Making Make-throughs: Supporting Young Makers Sharing Design Process

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ABSTRACT

This paper introduces the concept of *make-throughs*, a documentation format in which Makers share their design process throughout the development of a design project. Make-throughs capture the rich, iterative nature of a design process in which a project is constantly revised and refined over time. In contrast to tutorials, make-through documentation is shared throughout the design process (rather than after a project is complete), and incorporates iteration (rather than a finalized list of instructions). A personal narrative of the accomplishments and struggles in developing a project, make-throughs are *expressive* rather than *efficient*.

I begin with a definition of make-throughs and share examples of *process-oriented* documentation in domains outside of the Maker community. I then describe four examples of make-throughs shared on the online community Build in Progress. From these examples, I discuss four emergent themes that suggest the potential for make-through documentation: facilitating feedback, creating expressive documentation, representing effort, and documenting-in-action. Finally, I end by describing several future directions for supporting rich opportunities around make-through documentation practices.

Categories and Subject Descriptors

K.3.0. [**Computer Uses in Education**]: General

General Terms

Design

Keywords

Design documentation, design process, reflection, DIY, Making

1. INTRODUCTION

Design documentation has long been valued as a tool for communication and self-reflection, particularly within the engineering, design, and arts communities [1, 2, 4, 13]. In professional practice, design documentation takes several forms, from personal design notebooks to more outward-facing portfolios. This documentation describes, in varying levels of detail, the sketches, calculation, and notes related to developing a project.

Documentation within professional practice is commonly motivated by issues surrounding intellectual property, but in the Do-It-Yourself (DIY) "Maker" community, documentation is often shared openly through open source software and hardware. This documentation supports hobbyists learning about new techniques and tools in the context of building a project. Knowledge sharing within the maker community has been fostered through the sharing of design files, tutorials, and project documentation online.

Researchers have begun to study how documentation practices can be meaningfully integrated for younger audiences in the DIY community, or "makers." Inspired in part by the introduction of "Maker portfolios" as part of the college application process at universities such as MIT, Maker Education embarked on an Open Portfolio Initiative to understand the role of portfolios for young makers [14]. Through investigations of existing documentation practices in Makerspaces, the Open Portfolio Initiative surfaced challenges around motivating documentation, integrating documentation into making practice, and sharing this documentation with others. Documentation for young makers has the potential for supporting identity development, reflection, and communication of design experience.

Designing documentation tools and supports for young makers requires an understanding of the broader landscape of platforms and practices within the DIY community. The dominant form of documentation on popular DIY communities such as Hackaday [8] and Instructables [10] are *instructional* guides that are intended to help others replicate a specific project or technique. Often displayed as a list of steps, these tutorials are not unlike common cookbook recipes, beginning with a list of necessary tools ('ingredients') and walking through each step of the process. Traditionally, much of the documentation is compiled after a project is completed, though it may integrate photographs taken throughout the process [19].

Because documentation of DIY projects online has largely been represented in the tutorial format, research has similarly centered on how authors generate instructional documentation and how readers follow this documentation [12, 16, 19, 25]. This is exemplified in prior work on how electronic hobbyists write How-Tos [19] and recent work specifi-

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cally on the format of DIY tutorials [25]. However, an analysis of the Instructables community previously surfaced several tensions in developing instructional documentation [23].

First, authors often edit out much of their design process for the sake of writing efficient instructions that only contain the necessary steps for replicating a design. This means that the iterations and challenges in developing a project, or the 'story' of how a project came to be, are often omitted from this format. Second, readers do not necessarily seek out documentation to replicate projects despite the instructional format of Instructables. Instead, readers modify projects through personalization or substituting materials or tools.

These results have inspired the design of an alternative platform called Build in Progress for sharing *process-oriented* documentation that reveals the backstory of creating and modifying design projects. With Build in Progress, users share how their projects develop over time, including the iterations, missteps, and fortuitous discoveries that often characterize a design process. Over the past two years, projects shared on Build in Progress have shown the potential for an alternative style of documentation that I am introducing in this paper as **make-throughs**:

> **Make-throughs** are a style of design documentation that highlight iterative design processes through personal narrative.

