Towards Authoring Tools For DIY Tutorials: From Tutorial User Strategies to Guidelines (Free Template Included!)

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ABSTRACT

Tutorials are essential for knowledge exchange in the DIY community. However, they often have quality issues leading to misunderstandings, mistakes, and safety risks. This indicates a need for research into how to design interactive systems that reduce author workload, improve tutorial quality, and present tutorial content more dynamically adapted to users' needs. As a baseline for such research, we need to understand how tutorial users determine tutorial quality. To this end, we conducted a qualitative study with 13 makers seeking out tutorials to implement a chosen project. We observed them selecting tutorials and asked about their selection criteria and strategies in semi-structured retrospective interviews. We combined our findings with related work, derived tutorial authoring guidelines, and created an example template embodying these recommendations. Our contributions can benefit researchers and practitioners designing authoring tools for DIY tutorials, but also DIY tutorial authors and websites.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**.

KEYWORDS

Personal Fabrication, DIY, Making Culture, Tutorials, Design Documentation, Guidelines, Template

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1 INTRODUCTION & RELATED WORK

Documentation and tutorials are an essential part of the DIY community [9, 17]. Authors use them to showcase and document their projects [9, 17], and users[1] get inspiration, technical information, and replication instructions [3, 16]. Specialized digital tutorial publishing platforms provide authors with tutorial format recommendations [11, 12] and authors share their authoring processes [10]. Additionally, the field of technical communication provides a great body of knowledge about formatting instructions in a manual style to guide users during a task [6, 19]. However, the premises of this domain differ from those of the DIY community: Manuals instruct mostly under the premise that all required materials are present and identical for most users. For example, when a drill manual instructs a user to set the torque of a drill by using the torque collar on the drill, the author assumes a specific layout of the drill because the manual was shipped with it. Users, however, frequently substitute materials and tools and adapt tutorials to their own project [9, 16]. To support these differences and the additional purpose of community exchange, DIY tutorials may require different formatting [3, 9]. Further, most DIY tutorials contain quality issues, from missing material lists to inaccurate information [18]. We expect that identifying and outlining good DIY tutorial elements can guide system research by clarifying what goals these systems should help authors reach. While consistent formats to exchange crafting instructions exist [7], tutorials within the DIY community do not generally share a common format [18]. Initial tutorial guidelines have been presented based on a self-experiment [18], a single-tutorial preliminary study [8], a semi-structured interview with four expert makers [15], and a tacit skill (clay centering) focused study [4]. To continue this research and comprehensively answer the question, *What makes a good DIY tutorial?*, we combined these findings with a study observing and interviewing 13 makers tasked to find tutorials to implement a chosen project idea. We focused our study on the less thoroughly studied tutorial selection process, to extend the related work that so far has rather looked at DIY tutorial execution [8, 18]. Based on these combined findings, we derived 23 guidelines for the DIY tutorial authoring process. The appendix includes a DIY tutorial format template (Fig. 2) as an example of how to adopt our findings.

[1]Throughout this paper, we will use the media-agnostic term "user", referring to people who utilize tutorials of any media type.

2 METHODOLOGY

The focus of our study was to investigate the tutorial selection process of users to derive tutorial quality criteria. We conducted a think-aloud study with a retrospective semi-structured interview. We observed participants in an online video call while they searched for online tutorials to complete a chosen project. Since our focus was not on the participants' process of developing project ideas, we presented them with the choice of three DIY projects: a desk lamp, an Arduino weather station, and a side table. Those projects represent the most frequent tutorial themes on instructables.com, identified in a preliminary study and selected to cover a variety of different DIY skills. We expected this to increase the likelihood of well-documented projects, the possibility of finding tutorials, enjoyment in following them, and reflection of the variety of DIY skills. Participants could choose their own project, to further increase their likely interest in such a hobby-related scenario.

