Breaking Tradition: Recreating Tutorials with Unconventional Techniques

by

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Abstract

Do-It-Yourself (DIY) tutorials have become part of our every day landscape. From IKEA style furniture directions to clothing tags detailing how to wash them, people are surrounded by directions listing the steps required to accomplish a task by themselves. The Maker movement, utilizing this form of instruction, has popularized and standardized the format. HCI research and tutorial makers explore methods of streamlining the creation of DIY tutorials, but very little research has been done to explore alternatives. By applying Research through Design (RtD) techniques, this work seeks to explore twelve alternative approaches to traditional tutorial presentation methods. Both amateur and expert participants were then asked nineteen different open-ended questions pertaining to the designed tutorials. Their responses were coded and sorted utilizing grounded theory, and serve to support the RtD methodologies already applied. The findings of this study reveal a need for identifying a tutorials audience, in addition to better supporting tutorial authors.

Keywords: Tutorials; DIY; Research through Design; Maker

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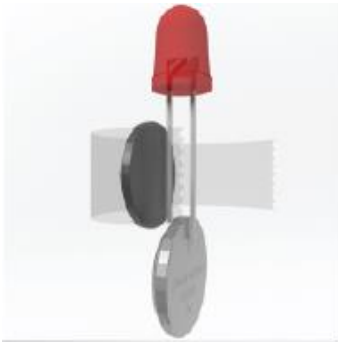
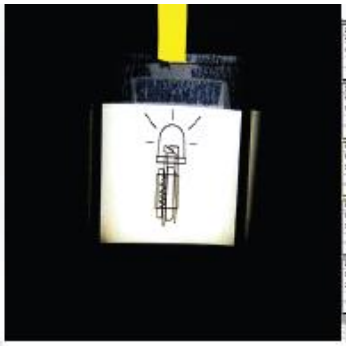
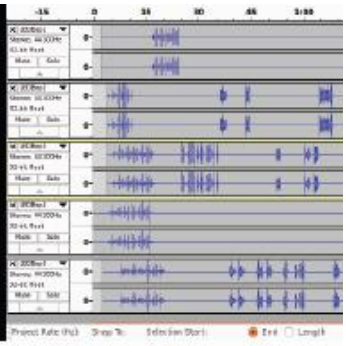
List of Acronyms

DIY	Do It Yourself
BoM	Bill of Materials
CYOA	Choose your own Adventure
BYOA	Build Your Own Adventure
RtD	Research through Design
GTM	Grounded Theory Methodology
HCI	Human Computer Interaction
CAD	Computer Aided Drafting
GIMP	GNU Image Manipulation Program

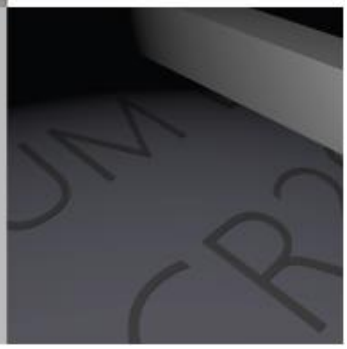






Leg, leg straddling
A battery in between
Add a magnet, tape!

abstract



Chapter 1. Introduction

The Maker movement began as a means to fight back against mass produced items and the lack of accessibility to products an individual owns. Make: Magazine coined phrases like "If you can't open it, you don't own it" and “void your warranty” while providing step-by-step instructions on how to create an array of projects with tools, devices, materials, and components on hand or easily acquired. *The Maker Movement Manifesto* (Hatch:, 2013), a book designed to motivate individuals to become a part of the Maker community and to want to learn more about making says, "You cannot make and not share." Do-It-Yourself (DIY) enthusiasts utilize whatever tools they have available to them to create and follow a wide range of tutorials across many different disciplines including: craft, electronics, mechanics, recipes, and more. These DIY tutorials find uses for old or discarded electronics, ways of repurposing new electronic devices, or methods of creating entirely unique projects from base parts and materials.

Tutorials have become routine for the average person. DIY tutorials range across an assortment of genres including, but not limited to, knitting, crochet, needlework, woodwork, metalwork, electronics, home improvement, and cooking. The tutorials in each of these genres are presented in a step-by-step sequence dictating how to accomplish the task described in their introduction. Most of these tutorials will present an image of the finished work up front, along with a list of the tools, materials, or ingredients required by the reader. Finally, when the sequence of steps required to remake the project is completed, most of these tutorials will present the reader with additional actions to explore. These actions can be as simple as a link to a more complicated tutorial, or more complicated musings about possible advancements to the design. Whether these tutorials are presented in person, or through video, audio, text, image or other format, the core structure of the instructions are clearly similar. While specifying the need for a parts list, and schematics or drivers, the Maker’s Bill of Rights

(http://makezine.com/2006/12/01/the-makers-bill-of-rights/) doesn't note any other aspects of what should or should not be included in a DIY tutorial.

The Maker movement generally has the reputation and is sometimes seen as a disruptive force to industry, including by the makers themselves. However, when presenting how to recreate their work, there is rarely any attempt to alter the basic format and presentation style of instructions. In a field where being disruptive and fighting against industry standards are considered the norm — when all of those disruptive works are being presented in exactly the same format, this takes away from the message and underlying meaning.

1.1. Purpose of Study

Even within the human-computer interaction (HCI) community, DIY tutorials tend to be researched with an inside-the-box approach, either in trying to streamline or obscure the process of making tutorials. This thesis articulates a set of research and design implications for creating DIY tutorials for experts and amateurs, as well as opening up new questions within the HCI community for further research. Two research questions will be analyzed:

> What are important design factors in non-traditional ways of presenting a DIY tutorial?
>
> How might these design factors be applied to tutorials with different audiences?

To fully explore these tutorial design factors, three areas needed to be observed and examined. First, there was the exploration of the DIY tutorial itself. Before remaking tutorials, a definition of tutorials needed to be generated, and exploring its expandability into non-traditional space was necessary. Second, identifying the wants and needs of tutorial makers was required. Third, the wants and needs of tutorial readers also had to

be established. Each of these factors will be taken into account when examining the first research question.

The second research question examines findings discovered while investigating the first research question, and attempts to apply these findings to tutorials and their audiences. The Discussion (Chapter 6), will provide the platform to fully explore this question and identify its applications. By seeing which design decisions participants ranked above others, it's possible to begin inferring how to apply them in alternative tutorials. Additionally, since both experts and amateurs provided feedback, it's possible to infer preferred design decisions within each participant group.

1.2. Description of Study

As the research questions demonstrate, the aim of this thesis is twofold. It first seeks to identify and describe what non-traditional tutorials are, then provide applications for their use. Through investigating these, this work highlights the limitations of current DIY tutorial research within the HCI community, and lays the foundation for future work to better address the issues and concerns of both makers and users of tutorials.

In order to identify non-traditional tutorials, this work will first examine and define what a traditional tutorial is by looking across an array of tutorials, as well as research within the field. Alternative methods of tutorials presentation, or non-traditional tutorials, will then be created for the purpose of investigating this research. These alternative tutorials represent the primary focus of this study

To create the alternative tutorials, one DIY tutorial was chosen as a constraint. The LED Throwie tutorial is popular amongst the DIY community, having been presented in both Make Magazine and on Instructables, in addition to numerous blogs. It is also simple enough even children can construct them.

The LED Throwie tutorial's structure was identified, broken apart, and then rebuilt in twelve unique ways. Each of the twelve alternative tutorials were created to explore different aspects of a traditional tutorial structure, pushing back at common tutorial design decisions in order to understand why those choices were made. Each of the modified tutorials went through a series of ideation, prototyping, modification, and final construction phases before being presented to participants for feedback.

Both expert and amateur participants were then asked to look at each of the tutorials and provide feedback on them. Once all of the tutorials were seen, participants were then asked to complete a seven question survey. Survey questions were designed to focus on different aspects of the research, and gave participants a blank field to write whatever they chose. Feedback gathered through these techniques provided a method of accomplishing the secondary focus of this paper. Through identifying trends and patterns in participants' responses, design decisions were identified which should be considered when creating tutorials, or the platforms used to create tutorials.

1.3. Approach

The Sage Handbook of Qualitative Data Analysis (Flick, 2014) describes qualitative research:

> "Data analysis is the central step in qualitative research. Whatever the data are, it is their analysis that, in a decisive way, forms the outcomes of the research."

In line with this idea, two qualitative research methods are applied at different stages of this research. The primary methodology used throughout the ideation, prototyping and construction of each tutorial is Research through Design (RtD). RtD uses details of a designed artifact's creation process and finished prototype to constitute, contain and construct knowledge, through revision, study and reflection (James Pierce, 2014). This research develops twelve DIY tutorial designs, each created to present the

same set of instructions in a unique way. RtD techniques are utilized across each tutorial to help develop concepts, reflect on design decisions, and to better understand tutorial design.

As will be further explained in Chapter 3, RtD has no set guidelines for data acquisition or analysis, so the decision was made that a qualitative research method should be conjoined to bolster RtD in the areas it lacks. This was accomplished using Charmaz's constructionist grounded theory methodology (GTM), which gives researchers “guidelines for collecting and analyzing qualitative data to construct theories 'grounded' in the data themselves” (Charmaz, 2006). GTM served two functions: first, to help construct a definition and structure for DIY tutorials, and second, to code participant responses from sixteen amateurs and seventeen experts on nineteen different open-ended questions pertaining to the designed tutorials. In addition, GTM was used in each of these instances to find patterns within the data.

1.4. DIY Tutorial Analysis

As outlined in the next chapter, there are several conflicting definitions for what is a DIY tutorial. Additionally, much of this research relies on the premise that DIY tutorials share a similar structure across platforms and medium. Consequently, it is important to establish a definition and structure for DIY tutorials in advance.

Research on DIY tutorials within the HCI community is still in the exploratory stage. There is no research that looks at tutorials across a spectrum to analyze the differences between layouts. As such, there is no formal definition within the HCI community for what is a DIY tutorial (which will be demonstrated in Chapter 2). In order to properly understand what defines a DIY tutorial and to justify claims that the structure of tutorials generally follow similar actions, this paper will start by looking at similarities and differences between tutorials across a wide range of platforms. The information below refers to the table presented in Appendix B, a small example of what is referenced in Table 1.1.

Table 1.1. Tutorial Codes: Excerpt One

Project or Kit Title Hosted Company	Website	Tutorial Sequence (Initial Codes)	Sequence Codes (Second Round Codes)
Leonardo da Vinci: Catapult Elenco	elenco.com/ admin_data/ pdffiles/ EDU61009.pdf	Title -Image of finished project Table of Contents Introduction -Information about Leonardo da Vinci -Information about siege engines -Images Components -Individual Images of each component -Letter associations with each component Steps -Individual diagram per step -Components shown in diagram with letter associations -Green arrows used to show where components attach or move too -Minimum of one arrow used on each step -Red arrows and outlines used to draw attention -only two step has any text (and each time, only one word) -Steps also show how to operate once finished	Title (image) TOC Intro Materials (image) Steps (image) Conclusion

Note: This is an excerpt from Table 7.1. To see all of the other tutorials, go to Appendix B.

As can be seen in Table 7.1, tutorials are presented with just text, image with very little text, a balance of text and image, text and video, or just video. Some of these tutorials were prepared with kits, and, therefore, do not contain a materials list. Some were professionally created to be used with a product, while others were prepared by enthusiasts who just want to show off their projects. Some platforms require the tutorials be created within a template specified by the host website, like Instructables, while others are self-published. Table 1.1 shows a tutorial from a kit produced from the Elenco Company that teaches children about Leonardo da Vinci, then it shows them how to

build one of his inventions, a catapult. Each of these tutorials were selected for a particular reason. Some were chosen because they represented either a project that was looking towards redefining the way people learn, like Cublets, Little Bits, and MIT Media Labs, while others are powerhouses in the DIY tutorial industry, like Adafruit, Make: Magazine and Instructables. A few highlight the most popular projects of well-known enthusiasts, like KipKay and The King of Random. The rest of the tutorials were picked for a uniqueness of venue or presentation style, like Howtoons, Linda.com, and Imgur. Effort was made, when possible, to ensure that tutorials selected had high accolades from both the community and the website hosting the tutorial. These accolades were established through winning contests, likes, thumbs ups, skulls, or features. These steps were taken to ensure that each tutorial represented the most popular in that style or category.

To investigate the sequencing of each of the tutorials, a simplified list was written of what each webpage or pamphlet contained (see the Tutorial Sequence column in Table 1.1). Everything was kept in list form and anything pertinent was included in bullets under the listed item to ensure everything stayed together. This was simplified even further to just basic labels, such as *title*, *introduction*, *materials*, or *steps* (Sequence Codes column in Table 1.1). In order to contain a wide array of text included in tutorials that did not present any knowledge necessary to complete a tutorial, like background information or how to use the finished project, the generalized label *info* was created and used as a placeholder for those sections. Further details on the development of coding and techniques used are discussed in Chapter 3.

By simplifying things in this method, several patterns began to emerge. First, there are three sections present in every tutorial: title, materials, and steps. They are always presented in that order, unless the steps and materials are merged, in which case the materials required in the step are listed at the beginning of each step. Second, at the beginning of almost every tutorial is an image of the finished project. Third, fifteen out of nineteen tutorials investigated contained introductions, and sixteen out of nineteen contained conclusions. Each of the introductions preceded the materials section and each of the conclusions either followed the steps section of a tutorial or were simply the last step. All but one tutorial contained either written or spoken text with each step. The

only tutorial that did not contain text was a Lego Mindstorms tutorial which diagrammed how to connect bricks together.

All of this leads to a basic five-element structure for tutorials: title, introduction, materials, steps, and conclusion. This structure begins with a finished image, and provides as much text and images as necessary to get the point across for each section or step. Additional steps can be added between any of the steps listed, and those steps can contain any information that the author wants to share. The addition of these bonus steps can not affect the overall order of the main four sections. Only two modifications can be made to the main four steps. First, when not required, either or both the introduction and conclusion can be left out, but it is usually present. Second, the materials list and the steps can be merged, but materials must be listed at the outset of a step.

While this structure can be found in almost every tutorial across any discipline that presents work in a step-by-step method, in the context of this research, it will only refer to the structure of DIY tutorials. Throughout this work, when referring to the basic structure of DIY tutorials, this five-element sequence is what is being referenced.

1.5. Contribution Statement

This research provides two contributions to the field of HCI. It presents twelve unique approaches to designing and presenting DIY tutorials. Utilizing a RtD approach, each of the twelve tutorial explorations are deconstructed to reveal three things. First, where each of the concepts originated and how those tutorial ideas first formed. Then, each goes on to detail the ideation and final presentation for that tutorial. Finally, each tutorial details the purpose of using that format through the questions it was intended to answer. Sticking closely with the ideals of RtD, two other aspects of the explorations were revealed. First, several failed tutorial attempts are described, as well as why they were not pursued further, to give a counterpoint to the finalized tutorials. Second, to provide the foundation required by RtD for the final tutorials, numerous supplementary

documents were created for the strict purpose of providing additional details to the reader. These extra documents will be linked throughout the research when they come up. Most of which are documented in detail on Instructables or YouTube.

This research also provides a comparative analysis of amateurs and experts in the field of DIY tutorials. The examination and interpretation of responses provided by sixteen amateurs and seventeen experts across thirty-one total questions, divided among individual tutorials and survey responses, were accomplished using GTM. Based on these findings, this thesis articulates a set of research and design implications for creating tutorials for different audiences, as well as opening up new questions within the HCI community for further research.

1.6. Thesis Structure

This thesis is divided into seven chapters, including an introductory chapter (Chapter 1).

Chapter 2 investigates design research relevant to this study, starting with a general overview of tutorials, then focusing on DIY tutorials, and finally looking towards a possible future through work being done in software-based tutorials.

Chapter 3 provides a foundation for the Research through Design and grounded theory methodologies used in this research. It then describes how those methods were applied though the four phases of this research. Finally, this chapter details data gathering and coding procedures used to identify patterns in participant responses.

Chapter 4 outlines the ideation and creation of the twelve tutorials used in this research, providing details on how each was built, and posing questions each was designed to answer.

Chapter 5 analyzes participant feedback across the twelve tutorial and survey responses. It first focuses on each tutorial, identifying common codes brought up by participants and answering questions laid out in Chapter 4. The focus is on individual survey questions identifying important concepts on which participants commented. Between the tutorial and survey analysis, codes are presented that appear throughout the responses, but never with enough density to warrant noting them in either a survey question or an individual tutorial.

Chapter 6 begins the investigation of the second research question. It explores meanings within the data discussed in Chapter 5. It breaks the data down into two categories: tutorials needs and individual needs. Both of these categories are then further subdivided. Tutorials is split into applicability of the techniques discovered, and tutorial creation requirements. Individual needs are divided into experts, amateurs and everyone. An additional section in this chapter looks at a possible bridge between tutorials designed for experts and those designed for amateurs.

Chapter 7 presents concluding remarks, and revisits the research question in relation to the new data presented within this research. It also provides suggestions for future research.

Chapter 2. Literature Review

This research examines the underlying structure and presentation of DIY tutorials. It will specifically focus on a single DIY tutorial that contains basic electronics and simple techniques required for assembly. DIY tutorials can be found on a multitude of websites, like instructables.com or makezine.com, and they are a passing of expert amateur knowledge (Kuznetsov & Paulos, 2010). In their paper, Kuznetsov and Paulos describe experts in the DIY community as hobbyists and enthusiasts. These DIY experts give advice to others, share their own work, and learn from other works. Since many do not possess a formal education for the hobbies they are sharing, and they have become skilled while practicing those hobbies, Kuznetsov and Paulos describe them as “expert amateurs.”

While periodicals like Popular Mechanics (Throm, 1951) have been around since 1902, there are differences of opinion as to when DIY began. According to Kuznetsov and Paulos (2010), “DIY predates recorded history.” In their view, DIY was essential to human survival, so therefore, has been around since time immemorial. To Atkinson (2006) the current concept of DIY tutorials has been around since the 1950's, and similarly, Wakkary et al. (2015) places early DIY in the 1970’s. These both make sense when taken from each authors definition of what DIY is. Atkinson defines DIY as “mass marked phenomenon of home maintenance and improvement,” while Wakkary et al. sees it as a “convergence of counter-culture and system thinking,” both of which can easily describe how modern DIY has been portrayed in recent history. While the backstory of DIY and DIY tutorials through the decades or centuries has been interesting, this research will focus on contemporary tutorials, and attempt to show a similarity across all of the platforms which they are currently presented. In the following three sections, I will give a brief overview of the current state of tutorials, and investigate the research currently undertaken on DIY and software tutorials.

2.1. DIY Tutorial Basics

As this research attempts to redefine the structure and presentation of a DIY tutorial, it is important that it first define what a DIY tutorial is and what it means in the context of this thesis. To do this, I will investigate three aspects of tutorials: what are they, where are they presented, and why do people use them. Each of these facets will give insight into how tutorials are utilized and how they are displayed, and help inform the modified designs that will be demonstrated later.

You will find many definitions and titles for DIY tutorials. For the purposes of this thesis: how-to, step-by-step, DIY tutorial, and DIY instruction can all be considered essentially the same thing. A simple definition points out that a DIY tutorial "refers to online content that describes how something is done" (Torrey, McDonald, Schilit, & Bly, 2007). It continues by stating that they "are characterized by a sequential description of procedural information."

In addition to online content, I would add offline content to the definition above. Online, you can go to Adafruit, Craftster, Hackaday, YouTube or Instructables to find tutorials coverings just about any topic. The same material, or very similar tutorials can also be found offline. Books can explain everything from how to fix up your house (Editors of Creative Publishing, 2009) to building robots (Hrynkiw & Tilden, 2002). Magazines like Make: Technology On Your Time or Better Homes and Gardens have tutorials in similar categories as the websites listed above.

> "We define DIY as any creation, modification or repair of objects without the aid of paid professionals." (Kuznetsov & Paulos, 2010)

In the quote above, Kuznetsov and Paulos expand on the definition put forward by Torrey et al. This is evident in the previous chapters' investigation of tutorials across different medium. Each of the tutorials presented are arranged in a sequential fashion. Each of the tutorials relay the materials and steps required to perform a basic task. Each tutorial is also designed to take the place of an expert, empowering those following the

tutorial to build it themselves. Within Kuznetsov and Paulos' definition, directions do not need to be associated with a repair for it to be DIY. Many people who utilize duct tape in day-to-day repairs would fall under this definition of DIY. This research focuses on DIY tutorials, and in doing so acknowledges that while DIY can happen without the aid of tutorials, that topic will not be focused on in any further discussion.

In the context of this research, a DIY tutorial will refer to anything publishable to instructables.com. There are three reasons for this. First, Instructables is a platform designed to help people create tutorials, and has been a proven staple in the online community since 2005. It is one of the most popular DIY websites that doesn't get penalized when Google updates their algorithms (Levy, 2015). Meaning when Google updates their search algorithms to lower the rankings of DIY tutorial sites they feel don't meet a certain standard, Instructables has not been affected. Second, it allows text, files, images, and videos to be individually added or interspersed in as many or few steps as an author desires. This allows authors the freedom to publish a cooking recipe in a single step, containing one image and a bulleted list of instructions, or in a fifteen-step process with multiple images and videos placed at each step. Finally, when looking though the research contained in the literature review, the one consistent reference shared across all the papers but those focused on software based platforms (which can be found in Section 2.3), is the mention of instructables.com. While many papers also reference other locations for finding DIY tutorials like: DIY.org, YouTube, Craftster, Adafruit, Hackaday, Blogs, Forums, Cookbooks, Ravelry, Hizknits, WikiHow, Make: Magazine, and many others; no other website, book or magazine even came close to the number of mentions that Instructables received. Instructables has become the modern day standard for what a tutorial should look like, both on the web and within HCI research.

DIY tutorials are designed so the content can be accessible to almost any reader. Whether making a cell phone from components (Mellis & Buechley, 2014), e-sewing tutorials (Lovell & Buechley, 2010), or automatically generating tutorials for skilled CAD and digital art applications (Fernquist, Grossman, & Fitzmaurice, 2011; Li, Zhang, & Fitzmaurice, 2013), authors want their tutorials to be easily understood by everyone.

In creating a DIY cell phone, Mellis (2014) created a tutorial and had workshops where he assisted people building the tutorial. When people outside of his workshops started trying to follow the tutorial, he began receiving questions and difficulties. Over the course of receiving different responses, Mellis updated and simplified the instructions and techniques required to allow more and more individuals to accomplish the tutorial. Mellis also points out the need to help people "progress to more in-depth and meaningful forms of high-tech DIY practice." He does not want to just bring the instructions down to the level of the builder, but rather empower the builder to advance to more difficult tutorials.

Lovell (2010) focused her e-sewing research on young adults, and felt that a good tutorial was one that engages the reader, and enables them to independently accomplish the tutorial. Lovell goes on to say "it is important not to make assumptions about a user's prior experience." By not making prior assumptions, the designed tutorial not only requires steps to accomplish the task it is demonstrating, but it also needs to provide background knowledge in case the person following the tutorial is not as skilled as the designer assumes. When working on a previous paper (Wakkary et al., 2015), I was building and assisting others in building DIY tutorials. One of the tutorials we researched titled pimpMyBike (http://jdeboi.com/portfolio/pimpmybike/), detailed how to add a brake light, speedometer, odometer, and turn signals to your bike using an assortment of electronics. This tutorial ascribed to Lovell's idea of making no prior assumptions. Within the tutorial, each new electronic component introduced linked to at least one additional tutorial designed to help the audience get comfortable with that component. Several of the side training tutorials required completion in order to build the project, as the author assumed the audience followed the instructions and wired the part according to what the secondary tutorials suggested. This created a type of tutorial that was confusing as we were not always made aware of which steps from which tutorials we should be following next. At Adafruit, when presenting a tutorial for a product they sell, like the TV-B-Gone Kit (https://learn.adafruit.com/tv-b-gone-kit/preparation), start the tutorial with two links: one teaching the audience to solder, and the other teaching them how to use the multimeter. These links are presented in a way that does not require the reader to click them, but allows them the option if they do not feel experienced enough to complete the tutorial without the extra instructions. Both of these

examples are useful as they show two routes designers can take when addressing issues of prior knowledge in DIY tutorials.

Similar to Lovell, Fernquist (2011) also sees a good tutorial as one that engages the audience. Fernquist accomplishes this with a concept called “Flow” which “describes a state of optimal experience.” Another important aspect of Fernquist’s idea is that the tutorial should be adaptable to the user. This works in several ways. First, the tutorial should teach the person something. Fernquist sees many tutorials as static, and many also provide similar methods of accomplishing tasks. In her tutorials, Fernquist attempts to build a platform where tutorials can match the audiences’ ability. This allows the same tutorial demonstrating how to draw a horse to employ multiple drawing techniques for each drawing action, allowing the tutorial to adjust its challenge to the skill of the person following it. Additionally, Fernquist would like to give the audience the ability to skip small or large portions of a drawing tutorial, providing a base drawing at each stage and letting the audience focus on whichever skills they desire. This audience empowerment is simpler to offer in software tutorials, where the author knows exactly which tools are available to the audience and how to apply each of those tools. Finally, while the difficulty adjusts to the audiences’ skill level, it does so to engage the audience and empower them to gain greater skill. Should the person following the tutorial desire, they could bring the difficulty down, or just skip difficult portions and have the software fill that part in for them so they can focus on the next aspect.

When tutorials require higher-level concepts, authors will either link to simpler tutorials to give the reader the required foundation to understand what's going on (Wakkary et al., 2015), or they will assume prior knowledge (Phillips, Lockton, Baurley, & Silve, 2013; Wakkary et al., 2015), at times to the detriment of the builder. Each of these features of tutorial design helps to create simple to understand projects. By empowering and engaging readers, and supplying them with the tools needed to complete the project presented, most beginners and amateurs can easily follow along with properly designed tutorials. Even when the difficulty of a project is greater than the capability of the reader, well made tutorials support and guide the reader making the experience something that they become capable of completing.

This supportive format works well for allowing people to follow build instructions, but it may assume that everyone seeking DIY tutorials wants to recreate the project exactly as demonstrated, which is not always true. Some readers simply look at projects online in order to find inspiration for their own future projects (Torrey, Churchill, & McDonald, 2009; Tseng & Resnick, 2014). Tseng's research pointed to participants setting up alerts that would email them new projects on a daily basis. Additionally, this research showed that other participants looked at tutorials in a field they were thinking of creating a project just to get ideas that might help them with their own project. Other readers might want to recreate a build, but make it their own way (Tseng, 2015a; Wakkary et al., 2015), so they follow along with the tutorial for general guidance, but substitute their own materials, tools and individual flair along the way. Finally, when building projects and hitting a mental block, many makers will turn to other similar tutorials in order to find explanations for the action they're trying to perform (Torrey et al., 2009; Tseng & Resnick, 2014). Tseng highlights a participant who was not sure if they were performing an action correctly with a new tool they ordered. To verify the proper use, they watched YouTube videos of the tool in action so they would feel more proficient with it.

Tutorials can use images, videos, text, illustrations, and schematics (Torrey et al., 2009, 2007; Wakkary et al., 2015), in any combination they desire. Additionally, after comparing ten tutorials across different platforms, Wakkary et al. identified several important aspects to which tutorials should adhere. The findings in their paper included making tutorials step-by-step, properly sequencing those steps, including a tools and materials list, and using text and images throughout. Many of the tutorials presented in the Appendix B adhere to these exact stipulations.

In the context of this thesis, DIY tutorials can be interpreted as a step-by-step sequence, dictating how to accomplish a task without professional help. They include images and text, sometimes in the form of a video, along with the materials or tools that will be required. They can be presented online or off, and examples can easily be found on the homepage of instructables.com. Tutorials with good design inform, empower, and engage the audience, while encouraging them to want to continue. All of these features combine in a well-made tutorial that people can utilize to remake a project exactly or with

modification, get inspiration for other projects and ideas, or just use the tutorial for guidance in understanding an unrelated problem.

2.2. DIY Tutorials

This thesis suggests that whether you are looking at a video or text and image tutorial, the general flow of each is similar. To address this suggestion, this section will investigate the issues researchers have with DIY tutorials, and how they intend to fix them. Additionally, this section will look at any other technologies researchers are employing to try to improve DIY tutorials.

2.2.1. Tutorial Modification

In regards to modifying tutorials, I have only found three major methods of alteration put forth. The first sees tutorials as being too technically accurate and tries to move towards a more creative approach of presentation (Van Ittersum, 2013). Ittersum sees a difference between professional and amateur tutorials. Professional tutorials are considered as those found in textbooks, being as clear and concise as possible. Professional tutorials have no extraneous information in any steps, including personal narratives. Amateur tutorials, like those found on instructables.com, do contain a personal narrative element. Ittersum sees the personal narrative as something that “can be used to create more usable and motivating conventional instructions.” While the author understands that textbooks must follow certain requirements, he sees usefulness in not following those rules for certain students:

> “This difference in form, though, is precisely what makes these Instructables valuable for technical communication students. Students can see from Instructables that deviations from the conventions are not inherently wrong but instead represent choices made by authors to address different audiences and aim for different purposes.”

Ittersum sees the personal narrative in tutorials as having the ability to greater engage and empower the tutorials audience. It does this by connecting the tutorial to the audience. In the introduction to *The Most Useless Machine* (Appendix B) tutorial, the author explains that he wanted something that he saw someone else had. He felt he could make it simpler, and then did. He then shared his tutorial with others, and got feedback from a third party about how he could make an even simpler version. This introduction style lets the audience know at the beginning that they can improve on, and modify the project that is about to be presented. Once you get to the materials list and instructions though, the writing becomes all about the business of making the tutorial project. When you finish the required steps, the conclusion goes right back to where the introduction left off. Both versions talk to the audience in a very personal first person style. This technique might make the audience feel like they are just sharing instructions between friends. This feature is what Ittersum feels makes amateur tutorials better than professional versions when trying to engage an audience.

A second method for altering the format and presentation of tutorials is through creating projects on the platform, Build in Progress (Tseng, 2015a). Tseng notes that when making DIY tutorials, authors leave out aspects of the design process. One reason for this may be that the project took days or months to complete and the author has forgotten some of what they have done. Additionally, the paper notes that when authors publish tutorials, they do it at the end of the project, instead of along with the build. The Build in Progress platform encourages authors to share the projects they are making, as they make them. This small shift in publishing has a variety of benefits. Authors share much more backstory on their projects, which speaks to the Ittersum's personal narrative noted above. They also share failures or triumphs as they happen, allowing the community to provide feedback, suggestions or praise depending on the situation. Finally, the whole process highlights the iterative design process, encouraging people newer to DIY that projects do not necessarily work perfectly the first time. Each of these features attempts to assist the author with the writing process or the reader with the production process.

To have a more formalized approach to tutorials, the final modification looked to recipes to fill this niche (Dalton, Desjardins, & Wakkary, 2014). The authors found that

materials were not always presented in the most concise way, listing materials at the beginning of projects and then again in the steps. They also found that the material lists were often incomplete, leaving out key components or tools that would be needed midway through a project. Finally, unlike the previous two examples, this research showed that extended narration often overwhelms relevant information, causing required tasks to get lost in a sea of unnecessary text. To fix this problem, the authors looked to the 1975 edition of Joy of Cooking to provide a standardized format in which to fit tutorials. This new format ensured readers could quickly glance at a project to get an overview of what was required, and then could simply follow the sequencing without worrying about extraneous text.

In the three examples discussed above, each pushes for a slightly different style with tutorials. Two have greater personal narration from the author, one lets you add steps while you work, and one looks to streamline the whole process. Each example has a unique way of presenting tutorials, but none seems to push too hard on what a tutorial can be. While all the styles sound different, they are all still based on a step-by-step sequencing of tasks, with materials laid out in the beginning, or as they come up in the tutorial. The focus of these papers deal almost entirely with the language in which the tutorials are presented, and whether they seek to allow more verbose language to the project, or streamline it to be as concise as possible.

2.2.2. Tutorial Cosmetics

While each of the three previous tutorial alterations look to modify the format of the tutorial, other research focuses on changes that are far less cosmetic. One paper recognized that tutorials should support multiple learning styles while not making assumptions about skill levels (Lovell & Buechley, 2010). This was done through creating kits, and preparing a set of basic directions on how to use the components in the kit. The goal was for participants to learn through using the materials and then utilize the extra materials provided to make their own creation. Notably, the participants skipped the prepared instructions laid out for them, and instead went straight to making what they wanted. Similarly , the DIY cell phone mentioned earlier investigated people's

competencies with high-tech DIY, and how that differed from normal DIY (Mellis & Buechley, 2014). This research looked to bridge the gap found, and figure out how to support those at *normal DIY* levels while still challenging enthusiasts with more technical skills. Both of these papers looked into leveling the difficulty of tutorials so they could be approached by amateurs and experts alike, while still being challenging. Also, while the work Mellis did assumes the work is high-tech, the tutorial is written and modified in a way that makes no assumptions, so as his tutorial explains higher level concepts, it also provides links to information and support text that will assist the builder's understanding.

Other research looking into tutorials does not seek to change anything, but rather to investigate the underlying DIY culture and tutorials they produce. One paper sought to formalize a Maker Methodology (Silver, 2009). Silver developed this methodology through discussions with colleagues and members of the DIY community. He found that people create projects for "humans first and efficiency after." Consequently, he found that the normal mode of operation is to put modified versions of projects back into the community through new tutorials. He even points out that the way tutorials are drafted "pushes the expectation of appropriation." The idea of formatting tutorials for appropriation is an interesting one, and Silver perceives tutorial makers are inherently doing this, possibly without even knowing. In line with this, other research has found that the DIY community values "open sharing, learning, and creativity over profit and social capital" (Kuznetsov & Paulos, 2010). If the goals of a DIY tutorial are use, modification, repurposing, and sharing in a constant cycle, the values expressed in this paper would support that assertion.

One final style of paper that attempts to alter how to create DIY tutorials, does not look at the tutorial text at all, but rather the pictures. The researchers noted that images from one angle often miss something, or may not highlight a secondary element that is important to the reader. In order to correct this problem, Spin (Tseng, 2015b) was created. A turntable connected to a camera allows the tutorial author to take 360-degree images of their project. These images automatically become animation, allowing the tutorial readers a 360-degree view of the project and any element they want to see. While this technique may prove useful for limited projects, it does not attempt to alter the format of a DIY tutorial so much as to add an additional image or images for clarification.

2.2.3. Younger Audiences

As kindergarten children or younger do not have the patience or skills to sit still, read a multi-page tutorial, then follow it step-by-step, this is the one area where traditional tutorial formatting techniques do not work. As a result, the research that investigates how to completely alter the presentation of tutorials primarily focuses on young children. MIT Media Labs Lifelong Kindergarten's work on Scratch (Maloney, Resnick, & Rusk, 2010) is an example of this need. Scratch allows young children to learn to code, not by giving tutorials or presenting examples, but by changing the way children are able to code. Instead of typing commands and ensuring proper formatting, Scratch commands are created as a series of command blocks, like Lego bricks, that are color-coded and fit together in specific ways. This allows children using Scratch to figure out how to program through exploration, as opposed to a series of instructions. Scratch also provides a *Getting Started Guide* and *Video Tutorials* on their website (https://scratch.mit.edu/help/), which adheres to the traditional tutorial layout provided in the previous chapter. While Scratch proves a unique way to explore and learn programming concepts, the authors maintained that it was necessary to also provide traditional step-by-step directions to assist users.

Digital Dream Lab takes the ideas brought forward in Scratch and moves them forward to the physical world. By creating puzzle elements that sit on top of an interactive tabletop, they allow children to connect and move the puzzle pieces around, which in turn affects characters on a projected screen (Oh, Deshmane, Li, & Han, 2013). Children are able to transform the character, animation, color, size and background of the projection simply through moving puzzle pieces appropriately on a table. In this work, the authors kept the technology hidden so as not to overwhelm their younger participants. This is one of few examples of tutorial modification where the traditional tutorial element is completely missing. By creating puzzle pieces that can only fit in one location, children are able to explore how each element works, working towards a final goal.

Both of these examples show unique methods for allowing participants how to build something. Instead of relying on step-by-step directions or verbally tutoring them through the process, the designers created each project to be understood through experimentation and play. Both methods adhere to the concept that “enjoyment and engagement are integral and prerequisite aspects of children’s playful learning experiences” (Xie, Antle, & Motamedi, 2008). While enjoyment and engagement appear to be the focus of projects seeking to create environments for children to learn new concepts, DIY tutorials seem to lose sight of that idea. Instead, DIY tutorials seek to present information in the simplest of forms, text and images or talking over videos.

2.3. Software Tutorials

Unfortunately, there is not a vast amount of research being done on how to present DIY tutorials utilizing methods that are non-traditional. Software tutorials, on the contrary, have a significant amount of research on this topic. In the world of software tutorials, there have been advancements in different areas of tutorial research that may soon find footing in the DIY tutorial research field. This section will look at that research in order unlock all of the different aspects on which research is currently working in regards to tutorial creation.

2.3.1. Tutorial Automation

The majority of research on software tutorials seeks to automate the tutorial generation process. This is accomplished through software systems that either blend content together, create content from an image, or tracks content as it is produced. This section will explain these points in further detail.