The two defining characteristics of make-through documentation that distinguish it from instructional documentation are that

1. The documentation is shared throughout the design process (rather than after a project is complete)
2. The documentation captures iteration (including successful and unsuccessful design experiments)

Through this paper, I describe several examples of make-through documentation shared on the Build in Progress platform and show how the results point to implications for design documentation more broadly. I begin by describing the origins of the term make-through, which stems from a concept in the video game community know as play-throughs. I then provide additional examples of similarly styled process-oriented documentation in other domains. I follow with a brief description of the Build in Progress platform and share several vignettes of young makers creating make-throughs on the site. I then discuss four themes that emerged from this work and end with new directions that make-through documentation may support. The goal of this paper is to encourage further research and practice around supporting youth sharing their design process through the make-through style of documentation.

2. MAKE-THROUGHS: ORIGINS AND EXAMPLES FROM OTHER DOMAINS

The term *make-throughs* stems from the concept of *play-throughs* in the video game community. Much like instructions can be contrasted with stories, there are two distinct forms of documentation for gamers: walk-throughs and play-throughs. A walk-through is a guide written with the intention of helping others accomplish a particular goal within a game. They are to-the-point, edited to only include the necessary steps needed to complete a task. In contrast, an emerging format of documentation is play-throughs, which are either live-streamed or recorded footage of a user playing a game in realtime. Largely unedited, play-throughs capture a specific player's experience playing a game, often combined with humorous commentary. Examples of play-throughs can be found on the popular platform *Twitch*, in which users share a live-stream of a game alongside a chat window and video feed showing the player's facial expressions as they play the game [9].

Instructional DIY documentation is like walk-throughs: they are recipes, or guides, for completing a particular project. In contrast, a *make-through* is like a *play-through*: it is a personal account of a designer's or design team's experience developing a design. It is captured as the design is being created, rather than after it is complete, and it highlights the iterations and mistakes that may go into creating a project.

Sharing the social context around creating a design has been explored in other domains. While many cookbooks share recipes in an instructional format, cooking is strongly tied to cultural traditions, and recipes are sometimes accompanied by stories about their origins. Some researchers have begun to explore how the relationship between familial interaction, family history, and recipe sharing can be integrated into the design of 'homemade cookbooks' [7].

In the area of craft, the project *Spyn* enabled needlecrafters to embed personal stories into their handmade objects [17]. Using a mobile application, users can capture video narratives during the creation of a handmade object, sharing information such as technical details of how the design was constructed, the designer's current sentiments, and why they made particular design decisions. Recipients of the object can in turn learn about the context in which a crafted object was designed.

A final example is from the world of reality television. The popularity of design oriented reality competitions such as the fashion competition Project Runway or engineering-focused Design Squad, a PBS television series for teens, has helped reveal the messiness of the design process to viewers. Through these shows, viewers see how designers conceptualize a design, create prototypes, and execute finished products [6]. While the design process is necessarily edited to fit the television show format, these shows nonetheless depict an iterative design process to audiences who may not necessarily be designers or engineers themselves but appreciate learning more about how others engage in creative practices.

3. BUILD IN PROGRESS

This paper examines four examples of make-throughs from the platform Build in Progress [5]. Build in Progress (BiP) is an online community for makers to share DIY projects as they are being developed. It consists of a website and mobile applications that enable users to add text, photos, and videos to individual steps that share how their projects change over time. Steps can be visually organized and categorized into branches, which often represent iterations (Figure 1). Users can solicit advice on their projects and receive comments on their projects. Since its launch in May of 2013, the site has gone on to support over 1,000 registered users sharing over 750 projects. For additional information on the design of BiP, please refer to [22, 24].

BiP was designed to encourage users to be transparent about their process, and features on the site are created to support a make-through style of documentation. However,

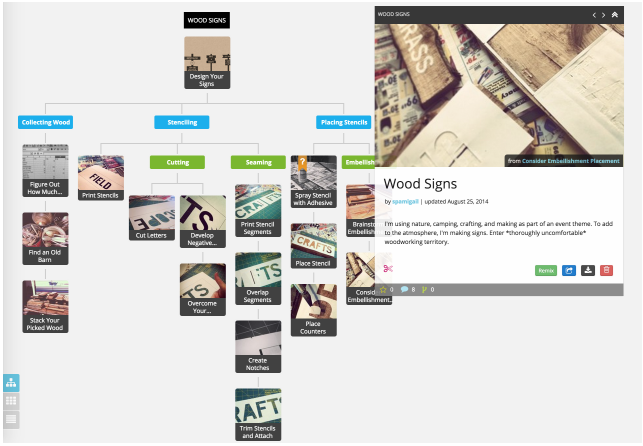

Figure 1: A sample Build in Progress project page

not all BiP projects are make-throughs; ultimately, it is up to the user to decide how and when they share their work. In this paper, I selected four examples of young makers' BiP projects that exemplify the make-through style and its affordances for supporting process-oriented documentation.

