

# Chapter 1

## Working with Constraints: Creativity through Repurposing

Danah Henriksen, Lauren J. Woo, and Punya Mishra

**Abstract** This chapter introduces repurposing as a core skill for creative teaching, particularly for working within constraints. Not only are constraints a reality in most educational settings; they are a necessary part of creative work in any domain. Repurposing, broadly defined, involves the use of a tool in ways that are not originally intended. We explore repurposing as a process of melioration, also known as the, “competence to borrow a concept from a field of knowledge supposedly far removed from his or her domain and adopt it to a pressing challenge in an area of personal knowledge or interest” (Passig, 2007). Teachers, and teacher educators should view repurposing as a creative pedagogical ability to adapt and use what is available, by seeing beyond the obvious designed purpose of an object. Unpacking the notion of repurposing based on literature argues for teaching as an act of design, noting that design (like teaching) is inherently purpose-driven and constrained. Both users and designers often repurpose objects, tools, or ideas to creatively rethink the possibilities and manage or address the constraints of their immediate situation. We discuss how tools and objects have affordances that signal what users can do with them, while also having a *zone of possibility* or alternate purposes that allow users to think beyond the tools intended purposes. By engaging this kind of design frame, we suggest that developing repurposing skills can be part of teachers' exercise of creativity to work with given constraints, particularly in interdisciplinary (e.g., STEAM) contexts. In highlighting several teaching examples from the teaching literature, we aim to exemplify the notion of repurposing as an essential pedagogical skill to allow creativity under constraint.

**Keywords** Creativity · Innovation · Equity · Repurposing · Constraints

### Author Note

Correspondence concerning this manuscript should be addressed to:

Danah Henriksen

Associate Professor, Mary Lou Fulton Teachers College, Arizona State University  
PO Box 37100, Mail Code 3151, Phoenix, AZ 85069, United States.

Email: [danah.henriksen@asu.edu](mailto:danah.henriksen@asu.edu)

Phone: 517-256-2344

## 1.1 Introduction

Adam, a high-school biology teacher, began a graduate level professional development course focused on design thinking—and using design habits of mind to address classroom challenges. Adam already had a problem in mind that he wanted to work on—the ninth-grade biology curriculum at his school was outdated, and students were not engaged in the coursework and class sessions. As he went through the design phases, Adam realized that design processes could help him create experiences that supported his pedagogical vision. Encouraged by this realization, he started constructively redesigning the biology curriculum—revising the driving questions and integrating more collaborative, real-world hands-on science activities and inclusive assessments. Many of his curricular redesigns involved using elements and tools from the existing curricula, but tweaked or altered with a new learning frame or purpose in mind. Initially, Adam was unsure if the changes were big enough or different enough from the priorities to make a difference. But students started to show more engagement and enjoyment in the new activities, and over time, the other science teachers in the school described how students seemed to be asking deeper questions and demonstrating a better understanding of the content.

In the above vignette adapted from Henriksen et al. (2019), we provide an example illustrating the potential of repurposing, or adapting new uses of objects and ideas for purposes other than originally intended, as a creative pedagogical ability from the perspective of teaching as a complex and challenging act of design. In that sense, it is an activity and process of devising “courses of action aimed at changing existing situations into preferred ones” (Simon, 1969, p. 130). In teaching, it means arranging artifacts, tools, and techniques to best accomplish the goals of teaching and learning. This process becomes even more important in the current educational context where educators are increasingly challenged to be creative in developing novel practices or learning experiences in evolving contexts (Norton & Hathaway, 2015). But this begs a question about what kinds of skills educators need in order to be creative designers, particularly when their actions are constrained by a large range of factors (time, budget, materials, state and national standards, etc.).

There is a lot of knowledge, experience, and practice that goes into being a good teacher. We argue that one critical skill teachers need is repurposing. The idea of repurposing is particularly important given the constrained nature of teaching. This means that teachers must be innovative; finding ways to create powerful learning experiences for their students, within these constraints. This often means looking at existing materials, processes, and systems in new ways to meet broader educational goals. This skill becomes particularly salient when we factor in the demands of contemporary schooling and the creative design aspect of what teachers actually do (which often differs from traditional views of teaching as implementing already existing curricula or lesson plans (Kirschner, 2015)). Further, the professional and creative capacity of teachers is one of the most essential factors in determining the educational value of the student experience (Darling-Hammond, 2003; Kalantzis & Cope, 2010). Yet, teacher education and professional development have often struggled to provide educators skills that help them solve

problems and design compelling learning situations with real-world constraints.

Teaching and teacher education requires specific skill sets that support educators in being able to operate creatively and develop effective teaching solutions (whether for lessons and learning designs, teaching situations, or anything else). Repurposing is a valuable skill here, as it offers the ability to notice, devise, or adapt new uses of something for purposes other than originally intended. Toth (2014) describes it in regard to teaching as, “the ability to repurpose items as models, tools, and visual representations and integrate them into the curriculum” (p. 172). Since creativity involves the ability to come up with novel and effective solutions (Runco & Jaeger, 2012), this focus on working with new uses for new purposes involves elements of creative practice.