Participants were instructed to search for and select tutorials online until they felt confident that they could implement the chosen project with only these tutorials, and that they could source all necessary materials and tools. We added this last restriction so that participants would select projects as they would probably do in real life. Further, participants were asked to vocalize their thoughts and impressions during the process. Afterward, we conducted a retrospective, semi-structured interview asking them why they selected or discarded tutorials and what their general expectations, preferences, and requirements were. We used process and evaluation codes from the qualitative data coding methodology [14] to structure our observations and participants' answers. Annotation was done by one author and refined and concretized into high-level categories in weekly meetings with another author. We applied 52 distinct process codes [14] to describe our participants' behavior, with 2228 coded segments. Participants' comments, voiced opinions, and remarks during the tutorial selection process and interview were coded with evaluation codes [14]. We applied 51 distinct "+" codes, for positive statements, with 112 coded segments. Additionally, we applied 60 distinct "—" codes, for negative statements, with 110 coded segments. Finally, we coded the recommendations that participants expressed with 60 distinct recommendation codes with 324 coded segments.

We found ten high-level categories related to a tutorial format: *title, hero shot & thumbnail, tutorial header, introduction, safety, table of contents, step-by-step structure, images and videos showing the crafting process, linking to external tutorials,* and *final section.*

3 RESULTS

We anticipate that most of our results apply to different tutorial media like text, images, or videos because our participants utilized different media tutorials as well. The following quotes from participants who did not speak English have been translated while aiming to keep their original meaning.

All participants started their tutorial search by typing keywords of their own choosing into a search engine like google.com or duckduckgo.com. Six participants reported skimming the resulting titles for keywords like 'DIY' or 'maker' because those imply tutorials targeted toward non-professionals. *P7: "And indeed this was the only link, even if I would have looked further, where I had the impression that it is about building it yourself just because of the keyword 'maker' [in the title]."* Further utilized distinguishing keywords were specific materials, a project budget, a particular component, or a specific technique. A title that concisely conveys the featured artifact or process and highlights distinguishing elements of the tutorial enables users to decide confidently whether a given tutorial potentially matches their requirements. From this, we extract our first guideline:

G1: The title should concisely convey the featured artifact or process and highlight distinguishing elements of the tutorial as keywords.

The thumbnail picture and the first pictures of the tutorial were the second initial selection elements. Four participants pointed out unrelated tutorial pictures during their search that confused them about the tutorial's content, like a set of physical dice as a thumbnail for a circuit-based digital random number generator. One participant also stated that they would skip tutorials where they felt unable to reproduce projects because the image, for example, implied a complex use of tools by showcasing precise cuts on an object. Additionally, we confirmed one participant exclusively deciding by project pictures whether to continue spending time on a tutorial or even look into it at all. *P10: "Otherwise, I just went with the pictures. Whenever I saw something about which I thought: 'oh that looks interesting, this is something what you might need'."* Overall, this implies that a thumbnail picture or the first picture showcasing the project should enable users to get a first impression of the project's content. Additionally, Knibbe et al. reported that experienced users valued an overview image at the beginning of the tutorial to enable them to plan ahead and skip part of the tutorial instructions using their experience to shortcut these steps [8]. Additionally, these pictures should follow general rules of photography, like proper focus and lighting, and should showcase the result of the tutorial clearly visible at the center of the image.

G2: A thumbnail picture provides an unobstructed, well-lit image showcasing a full view of the tutorial's resulting object.

When opening a tutorial, twelve participants positively acknowledged if something that we will refer to as a *tutorial header* existed. The content of the *tutorial header* differs across tutorials, but mostly it contains a list or table enumerating the required tools and materials to replicate the project. Other elements can be, for example, required skills, the estimated time to complete the project, or the project budget. The existence of such a *tutorial header* was valued because, for example, it enables discerning key elements of the tutorial quickly without skimming the tutorial text. The *tutorial header* also supported participants' varying selection criteria. For example, two participants tried to minimize the tools and materials they needed to buy by selecting tutorials that required materials they already had at hand. Another participant was looking for tutorials that used a specific tool or material. Participants also used the header to derive other information mentioned previously, like required skills, estimated time, or project budget. For example, if the header lists surface-mount (SMD) electronic components, it can be expected that soldering will be a required skill to replicate the project. However, DIY tutorial authors can support the user's selection process by explicitly listing those key elements as well.

