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BIDIRECTIONAL ARTIFACT ANALYSIS

A Method for Analyzing Digitally Mediated Creative Processes

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In this chapter, we describe bidirectional artifact analysis, an analytic method for understanding creative, digital production processes through ethnographic observations of participants in situ, the artifacts they create, and interviews with participants as they describe their activities over time. Marrying narrative analysis (Halverson, 2008; Labov, 1997), discourse analysis (Wood & Kroger, 2000), and artifact analysis, this framework echoes and extends Enyedy's (2005) description of bidirectional analysis: "go[ing] 'backwards' in time in an attempt to trace the origins of this intervention and 'forwards' in time to examine what subsequent impact it had on the way other students reasoned" (p. 437). While typical descriptive analyses move forward, we, like Enyedy, have found that moving bidirectionally—from final product backward and from initial idea forward—helps us to better understand participants' learning, as well as the role of social and collaborative audiences in that learning.

For researchers seeking to understand and design environments that honor and encourage the development of new literacies through technology, the current focus on production-oriented definitions of literacy requires a complementary shift in methodology and analysis. Learning in digitally mediated environments often focuses on project creation, and learners often save and reflect on many incomplete versions as they work toward a final artifact. To understand these processes, we extend methodological tools such as case study (e.g. Stake, 1995), ethnographic observation (e.g. Geertz, 1973), thematic coding (e.g. Boyatzis, 1998), grounded theory analysis (e.g. Strauss & Corbin, 1998), and discourse analysis (e.g. Wood & Kroger, 2000) to focus on process and, specifically, the relationship between the creation of artifacts over time and learners' discussions of these emergent artifacts.

The development of this method responds to recent research on new media and new literacies, which has begun to re-focus the meaning of "literacy" and "multi-literacies" (Cope & Kalantzis, 2009; Jenkins, Purushotma, Clinton, Weigel, & Robison 2007; Moje, Overby, Tysvaer, & Morris, 2008; New London Group, 1996). Beyond the comprehension and production of texts, "being literate" in a particular context or content area has come to describe practices, modes, spaces, and places where social interaction is a responsive activity in the learning environment that specifically addresses the needs of the learner's goals.

For learning to occur, we suggest that educators must consider not just what students do, but also how they do it (and with the idea). In this way, we can pay attention to building their identities as learners of creative processes and artwork. For example, factors are relevant to the learning process and share their experiences.

Di Sessa (2004) describes "a venue in which" (p. 300). Like any art project, the idea of "being literate" involves the right site and the right tool. Similarly, production methods that enable the multiple representations of artifacts can become the necessary tools for understanding and analyzing the artifact analysis.
has come to describe fluency in specific “constellations” (Steinkuechler, 2007) of practices, modes, spaces, and ways of knowing. These new understandings of what it means to become literate and to be literate have particular purchase in digital environments where social interactions are often shaped by the production and critique of artifacts for a responsive audience (Magnifico, 2010). In order to understand and, ultimately, design learning environments that support these complex practices, we must develop methods that specifically help researchers to describe the processes of digital production and how they lead to the creation of successful literacy artifacts. These new methods require analytical lenses that take complex creative works themselves—from online video to school essay to multimedia collage—as units of analysis and trace these works through the often-complex process of creation and revision.

For learning sciences researchers studying learning progressions, bidirectional analysis may also provide a robust system for analyzing students’ increasingly sophisticated reasoning within various content domains (Duncan & Hmelo-Silver, 2009). Learning progressions provide a foundation for aligning assessment, curriculum, and external standards, but their design provides little information for how researchers ought to analyze their utility or success. Bidirectional analysis can give researchers an analytic approach to studying the development of learning progressions in situ and create the capacity to examine how progressions develop in the context of the learning environment over time.

THEORETICAL PERSPECTIVES

In order to produce creative work—or to teach creative processes to others—producers must consider not only the quality of their original ideas (i.e. whether an idea is “good”), but also how these concepts will be translated to consumers (i.e. how others will engage with the idea). In our attempts to trace the learning of creative processes, we have found it useful to pay explicit attention to several factors: (1) the representations that artists use to build their ideas and describe them to others, (2) the role that audiences play in the creative process, and (3) the metrics of quality used to evaluate creative products. These factors are relevant to creative processes regardless of technological mediation, but have come to the forefront as increasing numbers of learners use digital technologies to create and share their work in a more public sphere.