Although good teaching is inherently creative (Eisner, 1983; Henriksen et al., 2017), and teachers often naturally employ creative repurposing in their lesson planning and learning design (Herring et al., 2016), there is no extensive scholarship to articulate a clear language for the specific skills educators need for classroom creativity. Teachers often assume that the pedagogical constraints they face in schools and classrooms (e.g., being tied to standards, having limited resources or time) restrict their creativity. Thus, teacher education and professional development need a deeper focus on skills that address creativity involving situations with constraints.

In this chapter, we explore repurposing as a creative teaching skill, particularly in dealing with the constraints of contextual classroom variables (e.g., tools, technologies, time, content, etc.). We begin with a scholarly grounding in the literature on creative teaching to situate our discussion. We then define and explore the concept of repurposing itself to consider how it connects to creativity, particularly within a ‘teaching as design’ frame. We discuss the theoretical grounding for this skill, and consider its relevance to creativity within constraints. Sharing several applications of this repurposing concept from the literature to different teaching situations, we then conclude with a forward-looking view to positioning repurposing in creative pedagogy for teaching and teacher education.

## 1.2 Creative Teaching and Repurposing: Understanding Creative Teaching

What constitutes “creativity?” Creativity has been described as the production of useful solutions to problems, or novel and interesting ideas across domains (Amabile, 1996). While there are nuances between common definitions, Runco and Jaeger (2012) noted a heavily referenced ‘standard definition’ of creativity that requires two common factors of *originality* (novelty, newness, freshness, distinctiveness, etc.) and *effectiveness* (useful, valuable, appropriate, important, relevant, etc.). Creative work brings something into the world that did not exist before (at least in that particular instantiation or context). But this novelty alone does not offer creativity—it must be joined to and useful toward some kind of purpose (e.g., effectiveness). Creativity, thus, is the process or ability that allows people to solve problems, with innovative ways of thinking or doing, or to develop new products, artifacts, solutions, or ideas that are effective toward a goal or

purpose.

The definition of *creative teaching* stems directly off of this; the ability to utilize high-quality ideas that “represent something different, new, or innovative” (Kaufman & Sternberg, 2007, p. 55) effectively and appropriately toward desired classroom, pedagogical, or learning goals and purposes (Davidovitch & Milgram, 2006; Henriksen et al., 2016). In addition to teaching in new and different ways, teaching creatively also means encouraging and valuing creativity not only in pedagogy but in students’ work, as well as in the overall classroom or learning environment (Henriksen et al., 2016; Smith & Smith, 2010). Students often need to see teachers modeling and being creative to feel comfortable in it themselves.

Creative teachers support students’ creative abilities and promote comfortable environments where learners can experiment with ideas, explore possibilities, and push boundaries (Hickey, 2001). In order to do this, they often have a developed approach to creativity and creative teaching skills centered in their pedagogical repertoire and practice. Lilly and Bramwell-Rejskind (2004) explained that these teachers foster a positive and exploratory learning climate, encourage curiosity and experimentation, and model flexibility—fostering their own creativity as a precursor to developing it in their students. Creative teachers’ willingness to try new approaches and ideas is often what elevates their practice (Torrance, 1995). Research has shown that teachers are among the most principal constituents in developing student creativity within their capacities as mentors and role models (Fasko, 2001); and teachers who are most successful at motivating creativity in their students also model creative or divergent thinking themselves (Anderson, 2002). However, this is easier said than done, as the environment and structure of schooling does not always allow for teacher creativity.

Creativity inherently brings some element of risk, in that being willing to try something new. These play out in the notion of repurposing—being able to adapt an idea for a new purpose, make unusual connections, step beyond the expectations of an object or idea, or test its assumptions. Anytime a person tries something new, there’s a possibility that it might not work. This is true in any instantiation of creativity, and therein lies some risk. Creative teaching brings risks too, as Anderson (2002) stated when describing creative teachers:

The most fundamental risk these teachers accept is found in their willingness to confront both success and failure in the interest of teaching better. They risk themselves in being responsible for their work. In this way, they are not so different from creative artists in other arenas. (p. 35)

But the risk, in its own way, may be even greater for teachers, who are often evaluated based on criteria that seek consistency in scores and standards, without much allowance for learning from creative experimentation. Policy settings tuned to standardization and metrics tend to promote risk aversion via a pursuit of narrow assessment conventions and single-correct-answer approaches (Creely et al., 2019; Hartlaub & Schneider, 2012). Further, constraints and pressures of time, resources, or lack of belief in one’s own creativity often hamper teachers from trying to be creative. Creativity needs to become a more accessible (and less intimidating)

possibility for teachers, and it may become more accessible when we see it as a means to working with constraints and building a better practice by experimenting with what already exists. While people often assume that creativity means devising something new out of thin air—most real-world creativity involves adaptations of existing tools and frames. Hoftstadter (2008) once described creativity as ‘variations on a theme’ or an act of twisting the existing knobs to see what new settings we can find.

Expecting teachers to reinvent the wheel and come up with dramatically new ideas, practices, lessons, or tools is a way to shut down the possibility of teacher creativity. But it becomes more accessible with a focus on skills—like repurposing—that allow them to work with existing situations, materials, constraints, etc., and see the adaptive possibilities for creativity.

