

# Beyond “One-Size-Fits-All”: Understanding the Diversity in How Software Newcomers Discover and Make Use of Help Resources

**Kimia Kiani**  
 Computing Science  
 Simon Fraser University  
 Burnaby, BC, Canada  
 kimia\_kiani@sfu.ca

**George Cui**  
 Computing Science  
 Simon Fraser University  
 Burnaby, BC, Canada  
 gcui@sfu.ca

**Andrea Bunt**  
 Computer Science  
 University of Manitoba  
 Winnipeg, MB, Canada  
 bunt@cs.umanitoba.ca

**Joanna McGrenere**  
 Computer Science  
 University of British Columbia  
 Vancouver, BC, Canada  
 joanna@cs.ubc.ca

**Parmit K. Chilana**  
 Computing Science  
 Simon Fraser University  
 Burnaby, BC, Canada  
 pchilana@cs.sfu.ca

## ABSTRACT

For most modern feature-rich software, considerable external help and learning resources are available on the web (e.g., documentation, tutorials, videos, Q&A forums). But, how do users new to an application discover and make use of such resources? We conducted in-lab and diary studies with 26 software newcomers from a variety of different backgrounds who were all using Fusion 360, a 3D modeling application, for the first time. Our results illustrate newcomers’ diverse needs, perceptions, and help-seeking behaviors. We found a number of distinctions in how technical and non-technical users approached help-seeking, including: when and how they initiated the help-seeking process, their struggles in recognizing relevant help, the degree to which they made coordinated use of the application and different resources, and in how they perceived the utility of different help formats. We discuss implications for moving beyond “one-size-fits-all” help resources towards more structured, personalized, and curated help and learning materials.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from [permissions@acm.org](mailto:permissions@acm.org).  
 CHI 2019, May 4–9, 2019, Glasgow, Scotland UK  
 © 2019 Copyright held by the owner/author(s). Publication rights licensed to ACM.

ACM ISBN 978-1-4503-5970-2/19/05...\$15.00  
<https://doi.org/10.1145/3290605.3300570>

## CCS CONCEPTS

• **Human-centered computing** → **Graphical user interfaces**.

## KEYWORDS

Software help, software learning, help-seeking

## ACM Reference Format:

Kimia Kiani, George Cui, Andrea Bunt, Joanna McGrenere, and Parmit K. Chilana. 2019. Beyond “One-Size-Fits-All”: Understanding the Diversity in How Software Newcomers Discover and Make Use of Help Resources. In *CHI Conference on Human Factors in Computing Systems Proceedings (CHI 2019)*, May 4–9, 2019, Glasgow, Scotland UK. ACM, New York, NY, USA, 14 pages. <https://doi.org/10.1145/3290605.3300570>

## 1 INTRODUCTION

Learning to use feature-rich software, such as 3D design tools and video editors, is a challenging endeavor. The volume of commands, which can number in the hundreds or thousands, makes it difficult for users to gain awareness of what is possible in the application, to locate relevant commands within the interface, and to discover how to combine the different commands into higher-level workflows [27]. Resources provided with the software, such as help manuals and documentation, are often quickly abandoned by frustrated users and not deemed helpful [45, 46, 48].

There is a rich history of human-computer interaction (HCI) research examining the issues and challenges that users face with seeking help when using feature-rich software (e.g., [3, 9, 43, 49]). With the introduction of Web 2.0 technologies and subsequent growing popularity of user-generated content, software help has evolved dramatically, even within the last 5-10 years. Users now have more outlets

than ever to disseminate and share their software knowledge. For most modern feature-rich software, there is now considerable external help and learning resources available on the web, such as interactive tutorials, videos, Q&A or FAQ sites, blogs, dedicated forums, among others.

A variety of innovative approaches for designing software help have also been proposed in the literature, usually with some underlying assumption about software users and their common help needs and behaviors. For example, some tools assume that users will learn by following expert users' behavior, step-by-step instructions (e.g., [6, 28, 38]) or video-based tutorials [32]; others assume that users will make coordinated use of a search engine when learning the application (e.g., [17, 20]); yet, other tools assume that users will learn by looking up questions and answers from other users (e.g., [10, 41]).