The Role of Representation in Creative Processes

Di Sessa (2004) argues that representation design is a fundamentally creative endeavor, “a venue in which creative and artistic skills are at a higher than normal premium” (p. 300). Like any representational domain, “getting smart” in the context of producing art “means coming to know the potential of the materials in relation to the aims of a project or problem” (Eisner, 2002, p. 72). The capacity to build the right representation in the right situation is a marker of creative expertise (Hayes, 1989), and thus, creative production means learning how to construct and evaluate these representations. While producers might use many media to draft a poem, video, or piece of visual art, and these multiple representations may transform over time and drafts, understanding how these artifacts contribute to the final “text”—the final draft of the creative production—is necessary to understanding the relationship between process and product. Bidirectional artifact analysis traces how artifacts are produced and edited over time in response to
critiques from audience members and "key moments" (Halverson & Gibbons, 2010) in the production process.

The Role of Audience

Placing the construction of artifacts at the center of technologically mediated learning processes draws attention to the role that audiences play in production. While audience is often seen as what happens at the end of a learning process, cognitive and sociocultural perspectives on technologically mediated environments have noted the crucial role that audiences play throughout the production process. Members of an interactive audience can talk back and become collaborators, and their feedback is often immediate. Online producers can read their audience's preferences in comments and post additional drafts if they choose. Workshop participants in the same physical space can work together to help producers clarify artifacts. Focusing on the role of audience throughout the production process has become increasingly important because this kind of analysis can provide additional theoretical insight into creative practices (Magnifico, 2010).

What Makes a Quality Creative Product?

Audience members also matter in the production because they serve as judges of the success of a creative product. Narrative theorists describe two key features of "good" products: reportability—that which makes an artifact unique—and credibility—that which allows an audience to understand and relate to it. This "reportability paradox" (Labov, 1997) introduces a key tension across creative production processes. Using a creative medium to tell a certain story or express a specific meaning demands engagement with both genre typicality and uniqueness. Beyond letting learners "be creative," good mentors must help novice artists to understand and wrestle with these concepts in their work. Narrative methods help us capture the evolving relationship between an artifact's reportability and credibility, as well as young artists' attempts to work with this tension.

BIDIRECTIONAL ARTIFACT ANALYSIS

To these three central constructs—representation, audience, and the reportability paradox—we add an understanding of time, and how young producers use the artifacts they produce to move backwards and forwards through their creative work. This understanding stands in contrast to most education, and most education research, which moves forward in time. Teachers and education researchers create curricular interventions, they teach those curricula to learners, and they observe the effects on learners' learning. Learning continually builds up from prior knowledge and, therefore, researchers teach and analyze in this direction, too. Prior's (2004) multi-textual "tracing" methodology, developed in higher education settings, deepens this notion of learning over time and captures multiple and contextual threads of students' writing and learning. He analyzes assignments and "initiating texts," classroom discourse, drafts of writings, teacher and peer feedback, and students' reflections to trace how particular texts, arguments, or intellectual ideas are written into being, often as hybridizations of student interest and teacher guidance. Similar multi-layered evolutions might be traced over time for any student in a school or creative production environment.
Enedy (2005) turns this forward-development timeline metaphor on its head in a study of elementary students working progressively to “inven[t] representations and iteratively refin[e] solutions to problems” (p. 428). Enedy analyzes these social and mathematical activities in a bidirectional way. Instead of examining students’ successive representations, his analysis reaches both backward and forward, examining how each new representation is built as a revision of prior ideas. By turning the analytical lens, this study shows how students’ reflections on past representations become a base of shared prior knowledge that is used in whole-class inquiry.

In our work, we extend Prior’s notion of tracing development and Enedy’s conception of bidirectional discovery to creative production endeavors. Learning in creative production settings often runs closely to the writers’ workshop or the design crit models of instruction that are common across literacy and arts education. Young writers and artists present drafts to an audience of mentors and peers, assess their current successes and difficulties, and receive revision suggestions. While we focus on creative production in this chapter, the cross-content implications for this approach to analysis are clear. When we analyze drafts as representations that grow and change as a result of individual cognitions, mentor responses, and social reflections, it becomes possible to build models for developmental learning progressions (e.g., Duschl, Schweingruber, & Shouse, 2007) that account for collaboration in many subject areas.