Based on interviews with highly accomplished and nationally award-winning U.S. teachers, Henriksen and Mishra (2015) found that the most successful creative teachers understand how to cross-pollinate ideas across disciplines and contexts encouraging intellectual risk-taking within their own -as well as students’- work. Looking at this in the context of repurposing might mean taking an idea from one context and repurposing it for a lesson in another. Alternatively, it could also be noticing the utility of a tool often used in a different setting, and bringing it in to use for pedagogical purposes. Henriksen and Mishra found that the most creative teachers consciously cultivate an attitude of open-mindedness by being willing to try new ideas and make unusual connections, which may allow them to see unusual uses or alternative solutions or practices. Building on this, they are able to reconsider the purpose of an object, idea, lesson, etc., and make it work in another context, allowing them to work with constraints of time and resources. This notion of ‘constraints’ is crucial to the overlapping concepts of creativity and repurposing, and it bears a closer look.

### **1.3 Constraints in Creativity and Creative Teaching**

While creativity is associated with mental flexibility and openness, people sometimes assume that creativity occurs in unbounded spaces, in reality, creativity almost always happens within some constraints (Tillander, 2011). Creative activities are often constrained by a range of variables related to materials, tools, time, goals, and purposes.

The inherently constrained nature of creativity aligns with the nature of teaching as well. Teachers are often constrained by pedagogical or classroom demands, time pressures, resource limitations, school structures, and standards-based assessments (Beghetto, 2010; Sternberg & Kaufman, 2010). Being pedagogically creative requires teachers to evaluate their constraints and strategically balance tradeoffs (Brown, 2008). Given this, teaching has been viewed as a craft (Eisner, 1983) and is an inherently constrained act of creative design involving the use of artifacts—including objects, tools, and ideas directed toward supporting pedagogical learning goals and purposes. Artifacts are intentionally designed things (e.g., technologies, materials, curricula) that have their own agency and purpose built into them (Glăveanu, 2013), and repurposing as a creative

teaching skill can enable teachers to develop the flexibility to move beyond the functional fixedness of artifacts and use them to implement creative learning solutions (Koehler et al., 2011; Quennerstedt et al., 2011). In this sense, when we consider classroom creativity, we should look to the quote by creativity expert Ronald Beghetto as cited in Henriksen & Mishra (2018, p. 543):

It's not about thinking outside the box, it's about thinking creatively inside the box. Which works well in educational settings because we're really really good at defining and specifying the task constraints down to an almost ridiculous level of detail. But we're not that great about creating spaces for originally meeting those task constraints in different and unexpected ways.

Further, contextual constraints can help teachers to act creatively by providing parameters to be creative within, helping to focus any decision-making and problem-solving towards their pedagogical goals (Beghetto, 2010).

## 1.4 Repurposing in the Field of Education

The term *repurpose* has often been used interchangeably with related terms like redesign, reuse, retool, transform, invent, and meliorate. However, repurposing has a distinctive identity and place in teacher creativity, requiring a comprehensive working definition that lets us examine factors conducive to repurposing, as well as connections with other educational concepts (e.g., creativity, play). One of the most cited definitions from Passig (2007) describes *repurposing* as a “thinking skill [or] the competence to borrow a concept from a field of knowledge supposedly far removed from [a familiar] domain and adapt it to a pressing challenge in an area of personal knowledge or interest” (p. 2).

Other scholars have built on Passig's definition to elaborate or clarify its meaning by borrowing and adapting concepts across fields. For example, the process of repurposing has been compared to forwarding in rewriting, where writers extend ideas and phrasings from texts by engaging, reshaping, and applying the ideas/phrasings to new situations and different purposes (DeSchryver, 2015). Based on this comparison, DeSchryver (2015) noted that *repurposing* is also a form of generative synthesis that requires the (a) modification of existing ideas in “substantive and productive ways” (p. 392), (b) retention of “one or more of the important qualities of the original idea while changing or adding other qualities” (p. 392), and the (c) active involvement in the facilitation of evolving existing ideas. Passig's definition is useful because of its breadth and applicability regarding what can be repurposed. But many studies have more tightly defined repurposing for a specific pedagogical purpose. Through all of this, one of the most common elements is the notion of adapting something toward a purpose—other than the one originally intended—and such adaptations can involve practices, tools, identities, and more (Braaten, 2019).

Koehler et al. (2011) specifically focused on the adaptation of tools (e.g., technologies) for instructional use, which is a common need for teachers, since

many technologies are not designed with an educational purpose as a primary function. For instance, in a recent study, a teacher asked the students enrolled in their entrepreneurship and innovation course to brainstorm project ideas by integrating the ideas generated by ChatGPT, a general-purpose chatbot powered by artificial intelligence (Wood & Kelly, 2023). Thus, Koehler et al. extended the concept of repurposing to include both digital technologies and other ‘tools’ such as curricula, objects, artifacts, practices, and more, noting:

Most technologies teachers use have typically not been designed for educational purposes...[As] such, teachers must repurpose them for use in educational contexts. This is a process of melioration, or the “competence to borrow a concept from a field of knowledge supposedly far removed from his or her domain, and adopt it to a pressing challenge in an area of personal knowledge or interest” (Passig, 2007). Melioration acknowledges the importance and necessity of the cognitive skill of drawing on knowledge from varying domains and combining them in unique and effective ways. Such repurposing is at the heart of melioration and is possible only when the teacher knows the rules of the game, and is fluent enough to know which rules to bend, which to break, and which to leave alone (2011, pp. 150-151).

