Designing learning experiences that initially spark students’ interests and sustain their engagement throughout the educational experience is difficult. Frequently, in the learning sciences, we contextualize learning with initial interest, or hooks, that are useful to engage a specific group for a short period of time. But as John Dewey (1913) suggests, external attempts may catch someone’s interest, but holding it and engaging learners in persistent effort and identification with a topic are much more difficult. What should educators do when initial interest can be sparked, but economic, cultural, or other considerations conspire to impede sustained learning? In this chapter, we explore how participatory design has shaped our interest-driven learning experiences into value-driven learning experiences. Using two case studies, we demonstrate how traditional participatory design practices and a meta-design approach to participatory design can help craft value-driven learning that enables students to navigate seemingly countervailing values, nurtures their interests, and creates supportive contexts in which to pursue those interests.

Our focus has been in integrating cultural value-driven design of informal learning in computer science. Recently, in the United States, a number of initiatives have been promoted to increase K-12 computer science education. Unfortunately, the underrepresentation of women, African American, Latino and Latina, Native American, and differently-abled populations, is a significant barrier to achieving “Computer Science for All” (Margolis, Good & Chapman, 2015; NSF, 2008; Peckham et al., 2007). Extensive research has studied why this underrepresentation exists (Margolis, 2008; Margolis & Fisher, 2002) and looked at the various approaches used for mitigating the differences (DiSalvo et al., 2013; Eglash, Gilbert, & Foster, 2013; Eglash, Bennett, O’Donnell, Jennings, & Cintorino, 2006; Kafai & Burke, 2014).
We use the term “value-driven learning,” rather than “interest-driven learning” (Edelson & Joseph, 2004), to identify an approach used to design learning experiences that build upon cultural values, rather than the individual’s identity or interest. While interests, such as music, games, or fashion, can be ways to entice young people into trying new disciplines, such as computing, Edelson and Joseph (2004) have highlighted how identifying authentic interest and sustaining interest is challenging and has not been addressed. González, Moll, and Amanti have put forth a related concept, *Funds of Knowledge*, the idea that learners bring their own personal and cultural experiences, values, and knowledge to formal instruction. However, teachers and designers of educational experiences do not listen to or leverage these cultural experiences. The result is the creation of interest-driven learning experiences that are based upon educators’ best guesses, which do not sustain interest and go out of fashion quickly.

*Cultural values* can be defined as the ways individuals choose to act in the world based upon their family, friends, media, and other influences to which they have been exposed (Swidler, 1986). In this way, cultural values are not simply the values expressed by the community or the values of the individual themselves. They are the ways in which individuals choose to meet or reject those values and the broader values they see in their culture. For example, a teen African American male may place a strong emphasis on the learning skills tied to employment because he perceives that his family values a man who is financially responsible for himself (B. DiSalvo et al., 2014). Whereas, a teen Latina may place a strong emphasis on training for employment because she perceives her family values her ability to financially contribute to the family (Sy & Romero, 2008). These values speak to potential motivations of not participating in a learning experience. An individual’s values not only differ by community, but they might also differ by the populations within those communities. For example, values that are applied by relatives to Latinas (e.g., staying close to home) might not be applied to male Latinos.

In the design of learning experiences, educators often try to appeal to a specific demographic through a targeted design of curricula that creates interest-driven experiences for students, such as music (Freeman et al., 2014), e-textiles (Buechley, Eisenberg, Catchen, & Crockett, 2008), or games (Repenning et al., 2015). Whether the experience results in value-driven learning depends entirely on the students’ ability to bring their own values to what they design as part of these learning experiences. It is not that these learning experiences aren’t able to center on the values of the learners; it is that incorporating values into a learning experience is difficult to do. Without scaffolding their involvement in the design process, students are unlikely to bring their values to these experiences. To design for value-driven learning, we explore two frameworks used in the practice of participatory design. First, is the use of formative participatory design as a method of uncovering cultural values that learners hold, which then become the anchors for designing learning interventions. Second, is the use of meta-design principles
to develop project-based learning activities that can be rooted in the values of learners and adapt to different groups and their cultural values.