Unfortunately, many of the assumptions about users' help needs and strategies have not considered the range of possible experiences of users who are entirely new to an application, henceforth, we call *software newcomers*. There is reason to believe that newcomers are likely to experience frustrations with the application and help resources (both internal and external to the application) that are even more acute than other users when it comes to using and learning feature-rich software [21]. The newcomer experience is especially an important problem today because the user base of feature-rich software (such as for 3D modeling) is not limited to professional, trained users—it is growing with a large number of casual users who bring in a diverse set of technical and domain knowledge and skills [29].

Missing in the literature is a deeper characterization of how software newcomers approach help-seeking in a feature-rich application. For example, what types of help resources do newcomers gravitate towards when they face difficulties, and for what reasons? What challenges, if any, do newcomers face as they seek help? Furthermore, and, importantly, to what extent are newcomers similar and different to one another in their approaches and points of difficulty?

In this paper, we tackle these questions and investigate help-seeking among newcomers in the context of learning a 3D modeling application, *Autodesk Fusion 360* [1]. We carried out a multi-phase study consisting of one-on-one laboratory observations and a take-home diary component with 26 participants who were all using Fusion 360 for the first time and were motivated to try out 3D modeling. Our sample included 20 participants who had no experience with 3D modeling: 10 *technical newcomers* (those with computer science (CS) and related backgrounds) and 10 *non-technical newcomers* (artists, writers, scientists, etc., without any CS training). For comparison, we also recruited 6 *domain expert newcomers* who had formal training in 3D modeling domain but who were new to Fusion 360.

The main contribution of our paper is in providing empirical insights into the diversity among software newcomers in terms of how they use and perceive external help resources when first learning to use a feature-rich application in a task-focused manner. Our findings reveal common challenges among the different groups of newcomers, as well as key distinctions including: differing abilities to articulate search queries and recognize relevant help, and the degree to which newcomers made coordinated use of the application and different resources. Our findings also highlight several opportunities for the HCI community to design more targeted curated and personalized help resources for different types of users, to ultimately make the learning process more efficient and less daunting for all software users.

## 2 RELATED WORK

This work builds upon existing studies of software help-seeking and the role of user expertise in software learning. Our study is also inspired by the wide range of prior novel systems in the literature that support software learning.

### Studies of Software Learning and Help-Seeking

The HCI field has long acknowledged the complex and challenging nature of learning and using complex software. Prior studies have provided important insights into the existence, prevalence and efficacy of different help-seeking and troubleshooting strategies.

Early HCI studies of software help seeking date back to the late 1980s and 1990s. At this time, it was still common practice for large printed manuals to accompany software. While some users did report consulting these physical manuals, other work suggested that users tended to avoid consulting formal documentation [48], often preferring to learn via self-directed experimentation or trial-and-error from within the application [48, 49]. Carroll coined this preference for self-directed experimentation over help-seeking the “paradox of the active user” [9]—even though it would be more efficient for users to seek help to resolve their breakdowns, they opt to tackle the task on their own first. Early studies also found that learning instances generally tended to occur in the context of specific tasks as opposed to more open-ended software exploration [49].

Studies from the mid-to-late 2000s identified and contrasted challenges that users face both when attempting to learn the application through interface exploration and when seeking help from the application's online help system (e.g., [3, 43–45]). For example, with in-application experimentation, users had difficulty understanding the application's vocabulary, leading to only limited success [43]. Nonetheless, users remained reluctant to seek help from the online help system, even when they needed it [43–45]. When consulting documentation, prior studies emphasized users' preference

for minimalist instruction sets [7] as compared to detailed documentation [45]. Prior work also found that the *vocabulary problem* [22] made it difficult for users to search within online help systems, since help systems often used the same (unfamiliar) vocabulary found in the application [3, 43].

Since the explosion of external online resources [39, 52], more recent studies on software help-seeking have tended to focus users' experiences with novel prototypes (e.g., [11, 14, 17, 34, 36]). One exception is a recent study by Hudson et al., [30], which examined tutorial use and help-seeking behaviors of children (ages 10-15) who were novice and newcomer users of the 3D design application *Tinkercad*. They found that the children were highly reluctant to search for online help. When prompted by an experimenter to do so, the children had difficulty formulating search queries and evaluating help resource suitability.

