Prototyping Puppets Beyond Borders

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Abstract

We report on an ongoing collaboration that uses puppetry as a shared cultural expression in educational workshop that inform intercultural exchange. Collaborators in Atlanta, USA and Medellín, Colombia work in tandem on the design and implementation of puppet-building workshops. These workshops use narrative framing, craft-based prototyping, and performance-based validation to teach students basic prototyping skills. They specifically encourage them to relate to their local culture and to inform an ongoing dialogue between the two cultural spheres.

Keywords

Narratives, Puppetry, STEM/STEAM, Participatory design, Co-creation and Collaboration, Craft, Intercultural exchange.

Introduction

The *Prototyping Puppets* project is a work in progress that grew out of a design collaboration between the authors. It combines local workshops in two different cultural spheres that use narrative scaffolding to combine craft and art in order to teach informal components for Science, Technology, Engineering, and Mathematics (STEM) education. Each workshop aims to facilitate aesthetic self-expression and encourages cultural interactions through the exchange of emerging results and new designs. The workshops originally target 10- 12 year -old students and follow the same basic structure: create a narrative for a short puppet performance, create the puppets for this play and include STEM prototyping components in these puppets, finally realize the play through these puppets. Workshop participants alter existent designs and adjust puppets to their narrative and particular performative needs. These modifications are swapped between different workshop instantiations to shape a creative exchange between the students as co-designers. Puppet designs emerge, stories reflect locale, and technology is adjusted to local needs. This collaboration has bridged researchers located in two distinct geographic and cultural locations: Atlanta, USA, and Medellín, Colombia.

Bridging differences in age, cultural background, levels of expertise, available technologies, or financial conditions has been a continuing challenge for creative design approaches, including Participatory Design (PD) (Muller & Druin, 2012). Adding to these challenges is the lack of colocation, leading to the field of Distributed Participatory Design (discussed in workshops at CHI 2006 and 2008 as well as PDC 2008). Distributed Participatory Design (DPD) actively deals with different locations and cultural conditions that affect a shared design process. It has been applied e.g. in software development, where Gumm et al. used a work-shop approach to connect different shareholders in the long-term software development (Gumm, Janneck, & Finck, 2006). But adjusting the processes and the designs to fit those different conditions is not always easy. Loebbecke and Powell argue, for example, that successful DPD entails inclusion of disciplines beyond PD (Loebbecke & Powell, 2009). *Prototyping Puppets* did not target a new theoretical framework for design but it emerged as a practice using shared approaches and is presented as a case for transnational collaboration through adjusting practices of "making" based on cultural diversity.

The goal was not to organize the processes toward a singular object or design but to use distributed co-creation itself as an educational tool in-between participants from different cultures and socio-economic conditions, while serving a global population in the development from STEM to STEAM (Science, Technology, Engineering, Arts, and Mathematics).

The emerging collaboration distributed the creative processes among the researchers and students. Maintaining such a balance between all parties is challenging, though (see also Fowles, 2000). In our case, this was introduced through a basic workshop structure that largely remained intact. It encourages participants to independently develop their own expressions and stories and create the responding objects, puppets,

and props for them. We provide a kit-like scaffolding to stimulate participants' own creative engagement in a play-based workshop setting. We designed tutorials with sample puppet characters but we consciously left the particular performance settings during a workshop open to the creativity of the participants. Participants are encouraged to perform their own stories and test their puppets at the same time. The workshops encourage personal expression first and deploy technology as a means in an accessible setting. Using traditional and familiar materials and combining those with a "combination of modelling with storytelling relativizes the quality of the model designed, and therefore levels out the modelling skills of experienced and inexperienced participants" (Schulz, Geithner, Woelfel & Krzywinski, 2015). Workshops close with informal reflections on the process.

Local interpretations are approached as opportunities for mutual learning through a form of asynchronous dialogue between culturally, and social-technologically distant partners. The project includes cultural differences as additive in a gradual discourse of the shared basic workshop structure. We found that puppetry stands out as a shared, yet culturally diverse form of expression that is particularly suited for this approach. While puppetry is an art form that can be found on every continent, its practices and local customs differ widely (Blumenthal, 2005). How such differences unfold in comparable workshop settings and how they are shared and affect each other is the story of the *Prototyping Puppets* pro-ject.