**Participatory Design**

While the term “participatory design” is often used to describe any design process that asks users to contribute ideas about a design, we use the term in a specific manner, referring to the branch of participatory design work that can be traced to Scandinavia in the 1970s and 1980s (Ehn, 2008; Simonson & Roberston, 2012). These early participatory design projects, focused on workplaces, were often conducted in conjunction with worker unions, and sought to bring both the knowledge of workers’ practices and the workers’ values into the design process, as many tasks were becoming automated (Simonson & Roberston, 2012). In these ways, participatory design is a set of methods, a practice of engagement, and a commitment to a particular set of values—all enacted through design. Today in this Scandinavian tradition, participatory design has been extended to many different contexts, from healthcare (Sjöberg & Timpka, 1998) to intelligence analysis (Chin Jr, Kuchar, & Wolf, 2009) to government (Anthopoulos, Siozos, & Tsoukalas, 2007), and, more recently, learning sciences (Bonsignore et al., 2013; DiSalvo & DiSalvo, 2014; Yip et al., 2013).

These new domains challenge the initial goals of participatory design. Instead of directly engaging participants in a known system, they often ask participants to work on design activities that seek to inform more nebulous goals. Still, this mode of participatory design is an extension of the foundational methods, practice of engagement, and commitment to democratic values as described by Ehn in Chapter 2. The difference in our use of participatory design is that the end goal is to create an experience or event that develops the agency of participants in the design of learning experiences, rather than in the design of a product, service, or system.

**Meta-Design**

Meta-design is a technique designers use to create something that enables the users to act as the designers themselves. Ehn describes how participatory design activities become meta-design, where infrastructuring provides the necessary resources to prompt, support, and sustain collective and collaborative inquiry through design (Ehn, 2008). It is seen as a type of participatory design that empowers stakeholders and democratizes design, enabling a flexible environment for the users (DiSalvo, Clement, & Pipek, 2012; Ehn, 2008; Fischer, 2013; Fischer & Giaccardi, 2006; Giaccardi & Fischer, 2008). Within the educational domain, the meta-designer (frequently a teacher) creates an educational environment that enables the students to become active in directing their own learning, usually as part of a project-based learning activity. Technology within the learning environment can be designed to
stimulate the students to take an active role in leading their own learning. One of the key features of meta-design is its ability to evolve and flexibly support change over time.

In designing value-driven learning, we leverage meta-design frameworks to focus closely on a structure that scaffolds students to integrate their values into the projects, creating value-driven designs that are student-led. Ehn (2008) describes four infrastructuring strategies that can be implemented in meta-design to assist users in becoming the designers. We use the following terms and definitions as originally outlined by Ehn (2008, pp. 5–6):

1. Formats—predefined solutions with an outline of important characteristics. These can be flexibly applied to new situations based on the users’ knowledge of the process to appropriately modify characteristics.
2. Component Strategy—LEGO block approach, in which the user can build solutions for specified problems they encounter using the components provided.
3. Design Patterns—configurations that are described in terms of a contextualized problem and a solution. Based on this knowledge, the pattern can be appropriated or modified based on a new problem.
4. Protocols—within a social context, the defined procedural agreements for completing activities and/or communicating.

In computer science education, a project-based approach is often taken that shares many similarities with meta-design. These projects can range from high to low structured experiences. The structure of these curricula usually defines the learning experience’s flexibility to target the students’ diversity. Highly structured interventions often lack the flexibility of being able to appeal to various demographics due to an over-constrained problem space. On the other hand, when you allow the students to have free reign over the designs of their projects, they have the ability to create something that they care about. However, these low-structured interventions are usually resource intensive in terms of time and materials. Furthermore, low-structured interventions also place a large burden on the educator to assist the students and appropriately scope the projects. By using a meta-design learning experience, we scaffolded the structure and focus the students on creating something within that structure that is reflective of and incorporates their cultural values. This provides value-driven design that is flexible (see Figure 13.1) but can still be constrained in terms of the structure to make the interventions more scalable.