A Summary of the Process

Briefly, bidirectional artifact analysis involves the following steps:

- **Identify** a learner-created digital artifact (i.e. start with the final product).
- **Document** relevant data around the artifact. Trace each step in the process of the artifact’s creation, identify all draft artifacts that relate to this production process, and create a timeline of all exogenous research data related to this particular artifact’s production. Not all process work might be evident in the final product; rather, the form and presentation of the artifact could change over the course of drafts and critiques.
- **Construct** narrative threads across the data types that trace the core ideas and tools present in the final product back through their development. The narrative threads could include artifact analysis (demonstrating the evolution of text and/or image over time), multimodal analysis (demonstrating changes in tool use over time), and discourse analysis (using critiques, conversations with mentors, interviews, journals, and the like to triangulate individuals’ interpretations of what their creative work means over time). In this step, examine the data timeline in both a “backwards” and “forwards” direction: Look for how later drafts and conversations reference and reflect earlier ideas, and how early drafts and conversations provide starting points for later representations.

These brief bullet points will be contextualized in an example that highlights how we trace one learner’s trajectory from his initial ideas to his final multimedia installation. In this example, we show how examining drafts and reflections alongside of each other enriches our understanding of his creative process, and, more broadly, his learning.
FRANK AS BORDER CROSSER

This example demonstrates how bidirectional artifact analysis allows researchers to "see" how students engage with their compositions and audiences, as well as their growing mastery of appropriate representational tools. We demonstrate how the method works and how it helps us to understand young people's emerging access to, and use of, the new literacy practices that researchers describe as crucial for 21st-century success. This example is drawn from Halverson's case studies of four United States youth media arts organizations; this larger project shows how young people learn to make art about their own stories and how this process contributes to identity development and literacy learning (Halverson, 2010, 2012; Halverson & Gibbons, 2010). Data collection traced students' digital art from initial program applications to final public presentations, and included ethnographic observations, artifact collection, semi-structured interviews, and post-mortem reflections.

Frank’s piece (Figure 35.1) is an autobiographical graphic design piece created through Street Level Youth Media’s 2007 program, “Represent!: Exploring your identity through history and culture.” This piece includes three elements: (1) a photoshopped image of himself in front of two flags; (2) a black and white line drawing of a person split down the middle; (3) below the images, a series of names/nicknames printed on individual placards. The meaning and genesis of these elements can be traced by examining Frank’s journal, interviews, and final piece. Frank’s artist statement describes his work as: “a graphic design piece dealing with him being a Mexican American, crossing borders each day going to different places with his art work and gathering all of his names.” Each of the elements is analogous to the components described in the statement; they are all connected with this vision for his art and how it represents his identity.

![Figure 35.1 Frank’s final piece: Represent!](image)
Self-portrait

Frank uses a visual self-portrait as one way to represent himself through his art. Frank first considers a visual representation of himself in one of his journal entries. The entry contains a line sketch of Frank with the words, "Find images that represent me!" printed underneath. In an interview, Frank describes his struggle with the representational process:

I was kind of straying from what this actually was [gesturing to his final piece]. I wanted to do different things about me. And [my mentor] told me, "Well, why don’t you just put yourself, why don’t you just take a picture of yourself? A picture of yourself basically represents who you are."

(Interview, 09/15/08)

Frank and his mentor set out to create an image of himself (rather than the "finding" an image suggested in the journal) by taking digital photographs. The image of Frank and the two flags is one of these photos, and his description of the photograph alternates between collaborative and independent—"we took about 100 pictures and I had to choose the right one . . . we did a few inside and we did a few outside. And I chose this one." Frank notes that it represents something, but not enough on its own. He says, "I was kind of looking at it, and it’s like, alright, what else am I?" Frank incorporates his mentor’s suggestion of a photograph, but points out that he is more than this picture, that an image does not equal an identity.

Frank da Tank

The first time participants shared their project ideas, Frank used his journal to craft a speech about what his piece would be about (see Table 35.1).