ID	Age	Gender	Self-Proclaimed Occupation	Nationality	How Often DIY	How Long DIYing
1	25	Male	Games Programmer	German	Less	Never
2	23	n/a	Student	German	Every Other Week	3 Years
3	26	Female	Research Assistant/PhD Student	German	Irregularly	4 Years
4	33	Female	Research Assistant	German	Yearly	10 Years
5	24	Male	Student	German	Yearly	7 Years
6	26	Male	Student	German	Weekly	2 Years
7	32	Male	IT Consultant	German	Monthly	Few Years
8	22	Male	Student	Belgian	Yearly	About 2 Years
9	61	Male	Chemical Labrorary Assistant	German	Monthly	25 Years
10	60	Female	Homemaker	German	Every Other Week	About 40 Years
11	65	Male	Professor	American/British/Israeli	Daily	A Little Less Than 65 Years
12	29	Female	Member of Technical Staff	American	Every Other Week	Since Childhood
13	47	n/a	Makerspace Director	German	Daily	Since Childhood

Table 1: Demographics and DIY experience of the study participants.

Further, images of the tools and materials can simplify identifying these components, especially when technical terms are used, or when the tutorial is not written in the user's native language. Providing references like numbers, letters, or symbols that link the listed components with their picture representation supports users in connecting the two, as technical communication research suggests [6]. Twelve participants mentioned, supported by related work [18], that users should be able to replicate a tutorial if they have all the tools and materials listed at the beginning available. This leads to the next four guidelines:

- **G3:** List elements like tools, materials, required skills, the estimated time to complete the project, and the project budget as lists or tables at the beginning of the tutorial.
- **G4:** Provide pictures of tools and materials to simplify identification.
- **G5:** Link pictures to lists of components by providing references like numbers, letters, or symbols.
- **G6:** List all tools and materials such that a user who has everything listed available can replicate the project without any additional components.

The introduction provides a context for the project and informs users what they will achieve if they follow the tutorial. Six participants stated that they valued a concise outline of what the project is about and who the author is. Similarly to an overview thumbnail image, expert participants of the exploratory study by Knibbe et al. stated that they appreciated a task overview and context to enable them to use their experience to shortcut tutorial instructions [8]. This is summarized in:

- **G7:** Provide a concise introduction outlining the project's uniqueness and/or purpose and what the users will achieve when they follow the tutorial.

The DIY community consists of hobbyists and enthusiasts [9]. Domain experts can share how to work safely with specific materials from their knowledge domain. Four participants pointed out the necessity that when authors are aware of any safety precautions that should be taken, they should include them in the tutorial because users might follow the instructions without being aware of potential dangers. We advocate safety instructions and precautions as a section in the tutorial to create a safe working culture inside the community. This way, users can trust that they can safely follow the author's instructions.

- **G8:** Be mindful of potential health risks of the project and include necessary precautions and good working practices in a separate section or in the corresponding step.

Initially, a tutorial's table of contents can help a user understand its content and structure. During the replication process, a table of contents or chapter markings that potentially even update with the user's progress can give them a sense of advancement. Four participants stated that they valued these benefits and appreciated when a table of contents was present. *P11: "I do like that I can see where I am in this table of contents."* This suggests:

- **G9:** Provide a table of contents that outlines the structure of the tutorial.

When confronted with a tutorial that primarily consisted of a block of text without visual separation, six participants stated that they felt overwhelmed and unable to skim or navigate the content. *P3: "I have a pile of text and don't really know where I have to start because, to me, this text feels overwhelming."* This is supported by the field of technical documentation, which recommends structuring instructions and procedures into chronological steps [6, 19]. Additionally, one participant added that smaller steps could be motivating because of the feeling of success after completing each step. There is no general rule for the level of detail for one single step because it depends on the expertise of the target audience [6]. The single instruction to disassemble an engine can be detailed enough for an audience who knows how to do this without further instructions [6]. Our participants' remarks supported this: some mentioned that a step was too detailed, while others said they would like more details.