4. METHODOLOGY

Prior work on BiP has analyzed how the visual format of the BiP project page contributes to learning about the design process [24]. This paper, instead, focuses on the temporal nature of sharing design iterations over time. I tell the story of four teenagers who shared make-through documentation on BiP over the last two years. Two of these young makers were introduced to BiP in after-school design centers called the Computer Clubhouse, while the other two participated in a four-week Arduino-based challenge hosted on the site. All participants of the Arduino challenge were given a new Bluetooth Low Energy (BLE) Arduino called the *Coin* to integrate into design projects of their choice.

All of the youth included in this paper were between the ages of 15 and 17 years old and were interviewed by the author after they completed their Build in Progress projects. These interviews were conducted to learn about the youth's motivations for sharing their design process, their experience adding to their BiP documentation over time, and their reflections on the tool compared to other types of documentation they previously created. These particular youth were selected because their documentation captured the spirit of the make-through format, incorporating both successful and frustrating elements of engaging in a design process. Additionally, each of the interviewed teenagers used various features of the platform to reach out to other makers, which will be described in each of the following vignettes.

Each of the four semi-structured interviews was approximately an hour in length and conducted online, with both video and audio recording captured using Google Hangout. These interviews took place from March 2014 to December 2014. All of the recordings were transcribed and then analyzed using thematic analysis and deductive coding [15] to identify themes related to motivations for capturing design iteration, techniques for representing design iteration using BiP, and methods in which BiP features were employed to interact with other makers on the site. Additionally, the maker's project pages on BiP were utilized to support statements made during the interviews about capturing design iteration. Predominantly, the text shared on these project pages as well as visual representation of iterations through branches were included in the thematic analysis.

In this paper, all of the teenagers are referred to using their usernames on BiP, though self-identifying usernames are given pseudonyms.

5. BIP MAKE-THROUGHS

In this section, I describe four examples of make-throughs created on BiP.

5.1 Elucidator's Kirito's Blade

Shortly after the platform was launched, a member named *blamb* created a project to share how he was designing a sword inspired by the online Anime series Sword Art Online. In his project *Elucidator's Kirito's Blade*, *blamb* documented how he created an electronics-enhanced replica from scratch over the course of five weeks as part of a final project for his art class. Then 17 years old, *blamb* was first introduced to BiP through a summer internship at a Computer Clubhouse and continued to use the platform on his own after the internship ended. In *Elucidator's Kirito's Blade*, *blamb* shared an expansive 22-step project that describes his conceptualization of the design (from early sketches and prototypes) to fabricating the wooden sword in a machine shop and integrating color-changing LEDs along the side of the sword (Figure 2).

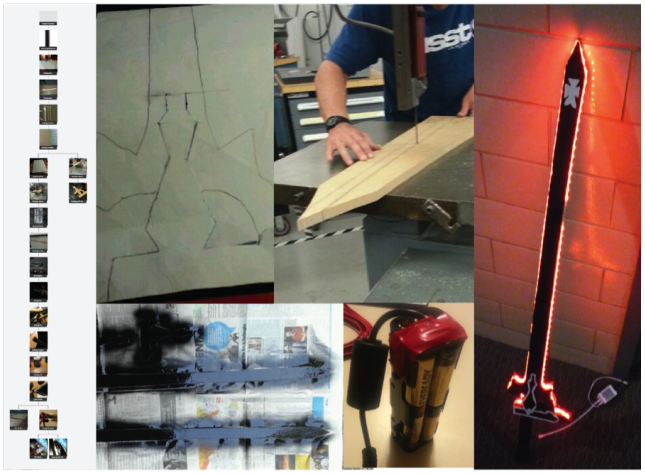

Figure 2: Select images from Elucidator's Kirito's Blade

After 'finishing' his design, *blamb* shared a step he titled 'The Final Product' which included a video of the sword powered by an AC adapter plugged into the wall. When this step was shared, several users on the site commented on the possibility of using batteries to self-power the sword, which would eliminate the need for a tethered power connection. Upon receiving these comments, *blamb* began working on a wireless version of the sword and asked other users on BiP for their opinions on battery options. This led to a chain of comments about the pros and cons of using different types of batteries and power considerations for his application (Figure 3).

