# Creativity Methods and Workshop Design

This section introduces vocabulary and constructs for describing and analyzing creativity methods. Using this vocabulary, it introduces design principles of creativity workshops. These design principles are grounded in creativity theory and illustrated in an example workshop.

---

These **example methods** will be described in a float/figure. They are referenced in the rest of the text.

***Analogy Introduction*** is an opening method that asks participants to introduce themselves through analogy, such as *"What animal are you today?"* This divergent method encourages the use of analogical reasoning which is valuable for creativity.

***Wishful Thinking*** is a divergent method that elicits participants' aspirations for visualization software. Participants are prompted with a scenario in their domain and asked to write ideas on post-it notes in response to the following three questions: *What would you like to be able to see? What would you like to be able to know? What would you like to be able to do?* We have adapted this method for use in repeated workshops [P3.R,P4.R,P5.R,P6.R,P7.R,P8.R].

***Visualization Analogies*** is a divergent method where visualization researchers show a variety of visualizations to participants (similar to *visualization awareness workshops* [Koh2011]). Participants record ideas about how the visualization techniques may apply to their domain i.e., analogies. This is a common method used in many of our workshops [P1.R,P2.R,P3.R,P4.R,P5.RP8.R]

***Storyboarding*** is a method where participants create *"short graphical depictions of a narrative"* [Truong2006]. We have used them as convergent methods near the end of workshops, asking participants to depict "a day in their life" imagining the impact of topics from the workshop [P3.R,P4.R,P5.R].

---

# Method overview

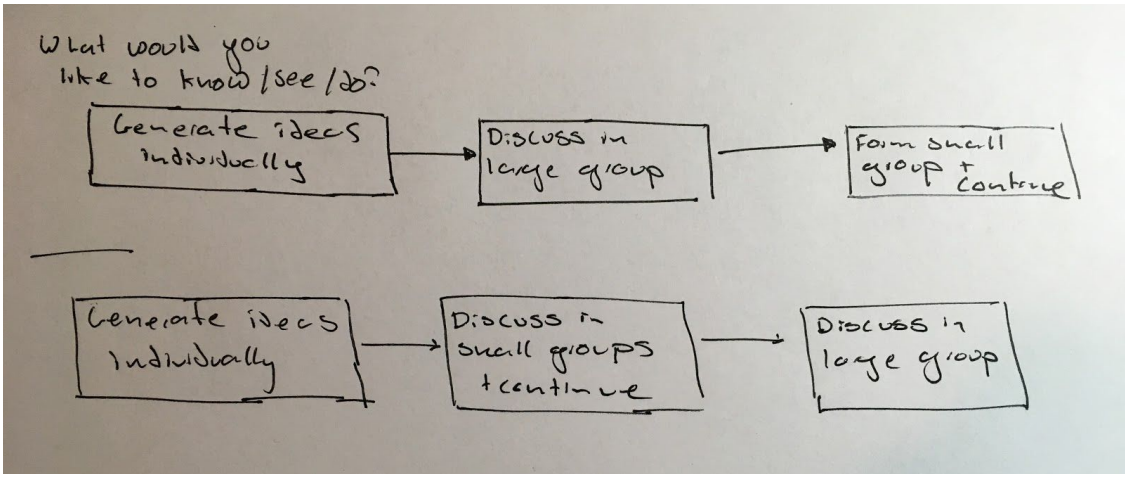
*Method* is a general term that describes the repeatable actions of researchers [Crotty1998]. Creativity workshops are creativity methods. Creativity workshops are composed of creativity methods. Analyzing workshop output uses creativity methods. Here we provide constructs for describing the methods used in workshops (see callout **example workshops**). Yet, these principles apply to workshops and workshop analysis as well.

## Method process, duration, interactions, and components

**Method process** describes how methods are conducted [Biskjaer2017]. A **method plan** articulates the process, describing the actions that facilitators and participants are expected to perform. The process is usually categorized by the amount of direction given to participants [Couger1993], from unstructured (e.g., brainstorming [Osborn1953]) to structured (e.g., storyboarding [Kumar2012]).

The process typically defines a **method duration**, the amount of time needed to run a method. The duration breaks down any steps of the method, such as time for individual ideation followed by time for group discussion. The duration is usually interpreted as time used for a method in an ideal setting, though discussions and other factors may influence the time required.