By using participatory design practices, we can better understand cultural values and how to design for cultural values. With the following two case studies, we explore more traditional approaches to participatory design to uncover cultural values in the development of the *Glitch Game Testers* and the use of meta-design frameworks for participatory design of project-based learning activities in the *Interactive Día de Muertos Puppets*. 
Case Study: Glitch Game Testers—Formative Participatory Design

We used a series of participatory design activities in the development of the Glitch Game Testers to better understand the values of young African American males living in economically depressed neighborhoods. Glitch was prompted by observations, interviews, and data that indicated young African American males had a strong interest in video games, but were not leveraging that interest in computer science like their white and Asian-American male peers (DiSalvo & Bruckman, 2009). Based upon a strong association with sports and value of sportsmanship, we found African American males’ general play practices with video games limited their interaction with the underlying computation of video games. To leverage their initial interest in video games, we needed to better understand their play practices, and what values might motivate them to pursue computing. We conducted a number of participatory design activities with teens in after-school programs that served economically depressed, predominantly African American neighborhoods. The goals of these activities were to develop a relationship with the teens, understand their perspectives on school and education, and find ways to design learning experiences with them that would meet their values, beyond what they found interesting or fun, to include what was important to them,
as well as to their families, peers, and community. These were not co-design activities that directly asked participants how to design something. Instead, the activities scaffolded experiences that allowed the participants and designers to develop a shared vocabulary, spend time on reflecting, and speculate about the future. Below, we describe two activities, a neighborhood tour and a media literacy activity; both highlight the ways that participatory design helped us create an open dialogue and understanding of our participants’ values regarding education.

**Neighborhood Tour**

Participatory design can help researchers establish dialogues with participants and shift power structures that might inhibit participants from sharing. In the *Glitch* program, one method we used to help us establish a dialogue was a Neighborhood Tour. The goal of this activity was not to design a tour with the participants. Instead, it was to learn from the process of creating a tour, and to create a more equal environment for designing because the participants were the experts in their neighborhoods. In our participatory design activities, we tried to make the activity educational or beneficial to the participants as well as the researcher. For this neighborhood tour, we provided the participants (consisting of five teenage African American males) with a camera, a handheld environmental sensor, and a set of questions about their neighborhood. Example questions were, “What is the best place in your neighborhood?” and “What is the most polluted place in your neighborhood?” At each location the participants chose, they told the researcher why the location was the “best” or “most polluted.” Then, we used the environmental sensor to measure pollutants in the area. This data sparked reflection on what it meant to be the “best,” because the young men chose a playground with a recycled tire surface, which emitted fumes picked up by the sensor. In contrast, we also reflected on the point that their “most polluted” area was a trash-strewn, empty field that registered few indications of pollution on our sensor.

In addition to the specific locations, participants also showed the researcher around the more general neighborhood. The young men demonstrated the pride they felt about their neighborhood, but also expressed dismay over the gentrification that was changing the neighborhood. A number of new homes recently built had displaced apartments and homes that were previously occupied by their friends and families. In addition, they pointed out the several homes developers could not sell. These homes had broken windows, which made the students assume that people were doing drugs in those abandoned buildings. It frustrated the young men to think that drug dealers and drug users had better homes than they did.

While walking around, the few white residents that were out with their dogs or jogging would cross the street before sharing the sidewalk with the five African American male teens and a white female researcher. The residents’ motivation for crossing the street was unclear, and it was difficult to determine if the participants
noticed this behavior. Regardless, the experience made the white researcher (first author B. DiSalvo) more aware that racially motivated fear (Russell & Russell-Brown, 1998) was a factor that could hamper a learning environment for young African American men, and noted that this factor would need to be mitigated or addressed in a learning environment.

The neighborhood tour accomplished a number of goals. It gave the teens the power to: direct the tour and conversation, break down barriers between researcher and subject, and let them recognize they had expert knowledge and understanding of their own experience, which could help inform the design. It also attuned us to some of the value systems at play. These young men were frustrated with the rewards they perceived drug users and dealers were getting. The young men also felt they had little power to address this issue or the negative consequences of gentrification in their neighborhood. And, finally, the neighborhood tour gave us researchers a glimpse into the experience of being a young African American male, and an idea of how other community members might negatively perceive them. In these ways, the participatory design activity helped us to begin to understand the cultural values of these young men. The use of open-ended explorations was part of the design process, and helped the participants and designers understand what is valued, what is “normal”, and how that might be disrupted in a positive manner. In this way, we were not trying to answer specific design issues, but we were better able to understand the design space with the participants.

