Data Literacy As Storytelling Practice In The *Open Data/Open Minds* Project

Elisabeth Sylvan, NEXMAP, San Francisco, California, USA sylvan@media.mit.edu

Abstract: Open Data/Open Minds is a series of educational initiatives that engage young learners and their educators in telling stories of their local concerns using science journaling, crafted visualization, and data investigation. A cohort of STEM and English Language Arts educators from two organizations have become close collaborator in efforts to teach data literacy in various subjects throughout the school-day. Together we have explored how the physicality of materials impacts experiential learning, how data literacy and technological fluency is critical to equitable education, and how storytelling is foundational to a multimodal literacy of technological fluency, data literacy, and physical materials.

Data as a Critical Part of Today's Literacy

For civil society to flourish citizens must be able to interpret data effectively and to create and understand data-driven arguments (Krajcik & Sutherland,2010). Without these abilities, people can dig into their polarized positions and treated all data-driven arguments as equivalently right or wrong, regardless of quality. Many people don't know how examine data and how it is collected to understand whether arguments are valid. And they don't know how to make a cogent argument based on their community's data and the interpretation of it.

Data on their own does not convey much meaning. A set of numbers, whether 100 or 1 billion does not describe a phenomenon or a relationship. It is when people build an understanding with data that they create meaning. It is the stories that we tell with data–nonfiction stories, stories based on facts, ones that lead us to argumentation and understanding.

Each field develops its own particular formalized process for how its contributors can come to know something and to describe what they know. Logical reasoning, scientific methods, and argumentation theories are all tools for both knowing and communicating our understanding. Our understanding as scientists, writers, and observant people is constructed through our representations of observations. These representations, whether composed of words, graphs or interactives, represent what we know at a moment in time. As we gain greater understanding, we may represent our knowledge in new ways.

Our constructions of meaning, whether in the form of formal papers, websites, or social media posts, both represent and become our understandings as individuals. Then they allow us to share our ideas and create dialogue with others. This is the iterative work of long societal dialogues, those between, writers, critics, and scientists alike. Thus, when we provide people with the tools to create representations of their understandings, we open up possibilities for them to participate in the public dialogue of ideas (Kahne,, Hodgin. & Eidman-Aadahl, 2016; Mirra, & Garcia, 2017).

Delving Into Data with The *Open Data/Open Minds* Project

Open Data/Open Minds is a series of educational initiatives that engage young learners and their educators in understanding and working with environmental and civic data. It supports learners to convey stories of their local concerns using science journaling, crafted visualization, and data investigation. This project combines traditional scientific research techniques and innovative new technology with its use of paper and electronics (see Figure 1). While we focus on the 10-14 age group and their educators, the approach and materials support learners and learning spaces of all kinds.

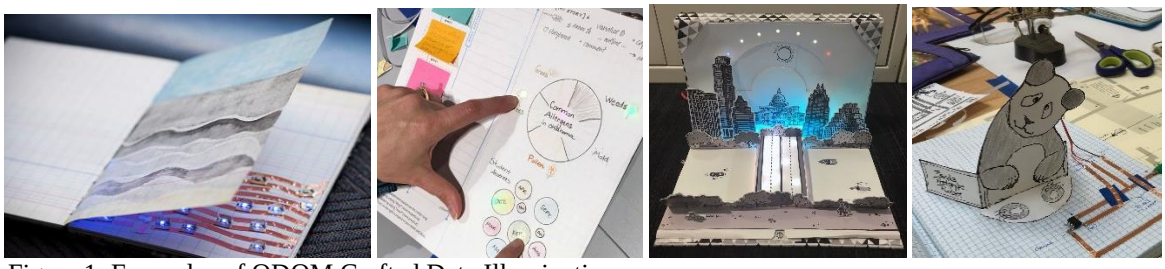

Figure 1: Examples of ODOM Crafted Data Illuminations

ODOM provides a structure that will work for a variety of community learning environments. Our approach encourages learners to explore data, to really play and have fun with it. It also fosters a rigorous and formal approach before drawing conclusions. When people learn about science through the ODOM program, they leave knowing how to identify problems that are important to their communities, how to find and study existing scientific research, how to identify new issues within those problems, how to collect data related to those problems, how to analyze that data, and how to share it in a way that can impact civic engagement.