Implied by the process are **group interactions** of the method. Group interactions include generating, discussing, or evaluating ideas. Interactions can be split into three categories: participants working *individually*, in *small groups* (2 - 5 participants), or in *large groups*. The latter often needs facilitators to effectively guide discussion. The same method can be executed with different levels of group interaction, for example, the *Wishful Thinking* method has been used with two different structures (see figure below).




**Caption**: Two processes for the same method *Wishful Thinking.* In one case, individuals generate ideas, the ideas are discussed in a large group, and participants form smaller groups for continued ideation. In another case, participants generate ideas, participants discuss ideas in small groups and continue ideation, then ideas are discussed in the large group. There are tradeoffs associated with each structure, and they ultimately depend on how the facilitator plans to execute the method and how the method is received by participants.

Also identified by the process are the method **components**, physical items involved in the method [Biskjaer2017]. **Prompts** present information relevant to the method, including handouts or slides. **Materials** are consumed as part of a method---e.g., post-it notes used to record ideas. **Tools** are used to transform materials into artifacts---e.g., a pen used to write on a post-it note. **Artifacts** are the tangible

output of methods. Artifacts can also be input to methods---such as when post-it notes created during brainstorming are later organized.

The process and components define the method **externalization**, how ideas are represented in physical media. Post-it notes prevail for externalization as they are a physical media that can be easily moved or grouped. Custom materials can also be created for externalization, for example, handing out screenshots of visualizations in the visualization analogies activities allows participants to externalize analogies directly.

## Atmosphere: agency and trust

The **atmosphere** refers to emotional environment that encourages creative thinking. It includes fostering unencumbered sharing of ideas [Sawyer2006]; promoting inter-personal leveling [Isaksen2000]; and encouraging confidence and willingness to take risks [Nickerson1999]. The atmosphere can be fostered by methods that promote *agency* and *trust.*

**Agency** is the feeling of ownership, responsibility, and ability to act [Brooks-Harris1999]. Agency can be promoted by using methods that encourage multi-directional communication between workshop participants and facilitators [Brooks-Harris1999]. Methods that encourage the one-way communication, such as lectures, are notorious for hindering agency [Lloyd2011]. Yet, this is a mistake we made repeatedly [P8].

**Trust** is the confidence that participants place in each other and in the workshop team. Encouraging trust between participants and facilitators leads to open communication, the uninhibited sharing of ideas between individuals [Jones1989]. This can be achieved by showing intent to listen, and demonstrating vulnerability [Brooks-Harris1999].

## Ideaspace: diverge, incubate, converge

Creativity methods can be characterized by their influence on an ideaspace as divergent, convergent and incubative [Osborn1953,McKenna2014]. **Divergent** methods generate ideas and expand the possible ideaspace. **Convergent** methods evaluative ideas and winnow the possible ideaspace. **Incubative** methods provide time for rest and unconscious combination of concepts necessary for creativity.

Methods are described as divergent, convergent, or incubative based on their *intended outcome*. Wishful Thinking, for example, generates aspirations to expand the idea space being discussed in the workshop. Within the method, there may be convergence as participants select ideas to discuss in the group. Regardless, the intent of this method is to elicit aspirations that expand the ideaspace of the workshop, making it primarily divergent.

Methods can be adapted to fulfill different purposes in workshops. Storyboards can be divergent methods, generating opportunities or requirements for software [Rosson2001]. They can be convergent

methods, synthesizing ideas into a coherent narrative [Kumar2012]. Ultimately, the purpose of a method depends on its intent and a reasonable interpretation of what will be its outcome.

## Mechanics: framing, creativity triggers, prioritization, aggregation

The **method mechanics** are commonly recurring theoretical constructs that describe the intended thoughts or actions of participants. This section describes mechanics that we have most commonly used and that we feel are most useful for visualization creativity workshops. See Biskjaer et al. for a recent summary for details on mechanics in design methods [Biskjaer2017].

Mechanics include the **framing**, the desired mindset and intent of participants [Nickerson1999]. In wishful thinking, participants are encouraged to frame domain challenges as aspirations or opportunities for collaboration. Other examples of framing include methods that ask participants about previous failures of visualization software (negative framing) or successes of existing software (positive framing).