The majority of automatically generated tutorial content tends to record user actions, as those users work with the system. To accomplish this, several steps need to be undertaken. First, the intended software for the tutorials you want to create needs to

be chosen. Grabler et al. (2009) decided to use GIMP (GNU Image Manipulation Program). From here, the researcher can create a separate program that will record the actions taken within the main program (GIMP). After this, an expert will start GIMP and the recording software and perform a series of actions for a specific effect (one of the tutorials in the research detailed how to get rid of red eye in photographs). After the recording is finished, the process generates a tutorial with annotated screenshots and accompanying text description, placed in a grid layout. The action within the program performed by the experts is what automatically generates the tutorial. Grabler et al. prefers this technique as they see the creation of tutorials as a tedious task for the author.

Other research has done similar work with Autodesk's SketchBook Pro. One difference is that the programmers embedded the tutorial generation software within the application, so anyone who used the software could record their actions. Those recorded actions would then be parsed, processed, and finally presented in a tutorial format without the user having to do anything extra (Fernquist et al., 2011; Grabler et al., 2009). Fernquist et al. comments that it is difficult to depict the text or video instructions of a tutorial to represent the physical act the reader is accomplishing. So, the tutorials presentation is embedded within the application. This allows users to reproduce the strokes, pressure sensitivity, and other features, and feel like they are drawing along with the professional artists.

Other tutorial generation software seeks to take automation to the next level by getting rid of the expert performing the initial sequence of actions. TutorialPlan (Li et al., 2013), can automatically create a tutorial in AutoCAD based on any CAD image a user may find. This enables users to follow a tutorial that tells them how to do exactly what they want, but only within AutoCAD. Li et al. noticed a lack of design experts available to make the tutorials, so they decided to create their own.

In each of these papers, it is the author's intention to make tutorial creation easier through automating the process entirely. In an effort to generate these tutorials automatically, each of these platforms strived to make the instructions as brief and to the

point as possible. Unfortunately, this removed any of the personal elements that are prevalent in DIY tutorials, and instead imposed an even more rigid structure than already existed.

While none of this process seems transferable to DIY tutorials, there are multiple methods possible to make it happen. It is conceivable to put sensors in tools to track how many turns required to twist a screw, or to have multiple cameras automatically switch their focus to capture ideal angles to record a build. Additionally, one could create a database of tasks commonly used in DIY tutorials, and write a program to create tutorials based on an image. In fact, research done by Lau et al. (2009) does the first half of that task. They created software that can parse tutorials found on the web to create a single super tutorial that will merge all of the information from similar tutorials.

2.3.2. Tutorial Combinations

Other research tries to blend multiple tutorial styles together, attempting to solve a two-fold problem. First, static tutorials, like images with text instructions, are not as easy to follow as dynamic interaction like video. Unfortunately, videos are more difficult to navigate, so research looks into blending both (Chi et al., 2012). Due to causing the author to perform more work, this strategy is infrequently utilized in DIY tutorials. Not only having to take images of important aspects of a project, but then needing to record those actions to video, and having to edit both the images and video to put online adds a significant amount of time to an author's workload. In many DIY tutorials, a single video might demonstrate how to achieve the finished work, and occasionally one or two videos capture the most critical elements.

What community enhanced tutorials attempt to correct is the lack of clarity created through authors omitting details, not clearly explaining steps, or simply having a different set of goals than the user. To rectify this problem, the authors created a system so the community could add images and text to each step (Lafreniere, Grossman, & Fitzmaurice, 2013). This allows the next users to see multiple examples of the same step and vote on those they think might be most useful to future tutorial users. The

obvious problem with this technique is an abundance of examples and the fact that the image or video with the most votes may not be the most useful to someone reading the tutorial for the first time.

2.3.3. Other Tutorial Modifications

Some software tutorials also attempt to force the user through a specific path in the tutorial. Stencils (Kelleher & Pausch, 2005), is a system designed to only allow users to interact with a single aspect of the software of the tutorial at one time. By controlling the user interaction, the in-context instructions provided prevent any mistakes by the user. The research found that users of this system felt as if they were being strictly directed at each step of the tutorial, and because of this, they had less aptitude to complete these tasks alone after the tutorial had ended. While this is addressed in future research (Harms, Louis, Kerr, & Kelleher, 2011), their fix was basically to hide the Stencils overlay. One of the reasons the researchers created Stencil was due to the difficulties in following image and text instructions that point to elements within applications. They found that people had difficulty matching the screenshot with annotations on paper to accomplish what they needed to do on screen. By hiding the Stencils overlay, it seems like a stepping back towards the separation of instructions and application.

Finally, the gamification of tutorials looks at creating a sense of fun in the completion of a tutorial (Li, Grossman, & Fitzmaurice, 2012). Unfortunately, for this particular game tutorial, they decided to use a timer element, which is a stressful feature when playing a game, but totally unnecessary when just attempting to learn. While other game elements were distracting, I thought the clock was possibly the biggest drawback to users. More work should be concentrated in this area, as almost every game made has players follow a tutorial in the beginning. I feel that researchers need to pay more attention to the video game tutorials that people enjoy, and not attempt to remake an already successful format.

2.4. Summary

Though investigating a wide spectrum of tutorial research, this chapter has laid out the motivations for conducting this study. This research has spanned three aspects of tutorials. First, a general overview of tutorials was outlined, and their targets were identified. Specifically, tutorials are step-by-step sequences of actions dictating how to accomplish a task, designed to be accessible by almost any reader (read: beginners). Second, the work currently happening with DIY tutorials within the research community was covered. Techniques ranged from making minor modifications to the structure, to how to create tutorials, to the final presentation of tutorials, though not straying far from a traditional structure. The only tutorials that greatly modified the presentation formula were those presenting instructions to participants so young that reading could be a barrier to accomplishing the tasks presented. Finally, to explore possible future paths DIY tutorials might take, this research looked at software tutorials. The majority of these papers sought to either automate the process of tutorial generation, or make the creation of tutorials as simple as possible for the author. While two possibly unique approaches to tutorial design explored gamification and community contribution, they continue to retain that already defined tutorial structure. Overall, the methods explored demonstrate a clear focus by researchers to streamline a process that already exists, making minor modifications to what I see as a much grander question: are there better ways to present tutorials?

Research presented within this section has pushed DIY tutorials to what are possibly the limits of their current form. This research has also exposed issues contained in traditional DIY tutorial formatting. This study attempts to build on prior work in two ways. First, it attempts to either define or break free from the structural limitations contained in DIY tutorials by creating twelve unique approaches to presenting an identical set of instructions. Second, this work will continue by identifying important aspects of tutorials through conducting a comparative analysis between expert and amateur participants. This will further reveal issues and potential solution areas for future researchers to investigate.

In the upcoming section, I will explain the methods I used to address these issues. I will show how I attempted to step back from what tutorials are, in order to create a different type of tutorial. Following that, I will detail the steps taken to create the tutorials presented in this research.

Chapter 3. Methodology

This research blends Research through Design (RtD) with Grounded Theory Methodology (GTM). It is important to note up front that RtD is the core methodology utilized in this research, and GTM applies specifically in a support role at each stage.

There are four sections to this chapter. The first section will restate the research questions. The second will offer an introduction to RtD, expanding on why that method is being used in this study, then explaining why a different qualitative method is being used to support it. The third section will introduce GTM, giving an overview of the theory. The final section of this chapter will demonstrate how both methodologies applied and used in conjunction with this study. However, since the next chapter goes into detail about the application of RtD methods leading to the construction of each tutorial, this chapter will focus more on GTM. Intertwined completely throughout the process, both methods will shift significantly back and forth between the two methodologies when progressing through the research.

3.1. Research Question

This research focuses on addressing two questions:

- What are the important design factors in non-traditional ways of presenting a DIY tutorial?
- How might these design factors be applied to tutorials with different audiences?

To explore these questions fully, additional questions were investigated as well. Before knowing what design factors were important to non-traditional presentation techniques, I had to know what non-traditional tutorials looked like. To accomplish this, I needed to discover the range of possible alternatives. Additionally, I needed to know how the aesthetics changed between different methods of non-traditional presentation. With the non-traditional techniques created, there was a further need to see what implications these techniques might have on different audiences. For tutorial designers, this entails learning the needs for creating tutorials, and seeing if non-traditional techniques will support those needs. For tutorial builders, this question reveals what to look for in tutorials, and how well techniques explored in this thesis could support those needs. Finally, I wanted to investigate the differences and similarities between what experts and amateurs desire when following or creating a tutorial.

3.2. Research through Design

3.2.1. Overview of Research through Design

RtD began as an alternative to the scientific research practices of its time. Frayling (1993) argued that creating something in the art or design fields, then reflecting on that creation or the actions leading to that creation are just as valid as other research methods. He described three methods artists and designers could wield to contribute to their own research. Those were Research: into, through, or for art and design. Researching through art and design was the choice of other researchers, molded and blended into what RtD is today.

A key theory blended with RtD is Rittel's (1973) wicked problems. They were issues that could not be researched by the scientific community. The main example of wicked problems was planning issues, things that a community could change causing waves of social repercussions. As an example, theories could suggest the implications relating to the addition of a park or low-rent housing to an area, but the only way to know

what would actually happen to that community a year or ten years later after one of the changes were made, would be to wait and watch. Rittel saw a need to address these problems through research that was not available at the time.

Frayling (1993) branches Research through art and design into three categories: materials research, development work, and action research. Research laying out RtD methods tends to focus on the latter two categories and blend them into one (Gaver, 2012; James Pierce, 2014; Zimmerman et al., 2007). Development work focuses on creating or customizing a new technology. As an example, Pierce (2014) details steps to create design artifacts which include prototypes, sketching, models, form study, images, and products. Along that same line, action research encompasses all of the ideation and presents it in a step-by-step fashion. Pierce goes on to explain the need for conceptual scaffolding, which is composed of in-process documentation, in order to justify the final product. The final goal of Pierce's design artifacts is to constitute, contain, and construct knowledge, through revision, study, and reflection.

3.2.2. Why Research through Design was Chosen

Two aspects of this research led toward RtD. Foremost, this research is an investigation of the design space within DIY tutorials. In order to best identify alternative methods to presenting tutorials, it was necessary to create them. To give direction to the creation of the tutorials, while not limiting how much creativity to apply, the obvious choice was RtD. In addition, identifying a wicked problem is seen as the first step in RtD (Gaver, 2012; Zimmerman, Stolterman, & Forlizzi, 2010). With a research question looking into changing the fundamental design of DIY tutorials, this quickly identified as a wicked problem, which further emboldened the RtD method.

3.2.3. A Need for Theory

Cross (2013) makes a distinction between design research and design practice, writing “I do not see how normal works of practice can be regarded as works of

research." In Cross's view, in order for practice to transcend to research, it needs to be reflective and communicate that reflection in the research. Zimmerman found theory development in RtD lacking, saying:

> "RtD has to find its own ways of approaching traditional research qualities such as reliability, repeatability, and validity through ways that are trustworthy while true to the approach" (Zimmerman et al., 2010).

While artifacts created though RtD methods create a discourse between researcher and community, allowing for reflection on a finished product (Zimmerman et al., 2007), this only represents a small part of what is RtD. What Zimmerman called conceptual framework, Pierce termed conceptual scaffolding, but the terminology does not matter, because it is a call to action for the same thing. From the simplest sketch to the last artifact, each successive step is important to understand what led to the final design. The ability to see and reflect on each step of the process, and instruct others allowing them to replicate any part of the design process, is what I consider the core of the RtD philosophy.

Since RtD has no set guidelines for data acquisition, analysis, or reflection, a qualitative research method combined with RtD bolstered the areas lacking in RtD alone. This led me to Creswell's (1998) five qualitative studies. Creswell presents biographical, phenomenological, grounded theory, ethnographic, and case study methodologies. After investigating each of the five methods, GTM proved to be best suited to support this research. This is due to the ability of GTM to analyze and sort data as well as its "construct-oriented approach" to generating theory.

3.3. Grounded Theory Methodology

It is important to emphasize, this research uses grounded theory solely to support and bolster the RtD methodology employed throughout the research. Research utilizing the RtD methodology is built on design documents, sketches, notes, prototypes

and other techniques used by the author that demonstrate how the final prototype was built, allowing other researchers to replicate the fieldwork. GTM provides many of the supporting documents used in RtD, as well as techniques for organizing and refining data for later stages of the research in order to identify interesting concepts and issues that arise throughout the research. It is important to note that this is not grounded theory research, but RtD utilizing grounded theory tools to support and strengthen RtD. This section will explain the use of GTM in further detail.

The original work in grounded theory published by Glaser and Strauss (1967), saw each author move the theory in different directions. These two distinct strategies would lead to proposals more divisive on different methods researchers could use to build grounded theory. Of the works on the subject, Flick called Kathy Charmaz' constructivist approach “the most prominent” (Flick, 2014). Due to how clearly the methods are illustrated, how well rooted the methods are in grounded theory's history, and how well her constructivist approach aligned with this research, it was chosen to supplement the RtD method used in this research.

Charmaz' constructionist grounded theory method (GTM) gives researchers “guidelines for collecting and analyzing qualitative data to construct theories 'grounded' in the data themselves” (Charmaz, 2006). Collecting and analyzing data throughout the study, helped to further develop and refine the theory. Her work lays out a four-step process for GTM, which begins with gathering data. The analyzing of the data through multiple iterations of coding, memo writing, theoretical sampling and sorting is a subject for more detail in section 3.5. An additional aspect of GTM is its ability to analyze social issues, which aligns with the wicked problems that RtD seeks to solve.

One point Charmaz made clear was that she considered GTM to be a tool. In Charmaz' view, while this tool could function on its own, it can also be used in conjunction with other methods to compliment or further embolden them. In this way I utilize GTM in this research as a tool, which if wielded correctly will support and strengthen RtD.

This will serve as a quick overview of the four aspects this research borrows from GTM. First, in gathering data, Charmaz suggests “creating open-ended, non-judgmental questions” so as not to influence the participant, as well as allowing the participant to create unanticipated statements. In my fieldwork, this was done through initial opinion questions, as well as survey questions, all presented as forms online.

The second stage in GTM is coding. When coding Charmaz specifies that it “consists of at least two phases: initial and focused coding.” Through initial coding, participant’s responses are closely read, and commented on in order to categorize and summarize each point the participant makes. After completing the initial coding, focused and axial coding were used to sift through and sort the data. These techniques help select and synthesize previous codes. Focused coding only looks at the most significant codes to better manage and sift through large amounts of data. Axial coding sorts and organizes large amounts of data in different ways to identify commonalities that may appear.

The third stage is memo writing. This allows the researcher to “stop and write informal analytic notes” (Charmaz, 2006). Described as the step between the data collection and the draft writing, memos can be anything from sketches to essays, and allow the researcher to analyze codes, jot down thoughts, explore questions, and generally engage the research in whatever manner they find useful.

Theoretical sampling is the final stage laid out by Charmaz for GTM. This stage allows the researcher to identify emerging theory in the research and to focus and refine that theory, through sorting and diagramming. While axial coding sorts data into categories, theoretical sorting allows the researcher “to compare categories at an abstract level.” Sorting at this stage looks at memos and categories, as opposed to individual codes. Diagramming divulges relationships found through sorting. While these four steps are a brief introduction to GTM, they serve as a foundation for more detailed discussion in section 3.5.

3.4. Research Study

In this section, the research divides into four distinct phases. Three of these phases represent a point in the research where data, collected and investigated according to GTM, affects the next step in the research. The other applies RtD methods to the creation of the tutorials. Phase one consisted of the initial research on tutorials and their structure. This leads to the construction of tutorials through RtD in phase two. Phase three began with making the tutorials available, and gathering an initial round of data from participants. Finally, phase four represents the second round of data collection from participants.

After the discussion of each of these data gathering techniques, data gathering and coding techniques will be examined in detail.

3.4.1. Phase One: Tutorial Research

This research began with the idea that tutorials all had a very similar underlying structure, and a desire to see what would happen if that structure changed. As mentioned earlier, due to a need to incorporate design research with what I considered a social problem, I quickly chose RtD as the fundamental research method to apply. However, the first step in investigating the structure of tutorials required GTM to properly pursue the question of whether the underlying tutorial structures were actually similar.

Phase one of my research began with investigating extant texts. In GTM, extant texts are those on which the researcher has no effect. This encompasses pre-existing documents. This research investigated twenty tutorials from different sources. The entire list is in Appendix B. Each tutorial selected stood out on its platform, or was featured from other sources. As an example, websites like Instructables, Little Bits, Youtube, Reddit, Hackaday and Make, all have audience voting, and several allow editors to highlight projects or award prizes for contests. Using these metrics, I selected projects from each of these platforms that had either won contests, or had one of the highest

ratings among the DIY projects on their websites. For websites without rating systems, I relied on traffic directed at projects to see the popularity. The selected Howtoons comic strip has appeared in Make: Magazine, Instructables, and a host of other DIY blogs. In addition to these, I considered DIY instructions associated with kits or projects working towards teaching people utilizing unique strategies to see if they would provide unique designs to their build instructions.

> "Coding is the pivotal link between collecting data and developing an emergent theory to explain these data. Through coding, you define what is happening in the data and begin to grapple with what it means" (Charmaz, 2006).

According to Charmaz, there is a three-step process following the acquisition of new data. This process begins with coding. Within this research, depending on the length of the tutorial, word-by-word, line-by-line, or what I term step-by-step coding was used. Word-by-word and line-by-line are staple coding practices used within GTM. The step-by-step technique was used on tutorials whose instructions were overly detailed without adding anything useful to code. Charmaz suggests using gerunds, which were not used at this stage of the research. However, gerunds were utilized after coding participant responses. Each word, line or step of the tutorials were coded by the information it was trying to convey. Table 3.1 shows an example of the coding process for one of the tutorials. The middle column displays the first round of coding, and the right column shows the second round. A completed version of this table is in Appendix B.

Table 3.1. Tutorial Codes: Excerpt Two

The Most Useless Machine	Title	Title (image)
	-Author	
Make: Magazine #23	-Final Image (In use)	
	Introduction	Intro (background)
	-Background	
	-Project Overview	
	Materials	Materials (image)
	-Listed	
	-Images for each Material	
	-Separate section for materials & tools	
	Steps	Steps (text/image)
	-steps divided into sub-steps (ex step 2 has sub-steps a, b, c, d, e, and f)	
	-each sub step has text + image	
	-Finish	Conclusion
	Use It	
	-Finished examples in use	Info (how to use)
	-Links to videos of machine in action, video how-to's and resources	

Note. The left column shows the title and location of the project, the middle column shows the first round of coding, and the right column shows second round of coding.

Charmaz' second step for making sense of data is memo writing. The primary focus of GTM is to ground the theory in the collected data (Maxwell, 1996), but memo writing and coding are the researcher's two most useful tools in understanding data. For the proper application of memo writing, researchers must first write about data collected and the codes they have attributed to that data. From there, the memo writing process moves into a more theoretical direction, and is applied throughout the research process (Charmaz, 2006).

The initial memos associated with these extant texts and simplified codes were basic. What began as simplified structures of tutorial designs evolved into ideas on how

to modify those structures. In addition, lists on other methods that could be changed into tutorials, and clustering diagrams attempting to expand tutorials started from different places in the basic structure, in order to get an idea about how the overall design might be affected.

Each tutorial created in this research is a retelling of the LED Throwies tutorial (Q-Branch, 2006). While the selection of this tutorial will be explained in the next chapter, GTM techniques were used to understand the structure and makeup of this tutorial. Line-by-line coding techniques were applied to ensure the understanding of every concept the tutorial presented. Later, memos would be written to extrapolate which codes were necessary, which could be moved, and other ways of modifying the base structure of the tutorial. Four memos that were reviewed multiple times were titled: *aspects*, *locations*, *projects* and *types*. *Locations* and *projects* were simple: *locations* listed where tutorials could be found, and *projects* listed potential tutorials that could be remade and the methods that might best be applied to them. One example from *projects* is a link to a beginner's MIG Welding Instructable, with notes on how it might be converted into a song.

The *aspects* memo looked at further extrapolating the steps of the tutorials and at what each step contained. By further coding each step of a tutorial using word-by-word techniques, this identified exactly what each piece of the tutorial was doing. The *aspects* memo breaks text into twelve different uses including these four: metaphors, expressing abstract concepts, introducing something, and explanatory text. Then it performs this same level of scrutiny with images and video. Also examined was how each part of the tutorial was displayed. *Aspects* investigated included: text, video, audio, and images. Terms used to describe text usages were: written, dialogue, paragraph, bulleted, and numbered.

Finally, *types* looked into possible places and ways of exploring new modes of tutorial building. This memo is where each of the twelve tutorials presented in this thesis were first written down, in addition to other tutorials that did not make it to the final stage.

3.4.2. Phase Two: Building Tutorials

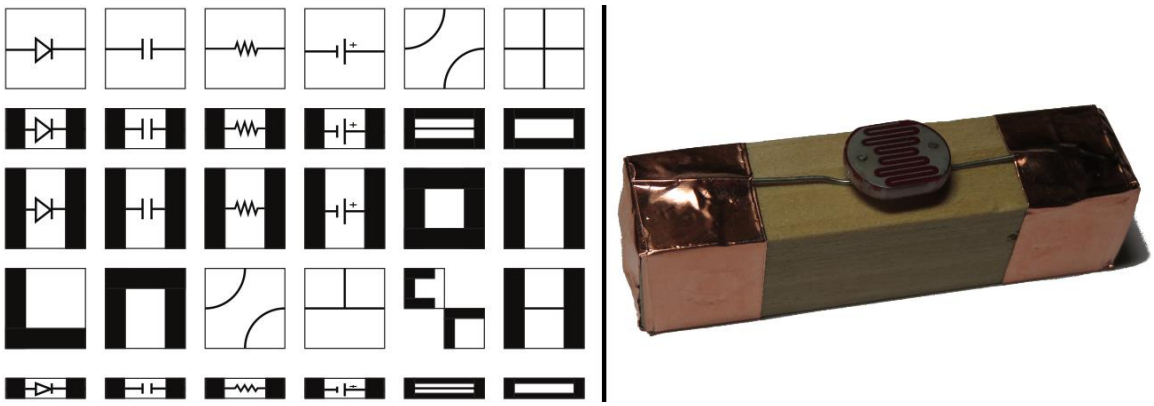
With the initial concepts written in the pages of a memo, the methodology shifted to RtD, where iteration and ideation were the foundation to the finished research. The ideas in memos were transferred first to sketches and outlines, which tried to model how each concept might move forward. Concepts that produced promising results were further developed and refined. The first tutorial to receive such treatment was the tutorial song. There were three reasons for this. First, I had never seen a DIY tutorial presented in a song format. Upon investigation, I was only able to find one tutorial song from a 1988 episode of Sesame Street where David instructs a girl on how to tie her shoelaces (http://muppet.wikia.com/wiki/Tying_Your_Shoelace). Savion Glover and Elmo performed the song again on a 1992 episode, but there was no modification made to the song. Breaking with every tradition I could find was the second reason for choosing a musical tutorial. Tutorials are presented with images, videos, texts, or some combination of the three, but a totally auditory tutorial set to music just is not done. The final reason for choosing the song tutorial was simply for the fun factor. For myself, and colleagues I have consulted, tutorial writing is viewed as work. Many people, including myself, create projects twice, so they can take pictures on the second build, already having an idea of what aspects will be important to capture. Others I have asked take a myriad of pictures at the start, and spend hours sifting through and cropping the final images to display. One idea I wanted to introduce into the creation of tutorials was fun. I hoped that this feeling of fun would translate through to the viewing of tutorials.

As the finished tutorials will be shown in more detail in the next chapter, and in Appendix F, examples examined here are ones that did not make it past the ideation phase. The intention is that these examples will give a better understanding of the process. One of the earlier ideas was to create a video for each step of a tutorial, then show all of those videos in a grid on the same page, making them all play through on a loop concurrently. The idea was to present every step of a tutorial to the participant simultaneously, while allowing participants to see the whole process or individual aspects at once. Several sketches mainly showed walls of video boxes. This idea did not

progress since it did not feel as fun or inviting as other prospects, even though the unique method of presenting all steps concurrently was a strongly compelling feature.

Two other concepts were similar, one the creation of an interactive e-book, the other a physical pop-up book. With the e-book, videos, text, and pop-up dialogues supplied the participant whatever information they wanted whenever they wanted it. With the pop-up book, the concept was much simpler in final presentation, but also seemed more playful. Because of the playfulness of the pop-up book, the e-book concept was abandoned to investigate the other further. Several books on how to create pop-ups and an assortment of colored poster board were acquired and weeks were spent learning proper folding techniques. As this idea progressed, a pop-up book turned into a pop-up page, which later became a pop-up card. One of the final versions of the card had the LED popping up in the center, while other rudimentary looking components moved toward it, but the inability to produce a polished final version of this method eventually lead to discontinuing this line of investigation.

Figure 3.1. Tutorial Game



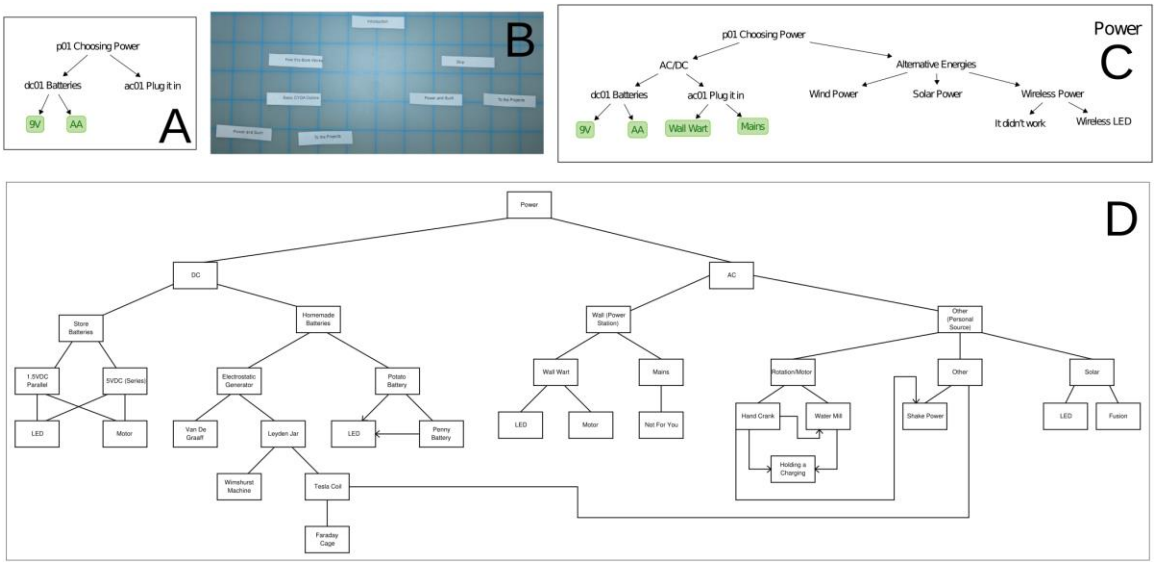
Note. Two different iterations of the Tutorial Game. Paper prototype on the left, and final prototype on the right.

A final concept explored making a board game. Many sketches, prototypes, play tests, and revisions were created during this project. The concept started out as a competitive game, but through investigating modern board games and how they are played, it became more and more collaborative. The final design had players working

with each other to build circuits using components. Each component a player used earned points. Additional points could be gained through finishing the circuit or with quest cards that remained hidden from other players. Figure 3.1 shows the initial paper template on the left. To play, each box must be cut out and used as a component in the game. The black lines in the boxes represent conductive portions of the final built piece. The paper prototypes yielded a quick understanding of which shapes worked, and which did not. To the right of the paper prototype in Figure 3.1 is a finished prototype of the final playable blocks used in game to build circuits. Details of how to build one of those blocks can be found at http://www.instructables.com/id/Quick-Connect-Circuits/.

The process of creating each tutorial was a little different, and will be discussed in detail in the next chapter, but the groundwork to building prototypes was usually similar. First ideas were jotted down in a memo. This happened both though GTM techniques, reflecting on patterns and techniques observed in popular tutorials, and while brainstorming with colleagues. The list of possible tutorials was often searched for new or old ideas. Each concept proceeded through an initial design phase, with sketching or wiring diagrams demonstrating possible ways to present the tutorial. With the Build Your Own Adventure (BYOA) book, which is covered later, a visual design was quickly chosen, but the content required many revisions. Figure 3.2 shows four stages of the planning process. Stage A shows a very early tree diagram exploring power. Stage C shows a later stage, after many revisions and considerable research in powering electronics. Stage B shows a point somewhere between C and D. Here is where the project reached a dead-end, and it did not make sense. So each of the titles from the tree diagram were printed out and cut to make a dynamic tree diagram that could be moved and edited in real time. There were over a hundred branches, and by taking a fresh look at it in this way, several of the questions that kept the project from moving forward were quickly addressed.

Figure 3.2. BYOA Tutorial Early Iterations



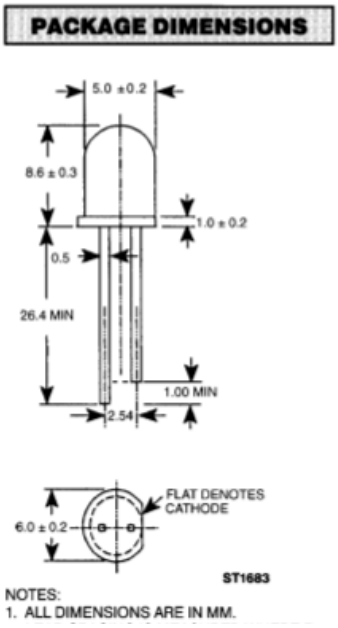
Note. Showing the power chapter through four stages:
A: Very early rough draft.
B: Paper labels used to reorganize previous draft.
C: Draft changing as sections are being written.
D: Final draft after writing chapter.

After this initial design phase comes a prototyping phase. For the BYOA, along with several of the other prototypes, this meant writing the content and determining if it worked. Twenty pages of content were written for the BYOA, turned into webpages, and sent to colleagues to attempt. The feedback from their efforts, and my own experience trying to navigate though the pages would lead to further iterations for clearer content. For projects that relied more heavily on images, the initial sketching phase was in a notebook, and from there it moved to Adobe Illustrator and finally to Blender to be modeled. The entire workflow can be seen at http://www.instructables.com/id/Creating-an-LED-in-Blender/.

Multiple revisions would be made to each prototype. Zimmerman (2007) lays out three steps for a RtD approach. First, identify opportunities for new technology. Second, create artifacts that embody theory. Third, frame conflicting perspectives to demonstrate the problem being addressed and the balance made. Coding and memo writing served as a jumping off point for each of these steps. Concepts written in those memos would

lead to drafts, sketches, and prototypes that were created for each tutorial to help ensure their accuracy, as well as to get an understanding of how they might work in the field as tutorials. Each tutorial presented a problem in how it would be received, as there were no other tutorials like them. One of the possible reasons research is being done to make tutorials conform, is people have expectations of what a tutorial should be. As this research looks to break away from conformity, at each stage of a tutorial, several colleagues within my lab would be asked to review the tutorial in its current condition and provide feedback. Each of the tutorials was treated separately. Initially this was so each tutorial could receive as much individual focus as possible. Over time, it also allowed a way to reflect on tutorials that had already been accomplished, while trying to create new ones. In certain cases, working through a problem on one tutorial would trigger a solution or concept that could be applied to another style of tutorial that had not been worked on in weeks. These ideas were noted, and when the current work was done, focus would return to the other tutorial to investigate the new idea.

Figure 3.3. LED Datasheet Excerpt



Since each of these tutorials looked at presenting concepts in unique methods, there was a need to look ahead at how participants might interpret instructions, and then

try to ensure issues would not arise. For instance, each component was 3D modeled to their exact specifications according to their datasheets. Figure 3.3 shows the dimensions of a Light Emitting Diode (LED) manufactured from Fairchild Semiconductor (part number: MV8140). Once the 3D model was made to these specifications, it was apparent that participants would not notice the different leg sizes without very close inspection. In order to address this, the length of each leg was accentuated to better illustrate the discrepancy in lengths without the need to have more written instructions. This basic approach of ideation, sketching, prototyping was repeated throughout the creation of each of the tutorials.

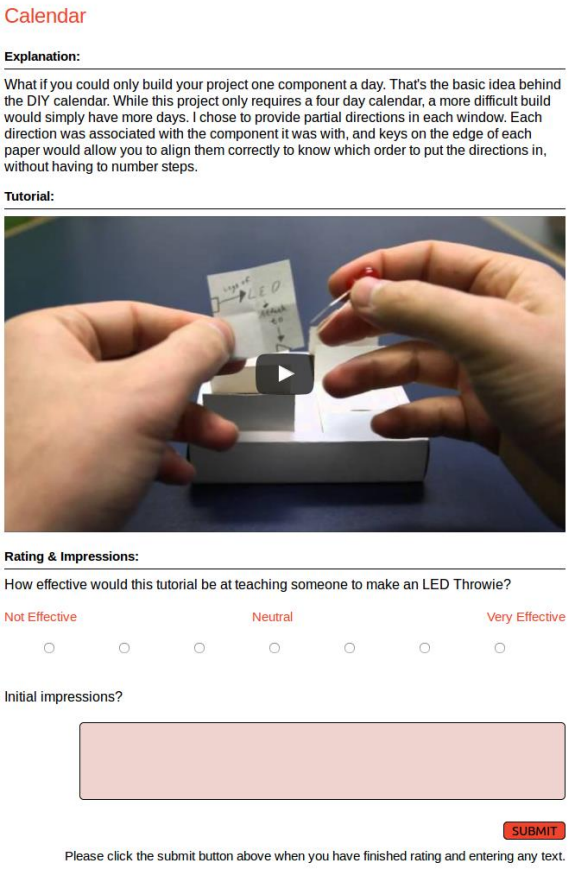
3.4.3. Phase Three: Expert Participants

Once each of the twelve tutorials were in a finished state, it was decided to initiate the third phase of the research: participant feedback. Since this research is directed at tutorial authors, it was determined that experienced tutorial authors would be the only people requested to be participants. Participants were selected from friends and colleagues who had worked with me in the past. Arbitrary requirements were set for what would be considered an expert tutorial maker. One consideration for participants was if they met a minimum of fifty published tutorials online on at least two different platforms. Alternately, participants could be working in the DIY field, which included being on staff at places like Instructables or Make: Magazine. A third method of consideration was having authored a published book with a focus on DIY tutorials. Each of the final seventeen expert participants met at least one of these requirements, while many met two or three. Ten of the expert participants were male, and the other seven were female.

Since authors were located around the world, a website was created to share and show the created tutorial and request feedback. Each participant was first sent a link to a consent website (Appendix D). Once that was finished, they were sent a link to the tutorials website that placed them on the Instructions page (Appendix E). From there, participants were free to browse tutorials in any order they chose, before completing the survey. The tutorials were created with similar page layouts (Figure 3.4), which

consisted of three vertical sections. Each tutorial was published with an explanation at the top of the page describing what it was doing and prerequisites the participant might need to know. Following the explanation, the webpage displayed the tutorial, which would use either an image, video, text, or audio presentation method. BYOA and recipe were the only tutorials that combined presentation methods. The last section on each tutorials webpage was devoted to ratings and impressions. There were two questions in this section. First, “How effective would this tutorial be at teaching someone to make an LED Throwie?” This question was followed by a Likert scale containing seven radio buttons on which the participant could click, the left-most radio button being “Not Effective”, while the right-most represented “Very Effective.” Below the Likert scale, the next question read “Initial Impressions?” This question was followed by a blank text box participants were asked to use in writing whatever they chose (Appendix F). Both of these questions were used to extract what Charmaz calls elicited texts (2006). While extant texts described earlier view work that has been previously published, elicited texts are filled in by the participants.

Figure 3.4. Calendar Tutorial: Website Screenshot



Note. One of the finished tutorials presented on the website. The webpage is divided into three parts vertically, Explanation (top), Tutorial (middle), and Rating (bottom).

Ratings and questions on individual tutorial pages were asked for several purposes. First, the hope was to get an honest first impression of each tutorial after it had initially been completed. Having a rating attached to each tutorial would allow comparing to see if participants rated familiar structures higher, or went with something else. To nudge a little more of what might be behind the rating, the comment box offered an open-ended question. This was to ensure that the questions did not influence the initial feedback in any way, while giving the participants free rein to write whatever they wanted. The idea was that comments would be confined to only the most polarizing feelings of each participant.

In addition to the questions on each page, a final survey of seven questions were included on the webpage. The survey was intended for after all of the tutorials had been completed. Participants were asked to take time between viewing the tutorials and beginning the survey to reflect on what they had seen. Each of the seven questions attempted to identify aspects of tutorials participants did or did not like. All of the questions can be seen in Appendix A, and each was designed to impose as little influence on the participants as possible.