Project Design and Context

The Center for Puppetry Arts in Atlanta is an internationally renowned center for the education on and performance of puppetry. It features one of the largest puppet collections in the United States, a recently expanded museum, and its own educational programs on site as well as online. In addition, they offer own puppet-creation workshops featuring original puppet designs. During these workshops, children assemble their own puppets made of basic craft materials, such as paper, wood, strings, and various customization elements. These workshops are extremely accessible (the center supports a very diverse population of students and includes special events for special needs students) and successfully combine performance with craft exercises. Inspired by these workshops, a group of researchers from the Digital World and Image group at Georgia Tech developed their own puppet designs to not only allow for mechanical construction but also include basic hardware prototyping elements. The goal was a STEM-based workshop allowing participants from different cultures to express themselves through a combination of craft and technology, making and performing. With this in mind, the Georgia Tech´s team started a cooperation with the research group Hipertrópico, arts and technology in Universidad de Antioquia (UdeA), Medellín to test the workshop in a different cultural environment. Although Medellín does not have a big center for education on and performance of puppetry, it has smalls independent theatrical companies that explore puppetry as an artistic media. Traditions seem to merge, as Galeano and Arias suggest, elements of the passage objects used in the rituals of the aboriginal cultures with the European tradition of puppetry brought to the region during the Spanish colonization (Arias/Galeano 2015). Medellín has a varied culture of social and cultural uses of puppetry, especially for children audiences, that goes from theatrical to recreational covering private parties, public festivities and institutional events. Although this tradition uses puppetry as performance, there is a need to strength the possibilities of using active participation of children in the creation of puppets as object and in the creation of performances of narratives with puppets. This participation can not only support self-expression and collective active learning but also can expand children's design and creative engagement with technology. The goal is not to adapt one form of puppetry but to build on the differences between forms across borders.

Craft and STEAM

The workshop was designed following the considerations of a systemic learning process that authors such as Boy proposed as a way to expand the disciplinary teaching processes of many schools to an interdisciplinary teaching and learning processes that must include art. "Systems need to be investigated and tested as wholes, which requires a cross-disciplinary approach and new conceptual principles and tools. Consequently, schools cannot continue to only teach isolated disciplines based on simple reductionism. Science, Technology, Engineering, and Mathematics (STEM) should also be integrated together with the Arts to promote creativity together with rationalization, and move (back) to STEAM (with an "A" for Arts)" (Boy, 2013).

The current turn to "making" and the combination

of craft and electronics/digital media acknowledges this role of context and interdisciplinarity. But projects often lack the experiential aspect of the referenced craft materials. Not every "maker" project is designed with its cultural and material conditions in mind. This has been rightfully debated by proponents of a "critical making" approach who lament a "disconnect between conceptual understandings of technological objects and our material experiences with them" (Ratto, 2011). In contrast, craft-as-practice is deeply grounded in socio-cultural context and provides a critical counter argument. Here, Buechley's combination of craft and computing (Buechley & Eisenberg, 2009) and related work on the use of soft circuits in education (Kuznetsov et al., 2011; Peppler & Glosson, 2013) are most relevant for our design, which combines basic prototyping technologies with traditional puppet making. Buechley's initial work was an expansion of technologies. In her case, this included the development of the Lilypad prototyping board to which she later added the concept of the "kit-of-no-parts," which leans directly on traditional craft materials (Perner-Wilson, Buechley & Satomi, 2011). Particularly this later approach mirrors *Prototyping Puppets*' use of craft: to combine aesthetic self-expression, familiar materials, and electronics into a creative and interest-driven learning STEAM experience. Peppler (Peppler, Tekinbas, Gresalfi & Santo, 2014) explores this domain further and shows that familiar materials and practices lower the entry threshold for participating students and notably speak to female students. Others have shown the appeal of a hybrid craft approach with at-risk population (Kuznetsov et al., 2011). Peppler and Glosson conclude that "learning happens best when toolkits afford a sense of transparency by providing opportunities for concretizing knowledge through tinkering with the materials" (Peppler & Glosson, 2013). *Prototyping Puppets* builds on these approaches as it applies technologies that combine material construction and electronics. It further extends them to experiential performance/ use: Students engage with technology not only in the practice of making but also through their creative use in playful performance. Both steps are culturally grounded in the students' own experiences and situations.