Mechanics include **creativity triggers,** the type of thinking that methods try to stimulate. A common trigger used in workshops is **analogy**, the transfer of concepts between domains [Goel1998]. Other triggers include metaphor [Gordon1961], combination [Boden2004] and analytical/intuitive processes [Miller1987].

Related to creativity triggers is **randomness**, the extent to which unpredictable stimuli are used in the method. Randomness can result from the method materials, for example, by rolling a die or shuffling a deck of cards. It can also result from the method process, such as how participants may form groups or move around during a method.

Two additional mechanics are useful for convergent methods. **Prioritization** describes ranking ideas by some metric, such as importance or feasibility. **Aggregation** describes the grouping of artifacts into meaningful sets where both the sets and individual artifacts are still useful. Wishful Thinking often relies on prioritization as participants select ideas that are interesting to discuss.

## Context: data, analysis, automation, and visualization

The **method context** describes how methods explore the relevant data, analysis workflows and automation of a domain. Context also includes the use of visualizations as that is likely the focus of applied research collaborations.

The **data context** is how a method incorporates domain data and whether it is investigating perception of data or real data. Data perceptions are explored by asking participants about their data in the abstract --- for example, in *Visualization Analogies* participants are asked to generate analogies based on memory of their domain data. In contrast, the *Domain Visualization* method described by Koh et al. [2011] involves showing visualizations of real domain data, though they recognize that required tremendous development efforts before the workshop.

The **analysis context** describes how the method relates to the analysis needs of domain collaborators. Analysis context ranges from concrete to abstract. A concrete analysis context examines the existing workflows, conventions and tools. For example, when working with neuroscientists, we used screenshots of their tools to elicit ideas in Wishful Thinking [P4.R]. An abstract analysis context is more about unconstrained possibilities, such as our workshop with energy analysts looking for wide-ranging future applications of smarthomes [P3.R]

The **automation context** explore the role of automation, an important part of applied visualization research that aims to balance between information location and task clarity [Sedlmair2012]. We have examined automation context with implicit language, for example, asking participants to assume part of their workflow had been automated [P4]. Explicit exploration of automation could be an interesting area for future work (See section...)

The **visualization context** describes how methods explore the role of visualization. Visualization features can be implicit by using visual language or asking about visualizations without directly showing them. An example implicit feature is the use of a visual language in a prompt: "What would you like to be able to see?" in wishful thinking. Visualizations features can be explicit by showing visualizations as in *Visualization Analogies* or asking participants to draw visualizations in *Storyboarding.*

### Participants: unpredictable but serendipitous

The aforementioned method constructs describe methods and participants in the abstract. They do not account for the complexities of human thought [Sawyer2006], the emergent nature of group creativity [Sawyer2003], nor the serendipitous interactions that workshops support [Brooks-Harris1999]. The constructs cannot predict how methods will be executed by groups as this depends on the context of the workshop. Therefore, we intend these constructs to be a starting point and a thinking tool for workshop design.

## Workshop overview

Here, we describe the key concepts of creativity workshops structure. We intend for this to provide scaffolding for thinking about how to select creativity methods for a workshop.

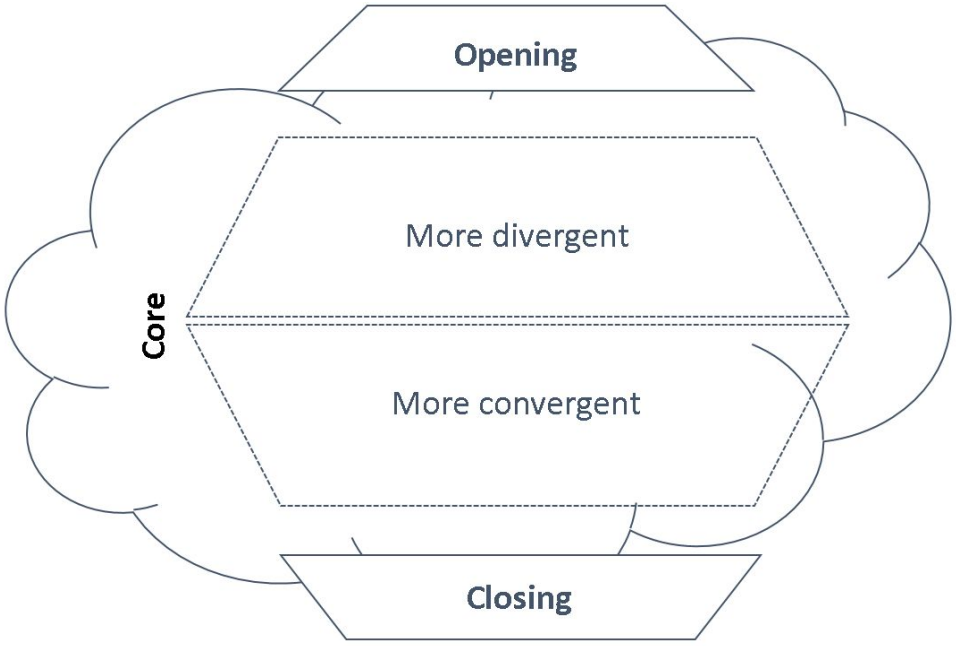
This section, instead, examines the question: *what does a creativity workshop look like?*

