable, personal, and collaborative, you might try asking a question that draws on all three ideas: is it fun? We noted that educators most enjoyed using creative learning design tools that were tinkerable, personal, and collaborative — joy therefore became a proxy that signalled how well our principles came together. And we have a hunch that if they find your tool fun to use as well, you're likely working in the right direction.

¹²⁰ We borrow the phrase “hard fun” from Seymour Papert. “Hard Fun”, Article for the Bangor Daily News (Bangor, Maine), 2002. <http://www.papert.org/articles/HardFun.html>

Appendix A: Wireframes

This section offers an overview of designs for our creative learning design tool. We began development of this tool in February 2020, but paused development in April after noticing how most educators we worked with seemed to enjoy Milanote. We paused development not because we felt Milanote was perfect, but because we wanted to deeply understand what educators were doing with Milanote and why they found it to be a powerful tool to think and tinker with as they designed and facilitated learning.

The wireframes that follow are based on what we learned from observing how educators used Milanote and other tools. Our goal here is to suggest possibilities that might enhance the design-based, creative work educators engage in.

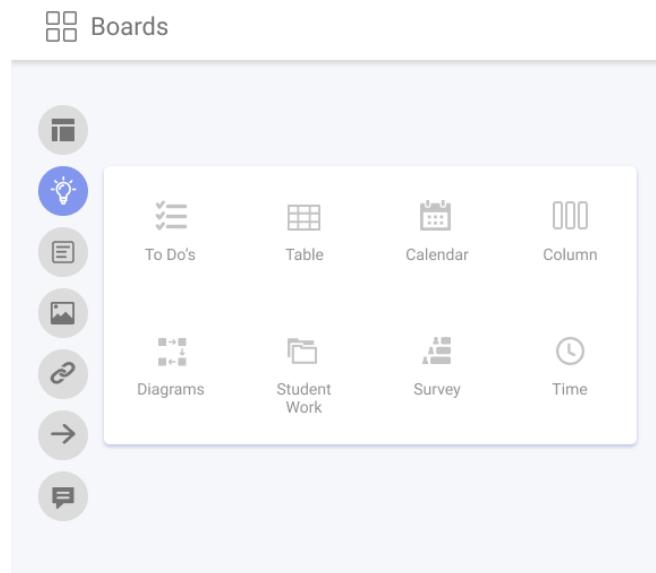
You can click through our wireframes here: <https://bit.ly/FigmaWireframes>. We've included a few example wireframes below to talk through some of our ideas. These wireframes were developed by Luciana Bueno. Earlier versions were implemented by Annie Liu and Trinity Gao.

Tinkerable building blocks

On the left of each 'board' is a column of icons. These icons represent the 'building blocks' that an educator might use when creating with this tool. We selected these building blocks after observing the kinds of work that educators did when using tools ranging from Milanote and Google Docs to pen, post-its, whiteboards, and paper.

We included blocks for adding: text, images, links, to-dos, tables, columns, diagrams, student-work, surveys, timing, and comments. We'll walk through each of these below.

We wanted these blocks to feel like LEGO blocks that could quickly be dropped into the workspace, combined, and reassembled fluidly.



Wireframe 1: Organization blocks

Templates

The first block in our menu opens templates that an educator could remix. We included these because we noticed that the ‘blank page’ problem could sometimes be overwhelming. We also wanted to use this as an opportunity to offer ideas for how one might organize their workspace and to encourage a user to customize and use this space in ways that work best for them.

The templates we included here were inspired by actual examples of designs that educators had created in our design workshops or that they had shared with us. It’s important to note that in future research, it would be important to further develop a set of remixable templates that offer different pathways into this tool.

The wireframe shows a template creation interface with the following sections:

- Boards**: A sidebar with various icons for creating different types of boards.
- Add a title...**: A text input field at the top right.
- Remix!**: A button at the top right.
- Objectives**: A section with a placeholder "Add an objective" and a "Add more" button.
- Get Ready**: A section with three items:
 - Check wifi connection
 - Set up tables
 - Set up a projector or monitor for sharing examplesA "Add more" button is present.
- Materials**: A section with three items:
 - Post it notes
 - Blank paper
 - Colored pencilsA "Add more" button is present.
- Activity Flow**: A central column with three steps:
 - Step 1: 40 min duration, placeholder "Add a description of step 1", icon of a person at a desk.
 - Step 2: 10 min duration, placeholder "Add a description of step 2", icon of a person at a desk.
 - Step 3: 25 min duration, placeholder "Add a description of step 3", icon of a person at a desk.A "Add a step" button is located below the third step.
- Standards**: A section with two items:
 - Add a standard
 - Add a standardA "Add more" button is present.
- Facilitation Tips**: A section with five items:
 - To get started...
 - For the newbies
 - For the ones who are ahead...
 - When someone gets stuck...
 - To spark discussion...A "Add more" button is present.
- Students Work**: A section with a placeholder "Send this link to your students, so they can upload their work." and a "Copy link" button.

Wireframe 2: Example Template

Click through our Figma Workspace to see more templates. This one includes space for objectives, standards, facilitation tips, prep work before the session ('Get Ready'), an activity flow, materials, and a place for student work to appear. It is based on how we saw educators use other tools in

their prep and tries to open up new opportunities for them to connect and explore ideas in parallel.

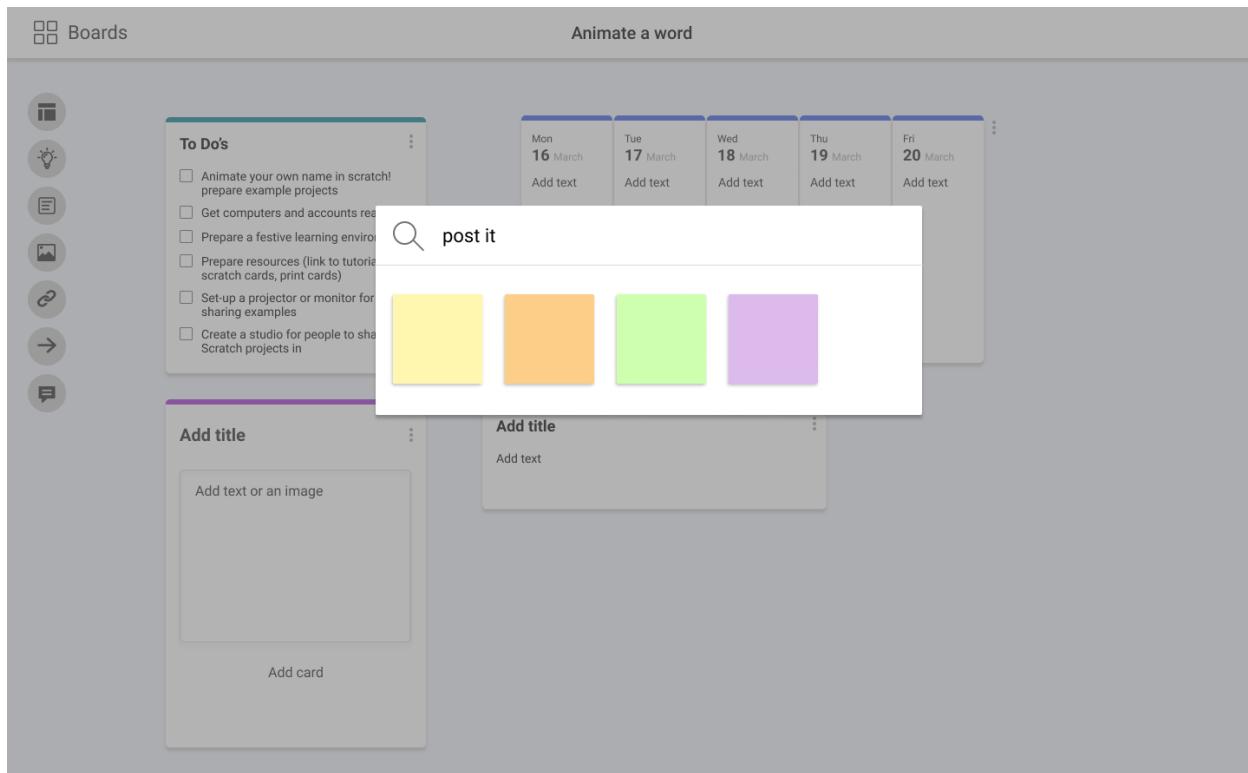
—

Organizational blocks

We decided to cluster what we call organizational blocks under a lightbulb icon (see first wireframe). These include blocks for a to-do list, table, calendar, columns, diagrams, adding student work, survey, and timing. We noticed educators moving between different tools to design with the above elements and feel that bringing these into one space could allow for a more fluid design process while allowing educators to move between details and an overall picture.