Role of Performance

Performance art presents a varied and ubiquitous form of personal and communal expression across all cultures. Schechner introduces performances as a "continuum" of human actions (Schechner, 2002) that stretch across cultures as well as activities. Its local variations, personal relevance, and global appeal predestine performance arts as a powerful tool in STEM education. Because it is practice-based, it sets the stage for a form of experiential learning propagated by Piaget, Dewey, and others. Experiential learning has been used in education for adults as well as children and its potential "to erode traditional boundaries between knowledge and skills, vocational and academic learning" (Reeve & Gallacher, 1999) speaks to the transnational and transdisciplinary nature of the *Prototyping Puppets* project.

As in other areas, the digital revolution had a profound impact on performance art and re-shaped numerous performance practices. It questioned the very nature of the performance as mediatized event (Auslander, 2008) and opened up new venues, such as "intermedia" (Chapple & Kattenbelt, 2006). At the same time, computer science and HCI adopted theatrical approaches such as Laurel's work on an Aristotelian model for HCI (Laurel, 1991) or Mixed reality performance design in ubiquitous computing (Benford & Giannachi, 2011). A fractured lineage can be drawn from evolving performance practices to often experimental forms of interaction design. However, these cases largely apply one domain to further the other: either they adapt technology to further performance or apply performance practice to improve HCI. A combination of the two as equal pedagogical partners is far less developed.

Targeting Puppets

Puppetry, as a particular form of performance art, has been applied to digital media in various ways. These include storytelling, improvisation, and public engagement (Bottoni etal., 2008) as well as educational (Marshall, Rogers, & Scaife, 2004), and technological projects (Martin, Johnson, Murphey & Egerstedt, 2011). Puppetry inherently depends on forms of engineering and technology through the object of the mechanical puppet. Puppets, such as the ones Hand-spring Puppet designed for the theatrical show *War Horse* (2007-), are often technological and mechanical master-pieces. At the same time, they are objects optimized for artistic expression. Puppetry remains a relevant cultural phenomenon as different practices remain in place and beloved today all over the world. This combination makes puppetry readily applicable to STEM. It also

allows for distinct cultural framing.

Thanks to this widespread acceptance, puppetry continues to be used in formal and informal education as an effective platform for communication and creative production (Bernier & O'Hare, 2005). *Prototyping Puppets* builds on these proven strengths of puppetry to attract and engage new groups of students through self-expression for a STEAM workshop on basic prototyping.

Puppets have the appeal of whimsical and extremely familiar personal objects. At the same time, they are rich in expression and pose complex technical challenges in construction and operation. They are complex mechanisms with delicate engineering components as well as culture icons and familiar characters. They are effective tools for STEM education precisely because they embody the engineering materiality as well as the immaterial cultural reference in performance. *Prototyping Puppets* combines making and performing in the construction of the personal expression.

Both tiers of the project, craft and performance, are naturally integrated in this field of puppetry. It offers the necessary combination of local culture through narrative and performance as well as technology and prototyping in the designs of the educational workshops.

Workshops

The Atlanta Workshops

The project started as a workshop modeled after existent puppet-making workshops at the Center for Puppetry Arts (CPA) in Atlanta adding to this craft-based mechanical construction a basic prototyping component. First, the designers learnt from the puppeteers and educators at the CPA before they devised their own basic puppet-making-designs. Those included traditional materials (paper, wood, wool) as well as prototyping components (LEDs, conductive copper tape, batteries). The initial target was to create a scaffolding that would allow early middle school children (aged 11-12) to experiment with simple circuit building in a STEAM environment. Basic puppet templates were provided as teaching material and reference material for students. We created video and assembly documentation material for various puppet designs. Those designs were developed not as blue-prints to be followed but as guiding samples to be adjusted to any specific needs from the participants. It was important to leave these designs open enough to allow students to make the puppets themselves and accordingly to their design intentions – not to follow a singular step-by-step walkthrough.

Figure 1. Reference puppet design (left); example for realization of the design for a performance (Atlanta workshop) (right)

In connection with these technical designs, the workshops were developed around the three steps of narrative development, craft-based technical puppet construction, and validaion through performance. The combination of the three-step approach with familiar materials in simple design references provided the targeted educational setting. Craft- as-practice is deeply grounded in socio- cultural context and provides a critical counter argument to an abstracted, somehow "general," potentially culturally unaware process.