Our paper builds on this body of prior research by providing an updated and detailed characterization of adult help-seeking strategies in light of the current landscape of software help resources. The diversity and availability of external resources has changed dramatically in recent years, necessitating new insight into user strategies and challenges. We also focus on the diversity of the newcomer experience.

### Expertise in Software Learning and Help-Seeking

In general, it is widely acknowledged that individual differences can play an important role in how users experience technology (e.g., [5, 13, 15, 16]). In software learning research more specifically, one attribute that has received a great deal of attention is the role of user expertise. For example, building on Nielsen's categorization of user experience levels [42] Grossman et al.'s survey of software learning metrics [27] proposed a taxonomy of software users consisting of four dimensions, all related to expertise: "Experience with computers", "Experience with the [specific application] interface", "Domain knowledge", and "Experience with similar software." Other studies have either included a wide range of user expertise in their participant pool [26, 49], or have purposefully narrowed their studies to the either expert (e.g., [14]) or novice groups (e.g., [3, 8, 30, 43, 44]).

Our study extends prior research in this space by closely examining the help-seeking behaviors of newcomers who come with and without domain expertise. In addition, we also consider the technical expertise of the newcomers and how it impacts their help-seeking approaches.

### Systems and Tools to Support Software Learning

Finally, there is a wide body of prior research on systems and techniques that aim to address specific software learning challenges and tendencies. For example, prior work has investigated ways of providing richer contextual help within

the application, to help users better understand how individual tools can be used [18, 25, 37]. Others have focused on making it easier for users to search for relevant tutorials by, for example, augmenting search engine results with the commands covered [17]. Still others have focused on the tutorial application problem by, for example, creating systems that highlight commands mentioned in the tutorial within the interface [20, 31] or use application interaction data to control video tutorial pacing [47]. Addressing vocabulary challenges, prior work has also proposed mapping higher-level keywords to individual actions or workflows [21, 36]. Finally, prior approaches have sought to make it easier for users to leverage community software wisdom through, for example, application-integrated forums [10, 41] or tutorials augmented with feedback and perspectives of other users [6, 38].

Many of the above systems have been tested using participants with relatively high degrees of application and technical expertise (e.g., industry professionals or students in CS), and therefore, there is little current empirical insight into the degree to which of the above approaches may or may not support a range of application newcomers.

## 3 METHOD

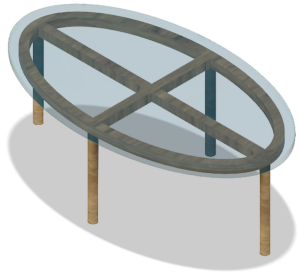
The main goal of our research was to investigate how newcomers find and make use of software help when trying to use a feature-rich software application. We first carried out an in-lab observational study to shed light on participants' behaviors and interactions when using help resources for their initial learning tasks. To investigate the extent to which participants' help-seeking approaches and perceptions might generalize beyond the short and controlled nature of the lab session, we invited participants for a take-home diary component and follow-up interviews.

### Choice of Application Domain

Given the popularity of 3D printing and the growing user base of novices trying to learn 3D modeling on their own [29], we decided to investigate help-seeking behaviors in the context of using *Autodesk Fusion 360*, a feature-rich cloud-based Computer-Aided Design (CAD) application. Fusion 360 allows users to create sketches of 3D models and turn these sketches into 3D printable objects that can be used for both professional and recreational uses.

### Choice of Tasks

For designing the modeling tasks, we consulted with Fusion 360 experts, and explored models that would be suitable for newcomers but would have some challenging aspects such that newcomers would want to seek help. Using feedback from the experts, we designed our own models and ran pilot



**Figure 1: Example model used in the main study task.**

tests to check the models' levels of difficulty. Based on our pilot tests, we expected that newcomers would make progress, but would also feel the need to find help when stuck.