But how do we come to understand how, when, and which rules to bend, break, change, or leave alone? Knowing how to repurpose (an idea, artifact, etc.) requires a fluent initial understanding of its purpose—what it is meant to do, what it can do, and thus, what it *affords* doing—in order to redirect it to another purpose. So, we need a good understanding of both a tool’s properties and its original vs. intended purpose to see new possibilities. Repurposing is possible because of the idea of *affordances*.

The term *affordance* refers to a property of designed objects or tools which reveals to users what they can do with it. All tools, objects, or artifacts have affordances. We might say that doorknobs ‘afford’ turning, because they are just the right shape for a hand to hold, and because their shape suggests they can be turned. You do not need a user manual. A hammer affords hitting with a levering action because its handle has an appropriate diameter to be held tightly rather than loosely, and the weight at the end naturally pulls heavily at that end. A small circular protrusion can be designed like a button, in order to afford pushing, or it could be designed as a knob, which would afford turning.

James Gibson (1966) developed the affordance theory to consider perceptual cues that humans receive from objects in their environment. Our perception of everything in our surrounding environment shapes how we behave and what we do (including what we can do creatively, and what we can make or create with tools). Affordances are cues or clues in the environment that indicate possibilities for what to do, like what we can do with tools or objects based on the properties that we perceive in them. Humans interact with technology, tools, or objects based on their possibilities for action or affordances. In other words, our perception drives our actions.

Each form of technology has its own affordances that guide how we can use it to think and create. A doorknob will not be turned if a person does not want to enter, a pen will not write if a person has nothing to write about (Norman, 1988). Tools will not lead to creativity, unless they support or align with people’s goals, creative instincts, or outcomes—unless people have an understanding of the affordances and possibilities of a tool, in order to direct it to a purpose.

Importantly, while the purpose of objects or tools are guided by their original design purpose and affordances, purposes are not pre-defined or set in stone, but can be malleable. Affordances, however, do not limit an object’s use. For instance, a pencil has affordances for writing with its graphite tip, but it could also be used to scratch your back (see Henriksen et al., 2021). A wooden box has a design that affords being used as storage. But it could also be creatively repurposed as a stool or to make a dollhouse, even though it may not obviously afford this use. A jacket has affordances to keep warm on a chilly day, but it might also be draped over the back of a chair as a marker of possession (e.g., ‘this seat is taken’). These uses and meanings are culturally created—shared and deeply embedded within the socio-cultural settings we inhabit. Every tool has affordances that enable some kinds of creativity and make other kinds less likely. And yet, within each tool’s constraints is the possibility of an alternate use, something surprising and potentially radical, or simply a helpful form of everyday creativity. Thus, we argue, objects, ideas, and concepts are not entirely defined by their affordances but rather exist in a “zone of possibility” (Dirkin & Mishra, 2010), waiting for someone to notice and see alternative possibilities, and that in turn redefines the purpose of the original.

It is the interactions of the object, environment, and human psyche that determine the object’s potential and significance. An educator who can evaluate an item and envision how to use it to mediate cognitive, motivational, or educational changes may be able to do so with any number of tools, technologies, or artifacts (Toth, 2014). Repurposing is a skill that lies beneath this kind of evaluation, envisioning, and mediation of learning. It offers a way to optimize existing resources and explore a broader range of creative solutions for the purposes of addressing constraints related to materials, concepts, and actions in classrooms (Koehler et al., 2011; McDonald, 2013).

While the term repurposing is not often used in describing pedagogical practices and skills, the *concept* of repurposing is fundamental in teaching and is sometimes implicitly threaded through instances of research and practice. For instance, the Apple Classrooms of Tomorrow (ACOT) framework examines progressive engagement with technology through the stages of entry, adoption, adaptation, appropriation, and invention, and teachers are expected to “be creative, subvert the original intentions of the programmer, and repurpose technology” (p. 45) at the invention stage (Tillander, 2011). Furthermore, the concept of play in technology integration and tool use in teacher professional development (Koehler et al., 2011).

## 1.5 Design and Repurposing in Teaching



Our view of repurposing is built on a view of teaching itself as an act of design, the teacher's role as a designer, and the concept of learning as design—all of which foregrounds the role of repurposing for creative teaching. From this perspective, *design* refers to intentional actions taken to change complex, real-world situations to better meet the needs and desires of specific groups of users, and design processes are iterative and involve creative thinking and value judgments (Norton & Hathaway, 2015). Design processes determine the most effective and appropriate actions based on *design knowledge*, which is “derived from observation and engagement with shared practices, enhanced and instantiated by reflection-in-action and reflection-on-action” (Norton & Hathaway, 2015, p. 6). Therefore, teaching practices are design-based activities which aim to positively influence learning experiences and outcomes by strategically utilizing existing resources and constraints and developing tasks with appropriate specifications (Goodyear, 2015). Moreover, a view of teaching as design asserts that teachers can solve problems and address situations that require creativity (e.g., diversification of student needs, intensification of pressure on teachers, and acceleration of technological trends) through design orientated practices (Goodyear, 2015; Norton & Hathaway, 2015). Design thinking models have been used to scaffold teachers' creativity and guide the design and implementation of actions to change situations in ways that support student needs (Henriksen et al., 2017; Norton & Hathaway, 2015).