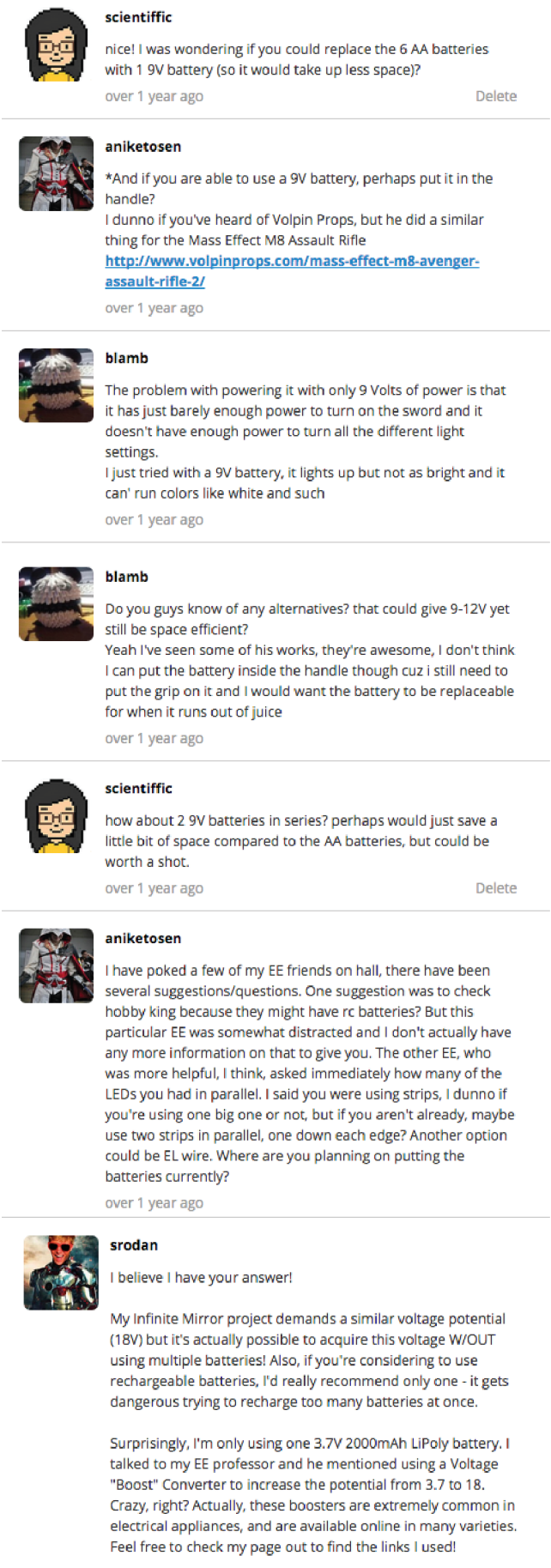

Figure 3: Comments on battery options

Eventually, *blamb* added another step in his project titled "THE FINAL wireless product" where he shared pictures of a sword powered with two 9V batteries connected in series. He wrote, "I tried the 2 9-volt batteries as was suggested and it worked! they were able to power the sword AND they're space efficient."

When I interviewed *blamb* about his experience using BiP to capture his design process, he contrasted his experience with using Instructables:

> This isn't like an Instructable where you have to do this then do that. You can just ask out questions and roll out your problems, and other people try to help out. That encouraged me to be more vulnerable with the weaknesses of my projects, so that if anyone would try to do it [remake the project] they could see the mistakes I made and go about it however they want.

Through this quote, *blamb* reveals how sharing his process throughout his project's development enabled him to get advice he could incorporate into its design. In particular, he comments on how this format encouraged him to be "vulnerable," as opening up about the shortcomings of a project can invite others to provide input.

Other descriptions from his project show how *blamb* openly spoke about problems he faced in creating his project. For example, he described how the construction of the hilt of the sword might be improved in a future iteration: "In hindsight this was not the best idea and it led to the wood cracking and me trying to fix it with wood glue." His reflection shows how *blamb* thought critically about his own design in an effort to prevent others from making similar mistakes.

Elucidator's Kirito's Blade shows how sharing how a project develops (and its associated challenges) opened up opportunities for others to contribute. By documenting throughout his design process, *blamb* provided context with which readers could provide specific suggestions that helped him achieve an even more desirable end product. This result suggests that make-through documentation may provide new opportunities for fostering dialog between makers.