### Participants and Recruitment

Our goal was to recruit people from a range of educational and technical backgrounds. We reached out to local makerspaces, libraries, and universities to recruit people who had any interest in learning about 3D modeling.

We ended up recruiting 26 adult newcomers (13M/13F), all new to Fusion 360, between the ages of 19-45, who were a mix of university students and working professionals. Their highest education ranged from high school diplomas to graduate degrees. We classified all of our participants with the following labels based on their self-reported expertise in 3D modeling and technical skills:

*Technical newcomers (T)*: majors in CS or Engineering and/or had experience with software development; did not have any experience with 3D modeling. (n=10)

*Non-technical newcomers (NT)*: non-CS majors (e.g., Arts, Business, Biology, English, Linguistics, etc.); did not have any experience with software development or 3D modeling. (n=10)

*Domain experts (DE)*: had formal training in 3D modeling and were regularly using another 3D modeling application. (n=6)

### In-Lab Observations

During the observational in-lab session, each participant was asked to try two different 3D modeling tasks. The main task was to create a 3D table from scratch (as shown in Figure 1). We had a secondary task of similar difficulty where participants were asked to produce a coffee cup and a cup sleeve.

*Study Protocol.* We told participants at the outset that the study tasks were designed to be challenging and that our main goal was to investigate help-seeking strategies and behaviors rather than participants' 3D modeling task performance. We encouraged participants to seek as much help

as necessary using whatever resources in or outside the application that they felt comfortable with. But, we also made it clear that the researchers would not be able to answer questions or provide any help.

We began the study with a 3-minute introductory video about 3D modeling, what it is, and its applications. The video did not contain any content about Fusion 360.

Participants were given 20 minutes for the main task and another 20 minutes for the second task and an additional 5 minutes to fill out a questionnaire after each task. We provided images of both target 3D models and optional design specifications (e.g., dimensions, materials) and made it clear that participants can be creative with their designs. We encouraged participants to think aloud while completing the tasks, so we could better understand any breakdowns that they face in tackling the task. We collected data through screen and audio recordings of each participant's interactions. We also installed a browser plug-in on the lab computer used for the study that allowed us to collect time-stamped browsing logs and create navigation timelines (as illustrated in Figure 2). For additional insights into the participant's perceptions and actions, we then conducted a semi-structured interview for 10 minutes. In most cases, there were two researchers who observed each in-lab session and took detailed notes. Each in-lab session lasted around 60 minutes.