Much like classroom practice, design also operates within the sociocultural world, where creative actions are influenced by dynamic interactions between designers, users, artifacts, and their affordances. Design is also a heavily purpose-driven activity, which also involves being able to identify an object's purpose and rethink it. In a sociocultural understanding of creativity, artifacts refer to intentionally designed materials, concepts, and actions defined by their role in meaning-making interactions rather than their physical presence (Glăveanu, 2013). Further, designers and users collaboratively generate new artifacts with new affordances because designers respond to the desired affordances of users by specifying properties of artifacts to create or change affordances (Glăveanu, 2013; Maier & Fadel, 2009). Yet, as we noted previously, *perceived* affordances are highly dependent on how individuals view an artifact and conceptualize its alternative possibilities (Gibson, 1979). For instance, although virtual assistants (e.g., Alexa, Siri) were initially designed to perform everyday tasks and services, users have also perceived their affordances as language learning tools (Dizon, 2020).

Affordances are subjective cognitive constructs that provide opportunities and constraints only after being perceived (Hammond, 2010; John & Sutherland, 2005), and they can be used to rethink tools and artifacts toward new and interesting purposes. All of this occurs within zones of possibilities, where people are limited or scaffolded by characteristics of artifacts and their assumptions about the artifacts and surrounding environment. Within zones of possibilities, teachers must navigate co-constraining relationships with artifacts but are also empowered to reinterpret and align artifacts with their beliefs, values, and visions (Dirkin & Mishra, 2010). In this study, Dirkin and Mishra (2010) explored the transactional relationship between faculty members' beliefs and values about teaching and learning and their use of a learning management system (LMS). The results of the study indicated that

teaching an online course was more than the simple translation of course content into the existing digital and conceptual infrastructure of the LMS. The faculty members varied significantly in their approach and use of the technology. Individual instructors either modified the existing structure of the LMS to align with their own values and beliefs, or adapted to it. When working with the LMS, instructors needed to operate within the tool's "zone of possibility," something broadly defined by the tool and the designers' assumptions about learning. This zone of possibility both limited and supported the instructors, allowing them to interpret and actualize their visions within certain boundaries. Similarly, since contextual classroom variables (e.g., tools, technologies, time, content) also operate within zones of possibilities, they are, in a sense, malleable and can be aligned to specific pedagogical beliefs and values.

## **1.6 Use of Repurposing as a Creative Teaching Skill to Address Educational Constraints**

Within restrictive educational environments that prioritize standards-based assessments, teacher-structured approaches, and assimilationist policies and practices (Ferreira et al., 2022; Thakurta, 2021), teachers often encounter constraints related to various contextual classroom variables. Many teachers believe these constraints, which were sharply exacerbated by the COVID-19 pandemic, are stymying to engaging in creative teaching and integrating more flexible, generative, and connected forms of learning (Braaten, 2019; Tan & Chua, 2022). That said, it is also important to recognize that constraints often play a necessary role for creative expression in helping us ensure that a new and unique idea is also suitable or appropriate and therefore creative (Beghetto, 2010). Components like usefulness, constraint satisfaction, adaptiveness, appropriateness, effectiveness, and relevance are all related to each other in determining creativity (Lubart, 2010), and repurposing as a creative teaching skill can be a way to incrementally adapt artifacts to the evolving constraints of educational environments (Gabora & Kaufman, 2010). This is not to minimize the challenges that educators face, nor of the rigid systems that often control their autonomy, but rather to suggest that there are still many possibilities worth exploring, even within these restrictive regimes.

Teachers have repurposed a range of variables, including knowledge, information, concepts, ideas, insights, tools, and technologies, to improve learning and teaching experiences and solve multifaceted problems of practice. We will look at several different areas of repurposing application in education, with a focus on how teachers have used repurposing to address constraints that could otherwise negatively impact social connectedness, learning engagement, motivation, learning equity, resource availability, and technological preparedness in classrooms. These examples from pedagogical literature exemplify how, through repurposing, teachers can think not only about their pedagogical goals but also about the artifacts around them and how they can be directed to address shifting goals and priorities.