**Media Literacy**

While a number of participatory design activities were conducted with young African American youth, one activity on media literacy provided pivotal insight into the design of the *Glitch Game Tester* program. The activity was conducted with 10 male and female participants at an after-school program. It started with an introduction to advertising, asking the participants to think about what advertisements were trying to do, and discussing what strategies they used to accomplish their advertising goals. Then, we described some of the methods used in brainstorming and pitching advertisements. Researchers asked participants to first individually, then in groups, mock up an advertisement that would encourage young people to stay in school. Finally, the whole group agreed on a strategy and produced a final advertisement together. The final mockup featured a dirty basement room with the tag line, “If you do not like to live in your mom’s basement, DO YOUR HOMEWORK!!!!!” (see Figure 13.2). In all of the advertising concepts, a focus on future economic independence was the primary concern. Other learning motivations, such as creativity, learning for the sake of learning, and living up to family expectations, were not mentioned in the discussions. Researchers gained an important insight into the values that would motivate these young people to participate in learning activities. It was not about
a focus on doing cool or interesting things. Instead, their values were based on pragmatic approaches to encourage economic stability. Based upon this finding and others, the researchers developed a program that not only leveraged the participants’ interest in games, but one that also directly addressed participants’ desire for economic stability by offering game tester jobs. These were paid positions where the participants tested real, pre-release video games. Over three years, the *Glitch Game Tester* program employed 33 young African American males. Over 60% of those males continued on to study computing or information technology in college (DiSalvo et al., 2013). The success of the project can be attributed to these two participatory design activities along with many others that helped researchers and young African American males develop and negotiate an understanding of the cultural values that would drive an educational program for computer science.

**Case Study: Interactive Día de Muertos Puppets—Meta-Design**

Within the Día de Muertos/Day of the Dead Puppet activity, participants were tasked to reflect on people who have been important in their lives, the cultural practices around death and mourning, and the ways they can express these complicated concepts with computer science and engineering. The students completed individual projects where they integrated microcontrollers to animate Día de Muertos puppets, which they designed themselves. The workshop was originally designed for an after-school program for middle school Latino and Latina students. However, based on that success, we implemented the activity in two semester-long, graduate-level prototyping courses (44 students total) to motivate a final project. We observed that the Día de Muertos puppets served as a meta-design, rather than as a culturally relevant or interest-driven project. The infrastructure of the puppet project allowed the students to design learning
experiences in the class based upon their own cultural values. We identified how
design patterns, component strategies, format, and protocol were critical in creat-
ing the scaffolding for flexible design that was still manageable for the instructor
in terms of time, knowledge, and materials.

Classes began with the instructor introducing how technology was used in various
art projects, and then the instructor presented artifacts, ranging from hacking toy dog
robots that “sniff” out environmental threats (Jeremijenko, 2014) to web-based appli-
cations that tracked a culture of surveillance (Institute for Applied Autonomy, 2001).
The initial class also introduced the cultural significance of Día de Muertos, which
included images of alters, sugar skulls, and puppets that demonstrated the symbolic
imagery, colors, and themes of celebration in many Día de Muertos artifacts. These
various examples and representations served as design patterns for students to under-
stand from a cultural perspective how symbols and designs could be used to express
emotions. Students expressed surprise at the range of ways artists had used technol-
ogy, and the ways that death was marked in different families and cultures.