### Phases: opening, core, closing

There is consensus from the workshop literature [Brooks-Harris1999,CreativeEducationFoundation2015, Gray2009,Hamilton2016,...] and every workshop in our experience that workshops consist of three phases:

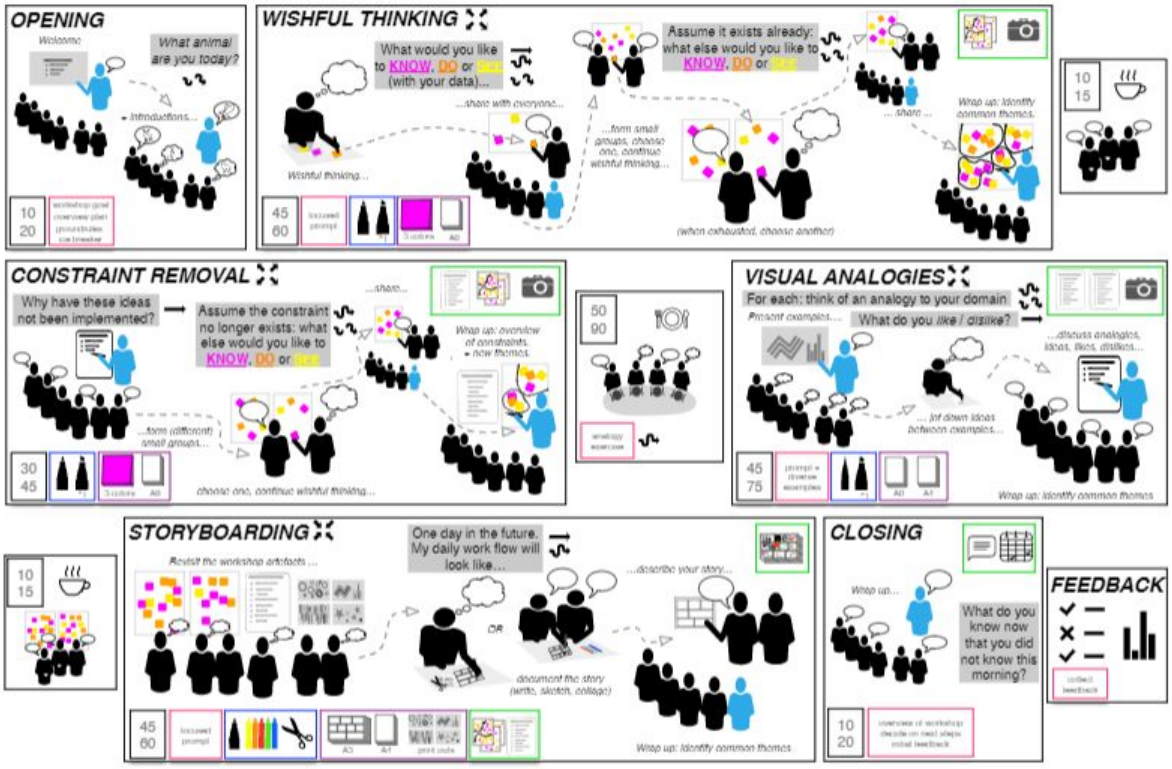
1. **Workshop opening** establishes the intent of the workshop. Effective openings prepare participants for creativity by promoting agency and trust.
2. **Workshop core** allows participants explore ideas. Effective cores promote creative thinking, often in cycles of divergent and convergent methods.
3. **Workshop closing** concludes the workshop. Effective closings validate participants time and energy, supporting continued creative collaboration.