5.2 Tower Defense Arcade Game and Box

In the summer of 2014, several high-school interns at a Computer Clubhouse on the West Coast developed games centered around promoting a social cause. Each group of interns collaborated on a game and documented their progress on BiP over several weeks. One of the teens was a 16-year-old named *joekol*, who created the majority (20 / 24 steps) of the documentation on his team's collaborative project *Tower Defense Arcade Game and Box* [20]. The group's project involved creating an Action-Script-based video game in which players eliminate carbon-emitting enemies such as cars in order to save the natural landscape (Figure 4). Through the team's BiP documentation, *joekol* shares how the team struggled to learn how to program a game for the first time and invited other users on BiP to test and resolve bugs.

A distinguishing feature of *joekol*'s BiP project was the descriptive language he used to describe his team's design process. While projects on BiP typically contain an average of 350 words, the *Tower Defense Arcade Game and Box* project has over 3300. Upon interviewing *joekol* after the project was complete, I learned that he enjoys creative writing but had never shared his writing publicly online before.

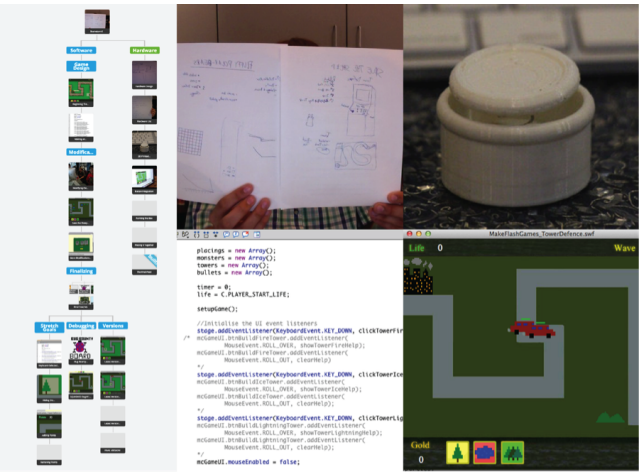

Figure 4: Tower Defense Arcade Game and Box

He told me that his intention in sharing the BiP documentation was to share his team's entire process of developing the game: "It would start from our initial thoughts and the way we changed our minds about something and removed some things and added aspects." He was especially keen on creating documentation that others would enjoy reading: "I know reading about projects is usually really boring...I didn't want to make something that people would be bored and click away from after a couple minutes." As a result, much of the documentation in the project is lighthearted and humorous. As an example, *joekol* described an early accomplishment in the project as follows:

> While the following days are certain to be wrought with terror and distress, I alone seem to have total confidence in our group's future, progression, and completion of our project.
>
> As for now, bottles of Martinelli's Non-Alcoholic Sparkling Cider are flying open, cheers being given, glasses clinked, and our under-aged group is rejoiced with the happiness and enthusiasm of a professional game development studio.

Similar to *blamb*, *joekol* used BiP to solicit feedback on his team's game. He organized different iterations of the game into branches and invited others to test bugs:

> Any help with any of these bugs will be GREATLY appreciated, and anyone who helps lead to their arrest will be duly compensated with a spot on the Credits section giving our many thanks, hugs, and kisses!

Finally, though his BiP documentation, *joekol* constantly reflected on his experience, culminating in a final post in which he shared reflections on his internship, his team's project, and the documentation they created on BiP:

> This internship, and project, has been one of the greatest experiences of my (and hopefully my group's) life. I am VERY proud of all the work we have done, all the things we have learned and the achievements we have strived for.
>
> ...Thank you everyone who gave advice, feedback, suggestions, and help. There are too many to name, so you know who you are!! Thank you for making this the most favorited, most posted-upon, and most commented project on Build in Progress.

Through his reflection, *joekol* shares a sense of accomplishment not only about the design he and his team created by also for the documentation they shared throughout his internship experience. This suggests that documentation itself can be a meaningful artifact that makers can enjoy developing and take pride in creating.

The *Tower Defense Arcade Game and Box* BiP project interweaves technical descriptions of the game with the personal experiences (the frustrations and the rejoicing) that accompanied each iteration. This rich documentation begins to show how make-through documentation can be a creative expression in and of itself that can communication the emotional experience of undergoing and conquering a design process.