While Frank does not explain the meaning of "Frank Da Tank," this description remains at the center of his representation. The next substantive entry in Frank’s journal is a two-page entry with a series of images and texts that becomes the outline for his final piece (Figure 35.2). The first component is an image of a list: "List of names friends and family use to refer to me like ‘frank the tank’ and ‘papa skoons’." "Frank Da Tank" has become a concept, and nicknaming as identity emerges as a method for self-representation. He builds a representation of a concept—the list of names that people call him—in his journal. Frank lists his nicknames and attributes (most of) them to a person or people. While there is no reflection on the meaning of this list, it is clear from the earlier

<table>
<thead>
<tr>
<th>Original version</th>
<th>Analytic version</th>
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<tbody>
<tr>
<td>(1) Well I am Frank Da Tank. (2) I like screen printing (3) it shows what i am</td>
<td>1. Well I am Frank Da Tank.</td>
</tr>
<tr>
<td>who i am and what i am about (4) making designs and putting it on my clothe (5)</td>
<td>2. I like screen printing.</td>
</tr>
<tr>
<td>gives me owner ship of my clothe (6) there is no . . . (7) Printing what’s in</td>
<td>3. It shows what I am, who I am, and what I am about:</td>
</tr>
<tr>
<td>his head out here</td>
<td>4. Making designs and putting it on my clothes</td>
</tr>
<tr>
<td></td>
<td>5. [It] gives me ownership of my clothes</td>
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<tr>
<td></td>
<td>6. There is no . . .</td>
</tr>
<tr>
<td></td>
<td>7. Printing what’s in his head out here</td>
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</tbody>
</table>
representation that he is trying to populate the image of “what people call him” in an identity display. Others’ naming becomes Frank’s identity representation.

This list becomes a series of printed placards across the bottom third of his final piece (see Figure 35.1). Their attributions are gone, so the audience might interpret that these are names for the artist, but not who made them or why. The through-line for this aspect of Frank’s piece began with his assertion that he is “Frank da Tank.” Next, he abstracts naming to a list, abandoning specifics for the idea of naming (see Figure 35.2). A real list of his names and social relationships follows. In the end, he chooses several names, each of which stands in for a social relationship and a narrative. Taken together the names represent how Frank sees himself through the eyes of others.

**Border Crossing**

The largest image in Frank’s final piece is a screen print, a color image of him and two simplified flags, American and Mexican (see Figure 35.1). The initial idea for the dual flags appears in his journal as a drawing of a black figure standing in front of a box that is half white and half grey. This image is accompanied by the text, “border crossing from Mexico to USA” (see Figure 35.2). Frank attributes this idea to his father. In a post-mortem interview, he describes struggling to represent himself in his final piece of art. His father asked him, “Why don’t you do something about you being Mexican American?” Not only did Frank embrace the idea, he felt motivated by this contribution: “That’s like, part of the reason I did this. Because of my dad. He helped me too” (09/15/08).

Frank’s journal entries end with the list of nicknames, but interviews with Frank reveal how he got from border crossing to the two flags present in the piece. He describes beginning by, “tak[ing] a regular flag from here and a regular Mexican flag and put[ting] them
in the background,” behind his photo. The simplified, adapted flags emerged from his artist-mentor’s suggestion—“[he] gave me the concept of make your own flag”—and an image from an album cover. He compares that flag to his own: “I had saw a flag that Trent Reznor did . . . It’s basically black. It’s all red. It’s like blood dripping down from the flag. I wanted to do that, but it kind of, it strayed from who I am” (09/15/08).

In describing the flag from a Nine Inch Nails album, Frank identifies what he likes about a self-made flag. The reason that he does not import this image, however, was that, “it strayed from who I am.” He recognized the need to keep his representation of himself at the forefront of his art. So he chose an aesthetic that appealed to him and created a Mexican-American border-crossing version of this image.

The black and white image to the right replicates the sketch from Frank’s journal. He describes this image as, “basically the same thing, have to dealing with borders. Only it’s . . . it’s the same thing as this only it’s stripped down of everything.” He sees the two images conveying similar meaning: Frank as border crosser. However, where the large image refers specifically to Frank’s Mexican-American identity, this “stripped down” version is different: “It can mean anything. I’m basically walking into anywhere. With the same concept of walking into different borders or different places” (Interview, 09/15/08). The final image included both border crossing representations, the full color image of Frank in front of two flags, and this initial sketch. But Frank transforms the initial sketch to represent himself as a border crossing more generally. He now understands and represents himself as someone who can “go anywhere,” a broader scope than his dad’s original idea.