The first two questions asked participants what they felt were the most useful and which were their favorite tutorials. There were two goals here. First, to see if the tutorials most liked were also the ones that received the highest initial rating in usefulness. The second purpose of these questions was to see if participants would separate these ideas or consider them the same thing. The third and fourth questions would try to learn whether participants would use these techniques or other equally non-traditional presentation techniques in the future. If any techniques were seen as novelty or not useful, those design decisions could be compared to other tutorials which had worked. The fifth sought to understand if there were situations or places were participants would feel any of these methods would be more acceptable then their current preference. This would help identify circumstances for applying specific design decisions, in addition to gaining a better understanding of participant's expectations. Question six looked to understand why each participant used the current presentation techniques they use, and pressed to see if there were any desires for change. Finally, question seven simply asked for "comments" in order to provide an outlet for anything additional participants may have wanted to put forward.

As impressions and surveys were completed, they were downloaded for coding. When coding these texts, gerunds were used, in addition to highlighting and underlining to emphasize key concepts or words. After reviewing responses from the first two participants, it was immediately apparent that amateur participants would also be required to explore another perspective.

3.4.4. Phase Four: Amateur Participants

Throughout this work, tutorial authors, specifically those who were entrenched in the tutorial world, were the focal group of this research. There was never a time when beginner or amateur tutorial authors were considered as participants, until the first two expert participants responded. The unexpected and overwhelming negativity of the second response was so surprising, that it destroyed several preconceptions I did not realize that I had. Throughout this research, I was aware of many of my preconceptions, and utilized strategies laid out by Charmaz to reveal other preconceptions that I may not be aware. While there was no expectation that each participant would love the ideas presented on the website, there was a general feeling that some would be well received, or at least not despised. An early memo written when I was trying to make sense of the anger and frustration directed towards the tutorials stated, “I don't think they can see the forest for the trees.” The meaning here was that expert tutorial authors might be so entrenched in their work and traditions; they might not be able to separate themselves from their craft anymore. This concept led me to seek out amateur authors as well. Using the same website and questions, participants who had little to no experience making tutorials were contacted in the same manner as expert authors. The requirements for amateur authors were that they had published less than five tutorials. Of sixteen total respondents, five were male and the other eleven were female.

3.5. Data Gathering and Coding

The process of coding and reviewing the data acquired through this research adheres closely to stipulations and suggestions set down by Charmaz (2006). Several of the rules laid out by Charmaz are to use open, simple, short, and precise codes that allow the researcher to code fast. Also utilized in this research is Charmaz’ suggestion to underline and use colors to highlight codes and arguments.

Prior to inviting participants to partake in this research, several categories were created to help focus coding. Categories remained general, but tried to focus on different

aspects of tutorials that could highlight what authors were seeking when grouped together. Categories like *process* detailed when participants wanted to see sequential steps, and *BoM* (Bill of Materials) was used when any sort of component or materials list was brought up. Many categories, such as *images*, *audio*, *simplicity*, and *annotation* were made to reference the specific aspect of tutorials on which participants would be expected to comment. Additionally, gerunds were created to add description to what was being said. *Liking*, *disliking*, and *wanting* were all decided on beforehand to try to help aspects of comments into their base elements. One of the reasons for using Research through Design to create tutorials that purposefully broke traditional tutorial elements was to spark debate amongst expert tutorial makers. To take professionals out of their element, make them uncomfortable, and then pick out the aspects they did or did not like out of each of the updated tutorials. These details could hopefully be utilized to paint a picture of what tutorials could or needed to be.

Participant responses were imported into four SQL databases, expert tutorial responses into one and survey responses into another, while amateur responses were similarly divided. The survey was presented on a single page, so survey responses were automatically appended to an individual participant. Tutorial responses were displayed on each tutorial page, which meant that each submitted comment on a tutorial was not associated with any other comments on the website or in the database. Refer to Figure 3.5, where row C shows responses to abstract tutorials, E to animated, G to BYOA and so on. For this reason, tutorial comments were grouped to similar time stamps and each group of comments was tagged as an individual participant. This process worked well as participants logged on to the website at very different times, allowing their responses to be easily grouped. Each grouped set of survey and tutorial responses was given either an A for amateur or E for expert and a number indicating the order in which the response was received. This means that the E05 survey respondent might be a different participant than the E05 tutorials respondent. Since this research will be looking at what experts and amateurs say as a group, this should not affect the data analyzation in any one way.

Figure 3.5. Tutorial SQL Database

	B	C	D	E	F	G	H	I	J	K	L	M	N	O
124	1	I need a visual to see what I ar	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
125	NULL	NULL	3	The visual is great, but without	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
126	NULL	NULL	NULL	NULL	4	If my task is to just build an LE	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
127	NULL	NULL	NULL	NULL	NULL	NULL	4	The visual shows you how to b	NULL	NULL	NULL	NULL	NULL	NULL
128	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	5	With the benefit of the other D	NULL	NULL	NULL	NULL
129	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	1	Not being familiar with games a	NULL	NULL
130	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	3	This reads like some po
131	2	This tutorial relies heavily on th	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
132	NULL	NULL	5	It's actually quite direct and sp	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
133	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
134	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
135	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
136	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
137	NULL	NULL	NULL	NULL	6	It's very entertaining and doesn	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
138	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
139	NULL	NULL	NULL	NULL	NULL	NULL	7	This is great. I think its very su	NULL	NULL	NULL	NULL	NULL	NULL
140	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	6	Reminds me of science book o	NULL	NULL	NULL	NULL
141	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	1	Too many barriers to access an	NULL	NULL
142	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	1	Creative, but really not l
143	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
144	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
145	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
146	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
147	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
148	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
149	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
150	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
151	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
152	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	4	As said, it is very minim
153	NULL	NULL	7	This would be literally what you	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
154	NULL	NULL	NULL	NULL	4	It won't be very an effective tut, But who would want to make a	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
155	NULL	NULL	NULL	NULL	NULL	NULL	3	It might be effective if you are	NULL	NULL	NULL	NULL	NULL	NULL
156	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	2	My ability of seeing these thing	NULL	NULL	NULL	NULL
157	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
158	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	4	Sorry, I skipped this one. Due t	NULL	NULL
159	4	I think it is very effective in giv	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
160	NULL	NULL	5	I was able to get the key points	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
161	NULL	NULL	NULL	NULL	4	It was very fun to read, but I go	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
162	NULL	NULL	NULL	NULL	NULL	NULL	NULL	The idea is novel and fun. The	NULL	NULL	NULL	NULL	NULL	NULL
163	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	4	I like the animated version mor	NULL	NULL	NULL	NULL
164	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	3	Gave up. I didn't figure out how	NULL	NULL
165	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	3	I like to use it as a shor
166	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Note. Screenshot of SQL database for tutorials. Columns are grouped B-C, D-E, F-G, H-I, and each group shows a rating and a response to the tutorial it is associated with.

SQL data was inserted in excel spreadsheets as it arrived. Survey responses were divided into questions; then individual responses were pasted into individual cells. Tutorial responses were similarly divided and organized. Each response was then coded in the cell to the right of the responses (Table 3.2).

Table 3.2. Example Code

A09	It was very fun to read, but I got distracted and felt a bit overwhelmed by so much information. It is a bit text heavy too. I just wanted to be able to build a LED throwies fast and feel some sense of accomplishment first.	Enjoying tutorial Overwhelming amount of information Disliking verbose Wanting quick build Wanting quick success

Note. An example response from the BYOA tutorial, including codes. Participant ID is in the left column, tutorial response in the middle, and codes on the right.

Once the initial round of coding was completed, responses and codes were copied to another spreadsheet that organized responses by participant. This allowed for viewing all the participant's responses to a single survey question, as well as seeing all

of an individual participant's responses at a glance. Doing this made it possible to see when an individual participant was making it seem like certain issues were more important than they actually were. Two coded excel spreadsheets were created for each of the four types of responses: amateur tutorial, amateur survey, expert tutorial, expert survey. Each of these spreadsheets became the master referred to throughout the next stage of the coding process when questions arose.

Figure 3.6. Axial Coding, Phase One

	A	B	C	D	E
339	Wanting BoM	T10-Song	A08		
340	Wanting BoM	T11-StopMo	A11		
341	Wanting BoM	T11-StopMo	A12		
342	Wanting BoM	T12-Zoetrope	A11		
343	Wanting BoM	T12-Zoetrope	A12		
344	Wanting BoM – for magnet	T02-Animated	A01		
345	Wanting BoM – for magnet	T02-Animated	A08		
346	Wanting BoM up front	T08-Recipe	A03		
347	Wanting BoM up front	T10-Song	A12		
348	Wanting clearer language	T01-Abstract	A15		
349	Wanting clickable links	T03-BYOA	A15		
350	Wanting concise	T03-BYOA	A06		
351	Wanting concise	T03-BYOA	A10		
352	Wanting concise	T03-BYOA	A12		
353	Wanting context	T04-Calendar	A05		
354	Wanting description – more	T05-Exploded	A04		
355	Wanting details	T07-Haiku	A08		
356	Wanting details – more	T01-Abstract	A09		
357	Wanting details – more	T07-Haiku	A04		

A-Surv-Import | **A-Tuts-Import** | E-Tuts-Import | E-Surv-Import

Once the initial coding phase was complete and codes were sorted, axial coding was used to identify and sort through abundant codes. Codes were initially separated from comments and placed in an excel spreadsheet. Each code was tagged with either the survey question or tutorial with which it was associated, along with the participant who had made the initial comment. Figure 3.6 shows a small section of the master document. Columns are sorted as codes on the left, tutorials in the center, and participants on the right. Below the codes, four tabs are located across the bottom. They

are divided into amateur (A) and expert (E), survey responses (Surv-Import) and tutorial responses (Tuts-Import). These four tabs contained all of the coded responses received from every participant. By keeping a master list of codes, responses could be referenced and copied to ensure accuracy.

Figure 3.7. Axial Coding, Phase Two

	A	B	C	D	E	F	G
1	Wanting BoM	T02-Animated	A05		Liking BoM	T08-Recipe	E15
2	Wanting BoM	T02-Animated	A09		Liking BoM	T10-Song	E08
3	Wanting BoM	T02-Animated	A10		Wanting BoM	T02-Animated	E07
4	Wanting BoM	T02-Animated	A11		Wanting BoM	T02-Animated	E10
5	Wanting BoM	T02-Animated	A12		Wanting BoM	T02-Animated	E11
6	Wanting BoM	T02-Animated	A13		Wanting BoM	T02-Animated	E15
7	Wanting BoM	T02-Animated	A14		Wanting BoM	T05-Exploded	E08
8	Wanting BoM	T02-Animated	A15		Wanting BoM	T05-Exploded	E09
9	Wanting BoM	T05-Exploded	A06		Wanting BoM	T05-Exploded	E10
10	Wanting BoM	T05-Exploded	A11		Wanting BoM	T05-Exploded	E15
11	Wanting BoM	T05-Exploded	A12		Wanting BoM	T07-Haiku	E08
12	Wanting BoM	T07-Haiku	A01		Wanting BoM	T07-Haiku	E13
13	Wanting BoM	T07-Haiku	A12		Wanting BoM	T07-Haiku	E15
14	Wanting BoM	T10-Song	A08		Wanting BoM	T10-Song	E15
15	Wanting BoM	T11-StopMo	A11		Wanting BoM	T11-StopMo	E01
16	Wanting BoM	T11-StopMo	A12		Wanting BoM	T11-StopMo	E05
17	Wanting BoM	T12-Zoetrope	A11		Wanting BoM	T11-StopMo	E07
18	Wanting BoM	T12-Zoetrope	A12		Wanting BoM	T11-StopMo	E08
19	Wanting BoM – for magnet	T02-Animated	A01		Wanting BoM	T11-StopMo	E10
20	Wanting BoM – for magnet	T02-Animated	A08		Wanting BoM	T12-Zoetrope	E05
21	Wanting BoM up front	T08-Recipe	A03		Wanting BoM	T12-Zoetrope	E07
22	Wanting BoM up front	T10-Song	A12		Wanting BoM at front	T08-Recipe	E12
23	Liking BoM	T08-Recipe	A03		Wanting BoM up front	T08-Recipe	E15
24	Liking BoM	T08-Recipe	A08		Misreading BoM formatting	T08-Recipe	E07
25	Liking BoM	T08-Recipe	A12				
26	Liking BoM – being visual	T09-Rubiks	A06				
27	Liking BoM – not having one	T11-StopMo	A05				
28	Liking BoM – not having one	T11-StopMo	A06				
29							

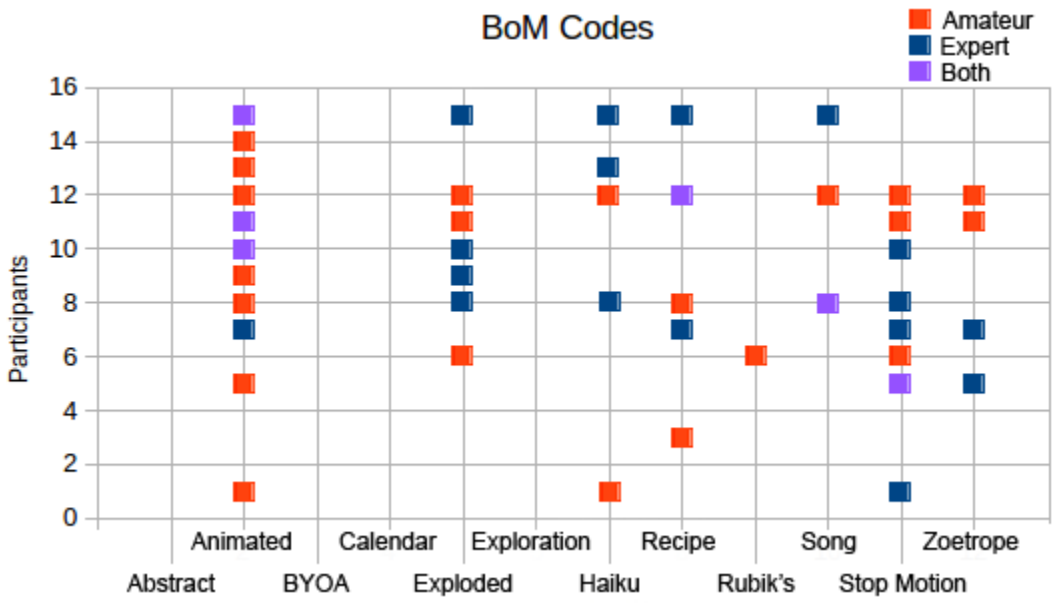
a-Tuts | e-Tuts | concept | fun | tutorial | **BoM** | images | a-v | why | pre-foc | comp

Sheet 6 of 11 | Default

With the master spreadsheet completed, the data was copied into other spreadsheets for sorting (Figure 3.7). This allowed for quick sorting and organizing of codes by different metrics to quickly identify trends and patterns as they surfaced across multiple tutorials or authors. Codes were initially split by gerunds describing the code: *wanting*, *liking*, *disliking*, and a few others. From there categories became more specific: *fun*, *traditional*, *BoM*, *images*, *audio/video*, *why*, *focus*, *presentation*, and *comparisons*. Each of these categories can be seen as tab labels across the bottom of Figure 3.7.

Within each of these categories, codes were explored only on the tutorial they appeared, among similar tutorials, and among all tutorials to reveal any patterns that might surface in the data. The figures I am showing focus specifically on the bill of materials (BoM) code, to demonstrate how one code progressed through the coding stages.

Figure 3.8. Axial Coding, Phase Three



One of the final stages of coding with the BoM category, led to the visualization seen in Figure 3.8. To better understand how many comments were being made within this category, the visualization was set to show each tutorial across the x-axis. By placing participants along the y-axis, I could quickly see which participants were making the most references towards the BoM, and which tutorials received the most comments. By graphing the visualization this way, I was also able to see the spread of amateurs versus experts commenting per tutorial. While it cannot be seen in the static image above, the version of the visualization I use allows toggling amateurs and experts responses on and off. The toggling enables closer focusing with each group.

Figure 3.9. Theoretical Sampling, Phase 4

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Title	Abstract	Animated	BYOA	Calendar	Exploded	Explore	Haiku	Recipe	Rubik's	Song	Stop Motion	Zoetrope	
2	Expert	1	6	1	1	4	0	0	4	0	1	4	3	Useful
3	Expert	0	2	1	0	0	1	0	0	0	1	5	2	Favorite
4	Expert	1	10	3	3	5	0	0	8	1	7	11	7	Liked Tutorials
5	Expert	0	0	4	0	1	2	5	2	7	4	0	4	Liked Concepts
6	Amateur	0	3	1	2	0	0	1	8	0	2	5	3	Useful
7	Amateur	0	0	1	1	0	1	3	0	0	3	9	1	Favorite
8	Amateur	2	5	7	5	1	0	5	10	0	5	12	3	Liked Tutorials
9	Amateur	4	3	2	3	1	2	7	0	4	8	3	4	Liked Concepts
10	Expert	4	0	0	0	0	3	3	0	2	2	0	0	Least Useful
11	Expert	2	0	1	1	0	2	0	0	3	0	0	0	Least Favorite
12	Expert	1	0	1	0	0	3	1	0	1	1	0	0	Disliked Tutorials
13	Amateur	3	2	2	0	2	2	5	0	3	2	0	0	Least Useful
14	Amateur	3	0	2	0	0	3	1	0	3	0	0	0	Least Favorite
15	Amateur	0	0	1	0	3	2	0	2	1	0	0	2	Disliked Tutorials

With the initial rounds of coding complete, theoretical sampling was used to sort and compare categories. One group of categories looked at how much participants *liked* or *disliked* the tutorials they were seeing (Figure 3.9). Many diagrams and graphs were created to try to make sense of participant's choices. Figures 5.2.1 and 5.13 are both results of trying to grasp those early stage diagrams, and showing where they led.

In total, fourteen amateur and eleven expert participants completed the survey. One amateur skipped a single question, and one expert skipped four questions. Fifteen amateurs and sixteen experts responded to the individual tutorials. In some cases, participants would post a response on a tutorial, then return to post more. In other cases, a participant might work through all of the tutorials over the course of a week, so their responses were divided up into multiple participants. For example, E03 only responded to the first six tutorials and E06 only responded to the last six tutorials. There is a very good chance that these two experts are actually the same participant, but to not confuse the data when there was no certainty that it was the same participant, they were left separate. In both groups, participants left responses between a single sentence and a long paragraph in length to both tutorials and survey questions. Occasionally a respondent would only leave a single word, but responses tended to be between 200 and 300 words. Due to the nature of the tutorials and unexpected results, many new categories were created as coding progressed. Unfortunately, there was no way to tell how much time an individual participant spent on any individual tutorial, or how long they waited after completing the tutorials before filling out the final survey. In the next chapter,

there will be thirty-six different categories viewed across the twelve tutorials. These categories are further subdivided by gerunds used to describe them. Many of the categories only appear on one or two of the tutorials, which at first makes it difficult to find patterns.

3.6. Conclusion

This chapter began by laying out the questions that would drive this research. An explanation followed about using Research through Design as the design methodology for this work. Constructivist grounded theory methodologies were also discussed, and it was detailed how they were going to be used to support the data acquisition and help build the foundation of RtD. The four phases of this research that would lead to participant feedback on the created tutorials were elaborated, and finally data gathering and coding methods were detailed. The following section will see RtD applied in more specific detail as it is applied to each of the tutorials to describe the design process that lead to each of the finished prototypes.

Chapter 4. Tutorials

4.1. Introduction

This chapter is divided into four sections. Following the introduction, section two details the author's background and the antecedents leading to this research. Section three is further divided into twelve sub-sections, each focusing on the look, creation and questions associated with a specific tutorial. The final section explains how the tutorials were ported to the web, and what would be asked of each participant. The following chapter will investigate and analyze feedback provided by the participants, to find patterns and commonalities that may arise.

4.2. Background

Before this research began, I was working within the DIY community. I had created webcomics that looked at DIY tutorials and projects, in addition to hosting a podcast that brainstormed project ideas with listeners, assisting them with how to proceed with building their projects when they found themselves at an impasse. I have also held jobs at Make: Magazine, Maker Faire, and Instructables. The work and research I performed over the decade leading up to this point studied tutorials, their structure, and how to modify them. When finally deciding to examine a complete redesign of tutorials for this thesis, the first step was to figure out which tutorial to modify.

Two decisions were immediately made. First, this research was going to modify an already created tutorial instead of creating a new one. This would allow for finding a

tutorial already tried and tested, and then to modify it to see if it worked in a different context. Second, the decision was made to use only one instead of multiple tutorials. The key to this decision was the desire to perform comparative research. By limiting all of the tutorials to the same project, feedback gathered would focus on aspects of each tutorial that were not influenced by different processes or final outcomes. Instead, the hope was that by seeing the same tutorial in repetition, participants might start looking deeper at different aspects of the project, revealing new concepts that had not been considered.

With those decisions made, the next task involved laying out different tutorial options for selection and modification. The initial list looked at three tutorials from Instructables: LED Throwies (Q-Branch, 2006), The Most Useless Machine (Frivolous Engineering, 2009), LED Cube 8x8x8 (chr, 2011), and three tutorials from Make: Insect Robot (Karvinen & Karvinen, 2011), Brain Machine (Frauenfelder, 2007), and Nice Dice (Platt, 2009). Both sets of three tutorials included what I considered an easy, medium, and difficult tutorial (in the order listed above). The difficulty of the tutorials was ascribed through personal experience, so when a tutorial was labelled with a difficulty scale, both would align.

The LED Throwies tutorial was broken down initially by following the first half of the translation process laid out in From DIY Tutorials to DIY Recipes (Dalton et al., 2014). Utilizing this approach, the first step took the written tutorial and converted it to a spreadsheet. The spreadsheet listed tools and components, annotating whether or not they were required, what steps with which they were associated, and the desired quantity. For each step, the associated components and techniques required to complete the step were written down, along with whether or not that step was required to complete the project. Once the tutorial was dissected so that it could be rebuilt using a multitude of techniques, that tutorial was set aside and a medium tutorial was selected to receive a similar process: The Most Useless Machine.

Once both project tutorials were dissected, there was a general understanding of the process required, and how steps would be broken apart in future deconstructions of

tutorials. Inspecting the final four tutorials that had not yet been broken down, the decision was made to use the LED Throwie instructions as the base tutorial for this research. The Useless Machine had a particular placement of servo motors that would be difficult to translate into a simple assortment of styles, and the harder tutorials would require too much work to simply test the viability of this thesis topic. A simple project, with easy to find components that most people already knew, seemed the best prospect to investigate the questions laid out in the beginning of the previous chapter.

4.2.1. Tutorial Possibilities

With a tutorial selected and deconstructed, the next requirement was to find new presentation methods for porting the tutorial. With the desire to go in as many different directions as possible, a list of unique presentation methods to be fused with tutorials were compiled. In the initial brainstorm session, thirteen different methods for presenting a DIY tutorial were conceived: interactive ebook, choose your own adventure, cookbook, interactive 3D models, song, multiple videos simultaneously showing different steps of the same project, stop motion, Fluxus art style, video game, board game, forced step-by-step, abstracted, and with a focus on reasons as opposed to action. Over time, other methods came up that were also good candidates, of which some of these were used in the final set of tutorials.

As a preliminary test, a colleague and I attempted to write a song that detailed the construction of an LED Throwie (Dalton, 2014b), to ensure reformatting a tutorial in this style was even viable. The song was selected as a jumping off point for this work for the simple reason that it seemed the most improbable idea at the time. Having searched for song based tutorials, the only one I found was a song teaching children how to tie shoelaces. Similar to tutorials, songs teaching math, science, and literature could easily be found, but never in a way that it would inform the listener in a step-by-step fashion how to make something. Once the task of writing a tutorial song began, it only took an hour to find a song to use as a backing track and to rewrite the song lyrics (Dalton, 2014a). The song we decided to use for the tune was Blitzkrieg Bop by The Ramones.

We recorded ourselves singing it off air and later had it mastered to give the song a professional finish.

When playing it to fellow graduate students, the positive responses spurred the idea that this thesis proposal was worth further investigation. With a constantly expanding list of possible presentation methods, the decision was made to limit the amount of tutorials that would be created. The goal: to have an amount of tutorials that were sufficient, making it seem like additional ideas were not doable, while also not making too many, which would take extra time without producing any new data. In the end, the total number of tutorials to create was set at twelve. If twelve different tutorial presentation methods could be imagined and constructed by one person, with a limited amount of time and budget, then anyone could probably produce a unique method for presenting tutorials.

The other reason twelve tutorials were chosen, was due to the fact that they would demonstrate a wide range of presentation styles which would enable greater comparison later. So the final step before creating the tutorials was to decide on the twelve to use. The list of tutorial methods was divided into categories that reflected competencies required to create the tutorial and the predominant techniques used to pass on information. Competencies were divided into creating 3D models, animating, video editing, creating stop motion, book layout, and programming to name a few. Techniques were similarly divided into text, speaking, images, video, and application. By accomplishing this first set of criteria, I was able to choose tutorials that covered the widest array of techniques, without having to learn too many new competencies. The final selection of twelve tutorials used the following techniques: abstract language, animation, choose your own adventure, forced structure, free exploration, poetic, structured, puzzle, and music. Animation was used in three separate techniques, 2D vector animation through a zoetrope, simple 3D animation, and stop motion, with each technique adding a little more structure.

It is also important to note that in addition to competencies and techniques, fun was always a driving factor in the creation and selection of each tutorial. In some cases,

the fun was focused on the construction of the tutorial, while in other models the idea of fun was associated with viewing the finished project. For myself, one aspect I found missing from tutorials was a sense of fun or enjoyment. When creating them, it felt like work, and when browsing through them it was akin to looking for something in a technical rider. One of the reasons this research is delving into non-traditional presentation techniques, is to discover if the creation or acquisition of tutorials can be separated from the idea of work. To this end, many ideas that would have usually been discarded outright, were considered and occasionally prototyped to see if they could work. Allowing for creativity, and a nothing is impossible method for presentation, this fuelled a sense wonder and enjoyment when facing each new tutorial creation, as each presented unique challenges and requirements.

4.3. Tutorial Creation

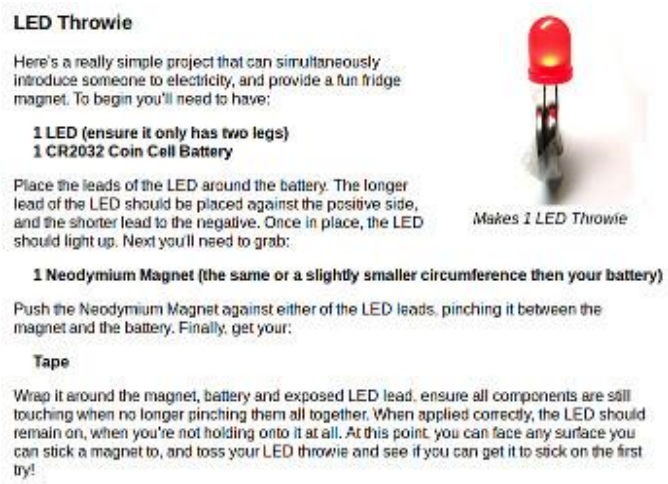
Every tutorial was created in a similar manner, and was designed one at a time. First, an outline was created, which was sketched into a rough draft. The draft was put aside for several days before returning to for further iteration. The second draft was shared with peers in my graduate laboratory, with the intention of receiving feedback for further iterations. Of the twelve tutorials, only one did not go through this process. The song created with a colleague was finished in a single take. After an hour brainstorm session we had the final lyrics that would be recorded and mastered, so no outside feedback was received until this tutorial was completed (Dalton, 2014a).

In the following sections, I will go into detail about each tutorial created. The tutorial sections will be divided into three parts, what is the tutorial, unique aspects about how it was created, and why it was created. Each tutorial is a retelling of the original LED Throwies tutorial which can be found on Instructables (Q-Branch, 2006). That version of the tutorial can be broken down into five parts summarized thus:

1. Title and Step 1: Introduction and overview of what will be made.
2. Step 2: Listing of required and optional materials used to make the project.

3. Step 3 through 5: Step-by-step, how to put the project together.
4. Step 6 and 7: Conclusion and using LED Throwies in the wild.
5. Step 8: Methods for modifying the project.

4.3.1. Recipe



LED Throwie

Here's a really simple project that can simultaneously introduce someone to electricity, and provide a fun fridge magnet. To begin you'll need to have:

1 LED (ensure it only has two legs)
1 CR2032 Coin Cell Battery

Place the leads of the LED around the battery. The longer lead of the LED should be placed against the positive side, and the shorter lead to the negative. Once in place, the LED should light up. Next you'll need to grab:

Makes 1 LED Throwie

1 Neodymium Magnet (the same or a slightly smaller circumference then your battery)

Push the Neodymium Magnet against either of the LED leads, pinching it between the magnet and the battery. Finally, get your:

Tape

Wrap it around the magnet, battery and exposed LED lead, ensure all components are still touching when no longer pinching them all together. When applied correctly, the LED should remain on, when you're not holding onto it at all. At this point, you can face any surface you can stick a magnet to, and toss your LED throwie and see if you can get it to stick on the first try!

Figure 4.1. Recipe Tutorial

In this tutorial, the DIY instructions are presented in the form of a cookbook recipe (Figure 4.1), specifically, the recipes found in the 1975 edition of Joy of Cooking.

One of the first things I wanted to try was to port one style of tutorial onto another. The key was using two styles of tutorial that do not really cross over. Previous work studying the alteration of DIY tutorials to recipe formats (Dalton et al., 2014), led to the Joy of Cooking. The format for this cookbook presents ingredients needed in bold type, as they appear in a recipe. This is quite different from modern cookbooks where the ingredients are listed before the instructions, followed by a series of steps to accomplish, which is similar to the style in the majority of DIY tutorials. I used the tactics laid out in From DIY Tutorials to DIY Recipes to format the LED Throwie instructions to the Joy of Cooking format. Transferring the tutorial to this format was very straight

forward. Once the original tutorial was broken down into base steps and components, it was simply a matter of transferring data over.

There are two main concepts that I hoped to explore by constructing this tutorial. First, to demonstrate that a DIY tutorial could be ported onto any generic tutorial format, even if the layouts are completely different. Second, to show that while only making minor modifications to a tutorial, the advanced tutorial makers would still be invested, while amateur tutorial makers would be less inclined to enjoy it. This is because I felt amateur tutorial makers desire to see different methods of tutorial presentation, while advanced makers may be more rigid in their views.

4.3.2. Abstract

Step 1: Materials List

- DC Light Source
- Portable DC Power Supply (Strong enough to power light source)
- Binding agent or material
- Tool, material or hardware for discriminant placement

Step 2: Test your Light Source

- With your DC light source selected, plug it into your portable DC power supply and ensure that it is powered.
- While it's lit, determine if you like the color/diffusion the light source has, and if not, change it.
- **Coloring:** There are many inks, paints or gels you can use to alter the appearance of your light (be sure to use inks/paints/gels that can withstand whatever temperatures your light may emit).
- **Diffusing:** There are lots of techniques to diffuse a surface, depending on what it is. If you're light source has a glass casing, you can use a glass etching cream to give it that diffused look.

Step 3: Bind the light source to the power source

- Using the binding agent or material you selected, bind your light source and power source together, so that your light source is always powered. Ensure you bind your parts together well, you don't want flickering lights, or lights to unplug.

Step 4: Bind your tool for discriminant placement

- Now attach the tool, material or hardware you choose to discriminatingly place your object around.
- **An important note on discriminant placement:** It's difficult to find a method to attach your object to any and every surface you happen across, while also allowing you to remove it and attach it to another surface without leaving permanent damage. Depending on the size and weight of your light and power source, let that inform how and where you attach it to things. Perhaps your technique for placement is to blend it into the background so it looks like it's supposed to be there. Using bricks, wood, or other materials that are common in the area. If you want to hang it up higher, you might use a nail and only stick it to tree's in public spaces. There are many options, so think about where you want to place it, then think about how you're going to place it there.

Step 5: Let your light loose on the world!

- If you want to put your piece in a public place, try to find times when no one is around, or do your best to look professional and be ready to answer questions when someone asks what you're doing. Maybe the city is looking into crowding in this location, and a camera in the building across the street needs to keep track shadows walking across this light to tally the number of people walking past in a day. Get creative, it's fun!

Figure 4.2. Abstract Tutorial

The abstract tutorial (Figure 4.2) is formatted identically to a typical DIY tutorial, with the exception of images or video. It starts with a title and introduction, proceeds to a

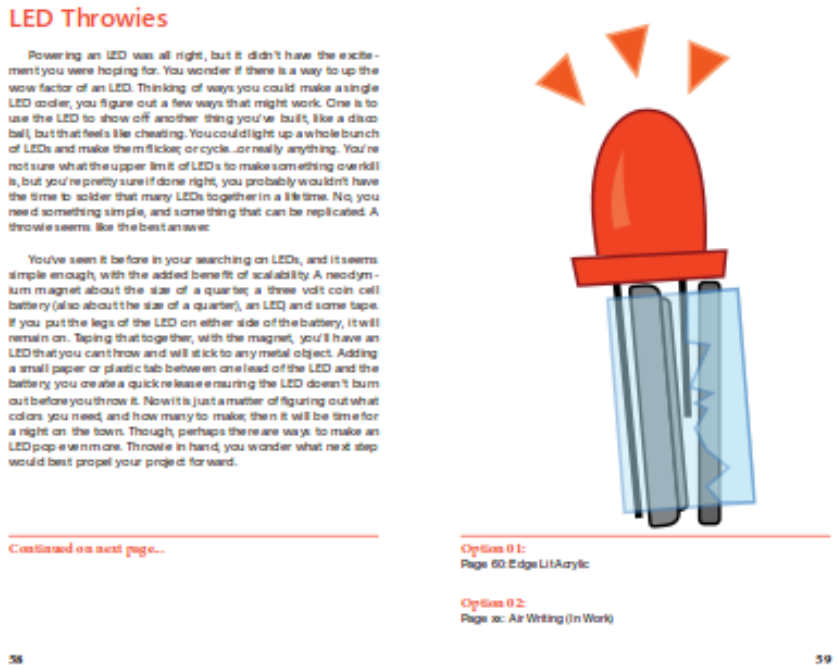
materials list and then outlines each step required to build the finished project. The difference between this and a traditional tutorial, is the purposeful vagueness used at each point in the tutorial. The concept and design principles behind this tutorial are loosely grounded in the instructional-based artworks by individuals like Sol LeWitt and Yoko Ono as part of the Conceptual Art movement (Obrist, Boltanski, & Lavier, 2013). The instructional art in this movement was created to allow anyone to remake their artwork, and through those directions, allow each of the remakes to be unique. The instructions below are taken from *Work from Instruction*, created by Sol LeWitt in 1971 (MoMA, 2013).

1. Using a black, hard crayon draw a twenty inch square.
2. Divide this square into one inch squares.
3. Within each one inch square, draw nothing, or draw a diagonal straight line from corner to corner or two crossing straight lines diagonally from corner to corner.

In this tutorial, the materials list does not give any specific materials, but instead calls for a light source and a portable DC power supply that is able to sufficiently power that light. By wording the materials list in this way, an individual may use a LED as easily as an incandescent boat light. Each step is also written in a way that allows the individual to make a unique version of the LED Throwie, by following the instruction to assemble the materials in the correct sequence. An interesting aspect of having instructions written in this way is that while it allows the LED Throwie to be built, it also allows for countless other options that follow the same build and design principles, but look and act very different. These instructions also do not require the purchasing of any materials, if an individual has a certain style of light or battery on hand or that they would prefer to use. While simple in concept, abstracting the original tutorial, creating these instructions were quite challenging. This is simply due to trying to find abstract methods of expressing specific materials. For example, changing the materials LED and CR2025, to any light source, and any battery source that is compatible with that light yet also wireless, doesn't really inform the reader. Due to this, several iterations were made to try to simplify language while also being abstract.

There are three main concepts I hoped to explore by expanding this tutorial. First, I wanted to see if people would dislike this tutorial because there were too many choices to make. Second, I wanted to ascertain if their dislike involved too many choices, or if the number of choices was confusing. Finally, I wanted to see if amateur tutorial makers might find more enjoyment if they were not limited to specific materials or design decisions.

4.3.3. BYOA



LED Throwies

Powering an LED was all right, but it didn't have the excitement you were hoping for. You wonder if there is a way to up the wow factor of an LED. Thinking of ways you could make a single LED cooler, you figure out a few ways that might work. One is to use the LED to show off another thing you've built, like a disco ball; but that feels like cheating. You could light up a whole bunch of LEDs and make them flicker, or cycle...or really anything. You're not sure what the upper limit of LEDs to make something overkill is, but you're pretty sure if done right, you probably wouldn't have the time to solder that many LEDs together in a lifetime. No, you need something simple, and something that can be replicated. A throwie seems like the best answer.

You've seen it before in your searching on LEDs, and it seems simple enough, with the added benefit of scalability. A neodymium magnet about the size of a quarter, a three volt coin cell battery (also about the size of a quarter), an LED and some tape. If you put the legs of the LED on either side of the battery, it will remain on. Taping that together, with the magnet, you'll have an LED that you can throw and will stick to any metal object. Adding a small paper or plastic tab between one lead of the LED and the battery, you create a quick release ensuring the LED doesn't burn out before you throw it. Now it is just a matter of figuring out what colors you need, and how many to make; then it will be time for a night on the town. Though, perhaps there are ways to make an LED pop even more. Throwie in hand, you wonder what next step would best propel your project forward.