However, participants mentioned that if in doubt, they appreciated more over fewer details because it was easier to skip some of the content than to be confused over missing information. This also occurred with experts in related work experiments [8]. Therefore, tutorial authors should be clear about their target audience and mention any advanced knowledge required to follow the tutorial.

Three participants suggested that complex tutorials could benefit from listing the step's necessary tools, materials, and also files like 3D models or code again at the beginning of each step. Otherwise, it is reported that missing this information can lead to confusion [18]. Additionally, eight of our participants and related work from technical documentation [19] recommend having an image at the beginning of a step that showcases what the project should look like after that step has been completed. This enables users to identify whether their replication was successful, to trace back to the point where an error might have occurred, and to have a seamless transition between steps [18].

Finally, participants were split about whether a step should contain reasons beyond instructions. This is contrary to related work where authors stated that they assumed it was expected for replication-style tutorials to only document the minimal amount of information necessary to complete a step [17]. However, four of our participants preferred to have simple instructions, while four others were curious about the author's insights. Additionally, there seems to be a split between realistically documenting mistakes and appearing competent [17]. We suggest an extra section at the end of a step as a compromise that provides context, best practice experiences, alternative approaches, and potential mistakes. The resulting guidelines are:

G10: Structure instructions in chronological steps.
G11: A step should be detailed enough that the target audience of the tutorial will be able to follow it without further information.
G12: List all necessary tools and materials to complete each step at its beginning.
G13: Provide an image at the beginning of each step that showcases what the project should look like after that step is completed.
G14: Provide additional information like known problems, common mistakes, or alternative approaches in a separate section at the end of each step.

Especially spatial builds can benefit from chronologically sequenced images and videos that support instructions that are structured in steps [18]. They can show how pieces fit together, where to drill a hole, or how to orient parts. Ten participants in our study either positively commented on the presence of such pictures or negatively noted their absence. Further, eight participants appreciated when a picture was visually related to a step, or ideally showed the step itself. If a step is connected to images, the step should not be too long such that the image can no longer reference everything in the step [18]. If a step requires specific movements, a video should be used instead of an image, explaining the step in motion. However, to avoid distraction, embedded videos should not start playing automatically, according to two participants and related work about the attention dominance of dynamic visual cues over static ones [1]. This leads to:

G15: Visualize the instructions of a text with images or videos.
G16: Provide references, like step numbers, which connect the images and videos to the step's text.
G17: When specific motions are necessary to replicate a step, consider using a video instead of an image.
G18: Embed videos in a tutorial such that they only play when the user wants them to.

There was no consensus among participants' remarks during our study regarding linking to other tutorials to learn about a specific technique. For example, a tutorial could link to a soldering tutorial instead of detailing how to solder. However, three participants preferred a tutorial being the only required source to replicate the project. In contrast, five participants liked a more concise tutorial that links to other tutorials to read up on specific techniques. Wakkary et al. found that linking to external sources can be helpful, but too many links can disturb the sequencing of the tutorial [18]. Thus, we assume that providing external resources is beneficial to keep the tutorial concise. However, a threshold apparently exists beyond which users might become overwhelmed by the amount of necessary additional information.

While linking to more detailed external instructions resulted in mixed participant feedback, explaining or linking to alternative materials, tools, or techniques was noted positively by five participants and emphasized by related work to enable substitution [8, 15]. When, for example, a tutorial used a specific type of glue, one participant was unsure whether they needed to use the same glue or whether other types of glue resulted in the same effect. This is especially important due to the global nature of the DIY community: Sometimes authors mention a specific regional product, and users need to find out how to substitute this product with one from their region [16]. These linking insights are reflected in:

G19: Link to other tutorials instead of explaining a technique again that has already been explained elsewhere.
G20: Consider that too many links to external tutorials can overwhelm users.
G21: Provide explanations for the usage of specific materials, tools, or techniques such that users can substitute if necessary.

Five participants mentioned that tutorials without a final section or summary felt like they ended suddenly or without any conclusion. It was expected that the final section would feature the finished object and showcase users' potential benefits from completing the tutorial. Additionally, supplementary files like 3D models for 3D printing were expected to be provided at the end of the final chapter if they were not provided in the related step. This suggests:

G22: Showcase the completed object and potential user's benefits of completing the tutorial in a final section at the end.
G23: Provide any supplementary files that have not already been provided during the tutorial steps, at the end of the tutorial.