5.3 Arduino BLE Breathalyzer

In the summer of 2014, ten makers from around the United States were invited to participate in a four-week Arduino-based challenge on BiP. These participants were recruited through makerspace and hackerpsace mailing lists and ranged in age from 14- to 54-years-old. One of the participants was a 17-year-old named *laurmie*, who created an Arduino-based breathalyzer [3]. The goal of her project was to develop an inexpensive yet effective breathalyzer that would lock the steering wheel of a car until a user passed the breathalyzer test; if the user failed, they would be prompted to call a cab from their mobile device.

Because of the lack of documentation around the new BLE board, none of the challenge participants ended up using the Bluetooth features of the Arduino, but many documented their frustrations attempting to do so. Over the four weeks, *laurmie* shared a six-step project on BiP, where the first two steps described issues trying to connect to the board:

> After spending all week with connecting issues, little progress has been made. We can connect to the Coin and it detects SOMETHING coming in, but no matter which characters I send, it receives non-English gibberish. The Arduino Mega's we use work perfectly and receive data, but not the Coin. It's frustrating.

Two weeks into the challenge, she decided to switch to using another Arduino board, which gave her more success. This led to a series of steps around testing an ethanol sensor and 3D printing an enclosure for her DIY breathalyzer, which was functional at the end of the challenge.

When I interviewed *laurmie* afterward, she discussed the importance of sharing her frustrations in her documentation:

> The fact that I had connection issues...I feel like that was the most important part of my [BiP] project, actually. I looked at a lot of projects, and they were like, I just plugged in a couple wires into the breadboard and it worked, and that's not what happened for me. So I think it's to show other people that it doesn't work on

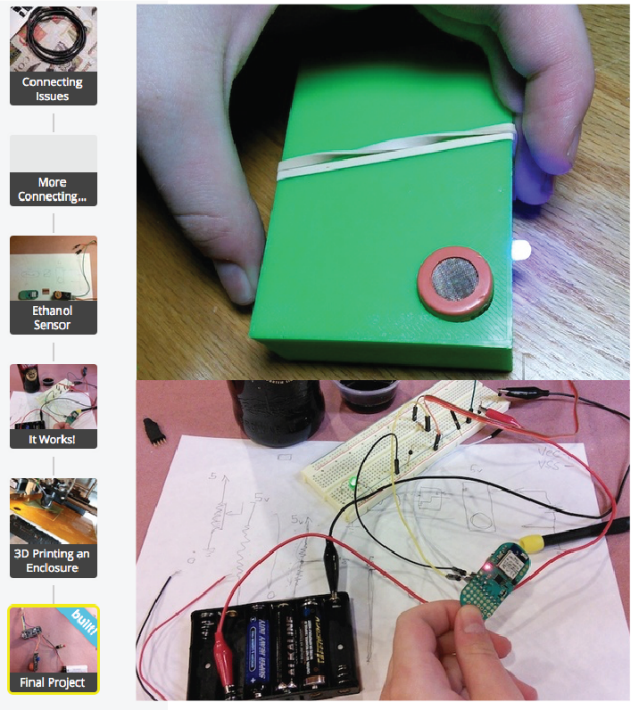

Figure 5: Select images from Arduino BLE Breathalyzer

> the first try and it's ok and just try something different.

In this way, *laurmie* shared her documentation as a way to support others in challenge, showing that they were not alone if they were facing similar difficulties. She later went on to describe the BiP documentation as a representation of her efforts: "When I started putting up steps for this, I definitely wanted to show a good representation of where my time went, and a good chunk of that time, which is 2/6 steps, is connection issues, which is absolutely how I spent my time." Thus, her BiP documentation became a proxy for the effort and time spent debugging.

Through our conversation, *laurmie* contrasted BiP with her personal website, where she shares photographs of art projects only after they are complete. By documenting throughout the process, *laurmie* shared that she received feedback she felt she would not have gained otherwise:

> For BiP, I was ok showing intermediate steps as opposed to just the final product because I know it's a lot of engineers using it, and everyone was asking questions and giving feedback and stuff throughout the process, so that was really cool.
>
> I got some pretty cool ideas from people...someone commented about the weight and height of the person, which would affect the levels, which I didn't think of because I was just making it for me. So it was really helpful to get feedback during the process, as opposed to, "Here's my final project. What do you guys think?"

In this quote, *laurmie* describes how feedback from other makers on BiP gave meaning to sharing work-in-progress. Overall, the make-through documentation she created showcased her efforts and persistence in creating her project.