Continued on next page...

58

Option 01:
Page 60: Edge Lit Acrylic

Option 02:
Page xx: Air Writing (In Work)

59

Figure 4.3. BYOA Tutorial
Note. Figure only shows pages 58 and 59 from downloadable PDF.

Based on the Choose Your Own Adventure (CYOA) books popularized decades ago, this tutorial is called Build Your Own Adventure (BYOA). The goal: to give the individual working through the tutorial agency to choose what they build as they build it. Pages were arranged in a two-page paperback format (Figure 4.3). When reading, the user will see a title at the top left of each page followed by the directions on how to make a particular thing. All the directions and materials are written in paragraph form and

accompanied by an illustration of what they are trying to make. Following the text and illustration, there is a choice that allows the reader to choose what they want to do next.

The first step in making this, was to lay out different ways someone could provide power to an LED, either through something they made or purchased. From there, a tree diagram (Appendix C) was created that allowed the building of one thing to lead to building the next. For instance, if the builder wanted to use a DC power source, their next choice would ask if they wanted to make one or purchase one. Once the power section was finished, the same format was used for the LED section. The final tree diagrams for the intro, power and LED sections can be found in Appendix C.

The LED section in BYOA begins with turning on an LED using the power supply built while reading the first section of the book. It then moves on to more complicated projects, each utilizing an LED as the primary component. Once the ordering was handled, every page had to be written in a second-person narrative, which is common in a CYOA book. After the writing was completed, illustrations needed to be created and the book needed to be formatted. Illustrations and proofreading were accomplished only for the pages intended to be read for this study, while pages not intended for people to use were included to replicate the experience of flipping through a CYOA style book. Large red arrows directed participants through the correct sequence of building an LED Throwie. In addition, explicit instructions were included on the web page where the book could be downloaded to ensure that there was no confusion. Two significant hurdles needed to be crossed in order to finish this tutorial. First, was learning Adobe InDesign to a point that I could layout a book. Second was figuring out the appropriate illustrations to accompany each page. Since the pages were written first, the illustrations needed to fit the writing. If I were able to start this from scratch, I might take notes on each page detailing what it’s about and either sketch or find photos to storyboard, and then write the book to match.

There are two main concepts I sought to explore by building out this tutorial. First, I wanted to see if the agency this style imposed would help participants engage more with the tutorial, garnering a sense of enjoyment. Second, I wanted to establish

whether amateur builders would appreciate seeing how the building of one project could to lead into the building of other projects in a way that might inspire them to go a step further in what they were building.

4.3.4. Song

Lyrics:

Hey ho, let's throw
Hey ho, let's throw

First you grab your batteries
Then you grab your LEDs
Magnet, Tape, Accessories
The LED Bop!

The Anode to the plus bit
The Cathode on the alternate
Tape it to your magnet
The LED Bop!

Hey Ho, let's throw
Toss them in the air now
Where they land I don't know
They're all charged up and ready to throw

Figure 4.4. Song Tutorial: Lyrics

LED Bop is a musical retelling of the LED Throwie instructions, to the tune of Blitzkrieg Bop by The Ramones. The song is broken into three verses and one chorus. The format of the song alternates between verse and chorus, then repeats. Once all the lyrics have been sung, they repeat a second time through. This tutorial is presented strictly in an audio format.

One of the main goals with the tutorial song was to try to transpose a tutorial to a popular music format, while retaining its basic structure. For that reason, each verse of the song functions as one aspect of the tutorial (Figure 4.4). The first verse lists the materials, the second lists the steps required to put it together, and the final verse tells the user what they can do with the LED Throwie. The lyrics, brainstormed with a colleague, were tried with several genres of music. Many different songs would have

worked, but Blitzkrieg Bop seemed like the best fit. The entire brainstorming session, and mastered song can be listened to on the podcasts where they were initially published (Dalton, 2014a, 2014b). In creating this, I learned that karaoke and midi versions of songs, created by companies not associated with the artist, create songs in slightly different times then the original song. I'm told this is due to copyright. My friend and I both recorded ourselves singing this song over the original version of the song. When finding karaoke and midi versions of the song, I was unable to get the audio to align with the vocals for more then twenty seconds. In the future, when recording a parody over another song, I plan to first find the karaoke version of the song and listen to that in the headphones while singing into the microphone.

There are two main concepts I hoped to explore by creating this tutorial. First, through drastically changing the delivery mechanism and presentation style of the tutorial, I wanted to see if it could preserve the audience enthusiasm for the project. Second, I wanted to see if people would remember the lyrics when they stepped away from their computers hoping the catchy tune would serve as a memory tool.

4.3.5. Haiku

Tutorial:

Leg, leg straddling
A battery inbetween
Add a magnet, tape!

Figure 4.5. Haiku Tutorial

The haiku might be one of the least likely formats in which to present a DIY tutorial. As in the traditional haiku format, the participant was presented with three lines: 5 syllables, 7 syllables, then 5 syllables again. Due to those restrictions, the materials were listed as they appeared in the haiku. The haiku presented did not mention an LED, which could easily be fixed with a title.

To format the haiku, the first thing that was required was a list of the exact parts and steps necessary to build an LED Throwie, and each step needed to be simplified as much as possible. Due to the constraints of the haiku format, once the required components were listed, it was just a matter of finding the appropriate connecting words to make the haiku work. LED is three syllables, so to finish the first line, I had to add two syllables that informed the participant of what to do with it. Through constructing the haiku, the focus moved away from the whole LED and towards the legs. This change modified the first line of the haiku from “Grab one LED,” to “Leg, Leg Straddling.” By doing this, more syllables could be used in the second line to explain what to do with the LED. In addition, it stylized the haiku, taking it away from strict instructions to a more poetic use of imagery. The final haiku can be seen in Figure 4.5.

There are two main concepts I hoped to explore by building out this tutorial. First, I wanted to see how succinctly a tutorial could be written within very limiting constraints. Second, I wanted to find out how effective DIY instructions could be, given these limitations.

4.3.6. Rubik's

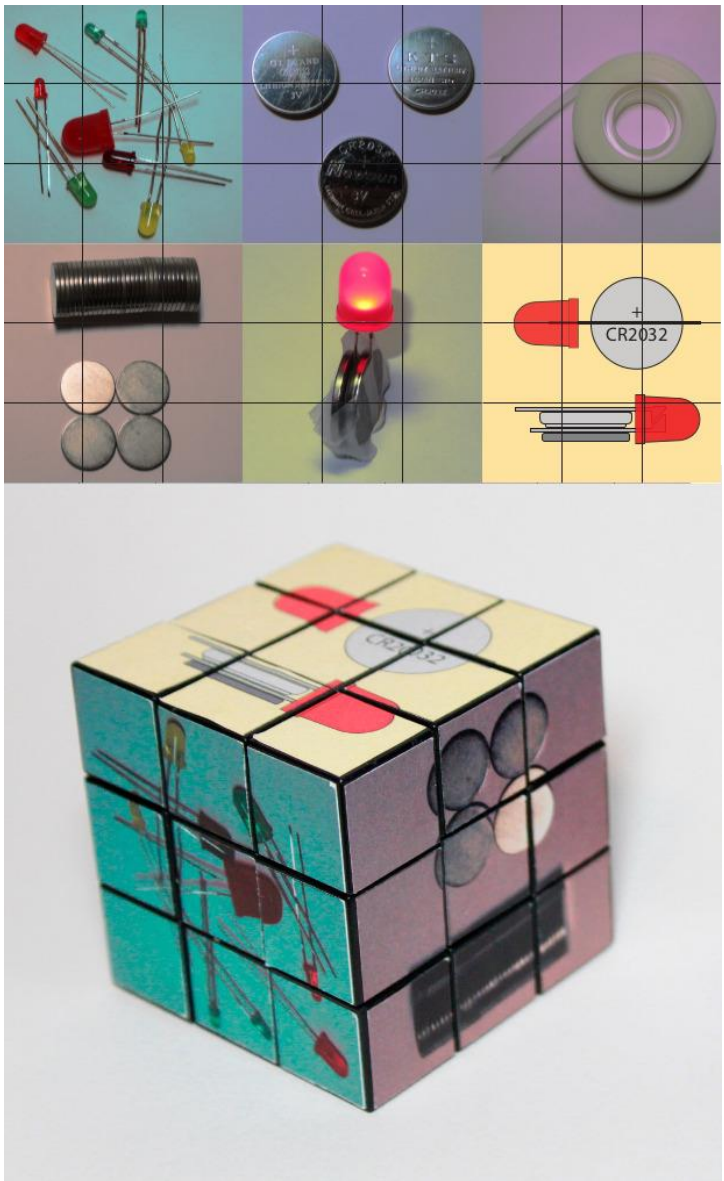


Figure 4.6. Rubik's Cube Tutorial
Note. Top: Shows each side of the Rubik's cube with lines for cutting.
Bottom: Shows the finished cube.

Most people are familiar with a Rubik's Cube: a six-sided cube with nine faces on each side that can be twisted in multiple orientations to make each side one of six different colors. The Rubik's Cube in this study was modified so four of the sides each had images of parts required, and the other two sides had finished versions of the LED

Throwie; one with a diagram and the other an image (Figure 4.6). Using text was considered, for example by placing the word 'Battery' on the side of the cube that showed an image of batteries. However, the images of materials and the finished LED Throwie were framed in such a way that explanatory text was deemed unnecessary.

To create the modified Rubik's Cube, images were framed and selected first to best demonstrate what each part was. Multiple components were framed in each image to give the participant an idea of what they were seeing. Using the previous example of a battery, not only are there three different brands of batteries in the image, but the text engraved on them can be read as well, so the participant would be able to see that they are batteries, as well as what type. With magnets, the image was framed so participants could see many of them stuck together, in addition to separated magnets. Though applying these techniques, the images attempted to best show the material or part being depicted. Once all the images were taken against a white background, photo editing work was employed to change the background colors to make solving the cube simpler. In future iterations, the photos would be taken on different color backdrops to simplify the process. When all of the photos were ready, they were sized to match the Rubik's Cube, printed on sticky paper, and cut into nine evenly sized stickers. The original colors on the cube were then replaced with the new stickers. Additional images and further documentation can be found on Instructables (http://www.instructables.com/id/Rubiks-Cube-Throwie-Instructions/). The most difficult part of creating this tutorial, was coming up with images to put on the non-component sides of the Rubik’s Cube.

There are two main concepts I hoped to explore by building out this tutorial. First, I wanted to see if a layer of obfuscation would deter people from wanting to finish the project. Second, I was curious if the challenge of the additional puzzle element would create a greater sense of accomplishment for those who did finish the project.

4.3.7. Calendar

Figure 4.7. Calendar Tutorial

What if someone could only build a project one component per day? That was the basic idea behind the DIY calendar (Figure 4.7). This technique can work over the course of days, weeks or months, to present tutorials of varying lengths, and provide a unique way of building something. Modeled on an Advent calendar and a DIY kit, the DIY calendar only has as many flaps as there are components required to build the project. Behind each flap is a component and a piece of the overall instructions, the participant using this set of instructions would not need additional tools or materials to complete the project.

The creation of the DIY calendar began by figuring out the number of materials required to build an LED Throwie: four. From that number, a box was build with four spaces, one for each piece. Large card-stock was laser cut to fold around the box placing laser scored flaps over each area a component was housed. With the look finalized, directions were needed. There were two self-imposed requirements the instructions needed to satisfy. First, the steps needed to be clearly divisible to put into each compartment of the box. For example, the direction that lets the participant know what to do with the battery should be housed in the same area as the battery. The

second aspect of the instructions required that each part of the directions be stand alone. This means that whatever step the participant was viewing, they would not know what came before or after, without having already seen one of those steps. To make the directions, a sheet of paper was cut into quarters. In the center of each quarter, one component was written in bold type. Lines were drawn from one component to the next in the series they would follow to make the LED Throwie. Then directions were written on each quarter of the sheet that did not reference future or past quarters, so steps could be independent of each other (Figure 4.8). Additional images and further documentation can be found on Instructables (http://www.instructables.com/id/LED-Throwie-Calendar/). Coming up with a serrated laser cut pattern to open each days component door proved more difficult then planned. After trying several patterns and numbers of serrations, I realized I also needed to figure out how big of a space to make for finger tips to reach in to pull the doors open.

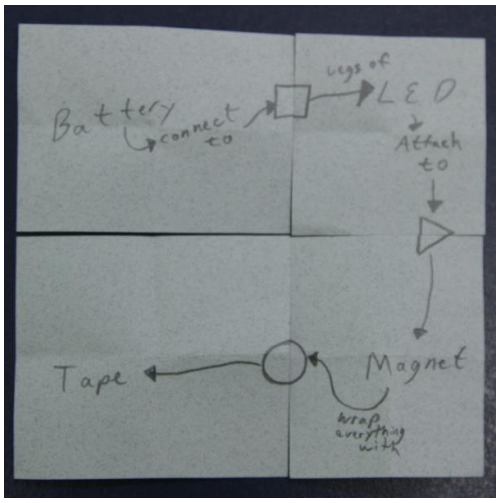


Figure 4.8. Calendar Tutorial: Daily Directions

There are two main concepts I hoped to explore by building out this tutorial. First, could slowing down the tutorial process encourage people to investigate the components of the tutorial on their own? Second, would it be possible to present instructions out of sequence, while preventing spoilers of what they might be doing or what other components they might require, either before or after that step in the tutorial?

4.3.8. Exploration

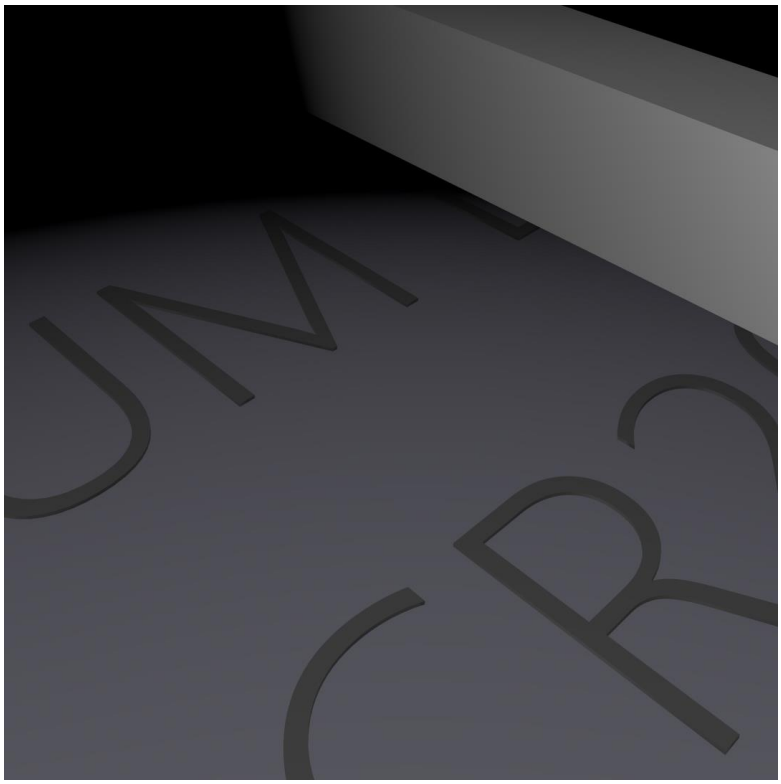


Figure 4.9. Exploration Tutorial

When the exploration game is opened, it starts by setting the player on a massive 3D modeled LED Throwie. Each component is modeled one hundred times its normal size. The user interacts with the environment in first person by walking around the completely constructed LED Throwie (Figure 4.9). When moving around the environment, participants are limited to how far away they can see, ensuring that the entire Throwie is never seen all at once. Typical game inputs are used: arrows to move around, mouse to look and space to jump, with the addition of the shift key used to fly. Scales are set in such a way to allow the participant to feel like an ant, exploring this object for the first time.

All component models were created in Blender. To distinguish the battery from the magnet, 'Neodymium' was written on the magnet, while 'Lithium Battery CR2032' was written on the battery. Each model was scaled up and put into position to create the

LED Throwie, and the LED Throwie was set on a fixed platform. A player character was created, placed on top of the Throwie, and given controls to interact with the environment. When reviewing the game, it was determined that a depth of vision so participants would not know what they were seeing immediately was needed, thus encouraging them to explore the environment. In future design iterations participants should be able to interact with each of the components to see how they connect and what those connections do. The largest issue in creating this game was learning Blender's programming interface. After programming in player movements, the next step was to create a splash screen showing what those commands and movements were. After a week of trying and failing though, I simply created a graphic and included it with the game.

There are two main concepts I hoped to explore by building out this tutorial. First, I wanted to see if I could gamify a tutorial in a way that the interaction would engage the participant. Second, I wanted to discover if there would be a greater exploration of the components since each was scaled in such a way as to allow for closer examination.

4.3.9. Exploded Diagram

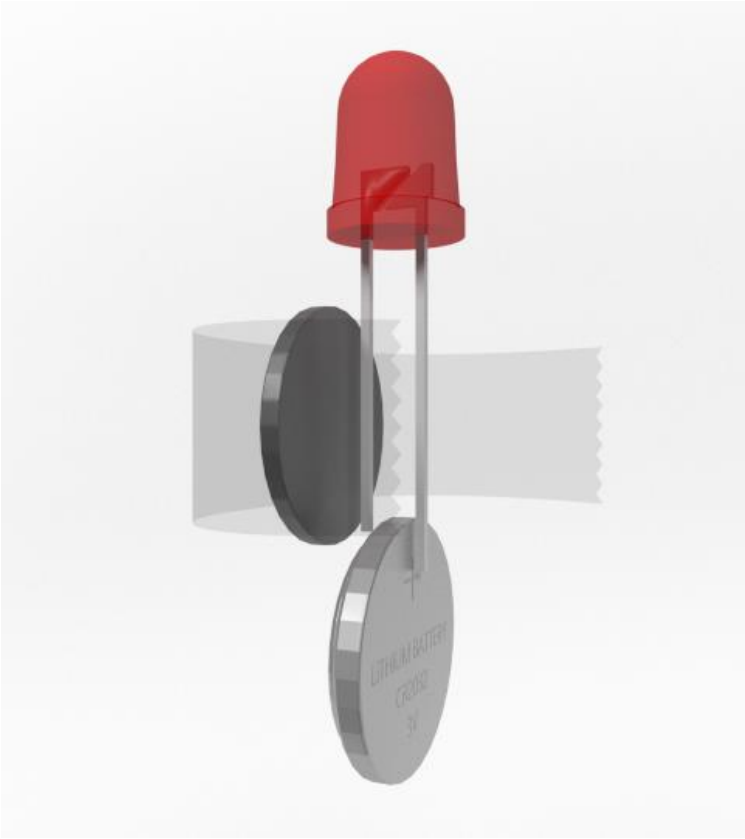


Figure 4.10. Exploded Tutorial

In the exploded diagram (Figure 4.10), the participant can see the LED Throwie coming together. It is a 3D modeled still image of the final stage of each component coming together. The battery is placed between the leads of the LED about to slide up into position, the magnet is set to the left of the leads about to butt up against them, and the tape, in the shape of a C, is wrapping itself around everything. The goal is to show multiple components coming together at a centralized location.

Each component was 3D modeled to its exact dimensions on the datasheets. Once everything was placed in the final exploded position, there was difficulty in seeing the difference between the lengths of each of the LED's leads. For this reason, the longer lead of the LED was lengthened to highlight the difference. The camera was

adjusted so the side of the battery with writing on it would be seen, ensuring participants knew which component it was. The color of the magnet was darkened significantly to create a greater contrast with the battery. Finally, the tape was bent into a 'C' shape and placed so it came between the camera, components and itself to show dimension. These modifications were done to clarify each component and to avoid adding text to describe what each item was. A detailed process of the creation of the 3D modeled LED used in this tutorial can be found on Instructables (http://www.instructables.com/id/Creating-an-LED-in-Blender/). All other 3D modeled components used in this tutorial, were created using identical methods. With all of the 3D modeled tutorials, one of the most difficult aspects of creating them, was learning to build and move around within the 3D environment. Once that was roughly figured out, the next hurdle became coloring and lighting the components. Each tutorial was modelled, colored and lit individually, so the process became easier with each new tutorial created, but each was still a struggle on its own.

There is one main concept I hoped to explore by building out this tutorial. Could a tutorial be expressed with a single image, using no explanatory text, and still be understood by the individual using it?

4.3.10. Zoetrope

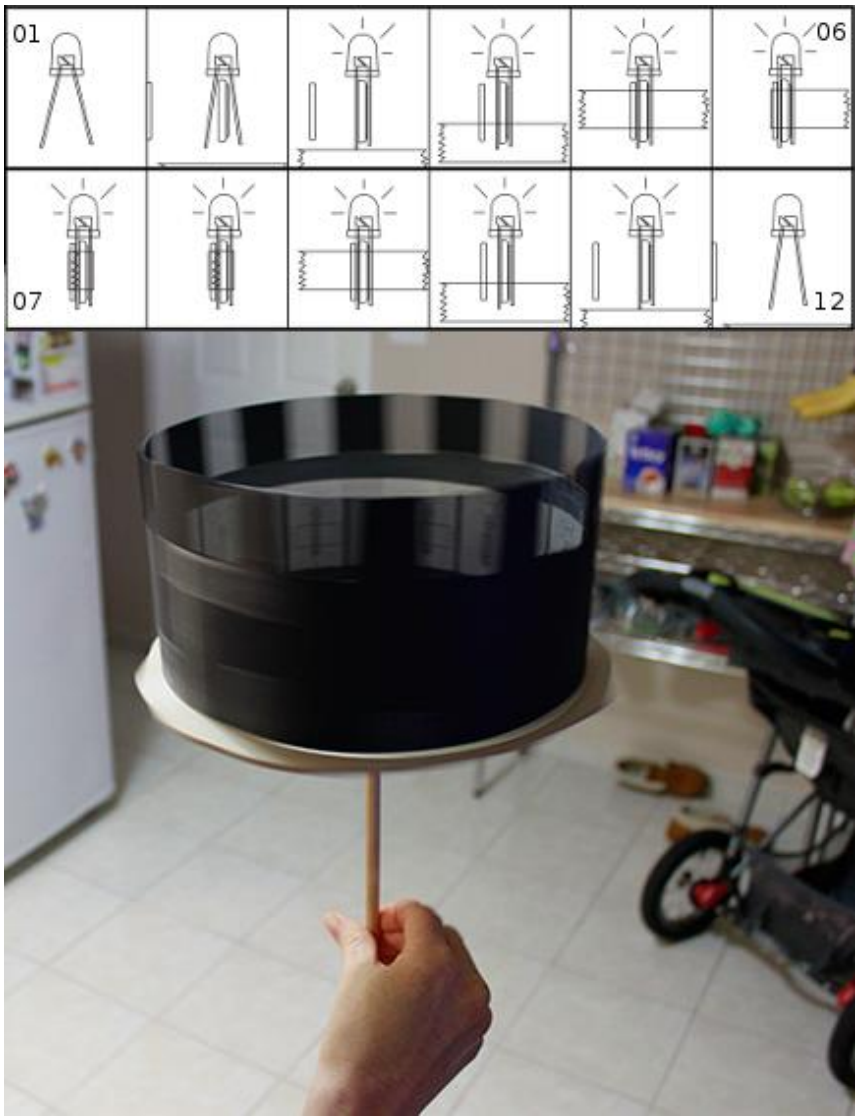


Figure 4.11. Zoetrope Tutorial
Note. Top: Sequence of 12 images on inner ring of
Bottom: finished zoetrope

A zoetrope is a device used to create the illusion of moving images. To do this, a sequence of images is placed inside of a cylinder. A slit is cut above each image just large enough to peer through. For this zoetrope, twelve black and white vector drawings were used with one slit centered above each image (Figure 4.11). The cylinder was

placed on top of a dowel rod. Spinning the rod in one's hands would spin the cylinder at eye level, so participants could easily watch the flip-book style animation.

To create the zoetrope, the first step was to build a zoetrope. To ensure that building it would be simple for any skill level, effort was made to only use easy to source materials and basic techniques. To give proper instructions with the shortest amount of images, twelve frames were chosen. Since the animation loops, that means there is really only six frames in which to get the point across. In addition, to keep the images as simple as possible, outlines for each component were used in only black. Each image was given two inches of space, which dictated the circumference of the cylinder. Then images were taped along the long edge of a piece of poster board, with a quarter inch of space between them. Once they were affixed to the poster board, a long rectangular strip with slits cut above each of the images was made using scissors. Taping the two short edges of the rectangle together created a cylinder with the images on the inside. With the cylinder put together, it was simply a matter of adding a bottom, and connecting that to a dowel rod. Additional images and further documentation can be found on Instructables (http://www.instructables.com/id/LED-Throwie-Zoetrope/). While other tutorials utilized laser cutters and other high end tools, this was made in my office, with hand tools and scrap wood lying around. This created two main issues in the build. First, sawing the wood into a circle to fit the poster board was not possible, so it was sawn as close as it could be. Second, finding a method of attaching the stick to the base that someone could hold and use to spin the zoetrope proved wrong on the first attempt which tried to use washers, nuts and bolts in order to secure a sturdy holding rod. In the end, a dowel rod that just happened to fit the hole drilled for the bolt was glued into place and left to hang dry to ensure straightness. It is not a method I would have sought out to employ, but as a quick and dirty technique to complete the build in order to try and verify the usability of the zoetrope, it worked perfectly.

There are three main concepts I hoped to explore by building out this tutorial. First, I wanted to see how simple an animation could be to demonstrate the entire build process of an LED Throwie. Second, I wanted to test if simple line art could express the process properly. Finally, I was curious to see if a non-traditional tool could express the instructions, with a zoetrope being the most non-traditional I could imagine. However,

using a similar set of images with tools like a ViewMaster (which the participant might already own), or an animated GIF would be much simpler to implement.

4.3.11. Animated

Figure 4.12. Animated Tutorial

This tutorial takes the concept of the zoetrope one step further. Using realistic 3D modeled parts, participants watched a twelve second animation of an LED Throwie being put together (Figure 4.12). No materials list is given in this tutorial, as each component is modeled and colored to look realistic. The battery also spins as it comes into frame, showing embedded text on the surface letting participants know which type of battery it is.

All components were modeled to scale using Blender and each component's datasheet. Appropriate material was applied to each model to give the proper look and reflectiveness of the actual components. The legs of the LED and the tape were rigged so they could be posed in different positions in 3D. When animating in 3D, models can be set in one position and have a key frame set, then moved into another position and have a second key frame set 30 frames later. The animation software will infer what the model is supposed to do between those key frames, and animate it. Using this technique, six strategic key frames were used to animate the entire LED Throwie build.

While 3D modelling the components was easier by this stage, adding skeletons to the models and animating them proved to be a new and unsurprisingly difficult experience. The full animation can be seen on YouTube (https://www.youtube.com/watch?v=2Z3fxYX7sGk).

There are two main concepts I hoped to explore by building out this tutorial. First, I wanted to see if there is a quick and simple method to animating a tutorial. Second, I hoped to determine if that animation would get better response than the zoetrope's simple 2D style of animation.

4.3.12. Stop Motion

Figure 4.13. Stop Motion Tutorial

The zoetrope gives a simple choppy animation of 2D components, while the animation shows realistic 3D models smoothly articulating throughout the video. To move beyond these, a method needed to be applied that would allow physical components to self articulate (Figure 4.13). Though stop motion, actual components can

be anthropomorphized to act inside of a storyline. When watching this forty-second video, an LED is seen walking up to and exploring a mountain of batteries to select the best one, then walking it home. Once home, the LED double checks that the battery works, before adventuring off to try to pry a magnet off a high perch. Once the second goal is achieved, the LED takes the magnet back to the battery and assembles itself. As the LED stands triumphantly lit, the slithering tape comes in to wrap everything up. All taped together, the LED is able to fulfil its destiny, climbing to the top of its magnetic perch. This story aspect, while very simplified in this example, gets lost in day-to-day tutorials that just present lifeless images and only give very succinct (or overly drawn out) bullet points on how to accomplish each aspect.

Before setting up to record the stop motion, two faces of a box were cut off to make an enclosure within which everything would happen. The camera was positioned so it could be referenced at each step to verify that the items set up looked good in frame. The cardboard box was lined with white walls, by cutting and taping printer paper to fit. Homemade Play-Doh was pressed along the bottom of the box, and used to hold components in place when positioned and moved within the box. The camera was linked to a computer. Components were moved by hand and I eyeballed the amount of movement between each frame. The space bar was pressed once an image of each new frame was ready to record, ensuring the camera did not move or get bumped. A total of 327 images were recorded and brought into Blender's video editor, where they were output at eight frames per second (fps). Using a lower frame count lengthened the animation, making it choppier. If I had used 30fps the final video would have only been eleven seconds, and the animation would have appeared smoother, giving the video a more professional finish. By having a more amateur feel, the hope was that participants would be a bit more patient with it. Further documentation and the final animation can be found on Instructables (http://www.instructables.com/id/Making-a-Stop-Motion-LED-Throwie/). Creating this tutorial proved simpler then expected, and very straight forward. It was created exactly how I thought a stop motion should be created, and turned out quite well. Having the experience of making it now though, there are programs I would use to simplify the creation process while also allowing the final video to look a lot better. The main way to accomplish this is through software that allows onion skinning, which

overlays a transparency of the most recent picture taken over what the camera is currently seeing, allowing for more exact movements in components.

There are three main concepts I hoped to explore by building out this tutorial. First, I wanted to see if components could have their own character traits, and if those characters would be interesting. Second, I hoped to determine if personifying components would make a difference in the reception to a non-standardized tutorial format. Finally, I attempted to separate a tutorial from everything that traditionally makes it a tutorial, and see if it could still work.

4.4. Presentation

Once the design of each tutorial was finished, there needed to be a method of sharing them with participants. Choices that focused on what and how much to share were: how many tutorials should each participant follow, should participants receive a kit of the tutorial to follow (if needed), and whether participants would actually be asked to build each tutorial? This section will answer these questions, and provide insight on how the final tutorials were shown to participants.

First, a decision had to be reached about how many tutorials each participant should receive. Only sending a few tutorials to each participant might increase the amount of feedback given on each. On the other hand, by allowing participants to see as many tutorials as possible, they would be able to compare them against each other. The ability to contrast and compare viewpoints between participants seemed useful, so the second option was chosen. To buffer the possible limitations of feedback received on each tutorial, it was decided that additional participants would be invited to partake in the study.

While having participants physically follow the tutorials would have provided additional insight, it was decided that no significant revelation would be discovered at this initial stage. So the idea of sending out kits was quickly discontinued. Further, each

of the tutorials could be presented through the web. After publishing tutorials to multiple websites: YouTube, Instructables, and my own website, a master page was created to consolidate them. The master website went though many revisions, but the final design consisted of embedded videos from YouTube, and rewriting the Instructables in order to better fit with the overall website design. The final webpage hosted each of the twelve tutorials, instructions for completing the study, additional study details, behind the scenes details for those that wanted more information, and a survey. A printable copy of the website can be found in Appendix A, E and F.

On the first iteration of the website, participants were faced with a survey of seven open-ended questions after they viewed all of the tutorials. While making website revisions and updates, it was discovered that there was another opportunity for initial impressions on each tutorials page, as well as a rating score. Due to the amount of work, and lack of compensation, it was decided that participants would not be asked to physically follow along with the tutorials. Instead, they were asked to read the tutorials and visualize physically building the projects laid out.

The tutorials in the previous section were organized and presented in my own groupings. These groupings followed the general format and structure of the tutorials. Modified versions of traditional step-by-steps were the recipe and abstract. Literary and poetic styles consisted of BYOA, the song and haiku. Other tutorials required patience or contained puzzles: Rubik's Cube, calendar and the exploration game. There were also the animations: zoetrope, 3D animated and stop-motion. Finally, there was the exploded diagram, in a category all its own, while also sharing a category with the other tutorials that utilized 3D modeled parts. This is how I divided and grouped these tutorials. A concept I hoped to explore across all of the tutorials was to see how participants might group the tutorials. It would also be interesting to see if certain groups were rated higher than other groups. Another concept I wished to explore, was whether general consensus while looking at the different techniques would elicit a greater sense of positive or negative reactions, which I hoped to understand when reading the responses.

4.4.1. Conclusion

This section looked at the background, planning stages and creation of the tutorials, all the way though to uploading them onto a website for the participants to evaluate. Every tutorial was explained, including the steps required to build it. In addition, each tutorial had questions associated with it, providing insight into why it was built and points to investigate within the research. A few additional points were also offered that encompassed multiple tutorials.

In the following section, I will analyze and investigate the findings from building each of the tutorials, along with feedback from the participants.

Chapter 5. Analysis and Findings

5.1. Introduction

This chapter will discuss the initial coding and data analysis that followed. The first section of this chapter will begin by detailing the coding techniques used on participant's responses, then show how those codes were utilized to find patterns within the data. The following section will discuss the data and patterns found in those responses. It will start by looking into questions brought up in the tutorial chapter, and identify how participant’s responses addressed those issues. It will then review survey responses, identifying patterns that emerged within those answers. Throughout the tutorial and survey investigations, effort was made to identify patterns within the expert and amateur groups, as well as patterns that transcended to both groups, in order to identify commonalities and differences between the two groups of participants.

The following sections will present categories of interest found by using these methods and the next chapter will discuss further what these categories mean in regards to the future generation of tutorials.

5.2. Tutorial Analysis

This section begins with a focused analysis of the individual tutorials. Looking into the questions asked in the tutorials section, as well as additional information gleaned. Following tutorials, specific patterns that cropped up will be discussed as well as differences between expert and amateur responses.

Each of the tutorials will have three important elements. It will begin with a table presenting the most abundant codes found when reviewing the comments on that tutorial. Following that will be observations and comments on the codes, with occasional quotes to help make sense of observations. Finally, an image of the tutorial as it was displayed on the website will be shown. In two cases, this was not feasible: BYOA and Exploration. For these, a screenshot from within the book and within the game was used, as there were no images on the website. When the tutorial was presented in a video, a screenshot of the video player is shown. To view how each of the full tutorial pages looked, please refer to Appendix F.

5.2.1. Tutorial Responses

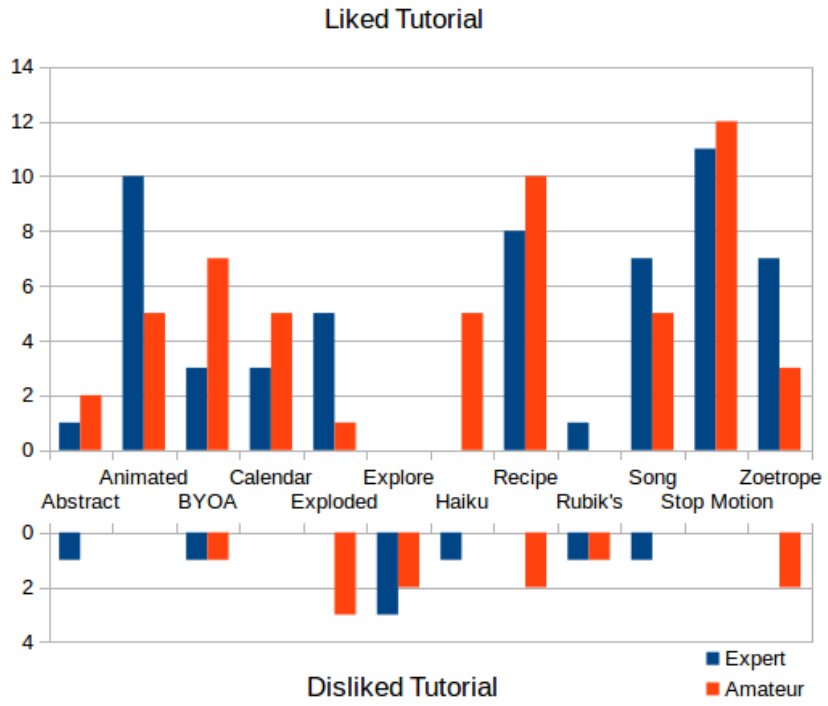


Figure 5.1. Liked and Disliked Tutorials

At the end of each tutorial an empty comment box was placed, and written just above the box were the words, “Initial impression?” While comments entered here brought up issues with tutorials and in which settings those tutorials might be useful, the

comment box occasionally contained the participant's feelings towards the presentation method being shown. These feeling were coded into one of four codes, liking tutorial, liking concept, disliking tutorial, or disliking concept. When participants referenced the tutorial specifically, saying things like, "*Very cool! I enjoyed this*" -A5 the comment was tagged as liking the tutorial. When the comment was less direct, only mentioning liking the idea, or that it does not work in this scenario, it was tagged as liking the concept.