## 1.7 What Else Could This Be? Some Applications of Repurposing Diverse Subject Areas and Programs

The continued advancement and spread of technology has led to a greater emphasis on developing cross-disciplinary 21st-century skills such as communication, critical thinking, creativity, and collaboration. In parallel, there has been interest in STEAM education, which seeks to “merge the arts with STEM subjects for the purpose of improving student engagement, creativity, innovation, problem-solving skills, and other cognitive benefits” (Perignat & Katz-Buonincontro, 2019, p. 31). To achieve these cross-disciplinary goals, teachers have often repurposed contextual classroom variables (e.g., activities, materials, spaces) to design learner-centric environments (Henriksen et al., 2019; Locicero & Trotz, 2018; Wong et al., 2015). These environments have focused on enabling students to (a) use cross-disciplinary problem-solving methods, (b) creatively view their surroundings in new, open-ended, and personal ways, and (c) develop the information, media, and communication skills to repurpose everyday technologies for educational ends (Darling & Foster, 2012; Liao et al., 2016). Thus, the strategy has been to take existing materials, processes, and lesson plans and to repurpose them to meet new needs.

Repurposing sometimes goes beyond tool-based moves, to repurpose curricula and shift existing pedagogical tools such as lessons toward more novel and purposeful ones. For instance, more project-based, open-ended inquiries on real-world issues can be incorporated into science classrooms to better align the curriculum with the STEAM paradigm and Next Generation Science Standards (NGSS) (as described in Henriksen et al., 2019). These kinds of moves reveal the connection between repurposing and design approaches.

In a study about teacher educators instructing new teachers in mathematics pedagogies, Toth (2014) shared instances where the most creative educators emphasized repurposing approaches (even if they did not explicitly refer to it as such). Their use of repurposing involved both digital and non-digital tools, where educators intentionally modeled and discussed alternate representations for traditional mathematics manipulatives like dice, fraction tiles, two-color counters, base-10 blocks, and Unifix cubes. The most facile educators in this study described numerous repurposed alternatives to using standard manufactured items as math manipulatives, and instead were careful to note that if something like Unifix cubes were unavailable, any number of items could provide excellent alternatives—like colored beads or beans in a cup for counting, grouping, exchanging, measuring, and creating patterns. The best and most creative educators reiterated that it is the use and thinking around teaching tools that is critical, not specific objects. Additionally, teachers need to be creative about what they use, given that the availability of materials and classroom tools is often constrained. This kind of thinking means focusing on the pedagogical goal, while thinking creatively and flexibly about affordances and the zones of possibilities for materials and tool use to demonstrate concepts or to let learners play with items and explore concepts.

In this small but in-depth case study, Toth (2014) described how creative teaching professors used and repurposed a wide range of objects and tools for pedagogy, including but not limited to: popsicle sticks (problem solving,

patterning), marshmallows and toothpicks (geometry), Unifix cubes (number operations, grouping, exchanging, patterning, sequencing, problem solving), paper (fractions), pen/paper and marker/whiteboard (visual models), popcorn (geometry), fraction tiles (fractions), magnets (problem solving), base-ten blocks (place value, number operations), straws cut and bundled in groups of ten (place value), counters or beans and different sized Dixie cups (number sense, number operations, exchanging, place value), clocks (multiplication, fractions), fingers (number sense, number operations), hula hoops (problem solving), penny strips (number operations), ten frames (number operations, place value), games (place value, exchanging, number sense, number operations, fractions), number line (counting, number operations, fractions), arrays (number operations), pennies (patterns, problem solving), pattern blocks or pattern cut-outs (geometry, fractions), egg cartons (fractions), music (fractions, patterns), and pipe cleaners (geometry). While the case study did not evaluate how the teachers and teacher educators analyzed the features of a tool, how they assessed its affordances, or how they chose and integrated tools toward goals, such line of future inquiry may offer valuable insight into creative approaches in teacher education utilizing repurposing. To our broader point—having a more intentional and clearly articulated focus on the skill of repurposing could be a benefit to the creativity of teachers.

Additionally, sometimes broader swaths of curricula have been repurposed, as courses have been restructured to implement flipped learning approaches, which require reduced direct instruction and a greater emphasis on learner-centered application activities (Guerrero et al., 2015; McLean et al., 2016; O’Brien & Murray, 2015). For example, Guerrero et. al. (2015) described how in an undergraduate-level mathematics course, the didactic elements of the course were redesigned as homework assignments, and much of the class time was allocated toward “group work or activities that encouraged in-class collaboration, communication, and problem-based applications” (p. 819). The instructor, in this context, thoughtfully selected content that could be flipped, extracted, and implemented the social processes of learning in an in-person classroom environment.

## **1.8 Distance Teaching and Learning Environments**

The advent of the internet is often seen as being an information boon for education—allowing students access to information at a scale not possible before. That said, most websites were not designed for pedagogical purposes—and need teachers to repurpose their existing curricula to take advantage of this glut of information and to provide frames, as well as, contexts for students to understand what they are finding online. A similar trend can be seen with the rise of Web 2.0 technologies—which emphasizes dynamic, distributed and user-generated interactions and engagement.