In their first active role, students focused on a design worksheet that placed
them as experts in understanding a death they experienced and their own cultural
response to that death. The worksheet was a component strategy, which required
the students to be thoughtful in identifying components they could use for the
aesthetics and the interactions their puppet would support. The handout guided
thinking about their expression with questions in five sections, allowing for room
to write and draw responses: 1. Who is someone important to you that has died?
2. Why were they important to you? How did their death impact you? 3. What is the story
you want to tell about the person you are celebrating? 4. Symbolic Representation—What
is something the person you are celebrating did in the world that mattered to you? How can
you represent that physically, visually, or with sound? 5. Symbolic Triggers—What are the
things that the person you are celebrating related to from the world around them? How can
you use physical computing to symbolize this reaction with sound, touch, light, or motion
data. Students completed these without knowing the project’s end goal. These
questions were structured to be components that would transfer to the next activity
of storyboarding.

Following the handouts, we gave the students a format for storyboarding to
guide the design process. This helped participants move from their conceptual
ideas, to the design of a puppet that incorporates programming, to the hardware
they needed to animate it. The storyboard format involved four states: START, INPUT, OUTPUT, and FINAL. As the instructor walked participants through
the sections, they could grasp the significance of the various storyboard sections
and tie them directly to the four worksheet questions. Then, the students sketched
out their concept on craft paper using drawing material and collage materials,
such as images from Día de Muertos celebrations, microcontrollers, sensors, and
output devices. The use of the four states (START, INPUT, OUTPUT, and FINAL) encouraged students to think about their puppets as interactive objects
and better tie their conceptual ideas about symbolic triggers and representations
into the hardware, such as light, motion sensors, speakers, or lights.
Critiques were integrated throughout the workflow and student-to-educator, and participants enabled an open environment for constructive criticism. Throughout the design process, the instructors visited individuals as they worked, offering critiques during the process. At the end of the design session, the participants pinned up their sketches for a group critique. These group critiques offered a chance for students to learn and be inspired by each other, gain a vocabulary for talking about technology and art, and reflect on their own ideas. For example, in critiques, the
instructor pointed out that one student had not thought about the end state of interaction with their designed puppet. It prompted the other students to explore what the end state of their puppet would be. This protocol helped the students develop skills within the practice of critiquing and of learning from one another.

Meta-design within the Día de Muertos puppet activity created an environment for the students to actively participate in designing their learning experience. The infrastructuring strategies that were applied scaffolded the students into creating thoughtful designs driven by their values and culture, which nurtured a community of learners in the environments. Within the Día de Muertos, the meta-designed curriculum helped students create objects that provided the class with a starting point to have a dialogue about family, culture, and how technology can embody and represent those concepts. Stimulating students to integrate this type of meaning into their creations set a precedent in the classes for students to be more open in sharing with one another. Not only were they engaged by each other, but also the enthusiasm of the participants seemed to be enhanced by the opportunity to bring their own expertise to the process. Because each participant was an expert in their own culture and family, this was a rich ground for engaging students with the design, even when they felt the technical or creative work was outside their capabilities. Our less technically experienced graduate students were highly motivated by the project, and often spent more time on the project than anticipated, so they could get it right.

Conclusion

These two case studies are examples of a participatory design process in value-driven learning. Participatory design as a tool for formative understanding of the design space was used in the design of the Glitch Game Testers program. And, in the form of meta-design, participatory design was also used to create a value-driven learning experience with the Interactive Día de Muertos Puppets. In both cases, cultural values—not just individual values, but the values of friends and family that our teen participants had internalized—were central to the design process and designed artifacts. For the Glitch Game Testers, participatory design activities helped address power structures inherent in the researcher-and-subject relationship, raised the researchers’ awareness of cultural issues and challenges that participants encountered, and shaped the central values of the program to focus on participants’ concerns with employment and other pragmatic motivations. In the case of the Día de Muertos Puppets, the ongoing participatory design nature of meta-design allowed educators to co-create project-based learning experiences with their students. The meta-design framework helped to scaffold a design process that incorporated various cultural values and gave students the freedom to create a flexible and meaningful project, while still remaining within practical constraints such as the instructors’ time, varying skill levels, and available materials. The approaches are not meant to upend the interest-driven or project-based
approaches that have been well documented and successful in the past. They are a way to explore how participatory design, as a formative and meta-design strategy, can incorporate the cultural values of students, increasing the chances of sustained engagement beyond initial interest.

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References


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