The 'liked' data was quite revealing, as can be seen in the graph presented in Figure 5.1. This graph is looking at participant's initial impressions. Animated, calendar, and stop motion did not have any detractors. Interestingly, even when combining comments from both experts and amateurs, no tutorial besides the exploration game had more than three participants out of twenty-four dislike it. Conversely, six tutorials had more than ten participants like them, and stop motion surpassed all of the tutorials with twenty-three participants liking it. When comparing experts to amateurs, there is a noticeable difference in animated, exploded, and zoetrope tutorials where experts can be seen preferring these methods. This can similarly be seen with BYOA, calendar, haiku, and recipe, though these were preferred by amateurs. These preferences will be discussed in more detail later.

5.2.2. Recipe

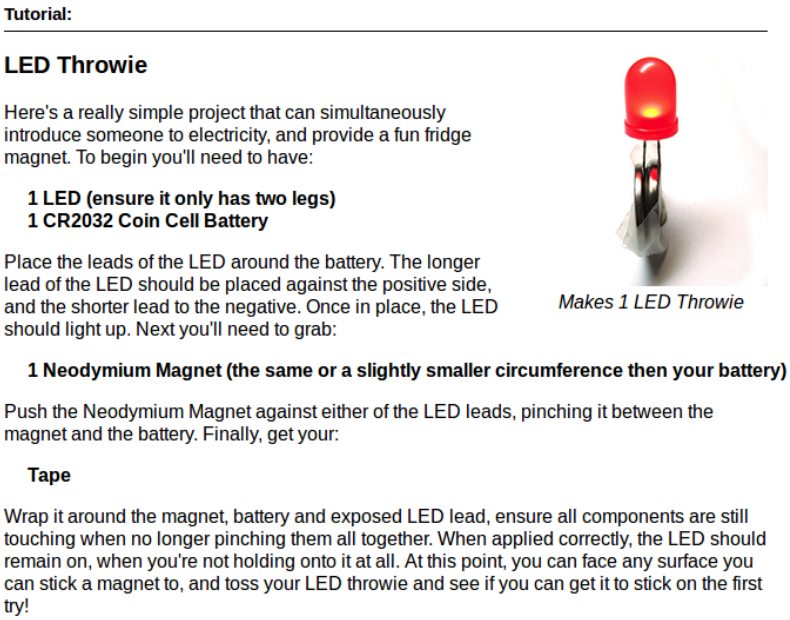
Table 5.1. Recipe Tutorial Codes

Codes	Amateur Participants	Expert Participants
Disliking tutorial	A04, A14	--
Disliking verbose	--	E02, E13
Liking BoM	A03, A08, A12	E15
Liking clarity	A04, A11	--
Liking concept	--	E02, E07
Liking image	A05, A07	--
Liking steps	A08, A12	--
Liking tutorial	A03, A05, A06, A07, A08, A09, A10, A12, A13, A15	E01, E05, E06, E08, E09, E12, E14, E15
Wanting BoM up front	A03	E07, E12, E15
Wanting images	A11, A15	E10, E13

The first goal of this tutorial was to demonstrate that a DIY tutorial could be ported onto any generic tutorial format, even if the layouts were completely different. To this end, this tutorial was a success. Amateurs and experts alike expressed their comfort with this tutorial style. I additionally wanted to show that advanced tutorial makers would enjoy this technique more than amateurs did, as it was the closest to what they already knew. While amateurs were the only group that disliked this tutorial format overall, there is nothing in the data that shows experts had any more inclination towards this technique than did amateurs.

The recipe was one of very few presented tutorials that contained a materials list for the project in a bolded textual format (Figure 5.2). The need for a materials list (*BoM*) was a common request among participants and would repeatedly be brought up in many other tutorials. While the recipe had fewer requests than most, and had amateurs and experts alike express how they enjoyed the way materials were presented, there were still several participants who wanted a list presented at the beginning of the tutorial. Two other features arise in this tutorial, which will be seen in several other tutorials. First, is

the desire for additional images. In many cases, both groups of participants requested images of the process or final state of the LED Throwie, depending on the state it was shown in the tutorial. Second, the code *disliking verbose* became very common. In this tutorial, experts wanted the recipe text to be more concise and to the point.



Tutorial:

LED Throwie

Here's a really simple project that can simultaneously introduce someone to electricity, and provide a fun fridge magnet. To begin you'll need to have:

1 LED (ensure it only has two legs)
1 CR2032 Coin Cell Battery

Place the leads of the LED around the battery. The longer lead of the LED should be placed against the positive side, and the shorter lead to the negative. Once in place, the LED should light up. Next you'll need to grab:

Makes 1 LED Throwie

1 Neodymium Magnet (the same or a slightly smaller circumference then your battery)

Push the Neodymium Magnet against either of the LED leads, pinching it between the magnet and the battery. Finally, get your:

Tape

Wrap it around the magnet, battery and exposed LED lead, ensure all components are still touching when no longer pinching them all together. When applied correctly, the LED should remain on, when you're not holding onto it at all. At this point, you can face any surface you can stick a magnet to, and toss your LED throwie and see if you can get it to stick on the first try!

Figure 5.2. Recipe Tutorial Screenshot

5.2.3. Abstract

Table 5.2. Abstract Tutorial Codes

Codes	Amateur Participants	Expert Participants
Disliking abstraction	A01, A05	--
Disliking barrier to entry	--	E07, E13
Disliking language	A15	E04, E13, E16
Disliking tutorial	--	E07
Disliking vague	A12	E01, E03, E04, E05, E07, E08, E09, E11, E12, E13
Disliking verbose	A03, A10, A14	--
Liking concept	A03, A07, A09, A10	--
Liking tutorial	A04, A07	E15
Wanting examples	A09, A13, A15	E11
Wanting images	A06, A07, A08, A11, A12	E02, E10, E15

I expected the abstract method to fail due to the ambiguous nature of the directions. While mainly experts commented on the vague, and overly descriptive nature of the tutorial, combining to create an overly confusing and complex instructional strategy, several amateurs made these observations as well. However, even though it was expected to fail, another concept this tutorial attempted to explore was whether amateurs might enjoy it more as it opened up the possibilities of what they could do, while providing more general information. As can be seen in the responses above, experts were far more adamant about disliking the vagueness present in the tutorials (all but two experts mentioning it specifically). Additionally, only one expert expressed any sense of liking the presentation method. Amateurs, however, while requesting simpler language and images to help visualize the basic concepts, felt these fixes would make the whole tutorial much better and possibly due to this, rated it higher.

In future iterations, this tutorial would need more concise language, while providing images of an assortment of optional components that could be substituted. With those two modifications, I feel amateurs would be even more inclined to like this method of presentation. Also, while uncertain how these changes would alter expert's

feelings, it was pointed out by several expert participants that this style might be better suited for presenting to experts.

> "I feel this method is suitable for people who are already invested in the challenge of making, not attracting new makers to build." -E2

Tutorial:

Step 1: Materials List

- DC Light Source
- Portable DC Power Supply (Strong enough to power light source)
- Binding agent or material
- Tool, material or hardware for discriminant placement

Step 2: Test your Light Source

- With your DC light source selected, plug it into your portable DC power supply and ensure that it is powered.
- While it's lit, determine if you like the color/diffusion the light source has, and if not, change it.
- **Coloring:** There are many inks, paints or gels you can use to alter the appearance of your light (be sure to use inks/paints/gels that can withstand whatever temperatures your light may emit).
- **Diffusing:** There are lots of techniques to diffuse a surface, depending on what it is. If you're light source has a glass casing, you can use a glass etching cream to give it that diffused look.

Step 3: Bind the light source to the power source

- Using the binding agent or material you selected, bind your light source and power source together, so that your light source is always powered. Ensure you bind your parts together well, you don't want flickering lights, or lights to unplug.

Step 4: Bind your tool for discriminant placement

- Now attach the tool, material or hardware you choose to discriminatingly place your object around.
- **An important note on discriminant placement:** It's difficult to find a method to attach your object to any and every surface you happen across, while also allowing you to remove it and attach it to another surface without leaving permanent damage. Depending on the size and weight of your light and power source, let that inform how and where you attach it to things. Perhaps your technique for placement is to blend it into the background so it looks like it's supposed to be there. Using bricks, wood, or other materials that are common in the area. If you want to hang it up higher, you might use a nail and only stick it to tree's in public spaces. There are many options, so think about where you want to place it, then think about how you're going to place it there.

Step 5: Let your light loose on the world!

- If you want to put your piece in a public place, try to find times when no one is around, or do your best to look professional and be ready to answer questions when someone asks what you're doing. Maybe the city is looking into crowding in this location, and a camera in the building across the street needs to keep track shadows walking across this light to tally the number of people walking past in a day. Get creative, it's fun!

Figure 5.3. Abstract Tutorial Screenshot

5.2.4. BYOA

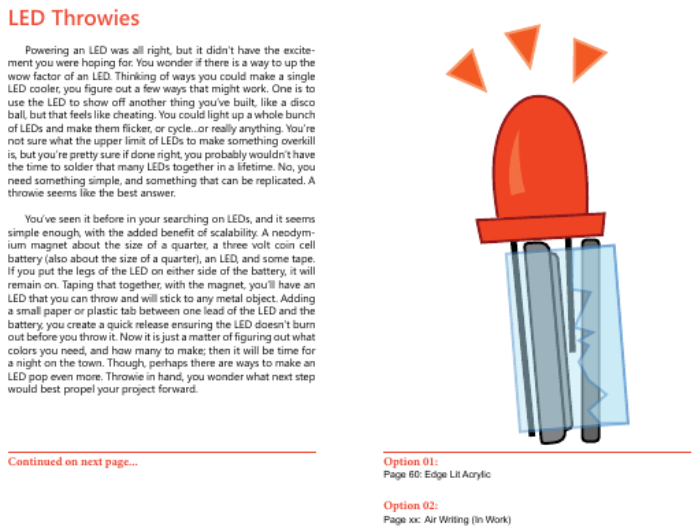
Table 5.3. BYOA Tutorial Codes

Codes	Amateur Participants	Expert Participants
Disliking length (wanting concise)	A02, A03, A06, A09, A10, A12	E05, E12, E15
Disliking verbose	A06, A09, A11, A12, A15	E01, E09, E10
Feeling accomplished	A05, A15	--
Liking choices	A01, A02, A11	E04, E13
Liking concept	A05, A13	E02, E04, E09, E15
Liking distraction	A04, A13	--
Liking exploration	A06, A08	E04, E13
Liking layout	A06, A07, A11	--
Liking tutorial	A01, A05, A08, A09, A10, A11, A15	E10, E12, E16
Wanting images	--	E12, E16

I wanted to explore two concepts with BYOA. First, was to see if agency would encourage engagement within the tutorial. Second, would be if the exploration of how one project can be built into another, would interest amateurs. Several amateurs not only enjoyed making choices and reading the information, they expressed feelings of accomplishment and learning from the tutorials. Several experts expressed their enjoyment of agency as well.

While participants were given explicit directions and a path to follow through the book, several either read extra on their own, or did not realize they were supposed to take a certain path. In a comment, E16 requested an image of a transistor to help make sense of a difficult portion of the third part of the Tesla coil instructions. Not only did the path marked in the book not lead to this tutorial, navigation this far off the path would be very difficult to accomplish accidentally. There is a significant chance that several of the participants who felt the tutorial was too “text heavy” may not have followed the path laid out, and therefore, were reading very rough, unedited passages that did not include accompanying illustrations.

While amateurs overwhelmingly liked this tutorial more than experts did, they also pointed to the overabundance of text used to describe everything. While the text might have been verbose, in this instance, it was written this way on purpose. The second-person style narrative traditionally used in this type of writing tends to be overly descriptive, and that aspect was maintained.



LED Throwies

Powering an LED was all right, but it didn't have the excitement you were hoping for. You wonder if there is a way to up the wow factor of an LED. Thinking of ways you could make a single LED cooler, you figure out a few ways that might work. One is to use the LED to show off another thing you've built, like a disco ball, but that feels like cheating. You could light up a whole bunch of LEDs and make them flicker, or cycle...or really anything. You're not sure what the upper limit of LEDs to make something overkill is, but you're pretty sure if done right, you probably wouldn't have the time to solder that many LEDs together in a lifetime. No, you need something simple, and something that can be replicated. A throwie seems like the best answer.

You've seen it before in your searching on LEDs, and it seems simple enough, with the added benefit of scalability. A neodymium magnet about the size of a quarter, a three volt coin cell battery (also about the size of a quarter), an LED, and some tape. If you put the legs of the LED on either side of the battery, it will remain on. Taping that together, with the magnet, you'll have an LED that you can throw and will stick to any metal object. Adding a small paper or plastic tab between one lead of the LED and the battery, you create a quick release ensuring the LED doesn't burn out before you throw it. Now it is just a matter of figuring out what colors you need, and how many to make; then it will be time for a night on the town. Though, perhaps there are ways to make an LED pop even more. Throwie in hand, you wonder what next step would best propel your project forward.

Continued on next page...

Option 01:
Page 60: Edge Lit Acrylic

Option 02:
Page xx: Air Writing (In Work)

Table 5.4. BYOA PDF Screenshot

5.2.5. Song

Table 5.5. Song Tutorial Codes

Codes	Amateur Participants	Expert Participants
Disliking language	A05, A10	E02, E07, E15, E16
Disliking speed	A04, A06, A12, A13, A14, A15	E09
Disliking tutorial	--	E01
Liking BoM	--	E08
Liking concept	A07, A08, A09, A10, A12, A13, A14, A15	E05, E14, E15, E16
Liking fun	A05, A06, A07, A08, A09, A11, A13	--
Liking tutorial	A05, A06, A07, A11, A13	E02, E04, E08, E09, E10, E12, E13
Wanting BoM	A08, A12	E15
Wanting images	A04	--
Disliking intro	A15	E07, E15
Wanting video	A03, A06, A12, A15	--

This tutorial looked into two concepts. First, was to see if audience enthusiasm could be retained though drastically altering the delivery mechanism of the tutorial. Second, would be to see if a catchy song might get stuck in participant's head. While this research was unable to answer whether the song got stuck in any of the participant's heads, the delivery mechanism was an overwhelming success, as this technique was similarly liked by both groups.

Participants had three issues with this song. Amateurs expressed their dislike for the speed of the song. This is not very surprising as the tutorial is sung to the tune of an up-tempo punk rock song, and no lyrics are given. In the future, having the lyrics might abate this issue. Another issue that arose slightly more with experts was the dislike of the language. Something that emerged in several tutorials was experts feigning ignorance on behalf of amateur makers. While amateurs would occasionally have these problems, or express similar issues, it would never be to the scale assumed by experts, as seen in Table 5.5 and the quote below. The final issue that was set forth by both

amateurs and experts was a dislike of the introduction. The song opens with a thirty-second instrumental which created more frustration than expected.

> “Bop? What kind of batteries? The cathode to the plus bit, but I can't get the other line, oh wait the cathode to the anode? What is an anode? Sorry. I don't know what LED throwies are other than magnets with lights that you throw at cars (very cool idea) but what is an anode?” -E7

On the other hand, a few positives emerged in the responses as well. Amateurs pointed out the fun aspect of the song. A8 summed up the feeling well with, “I have NO words. Only one half sung, half whispered word: Aaaaawwweeesssooommmeeee.” Many amateurs expressed their enjoyment of the fun in this tutorial. Several amateurs also expressed their desire for an accompanying music video, pointing out that it would do nothing but bolster the understanding of the lyrics and directions. One expert also noted their enjoyment of the materials list provided in the song. Since effort was made to port the essence of the Instructable as exact as possible to this format, the materials list was placed in the first verse, followed by the steps. While several other participants missed this, the fact that one noticed means that it is possible to express the materials list in this way.

Figure 5.4. Song Tutorial Screenshot

5.2.6. Haiku

Table 5.6. Haiku Tutorial Codes

Codes	Amateur Participants	Expert Participants
Confusing	A07, A09, A10, A11, A12, A14, A15	--
Disliking abstraction	--	E08, E09, E13, E15
Disliking tutorial	--	E02
Disliking usefulness	A03, A05, A06	E10
Liking concept	A04, A09, A10, A11, A12, A14, A15	E01, E07, E10, E13, E15
Liking tutorial	A03, A05, A07, A08, A13	--
Wanting BoM	A01, A12	E08, E13, E15
Wanting details	A04, A08	E01
Wanting kit	--	E08, E13

I wanted to explore two concepts within the Haiku. First, could a tutorial work within limited, succinct constraints. This was accomplished twice, with two different drafts of the haiku, both of which had directions worded slightly different. Second, was to see how effective these directions could be. Within this format there is plenty missing. Aside from the abstract and poetic nature, there is no materials list or image to assist the reader in putting the project together. Though even with these drawbacks, five amateurs expressed liking this tutorial when they initially saw it, and three tagged it as one of their favorite presentation methods overall after seeing everything else.

While a majority of participants from each group liked the concept of presenting tutorials this way, amateurs found the instructions confusing, while experts were not fans of the abstraction. Commenting on the lack of usefulness this technique employed, A03 points out, "*On the other hand, if it can be this simple, it might be so.*" The idea being, that if instructions can be presented in such a simple manner, it might remove some trepidation the participant may have had at the start.

Two experts expressed interest in these directions, if they were included within a kit. Their thought was that having all of the components in addition to the directions,

would preclude the confusing aspects individuals encountered when following the instructions.

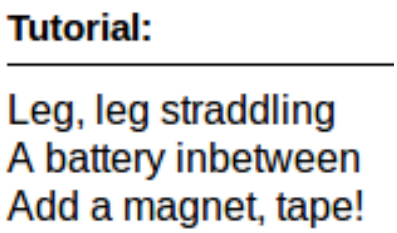


Figure 5.5. Haiku Tutorial Screenshot

5.2.7. Rubik's

Table 5.7. Rubik's Cube Tutorial Codes

Codes	Amateur Participants	Expert Participants
Disliking barrier to entry	A03, A04, A10, A12, A14, A15	E01, E05, E06, E08, E14, E16
Disliking tutorial	A07	E07
Liking BoM	A06	--
Liking concept	A05, A08, A10, A13	E04, E07, E08, E12, E13, E14, E15
Liking tutorial	--	E10
Wanting steps	A05, A06, A11, A12	--

The first concept I wanted to investigate with this tutorial was to see if a layer of obfuscation would deter people from making the project. In short, it did. Both groups expressed disliking any sort of barrier that needed to be solved to get to the task they wanted to do. There was a small group of amateur participants who were intrigued by the concept of this tutorial and they wanted to see more, these were among the minority. While several experts expressed how they did not like puzzles, they also saw effective uses for this presentation technique that they could immediately utilize. Their suggestions included gifting it to a friend, presenting it in a kit, and one expressed a desire to see it used within an escape room game, where solving the cube would give participants directions on how to get out.

The other concept explored was whether those who could solve a Rubik's Cube would feel a greater sense of accomplishment. While those who were able to solve the Rubik's Cube generally enjoyed the concept more, their feelings of accomplishment were not discussed. This is most likely due to not requiring participants to solve a cube, but instead playing them a video showing it being solved. Participant E10 suggested creating a cryptex styled device that reveals a hidden chamber with the Rubik's cube containing components when solved. This seemed like one method that might be able to infer that feeling of accomplishment. Several amateurs, including one who can solve a Rubik's Cube, expressed a desire simply to have steps, rather than to go through the process of solving one thing, to decipher another.

Figure 5.6. Rubik's Cube Tutorial Screenshot

5.2.8. Calendar

Table 5.8. Calendar Tutorial Codes

Codes	Amateur Participants	Expert Participants
Disliking instructions	A06, A13	--
Feeling impatient	A02, A04, A06, A10, A12, A15	E03, E04, E05, E13, E16
Liking concept	A03, A09, A14	--
Liking instructions	A01, A07, A09, A12	E03, E04, E08, E09, E13
Liking kit	A08, A11	--
Liking tutorial	A01, A05, A07, A11, A14	E10, E12, E15
Liking waiting	A03, A11, A13	E02, E09
Wanting audio	A07, A15	--
Wanting images	A09	E16

Of the two questions originally put forward about the Calendar tutorial, the second was answered as soon as the tutorial was created. The question asked if instructions could be presented without revealing any other components or tasks involved in the making of a project. The instructions developed for this project were overwhelmingly liked by experts, while receiving a slightly more mixed view from amateurs, with four participants exclaiming how they liked them, while two did not. While both groups felt they would be impatient if they had to build this project, they also expressed that they liked this project more than not. The impatience felt, among all participants, was the desire to open up all of the days at once. Participants wanted to be able to build projects at their own pace. The other concept this tutorial looked to explore was whether this method of presentation could encourage tutorial users to explore each component as they opened it. A minority of participants who were patient, or liked waiting, expressed their interest in exploring materials.

> "I think it is nice that you get to only have one piece at a time. It will let you really think about this one and get more familiar with it before you actually put all the pieces together." -A11

Two amateurs pointed out their enjoyment of the kit aspect of this project, getting the instructions and materials all together. Presenting this tutorial as a kit might also explain why no participants who requested a materials list. Additionally, two amateurs requested audio with this tutorial. Participants requesting audio/video will be discussed in detail later. I wanted to draw attention to it in relation to this tutorial to point out that even when audio does not make sense in the context of a tutorial, it was still requested. Both amateur participants requested a voice-over for the video that would describe what was happening, as it was happening.

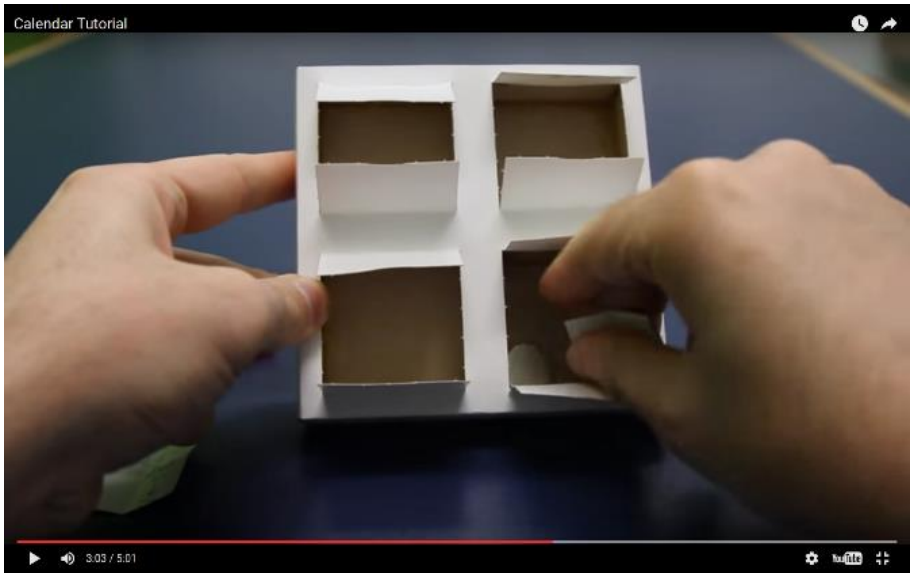


Figure 5.7. Calendar Tutorial Screenshot

5.2.9. Exploration

Table 5.9. Exploration Tutorial Codes

Codes	Amateur Participants	Expert Participants
Disliking barrier to entry	A04, A05, A09, A11, A12, A15	E01, E15
Disliking concept	A06, A12	--
Disliking tutorial	A05, A13	E03, E05, E15
Disorienting	--	E03, E05
Liking concept	A03, A13	E02, E16
Wanting to play/Unable	A03, A06, A09	E04, E08, E09, E10, E12

The exploration game was largely a failure. The main reason for this was due to the difficulty and extra steps required to open the software. While an executable had been created for Microsoft Windows, the game software was not able to export an executable for any other operating system. For participants not on a Windows computer, there was a multi-step process required to download the game file and the game engine. They had to install the game engine, open the game file, and learn basic functions in the game engine in order to run the game. For Windows users, the zipped file they downloaded consisted of over 2,000 files in different folders. While the executable was in the main folder with only sixteen other items, it still seemed to be a deterrent. Because of all of this, over half of the participants who choose to download the software were unable to get it to work, and four participants in each group decided to skip commenting on it entirely.

Once the remaining participants who were willing to downloaded the software figured out how to play the game, new issues arose. Several participants had problems with the fog, the scale, or they were not fans of the exploration aspect, two specifically calling it disorienting. Many of the participants who were not able to play the game expressed an interest and desire to play the game they read about. Of the minority of participants who were able to play this game, several commented on how to make it more effective.

> "It took some time to figure out how to play the game. This simple exploration model might not be effective, but if there was more interactivity, then <the player> might learn more from the game model." -A10

In creating this tutorial, the only software that was used was Blender and the Blender Game Engine. Due to this self-imposed constraint, a huge learning curve made it difficult to create an immersive or unique environment. Swapping to a game engine that was primarily for making games, and not as a 3D modeling program first and a game engine second, might alleviate some of these issues. At a minimum, using software like Unity (unity3d.com) would have allowed exporting a single executable file to all operating systems, and would have made creating interactions slightly easier. While it is unknown whether this would have helped make the game better, it would have allowed for quicker iterations, leading to finding issues faster to attempt to correct or redesign them.

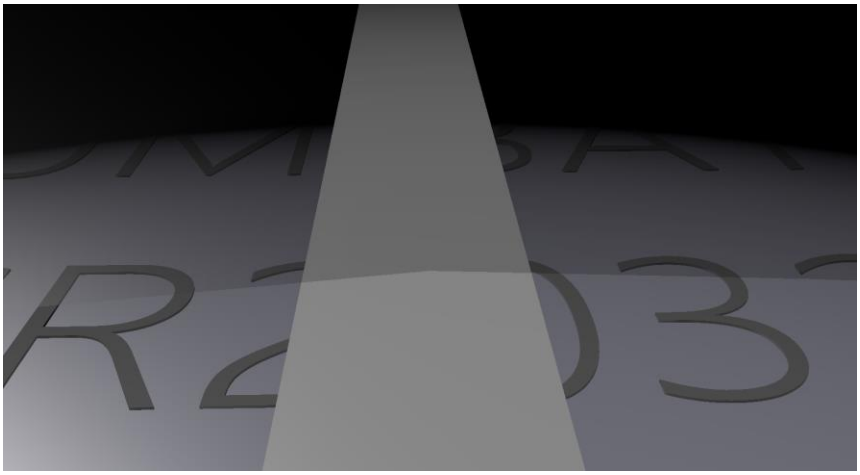


Figure 5.8. Exploration Tutorial Screenshot

5.2.10. Exploded

Table 5.10. Exploded Codes

Codes	Amateur Participants	Expert Participants
Disliking tutorial	A15	--
Liking concept	A13	E12
Liking tutorial	A11	E02, E03, E08, E10, E15
Misreading image	A07	--
Wanting annotation	A02, A03, A04, A05, A08, A10, A14	E15
Wanting BoM	A06, A11, A12	E02, E04, E05, E08, E09, E10, E12, E13, E15, E16
Wanting finished image	A02, A03, A05, A12	--
Wanting steps	A06, A07	E07

The exploded method only sought to explore one concept: could a single image, with no explanatory text be understood and utilized by individuals to create a project? There are two answers to this question. If you are an amateur, then the answer is no. Amateurs wanted annotations, material lists, steps, and additional images. They had difficulty understanding what stage in the process the image was showing. With no text to accompany the image, and no annotations on the image, amateurs were not sure which direction the components were supposed to go, or how it was all supposed to fit together. On the other hand, if you were an expert, the answer to this question is yes. While a majority of experts wanted to see a materials list accompanying the exploded diagram, it was their only issue. A few experts pointed out that this technique could only work for simple projects, and since this project was simple, it worked well. The only expert that requested to see addition stages of the process (wanting steps) did so on behalf of amateur builders, and only wanted to know what to do after it was built, not more details of the building process:

> “But assuming I don't know what a throwie is I would need the next step - what do you do with it?” -A7

Tutorial:

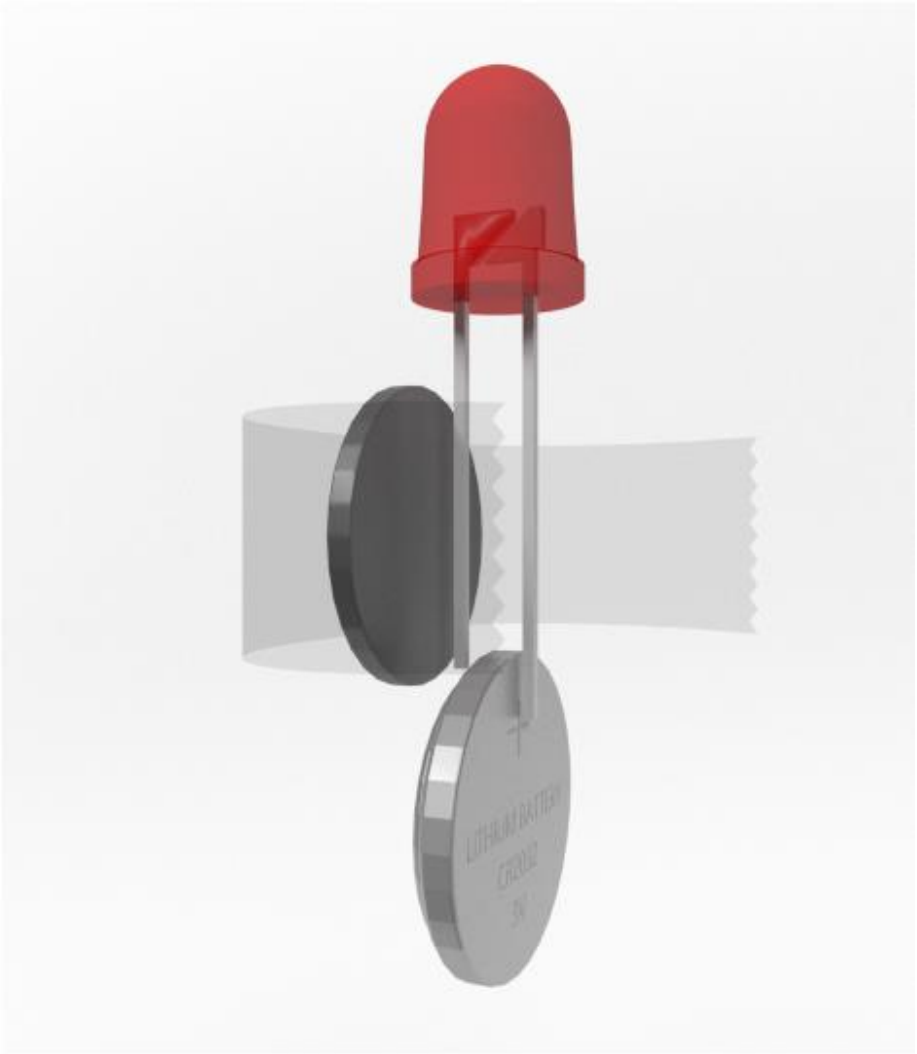


Figure 5.9. Exploded Tutorial Screenshot

5.2.11. Zoetrope

Table 5.11. Zoetrope Tutorial Codes

Codes	Amateur Participants	Expert Participants
Disliking barrier to entry	A12	E02
Disliking tutorial	A05, A15	--
Liking concept	A07, A10, A12, A13	E02, E05, E10, E15
Liking tutorial	A03, A04, A11	E04, E06, E08, E09, E12, E13, E16
Wanting BoM	A10, A11, A12	E05, E07

I wanted to explore three aspects in creating the zoetrope tutorial method. First, how simple could an animation be and still express how to build a project? With twelve frames, many of them duplicated, it was possible to express understandable directions to many participants with this technique. Second, could the how to build method be expressed solely with line art? Through participant's enjoyment of this tutorial, it seems that only using black lines on a white background is a viable method of expressing all the components and their interactions. This includes inferring the idea that the LED is turned on using action lines (seen in Figure 4.11), which was noted by several participants, as seen below.

> "This is great! Mainly because of the blinky light lines. it gives it the element of "why" I am putting this together." -E08

The final question, would participants be willing to use non-traditional tools to view the instructions? This question gets a more polar reaction. Much like the exploded diagram tutorial, experts overwhelmingly liked this method, while amateurs were less enthusiastic. Three amateurs liked this technique, while two others voiced disliking it. Many participants from both groups compared this technique to animation, but while experts commented that both the zoetrope and animation did a good job expressing the required steps, amateurs felt this technique was far inferior. Most amateurs skipped over what they did or did not like, instead pointing to comments they had already made on animation. Several experts did the same.

Figure 5.10. Zoetrope Tutorial Screenshot

Note. An additional image of the zoetrope was shown on the website and can be seen in Appendix F.

5.2.12. Animated

Table 5.12. Animated Tutorial Codes

Codes	Amateur Participants	Expert Participants
Liking concept	A06, A13, A15	--
Liking images	A07, A12	E09, E12, E15
Liking sequencing	A07, A08	--
Liking simplicity	A01, A03, A05	--
Liking speed	A09, A14	--
Liking structure	--	E09, E16
Liking tutorial	A01, A03, A07, A08, A11	E01, E03, E04, E05, E08, E10, E11, E12, E13, E15
Misreading materials	A08	E03, E04, E05, E07, E08, E11, E12, E13, E15, E16
Wanting audio	A07, A10, A12, A15	E01
Wanting BoM	A01, A05, A08, A09, A10, A11, A12, A13, A14, A15	E07, E10, E11, E15

Animation received rave reviews. The first concept I wanted to explore with this method was whether the reviews would be more favorable than the zoetrope. Between both groups of participants, this presentation technique was seen as superior to the zoetrope. Among experts, this is the highest rated tutorial overall. Experts felt this presentation method was the most useful of all tutorial methods shown. The main issue between both groups of participants was the lack of a materials list, which was noted by more than twice as many amateurs as experts. Many participants had difficulty recognizing the magnet, and several did not notice the beginning second of animation when the battery information was displayed, which can be seen in Figure 5.11. By showing the battery longer, or focusing on the battery as it rises up, this issue might easily be resolved. The magnet will be discussed later in this section.

The other concept I wanted to explore with the animation was to see if there was a simple method of animating all of the components that was not time consuming. While creating each component was a somewhat time intensive process, and creating bone

structures adds additional time, once the animation work was begun, it took less than ten minutes to create this tutorial. By downloading freely available models online of project materials, the total time to model and animate could be significantly reduced.

Two things garnered my attention about the responses to this tutorial. The first was the amateur's desire for audio, which was mentioned earlier and will be discussed later. The second was the number of experts who misread the materials in this animation. As stated earlier, experts feigned ignorance on behalf of amateurs and in a few cases that is all that appears to be happening. However, many of the responses from experts showed that they were genuinely confused about the materials. I am not sure if this was actual confusion from experts, further feigned ignorance on behalf of amateurs, or a passive way of asking for a materials list. The misreading of tutorials and materials will be discussed further after the next section.

Figure 5.11. Animated Tutorial Screenshot

5.2.13. Stop Motion

Table 5.13. Stop Motion Tutorial Codes

Codes	Amateur Participants	Expert Participants
Liking concept	A09, A10, A12	--
Liking no BoM	A05, A06	--
Liking personification	--	E09, E12, E13, E14
Liking sequencing	A06, A13	--
Liking story	A04	E04
Liking tutorial	A03, A04, A05, A06, A07, A08, A10, A11, A12, A13, A14, A15	E02, E06, E07, E08, E09, E10, E12, E13, E14, E15, E16
Wanting audio	A07, A09, A15	--
Wanting BoM	A11, A12	E01, E05, E07, E08, E10
Wanting more angles/shots	--	E13, E16

Two aspects were immediately evident from the responses of the stop motion. First, everyone liked the project. While a few people requested additional shots for clarification, some form of audio, or the addition of a materials list, all of the initial impressions expressed enthusiasm for this method. Additionally, along with enthusiasm, there seemed to be a general understanding of the process required for the build. The second thing that caught my attention was the almost childlike wonder at watching the components build themselves. Several participants commented on the LEDs 'limp' as a way of figuring out the lengths of each leg, which was entirely accidental. The comments on this tutorial were also most similar to the ones about the song. Participants acted like they were having more fun, or at least enjoyed commenting more, as can be seen in A03's comment: “SO CUTE - LOVE IT!!!!!!” All three concepts I wanted to explore by building this tutorial were affirmed. Components could have their own character traits, and those character traits could be interesting. Personifying components did make a difference in the reception of this tutorial. Finally, by separating a tutorial from everything I found that makes it a tutorial, it still works. On the survey, this tutorial was the overall favorite among both amateurs and experts. Amateurs also tagged it as the most useful.

Figure 5.12. Stop Motion Tutorial Screenshot

5.2.14. Shared

There were several common threads throughout all of the tutorials, across both amateur and expert. This section will quickly explore each of those, several of which were alluded to in earlier sections.

Fun

The idea of *fun* was pointed out in the song and stop motion tutorials, as seven amateur participants mentioned their enjoyment brought on by those techniques. This concept of fun was only found among amateur participant responses. The closest expert comments got to mentioning fun was complimenting the creativity in a project, as seen below.