In identifying these three phases, we are saying that all workshops have a beginning, a middle, and an end. These phases are abstract. Many actions and methods can fulfill any of the phases. These phases may be overlapping with ill-defined boundaries. This structure in shown in the figure:




**Caption:** Workshops follow a structure of three phases. In the **opening**, workshop intent is established and creativity is fostered. The **core** is where ideas are explored, often relying on cycles of divergent and convergent thinking. The nebulous shape of the core represents the emergent and unpredictable creativity that occurs during the workshop. The dashed lines around the diverge-converge cycles show the general pattern of workshop methods and ideaspace. In the **closing,** the workshop is concluded and next steps for action established.

Next, we describe phases in abstract terms. They are grounded in our example workshop. The workshop is in our supplemental material and illustrated in the figure below. The methods used in this workshop include the *Wishful Thinking*, *Visual Analogies*, and *Storyboarding* methods described previously.




**Caption**: An example workshop based on our successful experiences [P2.R,P3.R,P4.R]. The opening method establishes intent and primes for creativity. Divergent methods of *Wishful Thinking, Constraint Removal, and Visual Analogies* generate ideas for visualization software requirements. *Storyboarding* is used as a convergent method to synthesize ideas from the day into coherent narratives. A closing discussion is used to reflect on the workshop, validating and providing closure.

## Workshop opening

All workshops must start. Workshops that start effectively establish the deliberate and explicit intent of the workshop [Hamilton2016]. The opening communicates that participants are attending the workshop for a reason and ground rules are established.

**Guidelines:** Effective workshops foster creativity by introducing guidelines for workshop interactions. For example, guidelines from one of our workshops [P2.R] included:

- *All ideas are valid – record them; Let everyone have their say;*
- *Be supportive of others;*
- *Don't trash other people's ideas – use them to create additional ideas (2 ideas rather than 0);*
- *Think 'possibility' – not implementation*;
- *Speak in headlines and follow-up with detail;* and
- *Switch off all electronic devices!*

These guidelines match recommendations from the creativity literature, including the encouragement of suspending judgement [Osborn1953] and focused work without distraction from electronic devices [Sawyer2006].

**Atmosphere:** Communicating guidelines and other methods in the opening are intended to establish a creative atmosphere, characterized by open communication and inter-personal leveling [Sawyer2006]. Active and generative methods can encourage creative atmospheres as participants are primed to engage with workshop methods. A mistake we make in DiscoveryJam [2016] was to start the day with lectures which established a passive mindset of participants. We corrected this in DiscoveryJam [2017] as the workshop started with active methods of sketching and moving around. Methods can also establish creative atmospheres by encouraging trust and agency, such as through methods that demonstrate vulnerability like the *Analogy Introduction* described in our example workshop.

**Connection to example:** The example workshop starts with an *Analogy Introduction.* This method is included from our experience that it establishes trust and agency [P2]: *"the animal introductions required some audacity on the part of our facilitator...it seemed useful preparation for future exercises in initially putting all participants on an equal footing."* Subsequent workshops successfully used the method with similar effect to establish interpersonal leveling [P3,P4,P5,P6,P7].

## Workshop core

The workshop core is the central piece of the workshop, exploring a broad idea space and focusing on the more interesting ideas. The core of workshops must be designed. There is no correct or incorrect design for a workshop. Specific decisions that must be made in the workshop must account for the project context, discussed in the next section. But there are common principles of workshop cores that should be considered in design.

**Diverge-converge:** The methods used in the workshop core generally follow a pattern of divergent-thinking following by convergent-thinking [Osborn1953]. First, divergent methods explore a broad space of ideas. Second, convergent methods are used to winnow the idea space. Mixed into the two methods are opportunities for rest and incubation of ideas. Cycles of divergent and convergent thinking appear in *every one of our requirements workshops.* They are also repeatedly emphasized in the creativity workshop literature [CreativeEducationFoudnation2015,Hamilton2016,Osborn1953,...]