Following such a "turn to practice" the *Prototyping Puppets* project is set up as an sample educational approach to include "physical and mental activities of human bodies, the material environment, artifacts and their use, contexts, human capabilities, affinities and motivation" (Kuutti & Bannon, 2014). During the design phase, the researchers explored multiple puppet designs. One common element was that they grew out of the turn to craft and "making" outlined above. This means, they readily included specialized materials typical for this movement – such as self-adhesive conductive copper tape or conductive thread.

In practice, the designs included crafting paper, clothe pins, adhesive and conductive copper tape, LEDs, and various means of customization. Tools for assembly included basic craft tools, such as scissors, glue, and tape. The researchers provided the basic designs but these designs were quickly appropriated and changed (see fig. 1). The designs were pilot tested with significantly differing results depending on the setting. But the local differences are not the focus of this paper. It was more important to find that the work-shop design itself proved to be stable and the technology was feasible.

This work was conducted in a lab environment, thus the specific nature of chosen components (copper tape, conductive thread) or tools (multimeter) did not pose any restriction. This is typical for many craft-based

approaches emerging from university lab environments and – as we soon realized – it represents a detachment from the realities in the target audience's environment.

The Medellín Workshops

The work in Medellín started with an adaptation of the tutorials. The first approach to testing the tutorials was pilot tested by Isabel Restrepo and another adult with elementary school children. Since they needed to incorporate recycling materials, the original materials, which included sturdy craft paper, was replaced by cardboard from a box. The use of this material allowed the creation of larger entities and led to a stage for the puppets. This was a creative decision of the children but also included complications for the construction process. For example, scissors were not the right tool to cut the cardboard and the adults needed to help the children by using a scalpel.

Figure 2. Creating a complete stage (Medellín workshop)

Another material that needed to be replaced was the conducting tape, giving that it was not available in the city. Instead, electrical wires from recycled material were used. To build the basic circuits for the puppets we had to use soldered-brass tools, so this task was primarily done by the adults. Dealing with materials at hand emerged as a key challenge as well as an opportunity: functional parts had to be replaced and inherently shaped the nature of the puppet.

The second test was done by some members of the research group Hipertrópico, from UdeA. After translating and studying the tutorials the team decided to test two of them with three main goals in mind:

·Understand the mechanism.

·Measure the possibilities of using the tutorials with children.

·Test the materials and tools.

The team found an alternative material for the conductive tape: aluminum foil coated with rubber adhesive. This material that generated further changes from the original Atlanta design. The adhesive tape covered a big part of the character and electrical wire was used to warranty conductivity between the battery and the aluminum adhesive. Once the puppet prototypes were done, the team created a narrative by using the surrealistic methodology of the *Exquisite corpse* or *Cadavre exquis*. This strategy generated the need for designing extra props and a more elaborate stage including a rolling background. In this way, the team designed a kit-like scaffolding with all the needed elements to perform the piece as an introduction for the workshop with children.

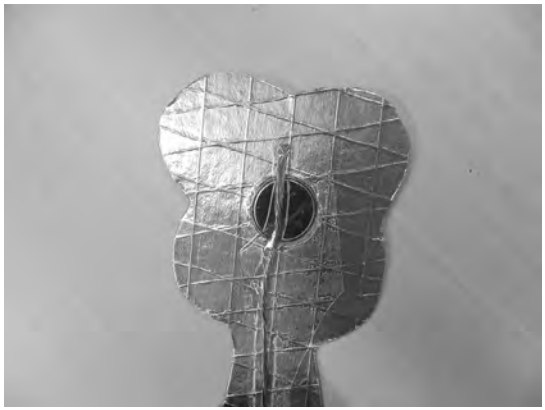

Figure 3. Medellín flower-tree design with aluminum adhesive

After testing the tutorial, designing puppets, props and background, and rehearsing the performance, the team designed the methodology of a three session workshops based on a cooperative work between children and adult instructors (members of the team). During the first session, the team performed the piece to the children and provided technical and conceptual information. After dividing the group up into four teams, each team, was encouraged to create a story and to build the electrical components for the main characters. During the second session, the teams finished the puppets and developed props and backgrounds. During the last session, the

children rehearsed, performed and evaluated the overall experience.

Figure 4. Performance situation on location (Medellín workshop)

Children were receptive and active participants during all sessions of the workshop. Yet, again, the local differences are not the focus of this paper. Instead, the necessary changes in the workshop designs were traced as formative evolutionary steps.