Following the Web 2.0 phenomenon in 2004, the educational landscape embraced the dynamic, distributed, and social nature of Web 2.0 (Hamid et al., 2009), and teachers began to consider ways to push back against educational systems that centered around “attending class for the sake of finding a job as soon

as possible, for the sake of getting a piece of paper, not for the sake of learning, thinking, and creating” (Wardle, 2012, p. 8). This led teachers to repurpose technologies that had not originally been designed for education (e.g., blogs, wikis, social networking sites, instant messaging applications) to promote agency, creativity, play, imagination, and innovation in their classrooms (Hamid et al., 2009; Lieberman et al., 2021; Tillander, 2011). An important point to note here is that repurposing such technology tools became a useful skill for teachers because the majority of available technologies out in the world were not explicitly designed for teaching, but rather for broader communication and connectivity use. That said, the communication and connectivity purposes within them are often exactly what supports new possibilities in the classroom. Thus, teachers often end up rethinking the intended tool purpose to use them for learning goals. An example might be for language learning, where video-sharing platforms (e.g., YouTube) have been appropriated as a resource for learning English idioms and phrases (Eisenlauer, 2020), and language learning platforms have incorporated elements of mobile dictionaries, e-reading platforms, and social networking spaces (Wong et al., 2015).

In recent years, digital tool repurposing has been a way to approach broader issues of educational equity. Going beyond the classroom, teachers and other educational stakeholders have utilized repurposing to promote educational access by designing distance learning platforms and spaces for community-based learning. For example, video cameras, audio-/video-mixers, videoconferencing and screen-casting software were repurposed to deliver music lessons to elementary and high school students in remote rural areas (King et al., 2019). As a result, students who “had not previously received [lessons]” and whose parents “would not have sought out [lessons] for [them] if this opportunity had not been available” (King et al., 2019, p. 202) were able to benefit from greater access. In addition to extending educational access, the implementation of blended and distance learning environments has led to increased revenues, promotion of institutional brands, research on teaching and learning innovations, and improved educational outcomes (Nissenson & Shih, 2016).

The COVID-19 pandemic widened opportunity and achievement gaps and brought equity issues to an even greater sense of urgency (Dorn et al., 2021). As a result of the pandemic, schools worldwide closed, and teachers needed to urgently adapt to emergency remote teaching (ERT) situations (Hodges et al., 2020). In efforts to maintain educational accessibility and quality in physically separated environments (Epps et al., 2021), teachers repurposed many aspects of their teaching and utilized a greater range of non-educational technologies. Examples of teacher creativity abound, from using cellphones as document cameras to show mathematical work, to zoom breakout rooms for small group discussions. Teachers and educators across the world looked at tools and technologies around them in new ways, to not just reach their students but to engage them in the learning process. As an example, in an undergraduate chemistry course that transitioned to ERT, open-source COVID-19 resources were adapted to design a supplementary unit on pandemic response, and the multiple-choice final exam was redesigned as a more feasible oral exam (Giordano & Christopher, 2020). Amid the ongoing technological revolution accelerated by the disruptions caused by the pandemic and mainstreaming of artificial intelligence, teachers need ample opportunities to

practice repurposing technologies and creating technological solutions tailored to their evolving curricular and pedagogical needs (Koehler et al., 2011).

## 1.9 Teacher Education Programs

Lastly, to prepare for the acceleration of technological trends, some teacher education programs have been redesigned to give pre-and in-service teachers opportunities to repurpose non-educational technologies (e.g., podcasts, social networking sites, video-conferencing platforms) for their own pedagogical goals and desires (Braaten, 2019; Cherner & Curry, 2017; Terry et al., 2013; Tillander, 2011). For example, in a masters-level teacher education program, pre-service social studies teachers were able to repurpose multimedia tools to design unique and relevant learning experiences, and a pre-service teacher in this program guided their students through the process of creating songs and music videos about the 2016 presidential candidates' political platforms (Cherner & Curry, 2017). In another teacher preparation program, pre-service science teachers reorganized and recontextualized ambitious science teaching practices in their field experience settings (Braaten, 2019). Braaten (2019) noted that their efforts were often limited or scaffolded by constraints related to the structures of instructional activities, interactions with students, and relationships between pre-service teachers and mentor teachers.

In addition to repurposing non-educational technologies, pre-and in-service teachers may need to consider ways to reuse physical objects as novel teaching tools, especially with the unprecedented school funding crisis caused by the pandemic (Baker & Di Carlo, 2020). For instance, creative writing prompts were developed in a language arts classroom around discarded items, junk drawer collections, postcard memos, and even fortune cookie fortunes (McDonald, 2013). For one of the prompts, students were asked to speculate on the history of a lost shoe and go through a “deliberate, constructive, and compelling process” of utilizing their writing skills to “endow newfound value... [on] a discarded insignificant object” (McDonald, 2013, p. 6). Also, in high school and undergraduate chemistry courses, discarded items (e.g., plastic bottles, whiteboard markers) have been used to create molecular models, which teachers have claimed to be more suitable than commercially available sets (Dragojlovic, 2015).