5.4 Internet Monitored Sprinkler System

Another participant in the Arduino BLE challenge was a 14-year-old named *slittle*, who created an Internet Monitored Sprinkler System to help him remotely water his lawn from a web interface [11]. Similar to *laurmie*, many of his steps are devoted to troubleshooting the Arduino BLE board, representing various attempts in distinct branches (Figure 6).

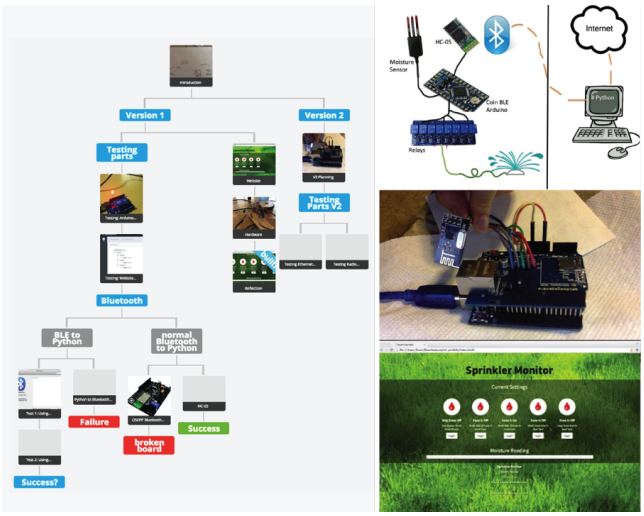

Figure 6: Select images from Internet Monitored Sprinkler System

When I asked *slittle* why he shared his troubleshooting steps in his BiP project, he said that his main motivation was to help others participating in the challenge:

> The amount of detail I included was definitely to help other people who were working on it, because I knew a lot of people were going through the same thing. I thought I'd try to be as helpful as I could and include as much code as I could.

An added side benefit to creating this documentation was the ability to use it as a personal reference: "Looking back at what I've created, there's a lot of trials, which I probably would have forgotten about. But after I've documented it, I'm able to look back and maybe use it. Hopefully other people can look at it and improve what they do, but I can see what worked and what didn't work." For *slittle*, documenting unsuccessful attempts served as both a memory tool and a way to reach out to others participating in the challenge who would likely face similar issues.

Finally, when I asked *slittle* to compare his experience using BiP to previous documentation he had created, he described how documenting with *BiP* extended beyond capturing what he had already completed:

> I found that using BiP isn't really just a tool to document your project, but it's more of a way of doing your projects. [With] each additional step, I was creating it before or while I was doing the step. It was just much different where I kind of wrote about what I planned to do.

Rather than documenting after each step was complete, *slittle* created steps on BiP beforehand, outlined what he planned to do. Then, after attempting to finish what he sought out to do, he would edit the same step and describe whether or not he was able to fully accomplish the task, changing the description from future to past-tense. In this way, the documentation served as a tool to organize his efforts around creating his design and then as a means to reflect on his work. I was especially interested in how documenting before and after integrated into his workflow, and *slittle* revealed that using BiP helped him develop more efficient documentation habits:

> I really liked being able to document as you go so it's not a big burden that you keep procrastinating once you're done. You can kind of do it as you're going, and it doesn't seem like it takes much extra time.

This idea of documentation as a planning tool was furthered by his response when I asked him if constantly documenting was disruptive to his design process: "It's not at all a disruption. In fact, it helps keep you on track."

By capturing his process throughout, *slittle* created documentation that could support others working with similar hardware and facing similar problems. His unique workflow in capturing his process both before and after a step was complete show how documentation created throughout the design process can aid with planning as well as reflecting.

6. DISCUSSION

Four major themes regarding creating and sharing make-through documentation emerged from this work: facilitating feedback, expressive documentation, representing effort, and documenting-in-action. For each of these themes, I describe how the two characteristics of make-through documentation (documenting throughout the design process and sharing iteration) lead to a different relationship between the makers, their documentation, and their audiences.

6.1 Facilitating Feedback

Documenting throughout the design process rather than after a project is complete provides new opportunities for facilitating feedback. In *blamb*, *joekol*, and *laurmie*'s projects, the make-through format invited others to provide feedback while the design was still under development. The suggestions of other BiP users led these authors to evolve their projects: for *blamb*, he was able to redesign his sword to become more portable; for *joekol*, feedback helped him resolve bugs in his game; and for *laurmie*, comments led her to consider design parameters she had not previously considered.