Search

We also included a search function for finding building blocks, templates, and resources within the tool. We noticed that educators would often quickly search online for images, resources, and tips and felt that including a simple search interface within the tool would simplify the user experience.



Wireframe 3: Search

The design was inspired by Spotlight search on the Mac O.S.

Image search

The general search tool is separate from the image search tool (Wireframe 4, below), which can be accessed through the photo icon in the blocks menu. We designed a few options for image search:

- An image library, possibly UnSplash (an open-source image search tool) or a curated library of images. The latter might be preferable in the longer term, as educators sometimes found friction in finding the right images on Unsplash.
- A sketch library, as we noticed that educators appreciated being able to visualize their ideas and share with others without worrying about privacy concerns related to photos.
- An icon and emoji library: We noticed that some of the educators we worked with used emojis in texts and wanted to make it easier to include simple icons and emojis in their design work.

The wireframe shows a user interface for an image search tool. At the top left is a 'Boards' button with a square icon. To its right is a 'Animate a word' button. On the far left is a vertical sidebar containing six circular icons: a document, a lightbulb, a list, a camera (highlighted in blue), a link, and an arrow. Below the sidebar is a search bar with a magnifying glass icon and the placeholder 'Search Image'. To the right of the search bar are four tabs: 'Image' (which is underlined in blue), 'Sketch', 'Icons', and 'Emoji'. Further to the right is a 'Choose grade' dropdown menu with a downward arrow. The main area displays a grid of nine images. The first row contains five images: students working on laptops, students in a classroom, two children looking at a tablet, two girls working on a laptop, and a group of students around a laptop. The second row contains four images: a group of students sitting on the floor, students raising their hands, two boys looking up, and students at a booth with a display board.

Wireframe 4: Image Search

Examples

To encourage diverse uses, we also created a diverse set of examples.

Boards

Solarpunk Fashion

Overview

3 week studio: designed projects inspired by SolarPunk theme with a former Project Runway Winner. Mainly fashion projects (based on student interest and expertise of the guest critic)

Concepts

Focus on people while incorporating tech + nature
2.0: Inspired by Web 2.0

Kickoff Project

Start project with mini-day long project. Dev wearables for plants, Focus on prototyping and working through design cycle

Documentation

NuVu | SolarPunk Fashion
<https://cambridge.nuvustudio.com/studios/unl>

Tips for Future Studios

1. Ipsum Lorem...

Fashion designer [Erin Robertson](#) has joined us this winter as our Coach-in-Residence, leading a studio called "Solarpunk Fashion." Erin is the winner of [Project Runway](#), Season 15 and the prestigious Council of Fashion Designers of America Teen Vogue Scholarship. Her

Miriam Lourie

7 cards

Start typing...

I am creating a professional suit jacket, that breaks many of today's standards for acceptable work attire. Aspects of this will include a hood and exaggerated sleeves. I am also creating a mask that can be worn over the hood and putting a hood on a suit jacket came from the common practice of schools or other establishments banning headcoverings indoors. Hopefully in the future, unnecessary rules like this will cease to exist.

Students ideating

Erin Robertson

Constructed Organic

Example 1: Project Documentation

This is a remix of public documentation from a project-based course at NuVu. Where the original documentation on the NuVu site is linear, this version is more easily explorable and encourages a user to see how the different parts might fit together. Our point here is to show that our tool could be used to document an experience — and in turn use that documentation to inform learning experience design work.

Example 2: Developing a structured lesson or workshop

This second example is inspired by educators at a large public high school and by teacher candidates we worked with. In both cases, we noted that they appreciated being able to organize learning experiences into columns. They might use this to organize a specific activity (e.g. collaborative work or share and reflect in the above example) and to think through patterns across columns. In contrast, in a text-editor they would need to constantly scroll up and down to compare different sections – here they can compare different sections side-by-side in one view – and can easily move ideas or content between them.

A Final Note

Again, these are only selections from our prototyping and wireframing. We include them here to suggest future directions for developing creative learning design tools and as provocations for you and others who might explore this new terrain with us.



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