> “Naturally this wouldn't work at all for anything more complex than an LED throwie, but I give it points for creativity.” -E12 (Haiku tutorial)

Among amateurs, the concept of fun came up in the haiku, recipe, Rubik's Cube, stop motion, and zoetrope tutorials. Each of these tutorials had no more than two amateurs commenting on fun, which is why they didn't make the main list as the song tutorial did. Overall, eight different amateur participants commented on the fun factor present in the tutorials. Some pointed out the lack of fun, as A04 mentioned with the recipe tutorial below, while others, like A07 commented on their enjoyment of fun being present in the stop motion tutorial: "*...it's cute and fun to watch.*"

> "The fun that is expressed in the other tutorials, is not showing in this one. It is super clear, but it is extensive and does not elicit the joy through the process that I experience at the end of the process." -A04 (Recipe tutorial)

Scale

Experts were twice as likely to comment on scale than the amateurs did. Calendar, haiku, Rubik's Cube, song, and zoetrope all received comments by at least one participant, and on every tutorial where an amateur questioned scalability, an expert commented as well. Each of these tutorials received comments on the severe constraints of the creation, and the difficulty to scale to projects that are more complex.

Audio/Video

Table 5.14. Codes Mentioning Audio or Video

Tutorial	Amateurs	Experts
Animated (wanting audio)	A07, A10, A12, A15	E01
Calendar (wanting audio)	A07, A15	--
Song (wanting video)	A03, A06, A12, A15	--
Stop Motion (wanting audio)	A07, A09	--
Zoetrope (wanting audio)	A07	--

Through many of the tutorials, amateurs kept asking for audio. A15 commented on the calendar tutorial, "*I'm so auditory and still not audio?*" Most of the amateurs had feelings similar as in A07's comment on the animated tutorial, "If there were spoken

words or subtitles with the video, it would be more effective." While amateurs simply wanted spoken directions to let them know what was going on, the only comment on audio or video by an expert mentioned the oddness of not having sound. There was no desire to elaborate on the animated tutorial presented; in fact, the first three words of the comment were, "*This is perfect*" -E01. The song, however, was presented as solely audio, and as pointed out in the song tutorial, several people felt a video should accompany it to help it make sense.

Misreading

While many experts misread materials on the animated tutorial, as shown earlier, they also had issues with the BYOA and recipe tutorials. E07 noticed an inconsistency within the recipe directions, as seen below.

> "You use the word 'legs' then (I think) change the ID to "lead". That would be a problem. Keep the same identifier words. Is a leg a lead?" -E07 (Recipe tutorial -part 1)

This issue immediately turned him off entirely to the rest of the instructions, making him find additional faults where there were none.

> "Next you call for in the instructions something that is not listed in the ingredients - a neodymium magnet. Why was this ingredient not listed in the ingredient list? Stuff like this really pisses me off in recipes. In fact I'm so pissed off that that I don't want to continue making this thing." -E07 (Recipe tutorial -part 2)

By breaking E07's preconceived notion of what a tutorial should be: materials up front, followed by a list of directions, it created a barrier to the instructions that did not need to be there. This participant went on to call this tutorial the worst he had seen, after pointing out that he had already seen Rubik's Cube and song.

Many of the other misreading issues happened from looking at images too quickly, or not recognizing the magnet. The magnet was modeled on what I use when

building an LED Throwie. The reason I use it is that it matches the size and general shape of the battery, so they fit well together. An unfortunate consequence of presenting this way is that the magnet was often confused with the battery, or participants were unsure what exactly it was. In the original tutorial, square magnets were used, but it is likely that while the cube would not be confused with the battery, it would still create questions.

BoM

As seen throughout the tutorials presented, both groups were adamant about the inclusion of a materials list. Certain tutorials, however, like stop motion, calendar and Rubik's Cube, received comments about the participant’s enjoyment of the unique methods used to present materials.

Barriers to Entry

Another code seen on several tutorials, but rarely discussed, was the dislike of encountering barriers to entry. Neither group wanted any prerequisite knowledge required to complete a tutorial. This means they did not want to learn new software, solve a cube, find their way through a book, or pick through concepts trying to decipher what the author was intending to say. Many in both groups just wanted the tutorials to list the materials up front, to state the directions simply, and to not waste time on complicated ideas or concepts.

Focus

Table 5.15. Codes Mentioning Focus

Tutorial	Focus on amateurs	Focus on experts
Abstract	--	A06, A13, E02, E12
Animated	E02, E13	E02
BYOA	E08, A11, E09, E12, E15	--
Calendar	E02	E01, E02
Exploded	E04	A07, A08, A15, E02, E09
Haiku	--	E04, E07, E16
Recipe	E08, E12, E13	--
Song	A11	--
StopMo	--	E13, E14
Zoetrope	--	E12

Both groups felt that certain tutorials would be more suitable for either amateurs or experts, and in almost every instance they agreed. The only outlier would be the exploded tutorial, where an expert feels the method might be suitable for amateurs, where amateurs clearly disagree. The amateur category encompasses comments where youth, family, or beginners were suggested as the prime audience for a tutorial. In a majority of cases in the graph above, amateur means youth. Experts refers to makers and experts.

5.2.15. Summary of Tutorial Analysis

Among amateurs, there were a few threads that were repetitive throughout the tutorials. First, amateurs were more likely to give projects the benefit of the doubt. Amateurs would often comment on the potential of the project, that the project was good, but it needed a few fixes. Experts were more likely to judge things as they were. When it comes to content, amateurs were far more likely to request images, audio and video to be included in tutorials, in addition to wanting the tutorial to give them a sense of a reason behind the build.

5.3. Survey Analysis

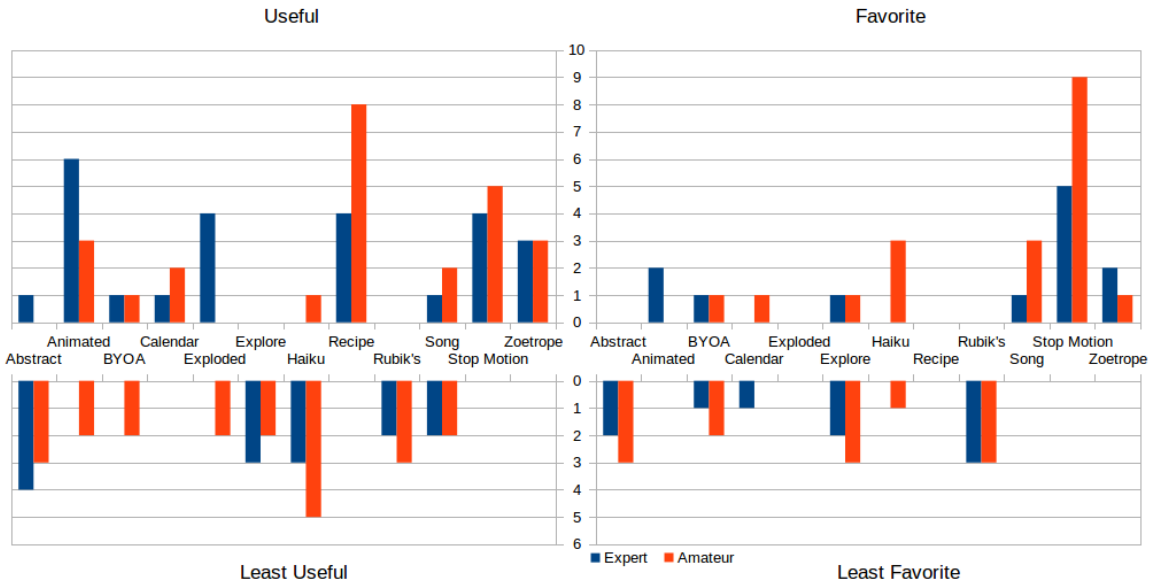
This section will focus on participant's responses to survey questions, which were answered following their exploration of the individual tutorials. Participants were asked to reflect on all of the tutorials they had seen before answering the survey questions. Questions one and two will be presented together as they were looking for very similar types of responses. The rest of the survey questions will be explored each in turn.

Each of the survey questions will have three important elements. They will begin by restating the survey question asked. For question six, each group received a different question, so the questions will divide the section. Following the question, a table will be presented containing the most abundant codes present from that question. Since questions one and two are presented together, one table will show the codes from both questions. Finally, my comments on the codes and other important information will be added.

5.3.1. Survey Responses

Questions one and two looked at two different things. On the surface, they asked participants what tutorial they felt most useful, or their favorite. The subtext of this question was to discover the reasons those tutorials were elevated or criticized by participants. Before looking at those reasons, which will be presented in the following section, an overview of participant's feelings about the tutorials as a whole will help position their reasons. Figure 5.13 shows participant's answers to the first two questions graphed.

Figure 5.13. Useful and Favorite Tutorials



Note: The X-axis shows tutorials while the Y-axis represents individual participant's choices.

Three methods did not have any negative responses. Those were: recipe, stop motion, and zoetrope. In addition, the two most popular tutorials are stop motion and recipe. However, while stop motion is the undisputed favorite among both amateurs and experts, its usefulness was not as highly considered. Instead, the recipe is thought to be the most useful among amateurs and the second most useful among experts, though it wasn't marked as a favorite by participants from either group. Animated was seen as the most useful among experts. Experts were more likely to consider fast, efficient tutorials as being most useful, while amateurs preferred seeing the process and having it be fun. This is obvious from the expert's useful rankings of animated, exploded and zoetrope. Additionally, while both groups agreed the haiku and song were not very useful, those were the amateur's top three favorites.

5.3.2. Questions 01 and 02

> Question 01: Of the methods you've seen here, which did you find most or least useful as a way of presenting instructions? Why?

Question 02: Which presentation technique would you describe as your most or least favorite? Why?

Table 5.16. Codes from Survey Questions 01 and 02

Codes	Amateurs	Experts
Disliking barriers	A03, A06, A07, A09, A11	E01, E05, E06, E09, E10, E11
Wanting BoM	A01, A07, A11	E01, E03
Wanting character	A02, A10, A11, A12, A13, A14	E03
Wanting clarity	A03, A04, A05, A06, A07, A14	E02, E03, E04, E06, E07, E09
Wanting concise	A01, A02, A03, A05, A10, A11	E01, E02, E04, E04, E06, E07, E09, E10
Wanting familiar	A12, A14	E01, E06, E08
Wanting fun	A04, A05, A06, A09, A10, A11, A13, A14	E04, E09, E10
Wanting images	A02, A03, A10, A11, A12	E04, E05, E06, E07, E08
Wanting process	A01, A04, A05, A06, A07, A10, A11	--
Wanting story	A03, A04, A11	--
Wanting why	A01, A04, A14	E02, E10
Disliked tutorials (all)	--	E11

Many participants explained why they chose specific tutorials as the positive or negative. Overall, the feedback here matched what participants pointed out liking and disliking on individual tutorials. Both groups had three things in common. They preferred images to text, wanted clarity and conciseness in writing and images, and neither enjoyed barriers within the instructions getting between them and finishing the project. These three points were the major things experts expressed. Amateurs also had three other major requests: character, fun, and process. The first two give the tutorial a sense of uniqueness and personality, while the third ensures that the directions can be followed. Minor points that interested both groups were seeing materials lists with projects, seeing a reason why they were making the project in the directions, and wanting to see familiar presentation techniques. Experts also expressed minor interest in wanting fun present in their tutorials. Amateurs expressed a minor interest in wanting to see a story woven throughout the tutorial, tying all of the steps together.

Also present in individual tutorial responses, were experts misreading tutorials without investigating them enough. Here is an example from E10 who commented, "*If you gave details on long and short leads, and which side of the battery is "+", then several [tutorials] would be really nice, I think. In particular: Animated, Stop Motion, and Zoetrope.*" While there's an argument to be made about how much of a battery you need to see to know what side is positive, the animated tutorial not only shows which side of the battery is positive (Figure 5.11), it also shows the viewer exactly what battery it is. The LED leads are shown to be different sizes in the animated and zoetrope methods, with extra effort being made in the creation of the tutorials to accentuate this difference. Had this been the only comment of this ilk, it might have been perceived as an outlier, but several experts expressed similar issues.

5.3.3. Question 03

> Would you utilize any of the methods presented here in future tutorials you create? Not as part of a larger tutorial, but as the sole DIY tutorial.

Table 5.17. Answers to Survey Question 03

Answer	Amateur	Expert
Yes	11	4
No	0	5
Maybe	3	2
Settling	3	1

The third survey question asked participants if they would use any of the techniques presented in this thesis in tutorials of their own in the future. Overwhelming, amateurs said yes, while experts leaned towards no. The reasons for many of the negative responses were due to time constraints, the difficulty thought to be involved in putting the tutorials together, or simply liking traditional formats. Of the six experts who said yes or maybe to using the presented methods, they all agreed that they would only be willing to use the calendar by itself. The ability to make calendars as gifts seemed like an idea that appealed to several experts. Many experts mentioned a desire to use some of the techniques presented, like animation, but as an addition to the traditional

techniques they already intended to employ. Several amateurs also expressed an interest in supplementing traditional presentation techniques with the methods presented, however, amateurs were more likely to favor presenting with non-traditional methods alone. Participants that settled mentioned their desire to work in one of the other presented methods, but pointed out the difficulties in doing so, then they continued by saying they would just settle on traditional techniques or the recipe.

5.3.4. Question 04

> Can you think of other methods for presenting DIY tutorials in non-traditional fashions? What would they be and would you use them?

Table 5.18. Methods Suggested by Participants

Art	In reverse	Pre-made toys	Time lapse
Braille	Interpretive dance	Puppets	To reinforce steps
Cards (flash, playing)	Mime	Real-time (Twitch)	Using baboesjka
Combining methods	Music video	Storytelling (orally)	Video game (puzzle)
Comic (panel, book)	Play	Submit to move on mechanic	VR exploration
Flip book	Podcast	Through components	

This question sought other non-traditional methods that the author may not have considered, and there were many. Some suggestions went farther outside the box, like presenting the tutorial through mime or interpretive dance. One objective of this research was to point out that different people have different ways they prefer information presented. This question was an overwhelming success. From flipbooks to puppetry, baboesjka's to reverse engineering, many methods were put forward that could be used in different situations. Several people also requested a music video to accompany the tutorial song, while another requested a Virtual Reality environment to allow the exploration game to be more immersive and, hopefully, more interesting. Every expert suggested at least one modified presentation method, and all but two amateur participants did the same. Table 5.18 shows an alphabetical list of all suggested

presentation methods put forward as a response to this question. Many of the suggestions listed had at least two different participants mention the idea.

5.3.5. Question 05

> Can you think of any situations where presenting a DIY tutorial in a non-traditional format would be preferred?

Table 5.19. Codes from Survey Question 05

Codes	Amateurs	Experts
Presenting for fun	A04, A08, A12, A13	E07
Presenting to beginners	A03, A10	E09
Presenting to experts	A14	E04
Presenting to group	A03, A12, A13, A06	E01, E03
Presenting to unknown	A02, A03, A05, A07	E02, E06, E07, E10
Presenting to youth	A01, A02, A03, A04, A05, A08, A09, A10, A11, A12	E04, E06, E09
Presenting gift	A12	E08

It was assumed that many participants would prefer a traditional tutorial format in general, so this question was devised to see which settings participants would prefer to see the tutorials presented in this research. Both groups saw the usefulness of these techniques when presenting to a large audience or workshop, as in *presenting to group*. Both also noted that these techniques would be useful for beginners, youth or in situations where the author is not sure who will be reading the tutorial, as in *presenting to unknown*. Youth was one of the most cited demographics for presenting these techniques, both here and in individual tutorials. As before, amateurs pointed to the fun nature of these methods, expressing that they might be used more for pleasure than work, as can be seen in the comment below.

> "Non-traditional tutorials are usually more fun. When I am not in a rush to learn something, I am especially interested in exploring these fun methods." -A08

5.3.6. Question 06

> **To experts**: Why do you use the presentation method you currently choose for presenting your own work to others? Do you have any desire to change that format?

Table 5.20. Expert Codes from Survey Question 06

Codes	Experts
Preferring easy to grasp	E03, E06, E10
Varying technique live	E03, E10
Preferring familiar	E02, E03, E04, E06, E07, E08
Writing step-by-step is easy	E02, E04, E09
Having time issues	E03, E09
Wanting to reach people	E05, E07

This is the only question formatted differently for expert and amateur participants. A majority of experts were content with their current presentation techniques. Several experts felt the method was the easiest for amateurs to grasp, the quickest to produce, and allowed them to reach the largest audience. E03 expressed a desire to change presentation methods, while expressing that too much time was required to implement the techniques shown here.

> "Presenting with materials lists, words, and images (a la Instructables) works and is clear but may not be quite as fun as some of the methods you shared. It's also one of the easiest. I edit projects more than make them." -E09

While the traditional method is preferred, it still takes longer to publish instructions for making a project than it does to make the actual project itself, at least for E09. In addition, E09 notes that the methods shown in this work are more difficult than traditional publishing methods.

To amateurs: When consuming tutorials, either DIY, recipes, IKEA instructions, etc, do you notice a similar format for all of them? Does it bother you? Do you have any desire to change that format?

Table 5.21. Amateur Codes from Survey Question 06

Codes	Amateurs
Not noticing similarity	A04, A07, A09
Noticing similarity	A06, A08, A10, A12, A13
Wanting change	A06, A08, A10, A11, A13
Liking traditional	A01, A02, A04, A05, A14

With amateurs, once the responses began to arrive, the realization hit that this question was very leading. It pointed to specific tutorials styles and called them all the same. Due to this fact, many responses either defended or condemned tutorials. When looking past those first reactions and digging deeper into the responses, amateurs made several points about the viability of both traditional and non-traditional techniques. Responses were coded for two things, seeing similarity and wanting change. While five amateurs noticed the similarity between the tutorials mentioned in the question, three had not and five others did not mention whether they noticed. Similarly, while an equal number of amateurs either wanted to change or liked traditional tutorial techniques, four other comments neglected to mention their preference. As the comments are almost evenly split, I feel this shows that an equal number of amateurs take either side of this issue. Half of the amateurs notice similarities and half do not; half want change and half do not. Interestingly, being in one group does not preclude being in another. Some of the amateurs who noticed similarities want change, while others do not, likewise is true of those who did notice similarities.

5.3.7. Question 07

Any other comments?

This question was used for participants who did not get a chance to say what they wanted in any of the other steps, or on any of the other tutorials. It was their final chance to comment. Most simply used it to say good job, question my methods, thank me, refuse to comment, or simply say good luck. While that was a majority of the responses, several were quite informative. One expert was happy to get a chance to see behind the scenes, and see how the tutorials were made, while several requested instructions on how to build things. Several experts expressed the desire to explore the option of presenting tutorials utilizing alternative techniques, and hypothesized when those might be appropriate, as shown in the quote below. Amateurs mainly mentioned their enjoyment of the tutorials, and several commented on why they liked alternative techniques.

> "Different methods might be good for different purposes. One might be good for memorizing steps. Others for just getting through the tutorial and building the thing. Others might be better if you have tons of time to do this in." -E5

5.3.8. Summary of Survey Analysis

Overall, survey responses tended to reinforce what participants mentioned on individual tutorials, though usually with more passion. Whether writing an immediate response to an individual tutorial, or reflecting on all of the presented tutorials while forming an answer, each group had very specific needs that often overlapped. Experts desired structure, explanation on each step, and the ability to scan the whole tutorial quickly. Amateurs wanted fun, sequenced steps, video, audio, story, and reasons for the build. Both requested a materials list, images, and clarity in the tutorial. These aspects that defined each group will be discussed more in the next section, and connected with each group's favorite and least favorite tutorials.

5.4. Conclusion

In this chapter, a coded overview of participant's responses was presented. Overlaps between tutorials were highlighted, and quotes from individual participants were used to clarify complicated codes or observations. Liked, favorites, and useful tutorials were displayed in graphs, with observations pointing to interesting aspects. In the following chapter, these observations and codes will be used to draw conclusions about what should be present in a tutorial, in addition to which group a specific tutorial should be presented.

Chapter 6. Discussion

6.1. Introduction

Work within DIY tutorial design is still in the exploratory stages. This research hopes to expand how researchers and designers see tutorial design, while expanding on presentation techniques available to tutorial designers. This chapter is grounded in chapter four's creation of tutorials and chapter five's analysis of participants' experiences when exploring alternative methods of tutorial presentation. This chapter attempts to provide a jumping off point for designers intending to research tutorial presentation design, empower tutorial designers with techniques not previously available, and to expand the resource pool available to tutorial designers and researchers. Additionally, this chapter moves to answering the second research question put forward in this thesis, which asked:

> How might these design factors be applied to tutorials with different audiences?

To accomplish this, the following three sections of this chapter explore findings from previous two chapters. First, it investigates the applicability of alternative tutorial techniques and what would be required from tutorial generation software. Second, it looks into what is needed in a tutorial, regardless of presentation format, divides the requirements of tutorials into three audiences, and details the needs of each audience. Finally, this chapter highlights and questions the best tutorial presentation method presented within this research. Following this, the chapter will look at limitations involved in the research.

6.2. Presentation Needs

This research examines alternative presentation methods. Field work exploring how a tutorial author documents, plans or builds their project is not pertinent to the research question. For this research, tutorial generation can be divided into three areas: formatting, creation, and consumption. This section will look into formatting and creation of tutorials. The following section will examine tutorial consumption and what individuals expect in a tutorial.

6.2.1. Applicability of Alternative Tutorial Techniques

Combining questions three through five from the survey with a host of responses from individual tutorials, gives a sense of whether participants would use the presentation techniques provided, on which groups they would focus those tutorials, and if there were other techniques that might also be applied in those situations. This section will investigate how participant's responses apply to these ideas.

When it comes to utilizing the presentation techniques provided, amateurs seem far more likely to attempt them (Table 5.17). While almost three times as many amateurs said they would use these methods, they were also more likely to settle on a presentation method because of its availability. When participants *settled* on a tutorial structure it was because they employed Instructables to make their tutorials. Other participants who used the Instructables format, were happy with it and felt it corresponded with the presentation method they would utilize if left to their own devices. This leads to two conclusions. First, not all participants who use the Instructables format are *settling* on it. Second, there is a group of people using the Instructables format that would rather have something allowing them more individual expression in their projects.

Finding which demographics participants would focus these modified tutorials required examining this data more in depth. Both sets of participants felt tutorials could be presented either online or in person, but that these were the only two options. When

presenting tutorials in person, participants mentioned workshops, conferences, and talks. In these situations, presenters had an understanding of their audience, and tailored their presentation methods to retain interest throughout the presentation. Online, there were specific tools that made publishing tutorials easier, like Instructables. However, since authors had no way of knowing who would find a published tutorial online, they had to structure each tutorial's design for a general audience potentially comprising both experts and amateurs.

Within these two situations, online or in person, participants generally felt they could structure their tutorial to focus on one of three specific groups of people: unknowns, experts, or amateurs. Unknown describes when authors put a tutorial online and did not know what the skill level of the audience using the tutorial. In these situations, unknown typically means that the tutorial needs to be accessible to both amateur and expert audiences, meaning everyone. Consequently, there are only two audiences for which authors are creating tutorials, and sometimes both groups need to be addressed within one tutorial.

As a group, experts are much simpler to identify. They include individuals knowledgeable in the tools, components, and competencies required to follow the tutorial. Experts generally have all the skills required to follow and make the tutorial they are viewing without additional support. Within the tutorials and survey, individuals from each group used the same three words to address experts: *experienced*, *experts*, and *makers*.

Defining which segments of a DIY tutorials audience should be categorized as amateurs is very complicated. This is due to different people having different terms of what is an amateur. While experts only had three labels that described the group, most of the participants could not agree on what being an amateur encompassed. Three codes mentioned by several amateur and expert participants were: *youth*, *amateurs*, and *beginners*. Each of these groups of people require the author to explain in more detail, provide more pictures and direction, and generally hand-hold their audience more. While not every young person is an amateur, participants mentioned youth when they felt a

tutorial was easier to understand. When looking in depth at a tutorial directed at amateurs, codes like *language proficiency*, *seniors*, *family*, *simple tutorials*, and *groups* also cross over into the amateur category. *Family* and *groups* might also infiltrate the unknown category, but from author's comments, it was generally accepted that when creating tutorials, it is for the least knowledgeable individual that you plan. *Simple tutorials* are for everyone to follow. Participants referred to *seniors* in a similar fashion as *youth*, noting that simpler tutorials would be better for this group. Finally, *language proficiency* refers to individuals who either do not desire or are not able to read a tutorial. This could label youth who are unable to read, or individuals who have no desire to read.

When asked to brainstorm other tutorial presentation methods, both amateurs and experts were not short of ideas (Table 5.18). Many of the techniques submitted by one group were suggested by the other. Both groups were not only equally inclined to come up with alternative presentation techniques for sharing and displaying tutorials, they often contributed the same ideas. An example is tutorial through mime, a method submitted by both A10 and E03. This led to two conclusions. First, through brainstorming and research leading to this thesis, there were numerous presentation techniques I never considered. This has further implication that utilizing new methods might spark in participants or researchers more ideas for presentation methods. Second, pocket groups enjoy being presented tutorials in specific ways, or through certain media. While this is further discussed in the next section, some participants preferred reading more, while others wanted pictures with text, and still others wanted video. With newly suggested presentation techniques, there may be methods that tutorial users would prefer to ones currently suggested. Real-time tutorials are an example of a field that have not been researched, but are currently being employed by the Twitch (twitch.tv) community.

Another detail is the occasional comment by participants pointing to the specific use of tutorials. While alternative methods of tutorial presentation emerged in the survey, others commented on individual tutorials. New ways of focusing on a tutorial, as pointed out in the last chapter, were as gifts or as part of an escape room game. Other suggestions were using BYOA as a troubleshooting guide or the zoetrope at a science museum. The idea of presenting tutorials to a niche audience might not be a popular concept, but one that would still be interesting to explore.

While I have personally utilized tutorials for a multitude of projects, only once have I seen a tutorial that encompasses the medium it attempts to teach. A simple example is singing or playing a musical instrument. To learn chord progressions on a guitar, the learner either has to perform repetitive chord patterns written by a teacher, or find a song that has a chord progression they like. There is no song that teaches chord progression. Similarly, there is no song that teaches an aspiring singer how to use their voice, except Tonic Sol-fa (do-re-mi) which teaches the octave. This has been in use for over a hundred years, a testament to the usefulness of good instructions embedded with the systems they attempt to teach. It would be interesting to see further research into what techniques might be used to embed DIY tutorials within their field and how those techniques might be utilized within other fields.

6.2.2. Tutorial Creation

Throughout the tutorial and survey responses, amateurs and experts expressed two things when it comes to the idea of tutorial creation. First, tutorials should be quick and easy to publish. Second, there were two types of tutorials one could publish: simple or difficult. The design and style of the final tutorial was dependant on which of those two types a person wanted to publish. Several tutorials had participants express that those could only be presented using the alternative techniques employed in this thesis because of the simplicity of the LED Throwie tutorial. The exploded tutorial is one example.

Tutorials sampled through this research, generally had at least two images per step and a paragraph of instructional text. The amount of steps was directly proportional to the difficulty of the project and how many actions were required to assemble the project. Taking multiple pictures, writing explanatory text, and then formatting and uploading them all to the web, takes time. The comment from E09 shared under survey question six in the previous chapter expresses the participant's satisfaction with the Instructables format. He was aware that it was not fun, but mentions that it gets the job done in a slow-moving fashion. That is, he spent more time editing projects than he spent making them. Having published tutorials on Instructables, I have run into similar

problems. While building a project takes a significant amount of time, going through all of the pictures to find the best, then organizing those and adding text also takes an inordinate amount of time. As an example, in creating these tutorials, I had to learn how to 3D model. After modeling the LED Throwie components, I decided to remake and screenshot the sequence of actions required to make a 3D model of an LED, in order to upload it to Instructables (http://www.instructables.com/id/Creating-an-LED-in-Blender/). The time it took to upload images and write text on Instructables was more than twice the process to model and take images of the LED. While this will not happen in every situation, it seems to be a recurring issue in the development of DIY tutorials.

Several of the papers on software in the methodology section examined ways to automate the process of making tutorials, either through capturing the actions of the author, or by pulling directions from multiple sources online to create a hodgepodge kind of tutorial (Chi et al., 2012; Fernquist et al., 2011; Grabler et al., 2009; Lau et al., 2009; Li et al., 2013). This is one way to lighten the author's load in creating tutorials. However, automating tutorial generation has its own drawbacks, many of which were noted in the papers. In addition to those already seen, the continued absence of fun or spirit that an author would try to instill in their directions is missing from automated tutorials.

It would be interesting to see alternative methods of tutorial generation that might give the author more options with what they create. For example, Fritzing (http://fritzing.org) is a software program that allows users to visually build circuits. It then turns those visual circuits into schematic diagrams and printed circuit boards. Created circuits can be shared with the community. Fritzing diagrams are occasionally supplemental to tutorials, but taken a little farther could easily be used to make a new platform for tutorial development and sharing. This platform would also allow users to borrow portions or whole circuits from other users and place them in their own circuitry. This would allow tracing circuit histories back to where they originated if users were interested in seeing what makes up complex circuits. While this might only work for circuits, adding additional models and images to the application would allow users to quickly model their projects and share them with others. Others could then navigate around the projects in 3D, taking them apart and putting them together to see exactly

how everything fits. This is one alternative method to how we can create unique ways for authors to share and modify tutorials.

Making a tutorial platform that scales with the difficulty of a build requires that the tutorial template be general enough that additions can be made. While a haiku may not be able to give complex directions, it can easily give a single direction. If a tutorial of ten steps were created in ten haikus, the scaling would no longer be a problem. This would bring up the additional issue of having to write ten haiku verses, but it is not a difficult possibility. One hope of this study is that researchers will continue to investigate alternative methods of tutorial generation and presentation, instead of only streamlining the process.

Each of the issues posed so far focus on the tutorial generation side of design, the platforms used by authors, and the abilities those platforms infer to the authors using them. Throughout the investigation of participant's feedback, aspects lacking in different areas of tutorial creation design were noted. By providing authors with more tools when creating tutorials, additional research could be developed that does not exist currently in this space. Tools could involve the ability to select or see the author's potential online audience, or the ability to alter the look of a tutorial format, either on the author's or viewer's side. Additionally, better understanding what experts want in creating a tutorial could be reached, instead of pushing the author aside, and to see what the amateur wants when browsing a tutorial. While much research seems to obfuscate tutorial generation, it might be more interesting to see what can be changed that would increase enjoyment, or make the creation process smoother.

6.3. Individual Needs

Tutorials need to be simpler for authors to create, but several features should always be contained in those tutorials, or present when directed to a specific audience. This section will more closely examine those features.

6.3.1. Everyone

Across all tutorial responses, four codes were repeated more than others: *BoM*, *images*, *clarity*, and *accessibility*. Comments on each of these points were similar and balanced between amateur and expert participants. While the comments were not divided exactly in half, they represent a good cross section of the interests of both amateurs and experts. The next highest comment codes were seen in less than half the responses compared to the least popular code listed above, reinforcing these as the most important topics. The next four paragraphs will describe each code in detail.

The Bill of Materials (BoM) is possibly the most important aspect of a tutorial. This includes all tools, components, ingredients, et cetera, that are required to build the project displayed. This aspect received the most comments across all tutorials. While many participants preferred to see this up front, exceptions were made for interesting presentation methods. For example, the BYOA and the calendar tutorial did not have any requests for a BoM, even though neither technically had one. Instead of providing a parts list with the calendar, it simply provided the parts. This approach was generally accepted as a substitute for a parts list. The BYOA however, had no such component offering, and each page detailed different components required within the text. Other tutorials, like Rubik's Cube and stop motion had participants enjoying the lack or unique display of components in lieu of a BoM. While tutorials like haiku were denounced for lacking a BoM, the simple addition of one outside of the tutorial might have created less dislike for the tutorial overall. Additionally, had a BoM been supplied with the tutorials that participants enjoyed that lacked a BoM, I do not feel it would have taken away from their overall experience. For this reason, unless the structure of a tutorial strictly prohibits the revealing of materials needed in the beginning, there is no drawback to including a BoM.

Images were the second most requested feature for tutorials among all participants. While both groups repeatedly requested images, they both had slightly different image needs. Amateurs wanted as many photographs as possible throughout the process detailing everything. Amateurs did not understand some fabrication

concepts as well as the experts. Additional images would provide the extra boost needed for amateurs to make sense of a difficult instruction. Experts, however, were generally content with a finished image. Occasionally, they would want more or better images of a finished project to see the details, but they were generally able to infer fabrication techniques from a single finished photo.

Clarity is a combination of the codes *clarity* and *concise*. In terms of clarity, participants wanted simple language without filler. When it comes to text, participants wanted simple, clear instructions. They did not want the language becoming too complex or going off on tangents. For images, participants wanted images or series of images that simply demonstrated what to do. Annotations were often requested by participants, which would be a simple way to improve the clarity of images.

Accessibility refers to the participants' ability to complete the task. Accessibility issues can be caused many ways and is a culmination of several codes, including disliking: *barrier to entry*, *investment for task*, *amount of info for task*, *puzzles*, and *prerequisites*. These codes were used on the zoetrope, Rubik's Cube, haiku, exploration, and BYOA tutorials. While each had different reasons listed, many participants all shared a sense of not being able to fully access or invest in these tutorials. For some, like the Rubik's Cube or exploration game, the reasons are more obvious. However, the BYOA, which was simply images and text, was not accessible to some participants, as they just did not want to invest the time required without a clear goal. There are occasions when this aspect was not as important to the participant, as many commented on using several of these presentation techniques as either gifts or within kits. Additionally, a small group of people did enjoy each of these tutorials, and if an author wanted to reach that select group, this might be a way to accomplish that goal.

The differences between the needs of amateurs and experts can be seen in the exploded diagram tutorial. Amateurs requested additional images, images representing multiple states of the project, annotations, BoM, and steps. A single expert requested annotations, and several others commented on the lack of a BoM. By meeting only expert needs, amateur’s needs will not be completely accommodated. However, if a

tutorial can meet an amateur's needs it will have a better chance of satisfying the needs of an expert. Although it might not, and the expert will then have to wade through additional text, images and sometimes steps that are not necessary or may be redundant for them. In the next two sections, I am going to discuss individual requirements from amateur and expert participants.

6.3.2. Amateurs

There are four elements amateurs want when looking through a tutorial. They want *images*, *process*, *additional media*, and *fun*. I have already pointed out the differences in image requirements, which basically shows that amateurs want more. In the next few paragraphs, I will discuss the other three needs of amateurs in tutorials.

Through axial coding, two codes combined into the broader term coined *process*. Eight amateur participants commented on the desire to see *steps* in different tutorials, while only one expert intoned a similar desire. Additionally, when commenting on the *sequencing* of steps, four amateur participants were the only ones to comment. Amateurs were adamant about seeing the process of the tutorial. Often this was done through asking for steps directly, but it can also be seen in the participant's different choices of useful and liked tutorials. Amateurs found the recipe tutorials most useful, while experts gave that same accolade to the exploded tutorial. The recipe tutorial is the closest to a traditional step-by-step that was shown to the participants. While both groups equally liked the stop motion tutorial the most, their second most liked tutorials corresponded with what they found the most useful. This reinforcement of their initial impression further cements each groups' desires. While experts will be discussed in the next section, amateur's desire for process in a step-by-step fashion can be seen here.

Audio and *video* were two different codes. They emerged from the original tutorials and can be seen in Table 5.14. In addition to *images*, these codes represent the extra media amateurs would like present in their tutorials. Some participants commented that they favored visual or auditory in their learning style. That idea is partially seen here. In almost every instance where there was a moving image present, A07 commented that

she thought it would be better with an audio component. This included tutorials that could not have audio components, like the calendar tutorial in which the video only demonstrated how the physical device would be used. In most instances, the type of audio did not seem to matter. It could be music or it could be narration explaining what was happening in the video. The only instance where consistency was desired was for a video accompaniment to the tutorial song, in order to showcase what was being said in the song. Compared to the thirteen amateurs that commented on audio or video elements in tutorials, only one expert mentioned it.

The final major amateur request was *fun*. It was mentioned throughout several tutorials and always by amateurs. Amateurs expressed a desire to enjoy the process of following the tutorial. This enjoyment embodied several aspects of the tutorial and it would be a useful concept to investigate further in future research. Through this research, the idea of fun is connected to how the tutorial is presented, the image and word choices, and the story and sense of why woven throughout the process. The concept of *fun* allowed several tutorials, which might not have been as highly regarded, to have more favorable reviews, such as the haiku tutorial. It is possible that the *fun* factor that amateur participants experienced in the haiku tutorial is the reason it was rated as their second favorite tutorial, while also being marked as their least useful.

Overall, amateurs seemed more inclined toward audio and visual elements than experts. This, coupled with their desire for fun in tutorials and their more forgiving nature when it comes to untraditional tutorial techniques, creates an interesting opportunity for tutorial research. When looking across amateur participants' favorite and most liked tutorials, even more interesting research options begin to emerge. Amateurs generally rated tutorials with storytelling or artistic elements much higher than experts did. By combining multiple versions of the tutorials presented here in different configurations, or utilizing the techniques found here to better focus the aspects of a tutorial, research might be done to better understand the wants and desires of amateur DIY tutorial builders. By providing the rigid step-by-step structure of the recipe tutorial, with the free choice associated with the BYOA, and the fun engagement of the song, a new form of tutorial might capture the attention of amateurs in a way that current tutorials are unable to do. For example, utilizing YouTube's capability of embedding creator determined

video links within the current video being viewed, creators can give users control of how tutorials progress, thus, giving the user agency over the tutorial and what they are building.