4 CONCLUSION

Our goal was to support and advance HCI research around DIY tutorial systems by providing guidelines on elements of good tutorials. We expect that findings around this question can provide a basis for DIY tutorial system research that aims to support authors in creating better DIY tutorials, by outlining the necessary elements based on combined results. As an example of our vision, we appended a DIY tutorial template that showcases our guidelines in an adoptable format.

We expect that such structured approaches, like our guidelines and the appended sample template, can guide our own and others' future work in developing supportive DIY tutorial systems. Tools

could use a well-formed *tutorial header* consisting of the elements suggested by our results (G3) to filter tutorials. For example, on the recipient side, future research on systems that assess DIY expertise [5] may help automate user skill assessment, which could further simplify today's daunting task of finding DIY tutorials that match one's own skill set [13]. Further, our findings emphasized the benefits of the listed individual tutorial elements. System research can investigate solutions to support the DIY tutorial authors in creating those elements. For example, research on automated tool tracking [5, 20, 21] can be utilized to provide a tool usage timeline, supplying authors with a step-by-step outline (G10) for their tutorial.

In summary, our results provide two benefits: First, researchers can utilize our guidelines to identify elements that may be created or identified automatically, as well as particular authoring processes that systems should be supporting. Second, system research that aims to support tutorial creation [2] can use our findings as a best-practice target for such systems. Overall, we hope that our work can inspire future HCI researchers to find new ways to improve the processes around DIY tutorial authorship, leading to better DIY tutorials and thus support of the DIY community as a whole.

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A THE 23 DERIVED GUIDELINES

DIY Tutorial Guidelines

The following research-based guidelines aim to support DIY enthusiasts in creating improved DIY tutorials with ease.

G01	The title should concisely convey the featured artifact or process and highlight distinguishing elements of the tutorial as keywords.
G02	A thumbnail picture provides an unobstructed, well-lit image showcasing a full view of the tutorial's resulting object.
G03	List elements like tools, materials, required skills, the estimated time to complete the project, and the project budget as lists or tables at the beginning of the tutorial.
G04	Provide pictures of tools and materials to simplify identification.
G05	Link pictures to lists of components by providing references like numbers, letters, or symbols.
G06	List all tools and materials such that a user who has everything listed available can replicate the project without any additional components.
G07	Provide a concise introduction outlining the project's uniqueness and/or purpose and what the users will achieve when they follow the tutorial.
G08	Be mindful of potential health risks of the project and include necessary precautions and good working practices in a separate section or in the corresponding step.
G09	Provide a table of contents that outlines the structure of the tutorial.
G10	Structure instructions in chronological steps.
G11	A step should be detailed enough that the target audience of the tutorial will be able to follow it without further information.
G12	List all necessary tools and materials to complete each step at its beginning
G13	Provide an image at the beginning of each step that showcases what the project should look like after that step is completed.
G14	Provide additional information like known problems, common mistakes, or alternative approaches in a separate section at the end of each step.
G15	Visualize the instructions of a text with images or videos.
G16	Provide references, like step numbers, which connect the images and videos to the step's text.
G17	When specific motions are necessary to replicate a step, consider using a video instead of an image.
G18	Embed videos in a tutorial such that they only play when the user wants them to.
G19	Link to other tutorials instead of explaining a technique again that has already been explained elsewhere
G20	Consider that too many links to external tutorials can overwhelm users.
G21	Provide explanations for the usage of specific materials, tools, or techniques such that users can substitute if necessary.
G22	Showcase the completed object and potential user's benefits of completing the tutorial in a final section at the end.
G23	Provide any supplementary files that have not already been provided during the tutorial steps, at the end of the tutorial.

These DIY tutorial guidelines are part of and further elaborated in the publication *Towards Authoring Tools For DIY Tutorials: From Tutorial User Strategies to Guidelines (Free Template Included!)* by Lahaye et al., MuC '23.