The above analysis traces each of the three key components of Frank’s piece from initial conception to final piece. However, this division is more analytic than temporal; Frank did not conceptualize each of these elements independently. Bidirectional analysis allows us to understand Frank’s artistic process and the evolving relationship between his concept (identity) and his representational choices (graphic design). Frank struggles initially, but through conversations, interviews, whole- and small-group instruction, and journal entries, he determines that he wants to create a visual representation of himself that portrays his identity as a Mexican American, a border crosser more generally, and a friend and family member with many roles and names. He marries his narrative perspective to the affordances of the tools, which results in his final piece and an artist statement that explains this relationship to an audience.

**ADVANTAGES**

Bidirectional artifact analysis directly juxtaposes two kinds of data: learners’ work and what learners say about their work. While many methodologies analyze these two data streams separately, we believe that we can learn more by examining them together. By employing this methodology, instructors and researchers can produce fine-grained maps of the learning inherent in creative processes. The analysis is rooted to the context of learning, and thus, this methodology is particularly useful for examining innovative, non-traditional learning environments and contexts.

In environments where researchers are interested in the role of technological tools in the making of creative products (e.g. Clark & Sheridan, 2010; Halverson, 2012), bidirectional artifact analysis shows how learners use tools for creating, reflecting, editing, and drafting over time. Formulating a timeline of artifacts, learners’ conversations about
those artifacts, and feedback on those artifacts allows researchers to specifically analyze how learners used earlier representations to plan and produce later drafts—and how planning was mediated by the tools used. While it is often tempting to center an analysis on learners’ interactions with digital tools, bidirectional artifact analysis documents how tool use becomes part of a learning process.

DISADVANTAGES AND CHALLENGES

Bidirectional artifact analysis allows mentors and researchers to remain close to learners as they draft representations. We see this feature of the method as a strength, but this analysis should be accompanied by descriptive observations to avoid eliding the broader environment. Detailed analyses of artifacts, critiques, and conversations are useful for uncovering micro-contextual patterns and specific details of the learning process, but at this tight focus it is easy to lose a full sense of the context. That is, bidirectional analysis is an effective tool for focused case studies—for example, zooming in on focal learners—but ineffective for creating general pictures of events in a large learning space. In addition, bidirectional artifact analysis is most useful when learning is process oriented and learners frequently reflect on their work, document their thinking, or receive feedback on interim drafts. This process can occur in many ways: for example, a learning environment might create small-group critiques, solicit online peer feedback, and mandate key moments for presentation of in-process work (Halverson & Gibbons, 2010). Without these elements of reflection on drafts or processes, too much inference is necessary to effectively trace and understand the links between various phases of a process or draft representations of a work.

The necessity of interpretation and inference represents, perhaps, the greatest challenge of this work. Bidirectional artifact analysis is a method for understanding qualitative, learner-focused, product-based, and, often, multimodal data over time. While the steps we describe here provide a starting place for this work, engaging in this method demands a commitment to detailed interpretive work: careful organization, reading and re-reading, drawing connections through code tables, and pattern collation. A similar commitment is necessary for most fine-grained qualitative analyses, particularly those that engage many data sources, but it can be challenging for time- or resource-limited projects.

CONCLUDING THOUGHTS

Frank designs and refines his autobiographical screen print by creating drafts in several media, consulting with his mentor and family, and journaling about his evolving thoughts. Taken together, these data sources demonstrate his representational decisions and his understanding of the role of digital media tools in representing self. Bidirectional analysis—with its focus on both draft artifacts and young artists’ interactions around those artifacts—shows us how internal and external representations shift through creative processes, how mentors can provide feedback to encourage these shifts, and how young artists use this feedback to refine their creative works and their knowledge of representational materials (Eisner, 2002).

No single analytic tool provides enough information to gain an understanding of how production processes and artifacts lead to literacy learning in complex environments.
These complex tasks and questions require broader methods that help researchers to parse macro-level and micro-level data and to use data drawn from observation, conversational discourse, and artifacts in careful combination. Bidirectional artifact analysis offers a way forward by articulating an analysis framework that combines methodologies for conducting inquiry with complex qualitative datasets.

REFERENCES