6.3.3. Experts

Unlike amateurs, experts were more interested in clear, concise, fast tutorials with a final image of the project. Among experts, there was not as much concern about process images, instead the focus was on a clear final image that communicates the entire build. There are several codes that support this premise, which will be detailed in the next few paragraphs.

Animated, exploded and zoetrope are three tutorials that experts *liked* twice as often as amateurs (Figure 5.1). In addition, both animated and exploded were seen as the most useful tutorials, and animated and zoetrope were in the top three favorites with experts (Figure 5.13). These tutorials have several things in common. They are very simple, none of them using any text or words. The exploded tutorial shows a freeze frame as all of the components are coming together, while the other two show simple animations of the building process. Even with the addition of a materials list, amateurs be confused by these tutorials. Since experts already have an understanding of each of the components, when seeing them put together into a single project, they have the ability to conceptualize what the circuit is going to do. This is not a trait amateurs share, as they do not have the same knowledge. This allows experts to see much simpler, straightforward directions and still make sense of them.

Experts also seemed to skim tutorials, picking out words and images they deemed important. This method of following tutorials led to several *misunderstandings* when reading the instructions, as seen in multiple tutorials in the previous section. Since experts have a better understanding of tools and materials, it is likely that they skim the tools and materials section to make sure they have the components they need, then glance at each step to see what the basic task is to build the project. Since experts are affluent in tools and materials, and are more highly skilled in techniques, it is not likely

that they would read each tutorial as carefully, but rather look for the general idea of what is required. This skimming can also be observed in expert codes asking for *clear*, *concise* and *fast* tutorials. The more streamlined and traditional a tutorial, the easier it is for experts to skim through to find something they would like to build or to learn new techniques.

By keeping the traditional format, experts know exactly where to look to find the information they need or want. Within the HCI community, there is little to no research focusing on expert tutorial makers and their desires when creating or following tutorials. This gap in the research can be addressed by working with individuals within the Maker community to develop a set of standards and practices when it comes to tutorials. Much of the current research is focused on what is made and less about how it is shared with others in the community. By combining the simplicity of the exploded diagram with the action of the animation, a material list, and some annotations, I think the perfect tutorial could be created for the expert tutorial audience. There is also an abundance of research comparing and contrasting the desires of expert and amateur tutorial makers and those who build and follow the tutorials that should be further investigated, research that does not focus on an all inclusive solution for the entire audience, but instead focuses on niche groups, and finds ideal solutions for each.

6.4. The Bridge

By combining and comparing participants most liked, useful and favorite tutorials, I was able to rank each tutorial on how well it was received. Each category, amateur, expert and everyone, had one tutorial which garnered at least twice as many accolades from participants as any other. The animation tutorial received praise eighteen times from experts and eight times from amateurs, while recipe received admiration eighteen times from amateurs, but only six times from experts. An interesting point that emerged was the adoration of the stop motion tutorial by everyone. Stop motion received a majority of both amateur's and expert's rating as their *favorite* method, and it also received the most *likes* from both groups on the initial impression in comment boxes.

The third tallied aspect was what participants found most *useful*. For both groups, stop motion ranked second, behind recipe for amateurs, and animated for experts. Overall, the stop motion tutorial received praise twenty-one times from experts and twenty-six times from amateurs. Due to this evidence, stop motion is the overall highest ranked tutorial among all participants.

There were two sets of tutorials in which stop motion was seen as similar. The first was in animated tutorials: zoetrope and animated. The second was in artistic storytelling tutorials; BYOA, haiku, and song. The zoetrope and animated tutorials were among the top ranked for experts, while haiku and song were among the top for amateurs. BYOA did not make the top ranking lists, but there were several participants who were adamant about their enjoyment of this method.

There is evidence that stop motion may combine the simple, fast, animated elements that experts crave with the fun, multimedia, and process aspects that amateurs desire. This combination of both group's desires enabled these groups to share an overall favorite tutorial. While I would enjoy seeing all tutorials presented utilizing stop-motion techniques, I wonder how well it would align with the requirement that tutorials need to be quick and easy to publish. Additionally, while the stop motion method seems to be the most well received technique for presenting the LED Throwie tutorial, if a website were nothing but DIY stop motion tutorials, the reception may not be as enthusiastic as these results seem to indicate. There is an opportunity within the HCI community to perform more research comparing and contrasting animated versus storytelling techniques when presenting tutorials. This work could help refine our understanding of the dynamics at play.

6.5. Limitations

Several of the limitations within this work did not become clear until the later stages of the research. Having had participants fill out a form at the beginning of the research detailing their thoughts, and definitions of tutorials at the start would have given

a framing for later comments. By only collecting responses at the end of the study, a starting point is missing. Along with this, tracking IP addresses in order to group responses to unique participants would have also been useful. While I do not feel the lack of ability to compare a participant's tutorial response with their survey response negatively affected this research, I do think it would have given more insight to be able to match both sets of participant data to contrast their initial reactions with their survey reflections.

This research also features open-ended feedback. This led to a different style of language used by amateurs and experts. Had a standard multiple choice survey been provided initially, it might have helped get both groups converge on a similar language. A question asking how important fun is within a tutorial could have suggested the idea of fun before seeing any of the tutorials. This may have encouraged more experts to talk about fun aspects present in tutorials, or directly say that it was not an important element. Similarly, a question asking participants to mark how important each aspect of a tutorial is to them would have been extremely helpful, though I would not have known what to include in the questionnaire until the research was finished. A questionnaire of this sort, given at the beginning and end of the research, could have been very insightful, so it will be pursued in further research.

Another limitation of this research is that it focuses on a single, simple tutorial. A different simple tutorial might perform differently in any or all of the techniques demonstrated here. Likewise, a more difficult tutorial would not only have uncovered additional issues with the final technique, but in the creation of the tutorial as well. Making a stop motion or animation of the building of a single LED Throwie is a simple process and does not require much time to learn. Animating 512 LEDs into an 8x8x8 LED Cube (chr, 2011) could create a host of problems that may not appear in this research.

Finally, while getting feedback about the good and bad aspects of each of the tutorials presented within this research, no repetitions of the research were conducted on the tutorials. A second round of amateur and expert participants would be incredibly

beneficial, and would further support the Research through Design methodology employed. Having a second or third round of instructions, possibly repeating only the top three choices by experts and amateurs to further develop and explore the methods is desired. This, however, will need to be follow-up research, that should also take into consideration the previously mentioned limitations.

6.6. Conclusion

This chapter began by demonstrating requirements for presenting tutorials by looking at the applicability of alternative techniques and specifications for tutorial creation. It went on to investigate what tutorial audiences needed, and divided those audiences into amateurs, experts and both. Finally, this chapter presented the best method of alternative tutorial presentation identified, followed by questions and a section on limitations of the research. The next and final chapter will contain concluding remarks.

Chapter 7. Conclusion

Tutorials are ubiquitous in the current global communication arena. Anything purchased at a store or online probably comes with a set of instructions. While these instructions might be as simple as a few steps written on a sheet of paper or as complex as a 200-page manual filled with step-by-step instructions in multiple languages, they can be found everywhere. This includes the clothes you are wearing as you read this, detailing the specific techniques that should be employed for cleaning them to get the optimum result. The DIY community arose as a counter-culture (Wakkary et al., 2015), and as such, many within the community sought to provide instructions on how to accomplish just about anything. Due to this trend, DIY tutorials have begun setting a standard in how to structure tutorials. Thus, these trend setters were sought out through this research to better identify, and then attempt to modify, that now commonly used format.

7.1. Summary of Thesis

This thesis began by defining a structure inherent in almost all DIY tutorials: a five-step structure that starts with a title, moves to an introduction, then presents a materials list followed by a sequence of steps, and finally ends with a conclusion. Using this as an outline, this research demonstrated twelve different ways of departing from that commonly accepted structure. It then asked both amateur and expert participants to look at the new styles of tutorials, comment on each, and partake in a survey. Responses from all thirty-three participants were coded and explored to find patterns within and across each of the participatory groups.

Through analyzing the data collected it was discovered, when designing a tutorial, you can choose to design for either amateurs or experts. If you wanted to design for both groups, you had to design towards amateurs, as experts are better equipped with all levels of directions. It was also deduced that participants wanted the tutorial creation process to be simpler. While this does not mean they wanted to be detached from the tutorial generation equation, like much of the research in software based tutorials (Chapter 2.3.1), they were interested in ways of streamlining the process.

7.2. Revisiting Research Questions

This research set out to focus on a two questions:

What are important design factors in non-traditional ways of presenting a DIY tutorial?

How might these design factors be applied to tutorials with different audiences?

To answer the first question, this thesis needed to identify the traits that a traditional DIY tutorial exhibited (Chapter 1) to properly investigate design factors when breaking with that tradition (Chapter 4). Twenty tutorials across twenty platforms were investigated and patterns were identified. Then new tutorial concepts were brainstormed and examined for the aspects of the traditional format from which they deviated. Finally, twelve tutorial formats were selected to demonstrate a cross sampling of methods for breaking with the traditional tutorial structure. Each of these tutorials were created and modified as needed to present the finished state.

By providing the history and stages of construction for each of the twelve tutorials created, this work demonstrates how to apply the RtD methodology to tutorial design. It also allows future researchers to replicate or build from any of the results presented. The thesis detailed how each tutorial would be created, and provided a starting point for how non-traditional tutorials would look. Through feedback from authors, at least twenty-three additional alternative methods for presenting tutorials were advanced. The majority of

participants contributed further tutorial ideas during the research process, and it is likely many more possibilities exist.

To explore how these design factors would apply to different audiences, both expert and amateur participants were asked to look at each of the twelve tutorials and provide feedback. Their feedback was coded and sorted utilizing GTM as defined by Charmaz (Chapter 5). Patterns were identified in the data and presented as areas of interest when designing DIY tutorials (Chapter 6). Design considerations were broken into two sections: first, with the platforms on which tutorials are being built or generated, and second, when designing for specific audiences.

7.3. Contributions of this research

This research hopes to contribute to both interactive design practice and design research. Outlined below are five contributions of the study.

First, this research provides a definition for a basic structure inherent in almost all DIY tutorials. This structure provides a starting point for researchers investigating modifications to DIY tutorials. Whether the modifications are intended to streamline or present an alternative layout, this basic structure is where that research should start.

Second, since RtD has never been utilized as the primary research methodology for creating tutorials, this research lays the foundation for future researchers to reference. Through detailing failed tutorials along with final prototypes, specifying each step in the ideation and prototyping process, and providing as much additional information as possible about the process used, this research attempts to set a standard for further studies to follow utilizing similar methods. By providing these extra details, other researchers will be able to more closely emulate or modify the research on their own terms.

Next, this research asserts that applying GTM techniques in order to support RtD is beneficial to the RtD method. Not only do I feel that using GTM has helped clarify and demonstrate the principles in which these alternative tutorials were designed to identify, but I feel this research demonstrates the usefulness of using these two methodologies in tandem.

Fourth, outside of the very specific conditions structured within the research, there was minimal work uncovered in the literature review (Chapter 2) that considered what participants desired in tutorials. By providing twelve unique methods for presenting the same tutorial, participants were able to identify aspects across a broad set of tutorials that they liked or did not like. Though the survey, participants had the opportunity to reflect on the design decisions and describe which aspects they most liked in a tutorial and why.

Finally, this research provides a comparison of expert and amateur wants and needs in reference to tutorial design. Since no studies were discovered that explored the different needs of experts and amateurs in the realm of DIY tutorials, this thesis provides a starting point for additional research in this field.

7.4. Future work

This work can be expanded with several approaches. First, more research can be undertaken to examine alternative tutorial presentation methods. Second, the platforms utilized by individuals to generate tutorials can be further researched. Third, the wants and desires of the individuals creating and consuming tutorials can be identified more specifically. Each of these points will be discussed in the following three paragraphs.

It would be interesting to see more experimentation conducted on modifying the tutorial structure. There are several approaches this could explore. Alternative formats contributed by participants were not investigated within the confines of this research.

Another area I wanted to explore, but did not have time to invest, was how to demonstrate a tutorial within the field it is embodying. Chapter 6 pointed to the example of Tonic Sol-fa (do-re-me), a method for teaching the scale, embedded within a song. An investigation of what makes specific DIY cultures, such as Steampunk, unique and expanding to find ways of embedding tutorials within those groups could lead to a further understanding of those communities and tutorials in general.

Since the majority of tutorials are uploaded through online platforms, there is an opportunity to modify these platforms to allow users more freedom with their tutorial construction. Alternatively, different platforms could also provide unique methods of uploading tutorials. Build in Progress (Tseng, 2015a) is an example, as it changes the method of delivery for DIY tutorials. Instead of presenting a finished product, projects on the Build in Progress platform are presented as they are built, as works in progress. By providing users with alternative methods of sharing their work, researchers can better understand what users want to share. Currently, with the one-size-fits-all mentality of tutorial publishing websites, there are no methods to identify different user needs.

There are certain aspects that should be present across all tutorials, like a list of materials or images, but when a tutorial is well-made, even these aspects can be modified without repercussions. I feel compelling research can be done here in exploring how much of any one tutorial component is important. In considering the BoM, why is this factor not important in BYOA? Does the story aspect of a tutorial change the dynamics of what an individual tutorial user expects? It would also be interesting to juxtapose fun and fast tutorials. Though quantifying when the amount of fun becomes too much or too little, or finding what makes a tutorial fast enough, points to important elements for the tutorial designer to consider. Finally, while it would be interesting to see animated or stop-motion versions of tutorials further explored, I feel this would require extensive work.

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Appendices

Appendix A.

Print Version of Website, Survey

The tutorial website was divided into three sections: tutorials, instructions, and the final survey. Below a print version of the survey section will be included for reference.

Survey

Your Final Task:

Below are seven open ended question. Please fill out each question in as much detail as you're comfortable providing.

I would recommend writing your answers down first in a text editor, and copying and pasting into the fields below when you're ready to submit (just in case something goes wrong with my code).

1) Of the methods you've seen here, which did you find most or least useful as a way of presenting instructions? Why?

2) Which presentation technique would you describe as your most or least favorite? Why?

3) Would you utilize any of the methods presented here in future tutorials you create?
   Not as part of a larger tutorial, but as the sole DIY tutorial.

4) Can you think of other methods for presenting DIY tutorials in non-traditional fashions?
   What would they be and would you use them?

5) Can you think of any situations where presenting a DIY tutorial in a non-traditional format would be preferred?

6) Why do you use the presentation method you current choose for presenting your own work to others? Do you have any desire to change that format?

7) Any other comments?

Button: Submit

Appendix B.

DIY Tutorial Content and Initial Codes

Table 7.1. Tutorial Codes

Project or Kit Title **Hosted Company**	**Website**	**Tutorial Sequence** **(Initial Codes)**	**Sequence Codes** **(Second Round Codes)**
Getting Started with Stop Motion Animation Modular Robotics	modrobotics.com/ cubelets/cubelets-getting-started/	Title Table of Contents Step (contains): -Title -Components -Image of finished project -Steps to build -Use Additional steps (each following the same format as above) Troubleshooting	 Title (Image) Materials (image/text) Steps (image/text) Conclusion (Use)
Bits on a string Little Bits Community	littlebits.cc/ projects/bits-on-a-string	Title -Image of finished project Introduction (with Duration) Right hand menu -Components, Materials & Tools -Additional Files Steps -Each step individually titled -Each step contains text and a single image -Final two steps of finished work have video demonstrations Comments	Title (Image) Intro Materials (image/text/link) Steps (image/text) Conclusion (Demo) Comments

Base Kit Little Bits	littlebits.cc/ kits/base-kit#inside	Projects Section: Title -Image of finished project Components (diagram and text) -Also includes additional materials) Steps -Almost all individually titled. A few left blank -Each step contains at least one diagram, text -Uses arrows to highlight information -Some steps contain things to try -Last step conclusion-go try/have fun Time Difficulty	 Title (Image) Materials (image) Steps (image/text) Conclusion Time Difficulty
DIY Life-Size Phone Controlled BB8 Droid Instructables Author: ASCAS	instructables.com/ id/DIY-Life-Size-Phone-Controlled-BB8-Droid/	Title Introduction -Multiple Images (finished project) -Multiple Videos (finished project) Information (reverse engineering product) -Multiple Images and Diagrams Components and Materials (Each links to store purchase page) -Multiple Images Information (science behind how it works) -Multiple images Steps -Each individually titled -Each step contained a minimum of one image -All but one step contains at least one line of text -Code linked in one step -Sound effects linked to in one step Information -Join Club -Future Improvements -Version 2.0 (teaser video) -Reactions	Title Intro (Image) Info (Background Images) Materials (Images) Info Steps (image/text) Info Conclusion

Getting Started with Scratch MIT Media Labs	scratch.mit.edu/ help/	Title Introduction -Image of finished project Tools -The Program, and how to get into the app window Steps -Each individually titled -Multiple images -Text description -Arrows to direct attention Information -Ways to explore the app -Tips -Saving and sharing -What to do next -About	Title Intro (image) Materials (software/image) Steps (images/text) Info Conclusion
Leonardo da Vinci: Catapult Elenco	elenco.com/ admin_data/ pdffiles/ EDU61009.pdf	Title -Image of finished project Table of Contents Introduction -Information about Leonardo da Vinci -Information about siege engines -Images Components -Individual Images of each component -Letter associations with each component Steps -Individual diagram per step -Components shown in diagram with letter associations -Green arrows used to show where components attach or move too -Minimum of one arrow used on each step -Red arrows and outlines used to draw attention -only two step has any text (and each time, only one word) -Steps also show how to operate once finished	Title (image) TOC Intro Materials (image) Steps (image) Conclusion

Track3r Lego: Mindstorms	lego.com/ en-us/mindstorms/build-a-robot/track3r	Skipping past table of contents: Title -Image of finished project Steps -New components required diagram (lego's) -Most steps only add one new component (sometimes add two) -Diagram of how to connect new piece to existing pieces -Red arrows used to show how to move pieces together -Black arrows used to show where pieces go -Refresh images (no explanation on what they mean – might be repeat) -Occasional finished image of section that is going to be worked on -No text Finished image of project Information -Connect to computer/phone -Go to website	Title (image) Steps & Materials (image) Conclusion (final image) Info

TV-B-Gone Cornfield Electronics & Adafruit	learn.adafruit.com/ tv-b-gone-kit	Title -Image of finished project Introduction -Images and Video of finished project -Text FAQ Table of Contents Tools -Image -Text Description -Links to purchase Components -Table with following columns: -Image, Name, Description, More Info, Quantity -All columns but image contained text and links to purchase -Also includes table for previous versions of kit Steps -Not numbered, but sequenced top to bottom -Horizontal lines separating steps -Two columns: -Left column contains at least one image -Right column contains text instructions and links to further information Information -How to test it -Contains videos, images, and text relating to finished project -How to use it -Text and video on how to operate -Detailed electronic information -Downloadable content	Title (image) Intro (image/video/text) FAQ TOC Materials (tools) (image/text) Materials (components) (image/text) Steps (image/text) Info (video/image/text) Conclusion

Primo GitHub Cubetto	primotoys.com/ docs/make.html	Title Information -Read Me Introduction Tools Materials -Links to purchase -Cost -Divided into three separate parts, for the three different builds Information -About design and energy consumption Laser cutter files Steps (Each of the three builds is one step) -Text, images and diagrams interspersed as you scroll -Text tells what you do, is followed by image representation of text -Some diagrams represented in a step-by-step numbered format -Only one exploded diagram for the second step Arduino Files Comments	Title Info Intro Materials (text/link) Info Steps (image/text) Comments
Theremin LightUp	webapp.lightup.io/ index.html#lesson/ Theremin/0	Title Introduction Materials -Images Steps -Images -Highlighted pieces for changes that are important -Text -Including code with flashing arrows to draw attention Information -Congratulations	Title Intro Materials (image) Steps (image/text) Conclusion

OpenROV v2.8 OpenROV	openrov.dozuki.com/c/OpenROV_v2.8_%28Kit_Assembly%29	Separated into six tutorials all with the same structure Title -Final Image -Tools Introduction (only on first two tutorials) Steps -Title -Single image with occasional colored arrows and/or boxes to highlight -Sometimes exploded diagram embedded in image -Text (if no text was needed, a single | was used in place of text) Information -Continue to next tutorial -Final tutorial also includes congratulations	Title (image) Materials Intro Steps (image/text) Info/Conclusion
The "Gas Blaster" Propane Torch Youtube The King of Random	youtube.com/watch?v=eO8NwseRxSA	Title Finished Image Title Sequence Materials & Tools -Text and Image Steps -Cuts to video of pieces being put together -Voice over explaining what's going on -Occasional text over video to draw attention -Colored arrows used to draw attention to specific parts Information -How to use it -What to use it with -Optional add-ons	Title (image) Intro (title sequence) Materials (image/text) Steps (video/speaking) Conclusion

Amazing Cheapy Lighter Laser Burner Youtube KipKay	kipkay.com/ episodes/amazing-lasers-cheapy-lighter-laser-burner/	Title Introduction Information -Disassembling a lighter Materials -Where to get them -Video cuts from component to component -Voice over's what components are, and where to buy -Text over with links to purchase Steps -Still Image (with text and pointing overlays) -Voice over explaining what's going on -Video Conclusion -Working video	Title Intro Info Materials (image/speaking/text) Steps (image/video/speaking) Conclusion
Getting Started with Stop Motion Animation Lynda.com	lynda.com/ After-Effects-tutorials/Shooting-tablet-smartphone/ 163241/167327-4.html	Title Introduction Information -History -What it is Tools -Each tool has its own video, shows to choose and what to look for Setting Up -Cleaning and prepping the work area Steps -stills and video of components being used for animation -talking about additional materials needed -pointing with finger to draw attention to certain pieces -talking about what's going on Conclusion -Other places to look for future work	Title Intro Info Materials (video/speaking) Info (Setup) Steps (image/video/speaking) Conclusion

I built a tree in my daughter's bedroom Reddit/Imgur	reddit.com/ r/DIY/ comments/ 420wu0/ i_built_a_tree_ in_my_daughters _bedroom/ imgur.com/ a/M6V45	Title -Image of finished project Information -Final results and wrap up of project Introduction -Sketch -Scale Model Tools -Image Steps -Individually Titled -Single Image -Text -Included additional tools and materials in steps Info -Contact me with any questions	Title (image) Info Intro Materials (image) Steps (image/text) Conclusion
RPi WiFi Hackaday Author: ajlitt	hackaday.io/ project/8678-rpi-wifi	Title -Image of Finished Project Introduction -Description -Details Files -required downloads (1 svg file) Components -required materials, components and tools to build project Information -Project Logs (how the project is going) Steps -numbered -Single image of wiring diagram, otherwise just text (mainly code) Discussions	Title (image) Intro Materials (text) Info Steps (image/text) Discussion

Smart Remote Control Make: Projects Author: Tony DiCola	makezine.com/ projects/smart-remote-control/	Title -Author -Difficulty Introduction -A branded video of the build -Image of the finished project -Description and Details Materials -Right hand side, Parts and Tools -Text and links to purchase Steps -Numbered -Multiple images per step (even to just show code) -Text descriptions for each step -Enjoy About the Author Comments	Title Intro (video/image) Materials (text/link) Steps (image/text) Info Comments
The Most Useless Machine Make: Magazine #23 Author: Brett Coulthard	make-digital.com/ make/vol23/ ?pg=96#pg96	Title -Author -Final Image (In use) Introduction -Background -Project Overview Materials -Listed -Images for each Material -Separate section for materials & tools Steps -steps divided into sub-steps (i.e. step 2 has sub-steps a, b, c, d, e, and f) -each sub step has text + image -Finish Use It -Finished examples in use -Links to videos of machine in action, video how-to's and resources	Title (image) Intro (background) Materials (image) Steps (text/image) Conclusion Info (how to use)

Marshmallow Shooter Howtoons (Re)Ignition Issue 01	howtoons.com/ ?page_id=3994	Title Drawing of Finished Project in action Materials & Steps -Listed -Image of all materials exploded out to show how they'd be put together Information -How it works -Tips for improving design	Title (image) Materials & Steps (text/image) Info (how to use) Conclusion

Appendix C

BYOA Tree Diagrams

The three tree diagrams below show the choices available in the BYOA tutorial. It is divided into Introduction, Power, and LED. Since the power tree diagram was too large to show on a single page, it was divided into two figures, and shown here on two different pages. Each box in the tree diagram represents at least one page, though in certain cases, like Tesla coil, a single box can represent up to three consecutive pages with no available branching.

Figure 7.1. BYOA Tree Diagram: Introduction Section

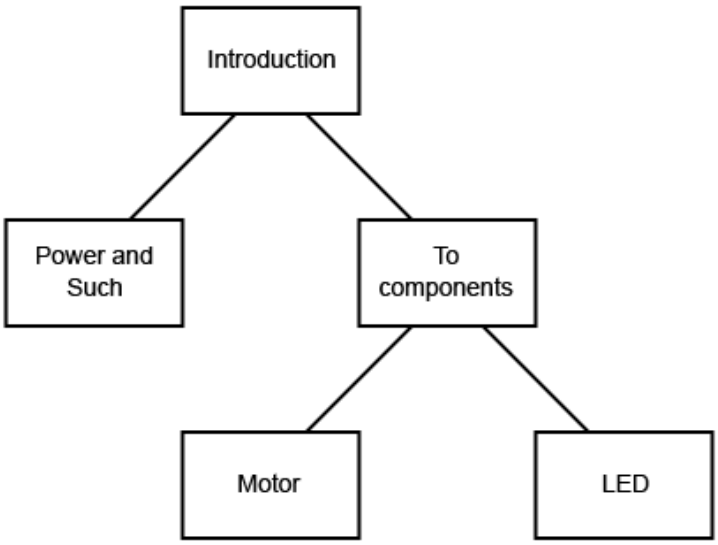
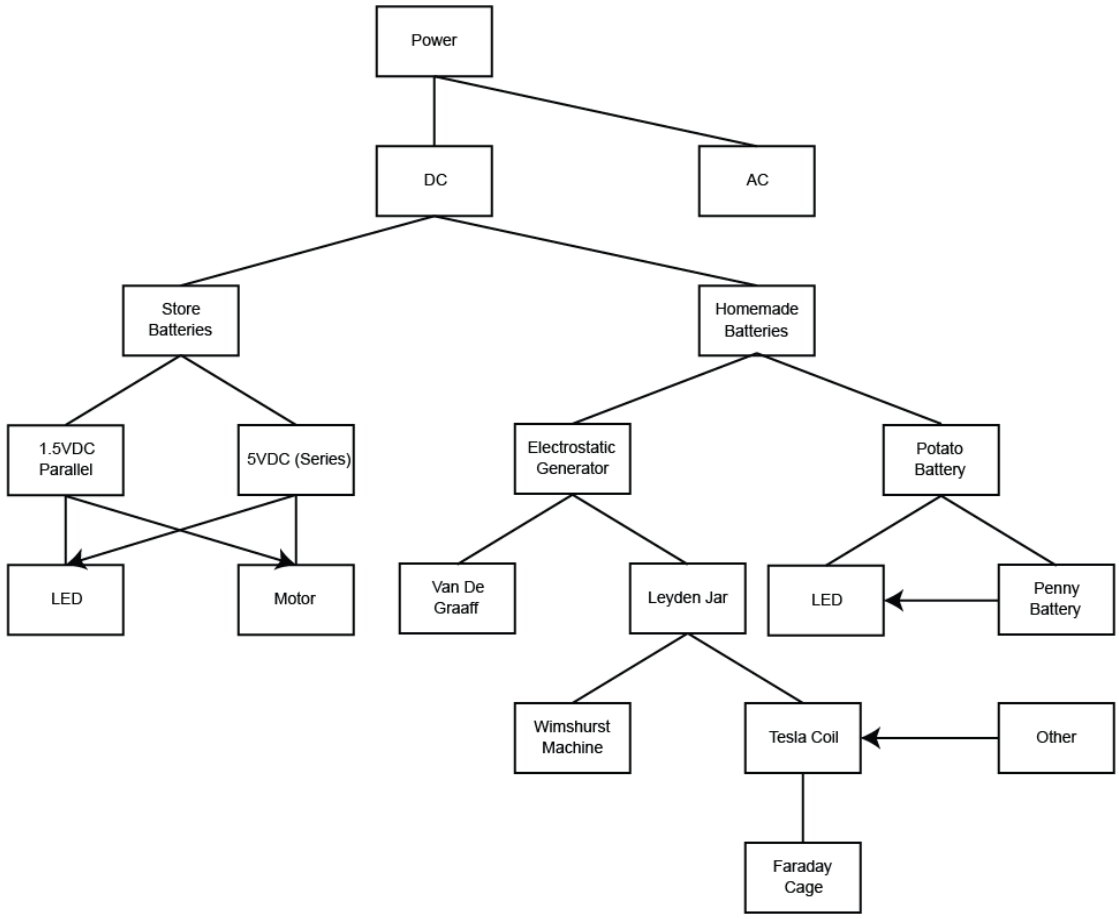


Figure 7.2. BYOA Tree Diagram: Power Section (part 1)



Note. The AC section and the “Other” box going to “Tesla Coil” will both be shown in part two of this figure.

Figure 7.3. BYOA Tree Diagram: Power Section (Part 2)

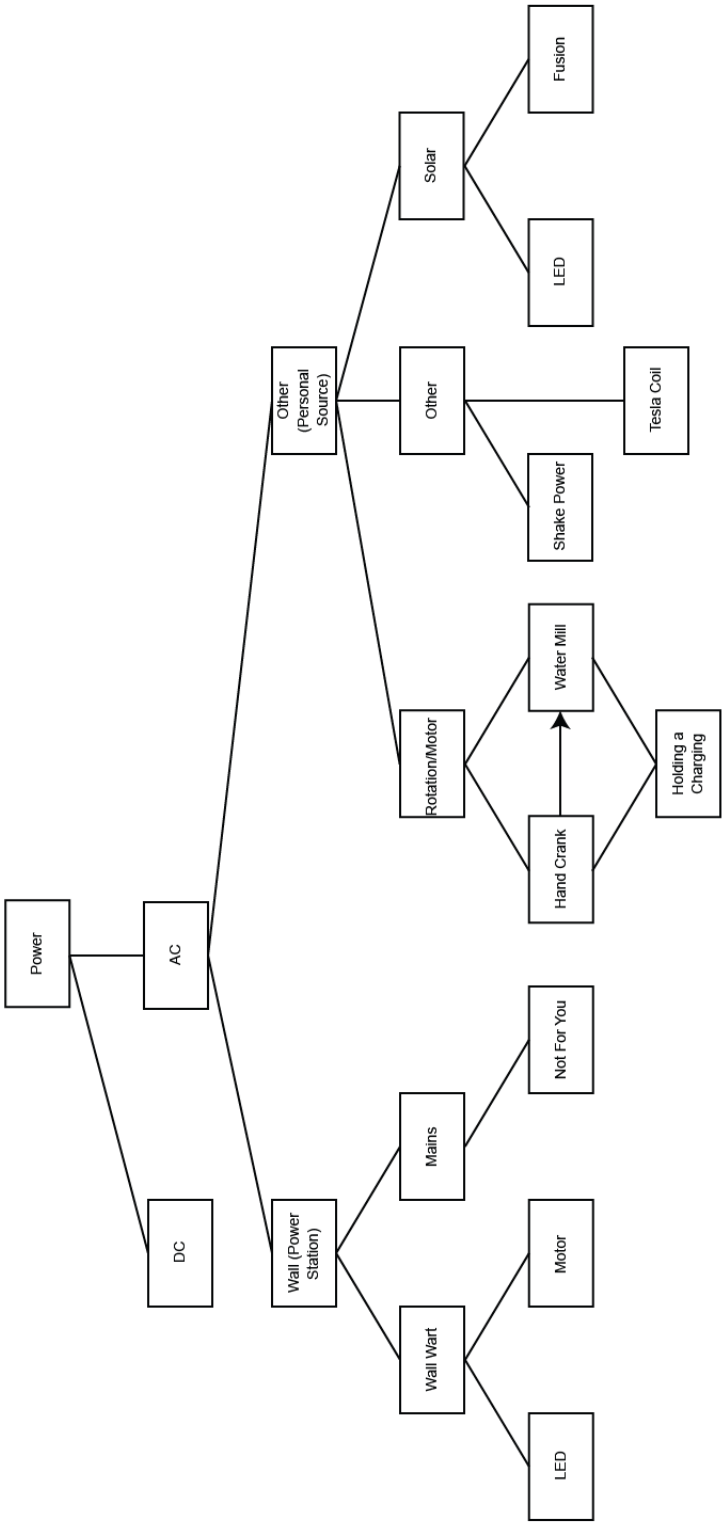
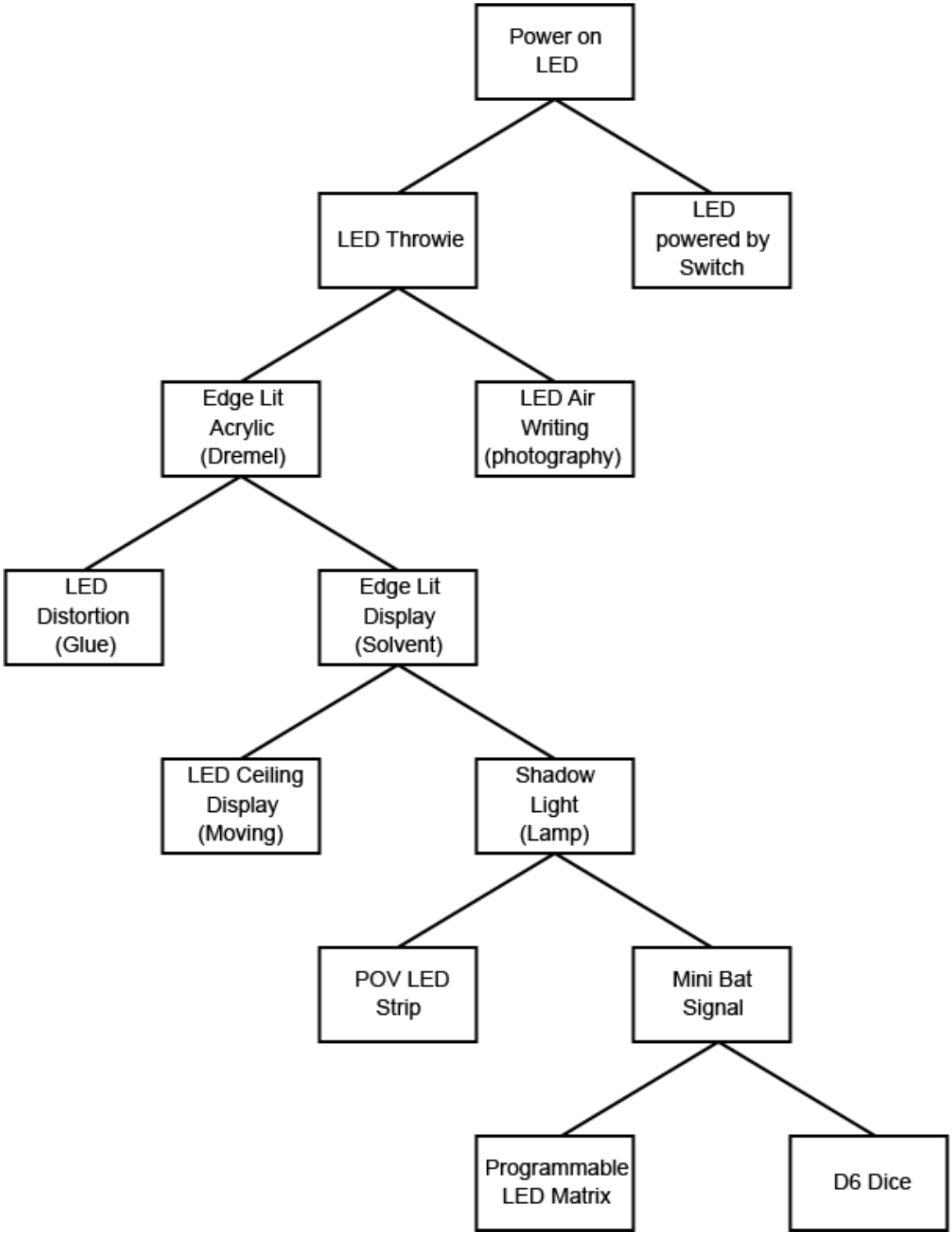


Figure 7.4. BYOA Tree Diagram: LED Section



Appendix D

Print Version of Website: Consent Form

In case the website and tutorials are unable to be found online, the next three sections will put web-content into a print format.

Study Overview

Thank you for accepting my invitation to partake in this study. I've invited you to participate based on your experience in the DIY community as both a creator and consumer of DIY tutorials.

The aim of this study is to investigate the viability of non-traditional instructional formats. Each tutorial presented here tries to break with one or more mechanics that crop up in just about every DIY tutorial.