Figure 1: Table listing all derived guidelines.

B EXAMPLE TEMPLATE

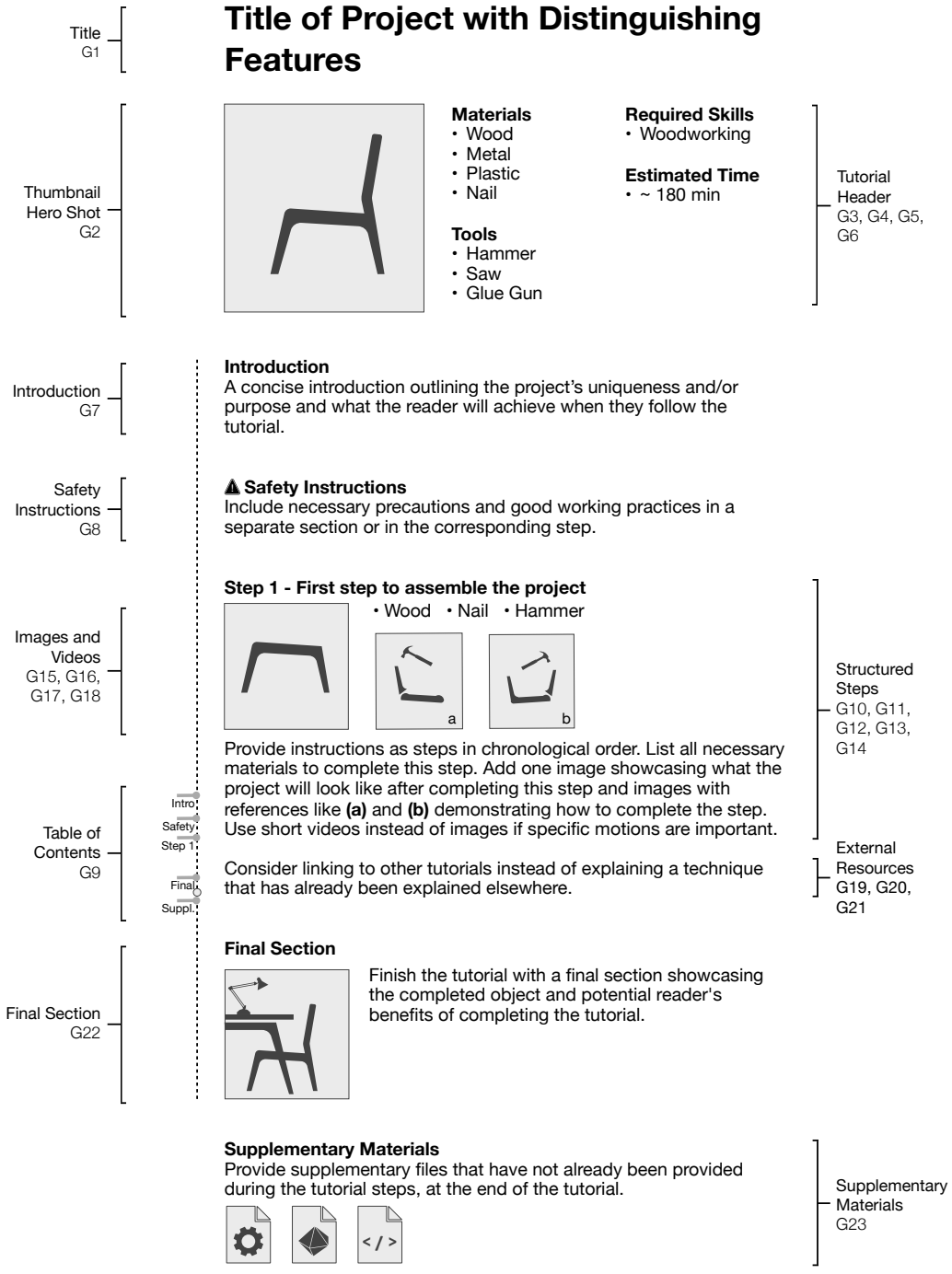

Figure 2: DIY tutorial template with guideline references.