Divergent and convergent thinking happens both between methods and within methods. Between methods, workshops start with divergent methods, such as wishful thinking to generate ideas. This is followed by convergent methods, such as clustering those ideas. This structure was used in our workshop with biologists [P8] and relates to existing methodologies [Gordon1961]. Within methods, participants can generate ideas then evaluate ideas. For example, in a requirements workshop with geographers, we invented a method called Current Problems and Successes: *"[participants recorded] problems and successes associated with the current clients on sticky notes. Participants were asked to highlight the most significant of their responses and report this characteristic to the group, drawing*

*attention to the scope of issues, common ideas and ensuring buy-in from all members."* This method involves divergence, generating ideas, followed by convergence, highlighting and discussion.

**Incubation:** Incubation is particularly important for creativity [Sawyer2006]. Including methods that allow for incubation, such as deliberate breaks for coffee and lunch will benefit the workshop. [Need discussion about quote from SG's lunch for P4.]

**Creativity support:** the methods used in the workshop core are intended to support creative thinking. Framing these methods as *creativity support tools* [Shneiderman2005] provides valuable guidance. Shneiderman et al [2005] proposed the following guidelines for creativity support tools that also apply to creativity workshop methods.

*Support collaboration and communication* - effective methods provide opportunities to work together on ideas. This includes time for ideation and discussion. We aim for this by allowing time for individual ideation (individual scale), small group ideation (small scale), and large group discussion (large scale). Selecting methods that explicitly externalize ideas helps to foster communication as artifacts provide a physical medium for ideas.

*Support many paths and many styles* - methods should support the different styles of workshop participants. This includes balancing active methods, such as brainstorming, with passive methods, such as breaks. Selecting methods with a diversity of method mechanics is useful too. We use different types of framing -- asking participants for positive and negative thoughts about existing software, for example [P1,P3,P8]. Different creativity triggers, such as metaphor and analogy, can also be used to encourage creativity.

*Low barriers, high ceilings, wide walls* - careful attention should be paid to select methods that have low barriers, allowing everyone to contribute. *Storyboarding* is a potentially risky method because it has a higher barrier, required skill for drawing. In one workshop participants struggled with the storyboarding method because they were not comfortable drawing in that style [P4]. Methods should have high ceilings, often with undefined stopping conditions to encourage participants to generate ideas beyond the point of exhaustion [Osborn1953]. And wide walls should allow participants to communicate the full breadth of their ideas.

Additional guidelines for creativity support tools should also be considered in selecting workshop methods. These include: *Encourage exploration*; *Make it as simple as possible*; *Invent things that you want to use yourself.* These principles should be considered in the context of the project, which requires following the workshop process described in Section…

**Context:** Methods should maintain an appropriate focus on the context of data, visualization, analysis, and automation. Creativity methods from existing resources can be customized to achieve this. *Wishful Thinking*, for example, asks participants "*What would you like be able **to see?"*** This extends the creativity method of *Aspirational Thinking* [McFadzean1998] with deliberately visual language.

Demonstrating visualizations in the *Visual Analogies* method also reinforces the explicit use of visualization.

**Connection to example:** In the example workshop, *Wishful Thinking*, *Constraint Removal*, and *Visualization Analogies* encourage divergent thinking. They support idea generation with many styles, allowing for individual ideation and group discussion. They use different mechanics, from brainstorming-like ideation to analogies. And they all encourage exploration, having no clearly defined stopping conditions nor boundaries. *Storyboarding* provides convergence as ideas are synthesized and summarized.

## Workshop closing

Effective closings provide a sense of closure and validation for participants. This can be achieved through methods that encourage reflection and metacognition [DeBono1983]. We have commonly asked participants reflective questions about highlights of the day or ideas that they found particularly interesting. It is also important to communicate the next steps of the project, to validate that participant's energy will influence the direction of the collaboration [Hamilton2016].

**Connection to example:** The example workshop illustrates a reflective closing method where participants are asked *"what do you know now that you did not know this morning?"* Because this question is intended to start a discussion, it requires participants prioritize their thoughts to talk about the more interesting ideas.

## After the workshop

Following the workshop, ideas and artifacts from it are analyzed. The analysis drives forward the visualization project by identifying areas for future work, exposing shared user needs, and establishing criteria for evaluating ideas. The ways in which we can analyze workshop output are described during the creativity workshop process in the next section.