Outlook and Dialogue

Workshops at both locations have shown that the overall framing and workshop design work across very different conditions. They also show emerging differences on every level of the core events. The created narratives, the materials, the puppet designs, and the final performances all differ. Exchanging these differences, realizing them in different cultural contexts, while operating within the given scaffolding of a puppet-building workshop establishes a transnational dialogue that includes material, practice, and social context. A key component of this dialogue is the shared use of online documentation. Both teams share videos, instructions, photo documentation, and related design materials online for ongoing discussions and further development.

A key component of the adjustments done in Colombia was the translation of the originally English instructions and the illustration of each step with clearer graphics. Their final documentation includes bilingual descriptors and is optimized for printing. This stands in clear contrast to the English workflow documentation from the Atlanta group, which used google documents and photo images. As the project stepped from a lab environment into the application on site, the localization of the original documentation from a research- based design work to an accessible and appealing format is one example of transnational and transcultural adjustment.

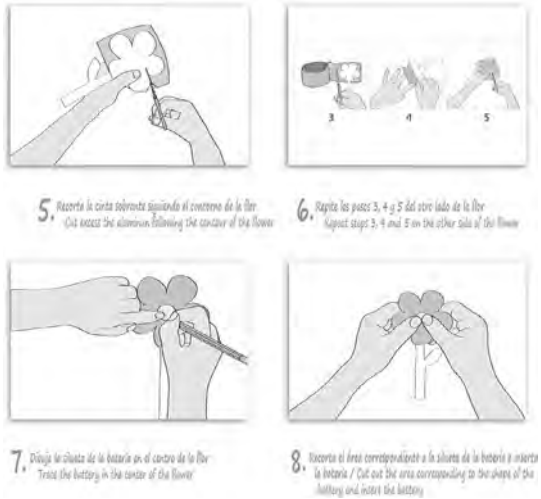

Figure 5. Sample page of documentation for the Medellín work-shop

Likewise, the changes in material from copper tape to conductive adhesives and from craft paper to sturdier carton changed the puppet designs, opening up new directions. One such direction is the turn to props and stage design. The Atlanta workshops focused entirely on the design and making of puppets with little work on props or scenery, the Medellin participants included much more differentiated scene design and stage development. The use of different materials might have supported this step. As the Medellín realization of the workshops led to a bigger focus on the surrounding stage and scenery, they also adapted the circuit building components to this stage set up. The participants in Medellín clearly demanded more context for the puppet performance than those in the US, where some props but almost no back-drops were created. This has led to a additional design components for a puppetry stage. The performance staging enters the design development of the workshops and will be one of the design impacts from the Medellín workshop that feeds back to the Atlanta versions.

The emerging stage design from the Medellín workshop resembles that of a single-standing performance theater. Notably, this reflects historic

developments in puppet theater, which has seen such portable stages in many variations (Blumenthal, 2005). These designs have been documented and reflected in the workshop documentation to test them in return in local workshops in Atlanta, be altered in reply and sent back to Medellín.

The workshops and puppet design have proven to work locally, yet the most relevant findings are the differences that materialized between the workshops in Atlanta and those in Medellín. We are only beginning to explore these differences through the workshop scaffolding that we have developed but the original set up has proven to be flexible and distinct enough to allow participants to articulate their own expression with the means available to their specific situation. This, in turn, shapes the ongoing transformations of the workshop practice both on the craft and technological as well as the performative and artistic side. We argue that this dual engagement provides the necessary depth for a distributed transnational STEAM based dialogue.

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Isabel Restrepo holds a PhD from Universidad de Antioquia and a MFA in Art with emphasis in Multimedia from San Diego State University. In 2008, Restrepo founded the interdisciplinary group Hipertrópico to study relationships between art, technology and society. She directed key research within that group, including the project on Augmented Reality and Imaging and Artistic Education: A Pedagogical Model. In her exploration, Restrepo has utilized Open Source as a tool for production, experimentation and teaching digital media in art. Such work has led to the creation of the pedagogical multimedia Líneas Digitales, based on the use of GIMP. In addition, she has worked as curator and educator.

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Michael Nitsche holds a Ph.D. from Cambridge (Darwin) in Architecture. He is Director of Graduate Studies for Digital Media at the School of LMC at Georgia Tech. His research combines Performance Studies and Craft Research to explore interaction with new media. He directs the Digital World and Image Group, which has received funding from the NSF, NEH, Alcatel Lucent, Turner Broadcasting, and GCATT, among others.

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