In order to participate in this study, you'll need to complete the following three things over the next week:

1. Complete the consent form
2. Review and rate each of twelve tutorials
3. Complete a questionnaire consisting of seven open ended questions

Button: Continue to Consent Form

Informed Consent Form — Study [2015s0500]

Should you wish to obtain information about your rights as a participant in research, or about the responsibility of researcher, or if you have any questions, concerns, or complaints about the manner in which you were treated in the study, please contact the principal investigator, Matthew A. Dalton or the Research Supervisor, Ron Wakkary, using this reference number: [2015s0500]. (contact information)

Your digital signature on this form will signify that you have received this document, which describes the procedures, whether there are possible risks, and benefits of this research study, that you have received an adequate opportunity to consider the information provided in this document, and that you voluntarily agree to participant in the study.

Title of Study: Designing Tutorials
Ethics Application Number: [2015s0500]
Principal Investigator: Matthew A. Dalton
Faculty Supervisor: Ron Wakkary
Investigator Department: School of Interactive Arts and Technology

Purpose and goals of this study: This study looks at non-traditional methods of presenting Do-It-Yourself (DIY) tutorials. These methods will be presented to tutorial authors for their feedback regarding the pros and cons of each different style of tutorial. From authors feedback on these different styles, I will investigate why non-traditional formats would be valuable, how they would look, what's gained or lost between the different formats, and what the implications are to the authors/designers who create them.

Participant Recruitment and Selection: You must be at least 21 years of age, and have published multiple DIY instructions (online or in print) for projects you have made.

Study Method: You will be given access to a website with a DIY tutorial written in twelve unique styles. You will be asked to look through each of the tutorials and to imagine rewriting your own tutorials in that format. You will be given one week to look through the tutorials, and following that, you will be sent a questionnaire to fill out. The questionnaire should take less than 30 minutes to complete, and will focus on your understanding and desire to use the tutorial methods shown to you.

Benefits and Risks: Participants will not benefit directly by participating in the study though they will contribute to broader knowledge and understand. There are no known risks to participation.

Data Collection: All data (consent forms, emails, survey responses, transcriptions and coding data) will be collected digitally.

Data for this study, input into online forms, will be stored in SQL databases on servers in the US. It is important to note that regulations and guidelines regarding data confidentiality and privacy may be different in other countries.

Digital files will be downloaded to a secure external storage device that is kept in a locked cabinet at SFU, Surrey campus, room 3400. When being transported data will be kept on encrypted drives. All digital files will be protected with a password and coded by participant numbers to ensure confidentiality. Digital data will be retained for five years and then destroyed. Matthew A. Dalton and Ron Wakkary will have access to the data.

If a participant decides to withdraw from the study, the data related to their participation will be destroyed. Refusal to participate or withdrawal/dropout after agreeing to participate will have no adversely affect or consequences on the participants.

The data may be used for publications and presentations at conferences. Participants will have access to the results of the study. We will share with them the reports and published papers based on the study, via email.

Inclusion of names of participants in report of the study: Data will be reported in a confidential manner (use of pseudonyms).

Acceptance of this Form: By completing this form you: 1) understand to your satisfaction the information provided to you about your participation in this research project, and 2) agree to participate as a research subject.

In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from this research project at any time. You should feel free to ask for clarification or new information throughout your participation.

To accept this form, please print your name below, date the form, and click the “I Consent” button. If you choose to not participate, please exit this web page by closing the page in your web browser.

To accept this form, please print your name below, date the form, and click the "I Consent" button. If you choose to not participate, please exit this web page by closing the page in your web browser.

Participant's Name: (mandatory field)
Participant's Email: (mandatory field)
Today's Date (yyyy-mm-dd): (mandatory field)

Button: I Consent

Thank You!

Thank you for agreeing taking part in this study.

Please head over to the tutorials page for instructions of what is expected of you, along with all of the tutorials.

I will be contacting you in the next couple of days to ensure you have access to everything you need, and to make sure you don't have any questions.

Happy Making!

Button: Continue to Tutorials

Appendix E

Print Version of Website: Instructions Section

The website was divided into three section, tutorials, instructions, and survey. The instructions section was divided into instructions, study details, and behind the scenes pages. When participants were initially forwarded to the website, they were sent to the instructions page. Below are each of the three pages in the instructions section, with links out to additional content redacted.

Instructions

What you need to do:

On the following pages you'll find twelve different methods for presenting instructions on how to make an LED Throwie. The aim of this study is to investigate the viability of non-traditional instructional formats. Each tutorial presented here tries to break with one or more mechanics that crop up in just about every DIY tutorial.

While reviewing each of these tutorials, please do two things:

Put yourself in the place of someone who has never made an LED Throwie.

Consider each technique described for its usefulness as a standalone DIY tutorial.

Try to imagine other DIY projects (possibly ones you're currently working on) using these formats and think of how effective they might be. Likewise, see if you can think of better, equally non-typical, formats for those DIY instructions to be presented in.

Each tutorial page (listed in the left hand menu) has a rating and initial impressions field at the bottom of the page. Please rate how effective you feel each

tutorial is at getting its message across. If you would like, add any initial impression comments as well. You will need to click the submit button after you enter any information.

Please take the next week to review the twelve tutorials, reflect on what you see, and then complete the survey asking for your overall opinions on the twelve techniques that were presented here.

Study Details

General Description of My Research:

Tutorials have become a common place encounter for everyday people. Whether cooking, operating your remote, writing a resume, or making air planes (paper or otherwise): tutorials can be found everywhere, telling you exactly how to accomplish the task at hand. Whether those tutorials are presented to you in person, video, audio, text, image or other format, the core structure of those instructions almost always remain intact.

It doesn't matter what information a tutorial is trying to get across, or what format it is presented in, they all seem to have fallen into a cookie cutter like mentality, where places designed to help people share what they've done (like instructables.com or recipes.com) all give the same basic format and structure to present the authors work. Because of these systems, even when writing tutorials on one's own terms, people still fall in line with traditional formatting styles. While these traditional styles obviously work in many situations, they shouldn't be the sole method employed when creating tutorials.

The Maker movement began as a means to fight back against mass produced items and the lack of accessibility to products an individual owns, with slogans like: "If you can't open it, you don't own it." The Do-It-Yourself (DIY) enthusiasts that make up this movement utilize whatever tools they have available to them to create and follow a

wide range of tutorials across many different disciplines (craft, electronics, mechanics, recipes, etc).

While the Maker movement, and makers in general are presented and sometimes seen as a disruptive force to industry, when presenting how to recreate their work, there is rarely any attempts to alter the basic format and presentation style of instructions. In a field where being disruptive and fighting against industry standards are seen as the norm — when all of those disruptive works are being presented in the exact same format, it takes away from their message and underlying meaning.

Behind the Scenes

How They Were Made:

I really like to get into the nitty gritty of how things are made to fully understand them. While it may not be important for some people, I figured it would be nice to include. On this page, you'll find the source files, makings of, and anything else I think might be interesting about the production of the tutorials presented on this site.

Source Files:

Abstracted

- The same tutorial in Instructables format

Animated

- Watch the animation from within the Blender source file. You can also zoom and pan around to see it from different angles if you so choose.

BYOA

- Some tree diagrams for an initial layout, and a much more recent layout of the power section. As well as an older version of the LED section.

Calendar

- You can see how I built it over at Instructables.

Exploded

- Blender source file, in case you want to look around the scene and see how things were set up.

Explore

- The Blender file is all you need on any system to get into the nitty gritty of how this was made.

Haiku

- While there are no real source files for this, I originally came up with a different Haiku that I decided not to use as I didn't find it as interesting. I just find it cool that there's more then one way to explain how to do this project in such a limited space:

- Grab one LED, Wrap legs around battery, Add magnet and tape!

Recipe

- Again, while there's no real source files for this project, it's based off of a paper I wrote with a friend. You can read the paper to discover why we decided to do this, and how we converted between DIY tutorials and recipes.

Rubik's

- First, no, I don't know how to solve a rubik's cube. Second, yes, the video was reversed. Third, no, I will never figure out how to make it pretty again.

- Build instructions in case you want to make your own.

Song

- In case you want to hear all takes, synced together, without the backing track.

- In case you want to hear the best of each take, edited to a single take, without any backing track.

Stop motion

- Stop motion making of a stop motion.

Zoetrope

- Here's my process for building the Zoetrope.
- An animated gif of the original line art, not connected to zoetrope, in case you want to compare to the zoetrope version.

Extra Stuff

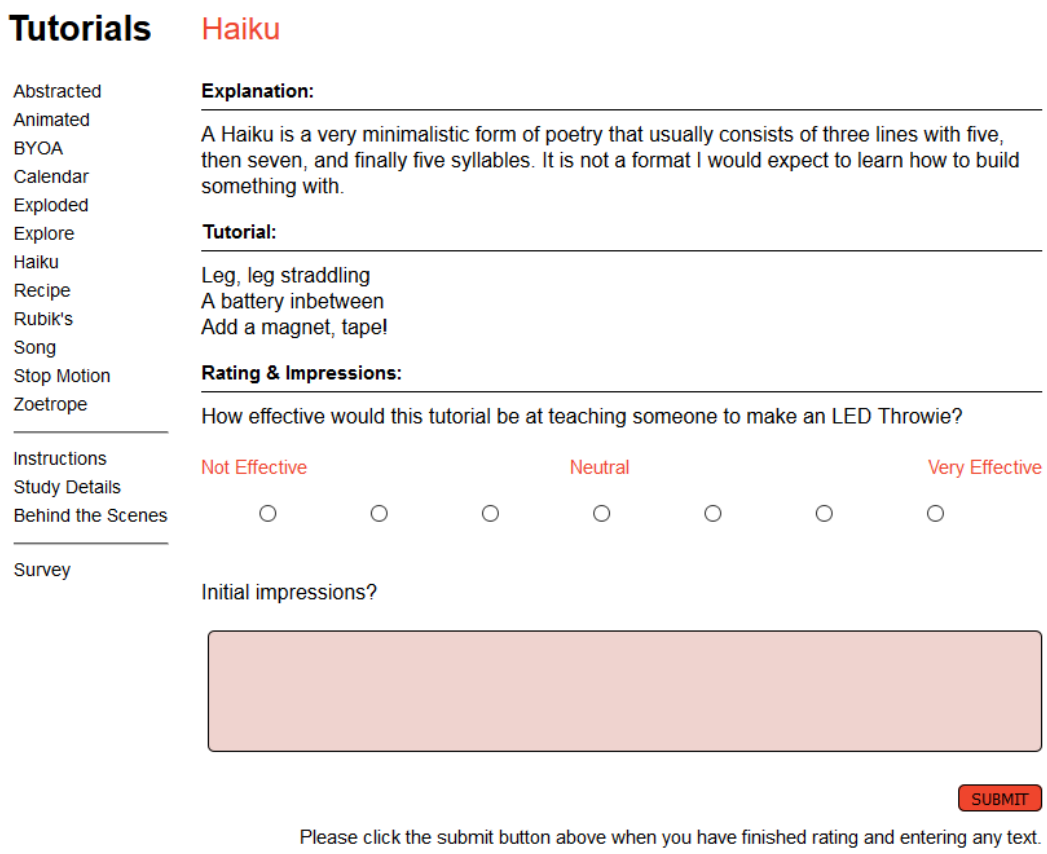
- In order to Make several of these projects, you would need to make a 3D model of the parts or materials you're showing off. I've provided my finished pieces so you can look/work with them as you want, but they don't tell the story of how easy/difficult it is to actually make any of these components individually. With that in mind, I decided to make a quick instructable on how I made one of the 3D models (I say quick, but it took at least three times as long to make the instructable as it did to actually 3D model the LED).

Appendix F

Print Version of the Website: Tutorials Section

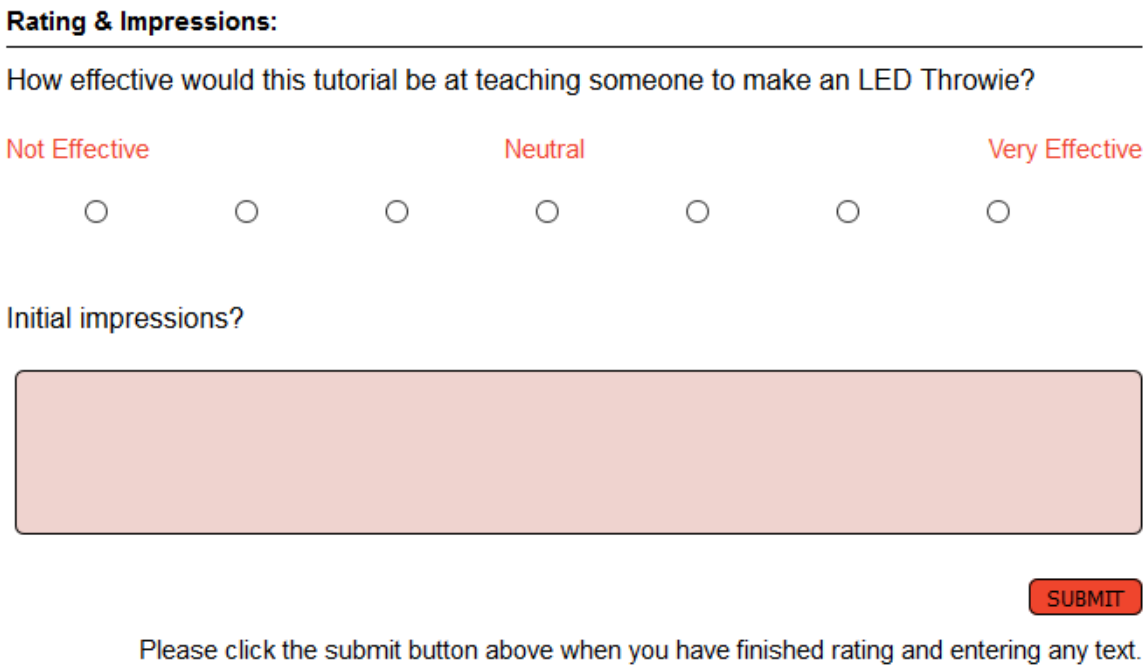
Each tutorial was divided into three section and listed alphabetically on the website. The three sections were divided from top to bottom on the page with an explanation at the top, the tutorial in the center, and ratings and impressions at the bottom, seen in the figure below.

Figure 7.5. Tutorial Website: Haiku Page



Since “Ratings & Impressions” are present at the bottom of every tutorial page, that section is going to be presented first, and not included in each of the tutorial here. Just note that Figure 7.6 ideally would appear at the bottom of each tutorial page.

Figure 7.6. Ratings & Impressions Section



Abstracted

Explanation:

You kind of need to forget what an LED Throwie is to follow these instructions properly. So try to imagine you've never heard of an LED Throwie, or how it's put together, and then follow the directions below. There are intentionally no images associated with these instructions.

One objective with this technique is to get people to build different things while always staying within the same constraints.

Tutorial:

Step 1: Materials List

- DC Light Source
- Portable DC Power Supply (Strong enough to power light source)
- Binding agent or material
- Tool, material or hardware for discriminant placement

Step 2: Test your Light Source

- With your DC light source selected, plug it into your portable DC power supply and ensure that it is powered.
- While it's lit, determine if you like the color/diffusion the light source has, and if not, change it.
- Coloring: There are many inks, paints or gels you can use to alter the appearance of your light (be sure to use inks/paints/gels that can withstand whatever temperatures your light may emit).
- Diffusing: There are lots of techniques to diffuse a surface, depending on what it is. If you're light source has a glass casing, you can use a glass etching cream to give it that diffused look.

Step 3: Bind the light source to the power source

- Using the binding agent or material you selected, bind your light source and power source together, so that your light source is always powered. Ensure you bind your parts together well, you don't want flickering lights, or lights to unplug.

Step 4: Bind your tool for discriminant placement

- Now attach the tool, material or hardware you choose to discriminatingly place your object around.
- An important note on discriminant placement: It's difficult to find a method to attach your object to any and every surface you happen across, while also allowing you to remove it and attach it to another surface without leaving permanent damage. Depending on the size and weight of your light and power source, let that inform how and where you attach it to things. Perhaps your technique for placement is to blend it into the background so it looks like it's supposed to be there. Using bricks, wood, or other materials

that are common in the area. If you want to hang it up higher, you might use a nail and only stick it to tree's in public spaces. There are many options, so think about where you want to place it, then think about how you're going to place it there.

Step 5: Let your light loose on the world!

- If you want to put your piece in a public place, try to find times when no one is around, or do your best to look professional and be ready to answer questions when someone asks what you're doing. Maybe the city is looking into crowding in this location, and a camera in the building across the street needs to keep track shadows walking across this light to tally the number of people walking past in a day. Get creative, it's fun!

Animated

Explanation:

I'm not sure I've ever seen a 3D animated cartoon show me how to build something. While this version is simply putting things together, it's conceivable to go one step further. Simply giving each component a personality and then have them interact with each other, you can make a cartoon where an LED Throwie builds itself (see Stopmotion for an example of what I'm talking about).

Tutorial:

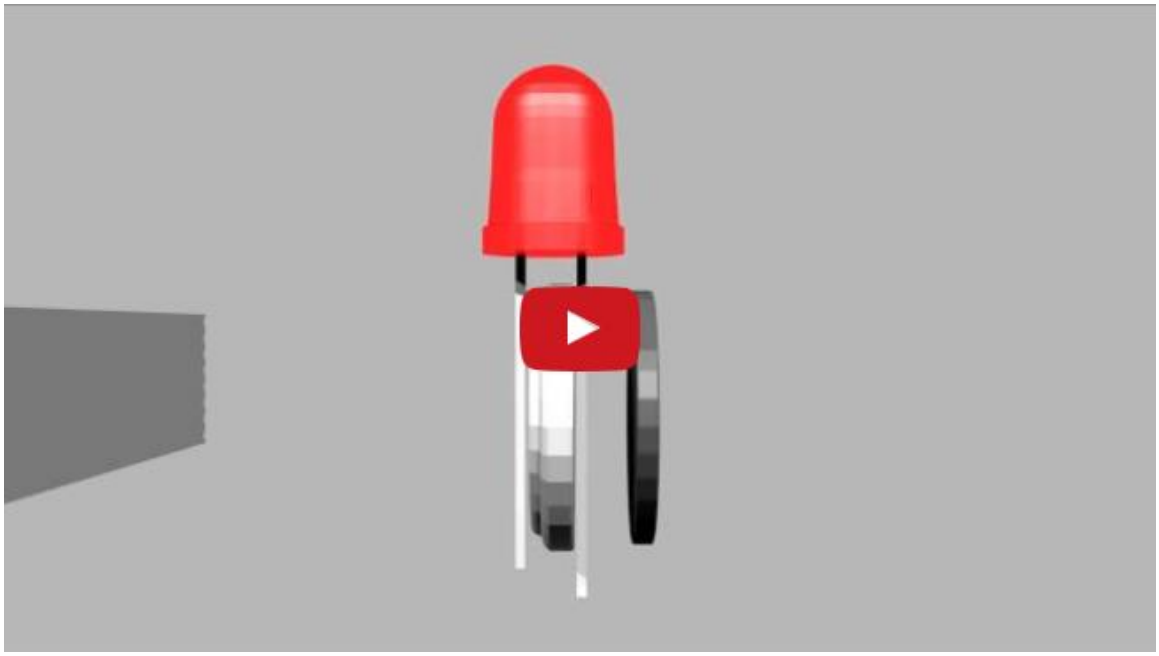


Figure 7.7. Animated Screenshot

BYOA

Explanation:

Playing a bit with the idea of choice, here you have a book with a whole lot of directions, and the reader's job is to choose the path they want to take. Very similar to old Choose Your Own Adventure games, but instead of fantasy, the intention here is for the reader to actively participate in the construction on each page.

Tutorial:

To view this tutorial, you need to download the following PDF:

Book PDF (please right click and save as)

This book is still in work, and as such, is very incomplete. There is currently only one path that has been finished, and it is marked with arrows (See Figure 7.8). All other paths need editing and images, so I'd ask that you look specifically at the arrowed path, and after that you can do what you like. If you run into page xx, it means that page hasn't been included yet.

Figure 7.8. BYOA Arrow

Calendar

Explanation:

What if you could only build your project one component a day. That's the basic idea behind the DIY calendar. While this project only requires a four-day calendar, a more difficult build would simply have more days. I chose to provide partial directions in each window. Each direction was associated with the component it was with, and keys on the edge of each paper would allow you to align them correctly to know which order to put the directions in, without having to number steps.

Tutorial:

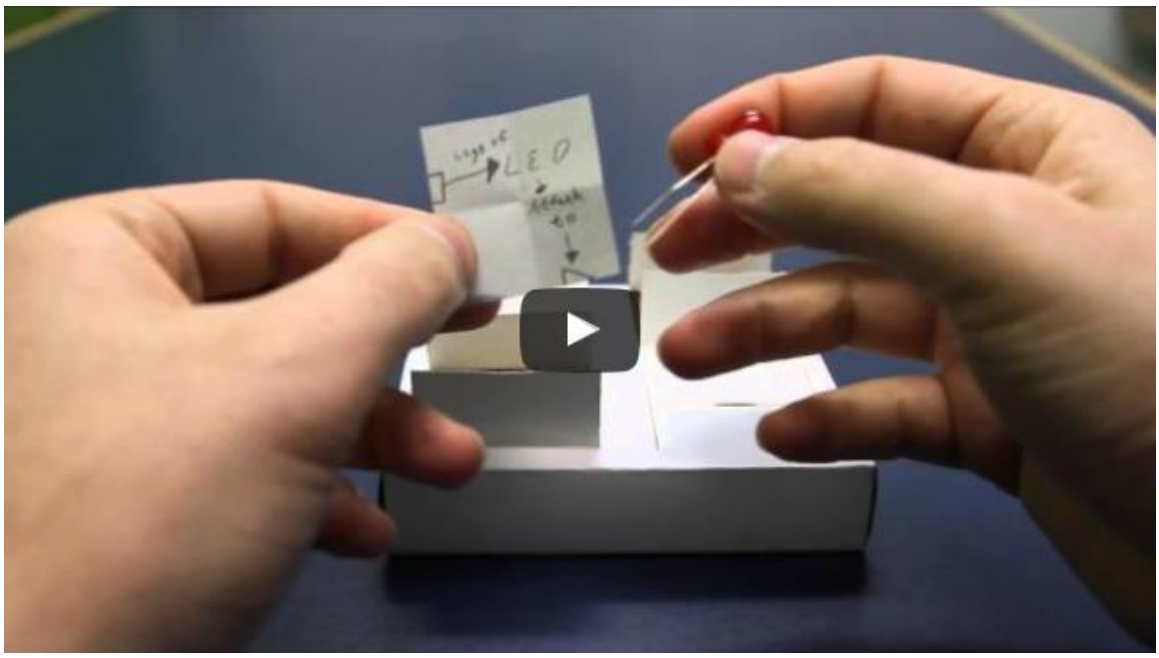


Figure 7.9. Calendar Screenshot

Exploded

Explanation:

While exploded diagrams are used a lot to show how things are constructed, they're very rarely used as stand-alone instructions.

Tutorial:

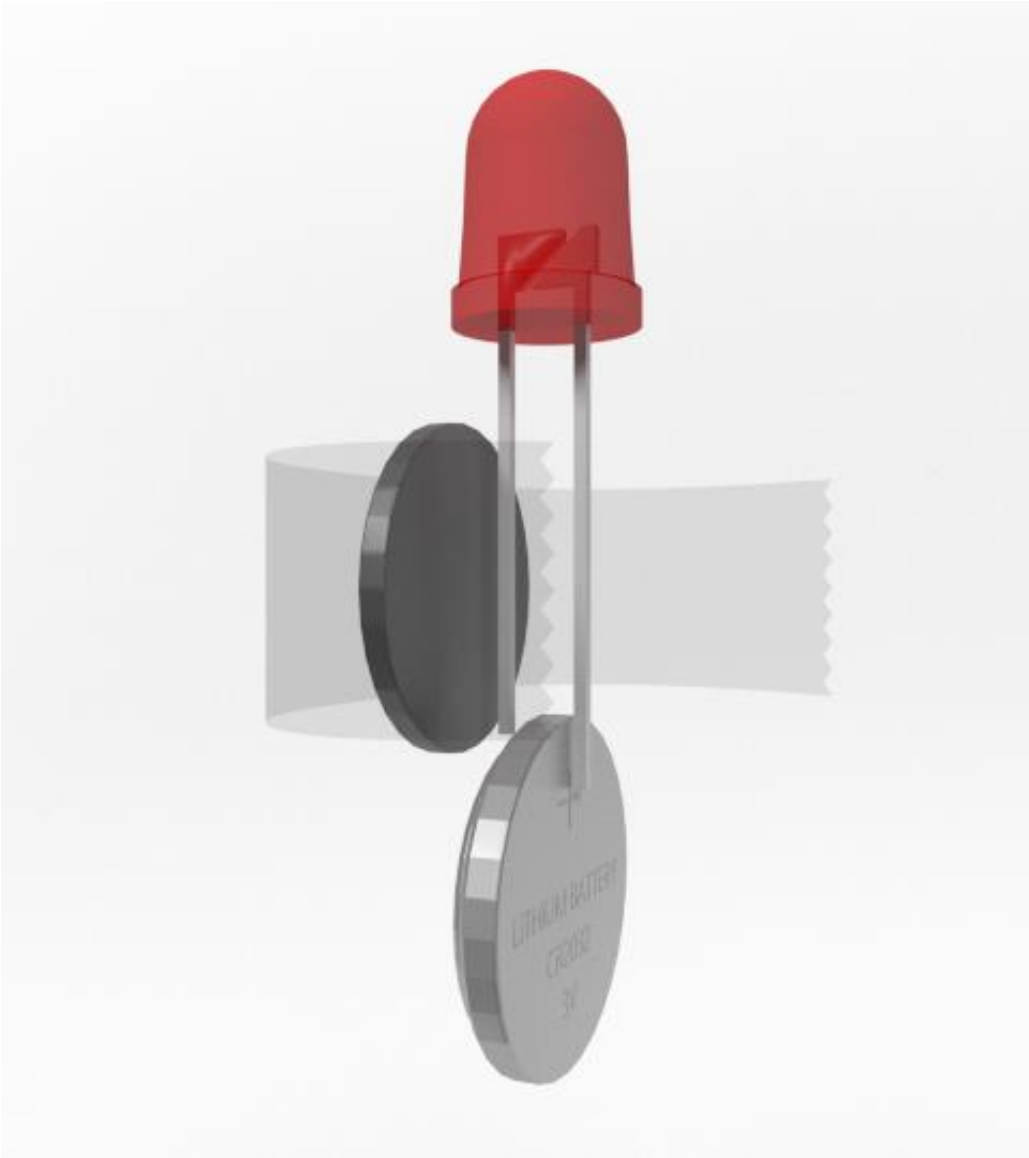


Figure 7.10. Exploded Screenshot

Explore

Explanation:

There are two concepts behind the game. First, there are no games showing people how to build physical projects. There is software that lets you wire things together or games that let you build Rube Goldberg machines, but those are different. Second, the idea here is that you have an ant's eye view of the world. Without being able to see everything at once, and needing to actively investigate the environment, would it create any additional interest? This also means that you don't get the step-by-step element of the instruction, as you just have to investigate yourself and figure out how to make your own, kind of like reverse engineering. With more time/knowledge, I would have liked the make the individual elements able to interact, but that'll have to wait for a future iteration.

Tutorial:

In order to play this tutorial, you will need to download and run the game from your computer. Depending on your system, you'll have to download one of the following files:

Windows Executable: If you have Windows, this should work fine.

Blender File: If you don't have Windows, or the above file doesn't work, you need to download this file.

The Blender file can be opened with the most recent version of Blender (I used 2.76). You can play the game from within Blender by mousing over the window with the red LED and pressing "p" on the keyboard.

Instructions to play the game can be found below.

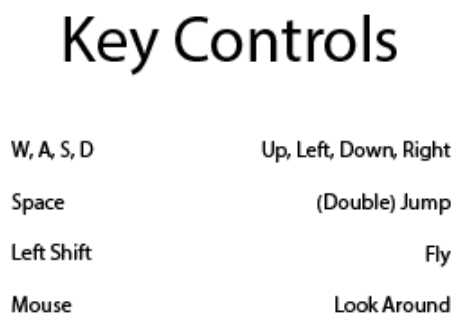


Figure 7.11. Exploded Screenshot

Haiku

Explanation:

A Haiku is a very minimalistic form of poetry that usually consists of three lines with five, then seven, and finally five syllables. It is not a format I would expect to learn how to build something with.

Tutorial:

Leg, leg straddling
A battery in-between

Add a magnet, tape!

Recipe

Explanation:

I wanted to see how easy it would be to swap formats from one tutorial style (DIY) to another (Recipe). To create this, I first broke the tutorial down to its most basic

parts, and then built it back up in a traditional recipe format from there. The recipe format I copied was presented in the 1975 version of The Joy of Cooking.

Tutorial:

Figure 7.12. Recipe Screenshot
Note. Makes 1 LED Throwie

Here's a really simple project that can simultaneously introduce someone to electricity, and provide a fun fridge magnet. To begin you'll need to have:

- 1 LED (ensure it only has two legs)
- 1 CR2032 Coin Cell Battery

Place the leads of the LED around the battery. The longer lead of the LED should be placed against the positive side, and the shorter lead to the negative. Once in place, the LED should light up. Next you'll need to grab:

- 1 Neodymium Magnet (the same or a slightly smaller circumference then your battery)

Push the Neodymium Magnet against either of the LED leads, pinching it between the magnet and the battery. Finally, get your:

- Tape

Wrap it around the magnet, battery and exposed LED lead, ensure all components are still touching when no longer pinching them all together.

When applied correctly, the LED should remain on, when you're not holding onto it at all. At this point, you can face any surface you can stick a magnet to, and toss your LED throwie and see if you can get it to stick on the first try!

Rubik's

Explanation:

While most instructions are as accessible as possible, the Rubik's Cube breaks with this tradition. On each side of the cube is one required component. On the top is the finished assembly, and on the bottom is an exploded style diagram of how to put it all together. While the components might be easier to identify with text next to each telling you what they are, I liked it much better without. The exploded diagram could also be changed out to a wiring diagram for a different project, but for this, I feel everything works as is.

One idea behind this is to give it to a friend mixed up, and once solved, they know what they're building. You can heighten the puzzle solving experience by making the thing the Rubik's Cube tells them to build: a way to decrypt something else you've given them. For projects with more materials, you can either use multiple cubes, or a cube with more sides.

Tutorial:

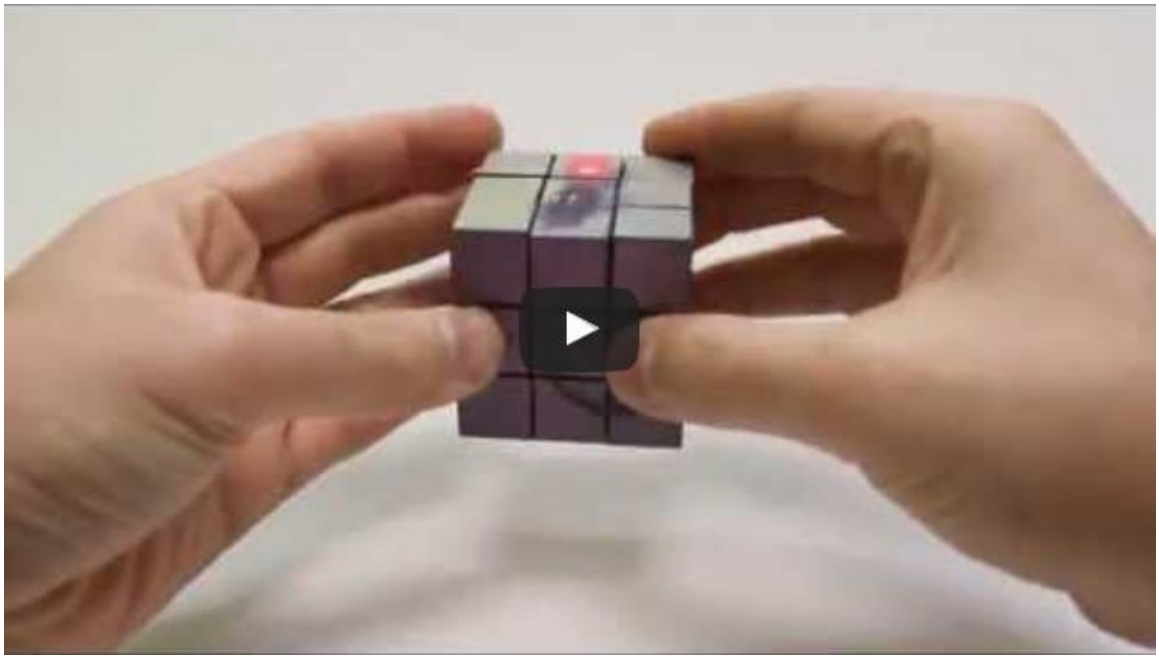


Figure 7.13. Rubik's Screenshot

Song

Explanation:

While there is the rare song that teaches kids how to tie their shoe laces or something similar (which are more often poems then songs), I don't know of any songs that teach someone how to build something. I do, however, know quite a few songs that teach Science, Math, English/Literature and other school subjects, but never Engineering.

Tutorial:

Figure 7.14. Song Screenshot

Stop Motion

Explanation:

A tutorial presented as a story, completely outside of the context of the materials. I thought about giving this more of a story line, but this is the first time I've ever done a stop-motion animation, and I didn't really want to bite off more than I could chew. There are some issues with the lighting for the first 10-15 seconds, but after that it will go away.

Tutorial:

Figure 7.15. Stop Motion Screenshot

Zoetrope

Explanation:

How about presenting instructions to someone through a spinning disk? Either having them insert the pictures into their own already made Zoetrope, or building one thing (a Zoetrope), in order to figure out how to make another. If you just had to add the images to your own Zoetrope though, it makes things pretty simple (like having a View-Master and just needing to get a new picture-disk to put in).

Tutorial:

In order to partake in this tutorial, you need to first imagine you have the persons view in the figures below. Then scroll down for an animated gif of the first person perspective.

Figure 7.16. Zoetrope Screenshot 01

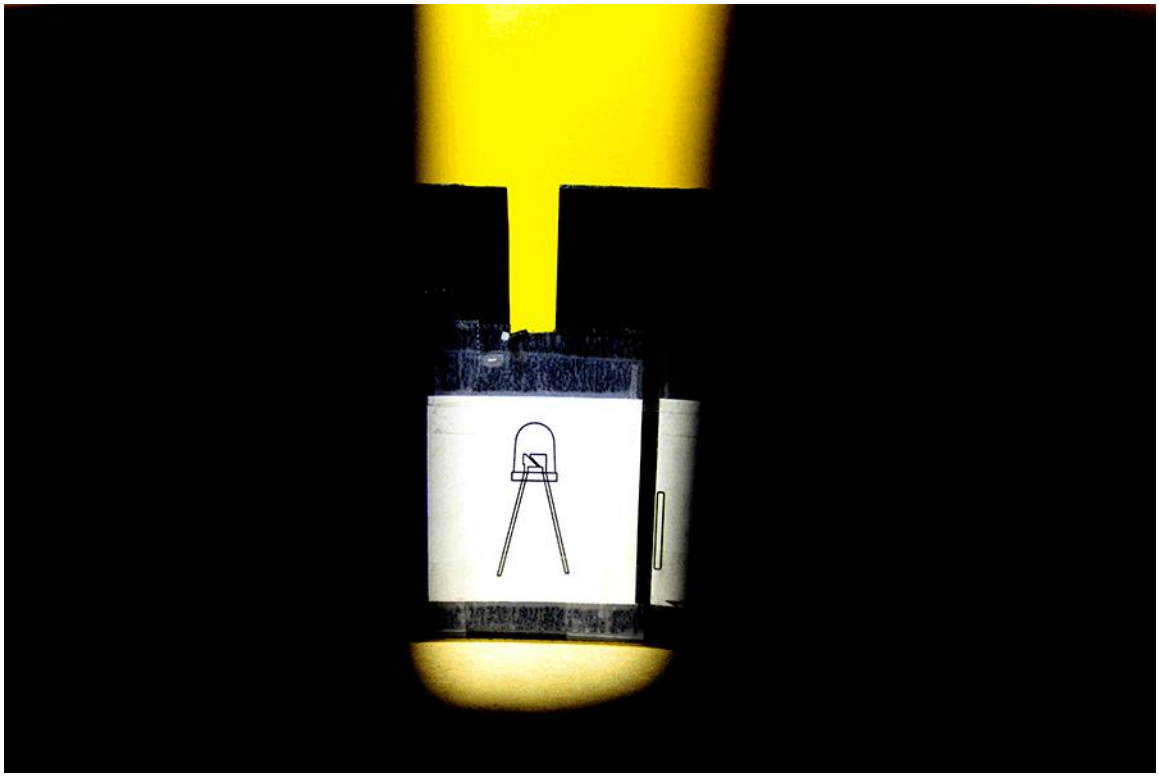


Figure 7.17. Zoetrope Screenshot 02
Note. This image was animated to show an eye-view while spinning the zoetrope.