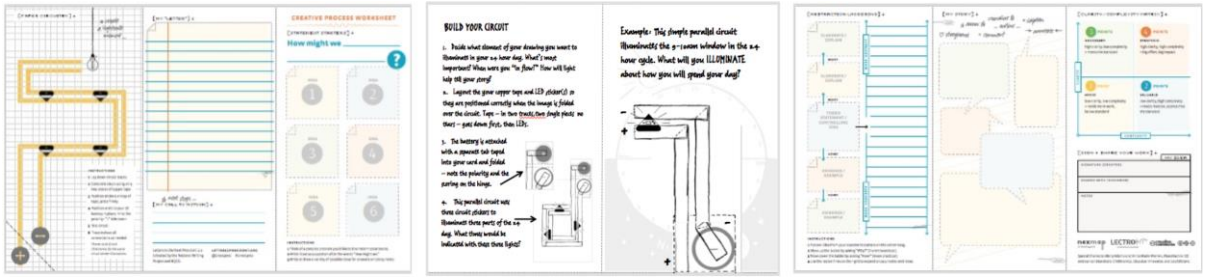

Figure 2: Examples of ODOM Worksheets

ODOM is built around a set of worksheets that scaffold and support a series of deepening activities (see Figure 2). At first learners find and tell stories about problems in their world and then visualize them through paper circuitry (Qi, Dick & Cole, 2016). Later, they work with existing data sets and learn how to collect and analyze their own. Throughout the process, participants are encouraged to think about the impact and context of the issues they are addressing.

Collaborating with the Fluency Project and the Western Pennsylvania Writing Project

As we develop the ODOM materials, we train teachers to use them. Thus, we function both as practitioners and developers. We continually learn from the educators we work with.

One cohort of STEM and English Language Arts educators have become close collaborators, influencing our work and vice versa. This cohort of educators is brought together by two collaborators who themselves are part-practitioners part-developers. The *Carnegie Mellon CREATE Lab* has a range of open data and data literacy projects. One of these is its *Fluency Project*, in which a cohort of educators with a wide range of backgrounds bring technological and data fluency to their practices. The *Western Pennsylvania Writing Project*, an affiliate of the *National Writing Project* and a close collaborator of the *CREATE Lab*, is a long-standing nonprofit hosted by *University of Pittsburgh's School of Education*. For over 30 years they have provided teacher-centered professional development, particularly for English Language Arts teachers.

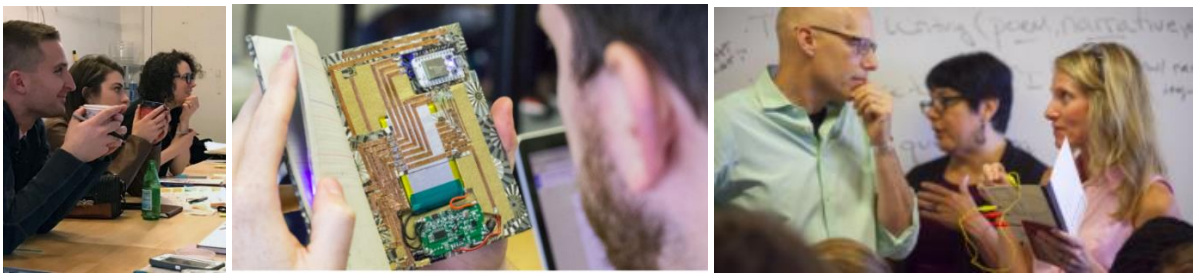

Figure 3: Images from learning parties with educators

Regularly we get together with these organizations and their cohorts of educators in what we call "Learning Parties" (See Figure 3). In these parties we ask educators to delve deeply into how they might bring numbers and narrative into their teaching practices using hands-on technology experiences. We pose questions such as: how might we use paper and electronics to support creative learning and multiple literacies? and how might we use craft to support learners to create problem statements about their localities? We invite attendees to question with us, to answer, and to create physical representations of their contributions. Together we are developing a shared language of multi-modal literacy, one which bridges technological fluency (Resnick et. al. 1998), quantitative literacy, mathematical literacy, and data literacy with composition, narrative argumentation and the creation of crafted physical objects.