## 1.10 Conclusion

In these illustrative cases, repurposing as a creative pedagogical ability enabled teachers to resourcefully use the artifacts around them to design experiences that increased learner engagement and learning equity and aligned with their pedagogical goals and priorities. These instances are but a small and limited set of examples from the literature that point to a few possible instantiations for how teachers can repurpose tools, technologies, or other elements for pedagogical creativity. However, the alternatives and possibilities for how artifacts and elements could be repurposed in the classroom are vast—perhaps only limited by the

perceived zones of possibilities and teachers' ability to be creative within constraints. It is clear that creativity is essential in teaching but often challenging to enact, given the constraints teachers work under, in addition to the perception that constraints limit creative opportunities. Our situating of repurposing as a critical creative teaching skill is built on the view of (a) teaching and learning as design (Goodyear, 2015), (b) creative actions in design-based processes as dynamic interactions between designers, users, artifacts, and their affordances (Gibson, 1979; Glăveanu, 2013), and (c) affordances as subjective cognitive constructs that can provide opportunities and constraints only after being perceived within zones of possibilities (Dirkin & Mishra, 2010; Hammond, 2010; John & Sutherland, 2005). An essential component of this involves thinking about affordances—not only what an artifact does, but what it could do, and how else it could be used. Further, the presence of constraints can enhance the perceptibility of affordances, providing unexpected insights into potential actions that can be taken to transform affordances into new opportunities that extend pedagogical capabilities (de la Fuente et al., 2015, John & Sutherland, 2005). For instance, a good example of a new technology offering new “zones of possibilities” could be the use of large language models (such as ChatGPT3 and others) in educational contexts. On one hand, these tools can be seen as being deeply disruptive of certain entrenched assessment techniques used in schools (such as writing the five-paragraph essay). On the other hand, they could be seen as a way of unpacking the nature of writing itself, providing students with opportunities to critique the outputs of these tools and through that enhance their own understanding of the writing process. Both of these exist within the zone of possibility of the tool, the question, however, becomes that of what the purposes of the use of this tool are. Applying the lens of a “zone of possibility” to the study of creative teaching with technology may allow us a new perspective to investigate how teachers work with the affordances of given tools to direct them toward their goals and purposes. By studying creativity, technology, and teaching together using the concept of the zone of possibility, we increase our awareness of the active role of technology, not just as static or passive objects or applications—but as tools that have agencies of their own, which plays a role in what we can do with them.

Repurposing encourages teachers to critically examine the elements they work with (artifacts, concepts, plans, or processes) in new ways, going beyond the obvious to develop appropriate solutions (Maier & Fadel, 2009; Markgraf & Hillis, 2021). Thus, teacher education and professional development focused on creative teaching and repurposing skills may help teachers think creatively with and within constraints to support the development of their evaluative abilities and creative use of tools. Teachers need opportunities to engage in open-ended, creative design tasks that will allow them to (a) explore the constraints and affordances of a range of artifacts, from everyday objects to cutting-edge, non-educational technologies, (b) freely experiment with repurposing these artifacts to enhance affordances that align with their pedagogical vision, and (c) adapt and apply approaches and frames for teaching creatively within constraints. When teachers are able to see themselves as designers and creative individuals, they are situated to evaluate, envision, and mediate changes. This opens the door to learning and teaching that fosters flexibility, open-mindedness, collaboration, and positive risk-taking (Henriksen &

Mishra, 2013).

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**Danah Henriksen** is an Associate Professor at Arizona State University, in

the Mary Lou Fulton Teachers College, Division of Educational Leadership and Innovation. She came to the field of education by way of years of working in higher education, in an outreach program that gave her a variety of experiences in working with educational technology, online learning and graphic design. Her interest in education, learning by design, and the psychology of creativity led her to pursue doctoral research in creative teaching and creative thinking skills. While her current research interests revolve around varied topics in education, creativity, and technology, she is particularly interested in creativity across disciplines, design thinking in education, the relationship between creativity and technology, and creative teaching and learning practices in education.

**Lauren J. Woo** is a doctoral student in the Learning, Literacies and Technologies program in the Mary Lou Fulton Teachers College at Arizona State University. She received her B.A. and M.A. degrees in Second Language Studies from the University of Hawaii at Manoa. Since 2011, she has taught at universities in Japan, South Korea, and the United States. Her research blends teacher education, online teaching and learning, emerging technologies, and creativity. Her current research projects focus on designing online teaching field experiences and creative learning environments. She is also examining the blended teaching readiness of pre-service teachers. She has co-authored articles in various journals, including *Teachers College Record*, *Journal of Online Learning Research*, *Journal of Technology and Teacher Education*, and *TechTrends*.

**Punya Mishra** is Associate Dean of *Scholarship & Innovation* and Professor in the *Mary Lou Fulton Teachers College at Arizona State University*. He also has an affiliate appointment in ASU's *Design School*. As associate dean he leads a range of initiatives that provide a future-forward, equity driven, approach to educational research. He is internationally recognized for his work in educational technology; the role of creativity and aesthetics in learning; and the application of design-based approaches to educational innovation. He has received \$9.5 million in grants; published over 200 articles and edited 5 books. With over 50,000 citations of his research, he is ranked among the top 2% of scientists worldwide and the top 100 scholars with the biggest influence on educational practice and policy. A *TED-Ed* educator, he co-hosts the award-winning *Silver Lining for Learning* webinar as well as the *Value Laden* and *Learning Futures* podcasts. Dr. Mishra is an award-winning instructor who has taught courses at undergraduate, masters and doctoral levels in the areas of educational technology, educational psychology, design, and creativity. He is also an engaging public speaker, and an accomplished visual artist and poet.