As described by *blamb*, taking advantage of this opportunity to garner feedback may require users to be more 'vulnerable' by revealing weaknesses of their project. This is quite different from instructional documentation where documentation is not shared until a problem is 'solved.' However, in a safe and supportive community, opening up about the potential weaknesses of a project invites others to leave constructive feedback.

Finally, the fact that make-through projects are incomplete may make them more inviting for others to leave feedback. As *laurmie* stated, "It was really helpful to get feedback during the process, as opposed to, "Here's my final project. What do you guys think?"

6.2 Expressive Documentation

The story of how *joekol* created his BiP project shows how make-through documentation can serve as a venue for creative storytelling. Instead of being a list of instructions, make-through documentation can provide outlets for makers who enjoy writing about their design process in creative ways. It is clear from the playful spirit of *joekol*'s documentation that he actually enjoyed creating his documentation, and through sharing his struggles, the accomplishments in his documentation are made even more vivid.

By enabling expressive storytelling, make-throughs introduce human elements to design documentation. They begin to reveal the context in which a design is created, which further personalize the documentation. In other words, the documentation itself becomes a form of creative expression in which the maker can communicate their personal journey of creating a design.

6.3 Representing Effort

Because make-throughs capture both successful and unsuccessful experiments, they can be used as tools to communicate the effort that goes into creating. For example, both *laurmie* and *slittle*'s projects revealed struggles associated with using the BLE board. This struggle took up a significant portion of their time, yet their completed projects show how they were able to persevere and use alternative hardware to build their designs.

As instructions typically only shows successful steps, all of their documentation regarding their struggles would normally be excluded. Having space to showcase these efforts can be especially important in educational settings where problem-solving efforts are, in many was, more important than the tangible output of a project.

6.4 Documenting-in-Action

A final theme of make-through documentation is the temporal nature of documenting as you go. An ongoing challenge with designing the BiP platform has been making it as easy and quick as possible for people to document consistently throughout their design process. A legitimate concern is whether documenting throughout rather than after a project is complete is too difficult and time consuming to be worthwhile.

However, *slittle*'s reflections on documenting both before and after completing each step reveal how documenting can both support planning and reflecting; he stated that rather than being disruptive, documenting during the process helped keep him 'on track.'

Donald Schon's work on reflection introduced the idea of *reflection-in-action* in which expert designers constantly reflect and act on these reflections as they design [18]. Here, I extend the idea to *documenting-in-action*, where make-throughs can serve as a tool to plan, reflect, and refine, all while being shared through public documentation. Documenting-in-action has potential implications for education more broadly as a way to support learning through systematic planning and reflection.

7. FUTURE WORK

Build in Progress is just one example of a platform designed to support *make-through* documentation, and there remain many questions about how to optimize tools to encourage open sharing of design process.

One rich area for future work is designing tools that can facilitate the capturing process. Make-throughs require more consistent documentation efforts than instructional documentation since documentation happens more frequently. As a result, the design of tools that can both remind users to document and make it faster to create the documentation once the user has elected to do so are critical to supporting make-throughs. One example within this space is the Spin photography turntable system that uses a mobile device to automate the process of capturing a design project through a series of images or a GIF [21].

Finally, the relationship between online and offline communities that support make-through documentation is an area for deep exploration. How can physical spaces be used in combination with networked tools to value and support iterative design processes? What facilitation techniques can be used to help young makers open up about both successful and unsuccessful iterations throughout their design process? Addressing these questions can help support young people recognizing the value of iteration and refinement through the creation of make-throughs.

8. CONCLUSION

Make-throughs are an alternative design documentation style to creating tutorials. The two distinguishing characteristics of make-throughs are that they are captured throughout the design process (rather than afterward), and they capture iterations in the design process. The analysis of four Build in Progress make-throughs in this paper shows how the make-through format can facilitate feedback, enable expressive documentation, represent effort in the design process, and create opportunities for planning and reflecting through documenting-in-action. By sharing these stories of make-through documentation, I hope to encourage educators and researchers to consider supporting and developing documentation tools that provides these distinct opportunities beyond traditional forms of instructional design documentation. By furthering efforts around creating make-throughs, we can develop new ways for young makers to tell the story of how they created their design projects.

9. ACKNOWLEDGMENTS

Thank you to all the makers who have shared their projects on BiP. This work is supported in part by the National Science Foundation Graduate Research Fellowship under Grant No. 1122374.

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