Learning From The Group

By working together as practitioners-developers and with regular meetings with overlapping cohorts of dedicated teachers, we all take learnings back to our practices. The following are one participant's reflections on what she takes home from the collaboration.

Bringing physical objects to my work with STEM and ELA teachers has profoundly deepened my understanding of how understanding can be constructed through and understood as objects. (Papert & Harel, 1991). These objects we work with and ask teachers to work with are often technological in nature. Because the technical objects often represent stories, the stories are multimodal. These multimodal elements are accessible to a youth audience who have come of age in a time of digital literacies. Thus, it is critical that we enable youth to be creators of this multimodal content and for us, as educators and designers, to build the infrastructure—the tools, community and practices— that empower their voices.

Our communities and school systems struggle to provide young learners with the experiences they need to build these competencies effectively. This is especially true for girls, people of color, and underserved populations. As the learning sciences begins to expand its understanding of the opportunities and challenges of learning with open data and tools, we see that these equity gaps are compounded.

Many of the teachers we work with do not see themselves as "makers." They may never work with physical materials whether in their teaching practice or elsewhere in their lives. We ask them not only to physically write (as opposed to type), but to draw, cut paper, stick copper tape to paper, apply circuit stickers and attach batteries. For some, drawing and cutting alone is intimidating. The idea of building a circuit can go far beyond their understanding of their own abilities and what they can envision themselves teaching.

Yet, again and again we observe technologically nervous teachers surprise themselves as they create a paper circuit for the first time. We often hear remarks like, "well, if I can do this, anyone can." Exactly. Circuit building with paper circuits is surprisingly simple to start (and can support surprisingly high ceilings.) We also hear comments like "I don't really need to know how to draw; I just need to be able to express my ideas. And have my students do the same thing." They begin to find the fun in learning through making.

And as we watch educators learn to develop their own map-based illuminated stories, we see them begin to see data as relevant to their own lives and to those of their students. They realize that they don't need to be experts in data to be able to discuss a bar graph or to help students identify important topics relevant to their local community.

Ultimately physical materials have costs, and most of our teachers are keenly aware of price. Though we do not charge for our worksheets and curricula, the third party circuit materials have to be purchased. We find that teachers are surprised by how low the cost is as compared to other technologies. This is particularly important for teachers serving low-income communities.

We often talk about how data is a tool with which we tell stories. This starting point works particularly well with our English Language Arts teachers, particularly since The Western Pennsylvania Writing Project program and its teacher cohort has long been concerned with addressing changing concepts of literacy for over thirty years. They have many practitioners who have incorporated technology, data, and maker practices as tools to support the teaching of writing. We discuss how data can support nonfiction argumentation and note the parallels between scientific process and the process of building an argument. We build these stories by looking at our world, creating a set of beliefs or theories about it, and then investigating. With those in hand, we think about the data we can collect or already have. We analyze the data, looking for meaning. Depending on what we find, we may revise our beliefs and theories and then do it all again.

It's at this point that we find some limitations of what we can do, at least so far. For learners to be able to weigh scientific evidence that they see in their everyday lives, teachers need to be able to support some scientifically technical discussions, something that many of our teachers do not feel equipped to do. We often get into discussions about what is "ok" to teach, what is beyond their scientific knowledge, and how to get support (from us or elsewhere) to address the more challenging topics. But so far these discussions do not have a clear resolution.

Working together has deepened our understanding of how to support the educators we teach and the practices of the teachers. We have all come to understand more deeply the ways in which inexpensive crafted experiences with technology can support youth to develop and [share] their voices and understand the power of data-driven argumentation. Together we build understanding on the multimodal representations of data and narrative and how to take action to empower youth voices with these representations.

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