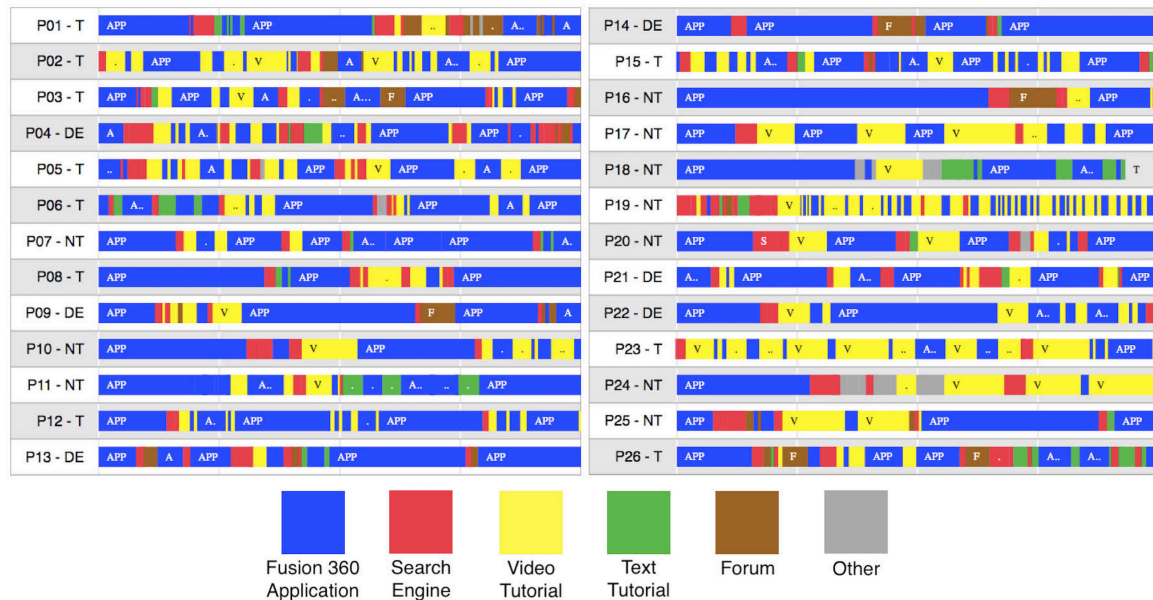
### Take-Home Diaries

During the diary study phase, we asked participants to spend at least two hours working on two additional modeling tasks (at home and at their own pace, on their own computers), with the goal of removing some of the time and observational pressure of the lab environment. We gave participants the choice of working on any two of five different modeling tasks (that were of the same level of difficulty as the ones prescribed in the lab). For each model, we supplied participants with a target image and optional design specifications.

For this phase of the study, our data collection focused on participants' self-reports of their help-seeking actions. To record their interactions, participants used a variant of "Eureka reports" [49], which are learning incident logs used in diary studies. We offered both online and paper-printed Eureka reports for participants to record each help-seeking attempt, including the usage of help resources and whether or not they perceived their attempt to be successful.

### Final Follow-Up Interviews

Following the diary phase, we scheduled a semi-structured final interview with each participant to gain further insights into their help-seeking strategies and the challenges that they encountered. During this interview, we went through the Eureka reports and also asked participants to reflect on their general impressions of and experiences with the



**Figure 2: Timeline overview of participants and their help-resource and application navigation. (On average it took participants 3 minutes to initiate their first help-seeking attempt, and DE newcomers on average spent 2 minutes more in the application.)**

different resources that they used throughout both the in-lab and diary phases of the study. All participants received \$50 gift cards at the final interview.

### Data Analysis

To understand how newcomers found and made use of different help resources, we first analyzed their different stages of help-seeking observed during the in-lab study. We further analyzed their perceptions of different help resources based on their use of help in the lab and at home.

*Analysis of Help-Seeking Stages.* For analyzing our in-lab observations, we adopted and modified an existing conceptual framework on in-person help-seeking by Nelson-Le Gall [23]. For our purposes, we classified software help-seeking activities in three stages: 1) finding help; 2) recognizing relevant help; and, 3) applying relevant help to the application.

*Finding Help:* For this stage, we considered to what extent participants were able to express their help needs and locate a relevant help resource. We assessed this by: 1) doing a query log analysis of search histories and participants' use of the built-in application help (where relevant) to identify both the relevant and irrelevant resources that they found; and, 2) we also analyzed the time it took for participants to make their first help attempt by looking at their navigation patterns and the first instance where they clicked on the built-in help or switched to the browser to search for help.

*Recognizing relevant help:* For the second stage, we considered what happens when users land on a relevant resource and to what extent they are able to recognize the relevance of the resource in relation to their help need. For this part of the analysis, two of the researchers triangulated data from users' browser-based navigation histories and screen recordings to assess the relevance of the resource and corroborated data with participants' think-aloud reasoning.

*Applying relevant help to the application:* In the last stage, we looked at the extent to which participants were able to apply the help they just found to the actual task at hand. For this analysis, we used browser-based navigation histories, screen recordings, and users' attempted models.

We note that our analysis of the in-lab observations is based on the main task (Figure 1) as we did not observe any qualitative differences in the help-seeking approaches across both tasks (and there were no significant differences in the responses to post-task questionnaires for the two tasks).

*Analysis of Users' Perceptions of Help Resources.* To better understand how users perceived the usefulness of the different help resources that they encountered, we considered participants' interactions both in the lab and during the take-home diary phase. For the lab component, we used our observations and users' responses in the post-task questionnaires and interviews. For the diary component, we analyzed participants' Eureka reports and follow-up interview responses. We used an inductive analysis approach [50] to look for

patterns and recurring themes in the data.

#### 4 OVERVIEW OF HELP-SEEKING ACTIVITIES

We first present an overview of newcomers' help-seeking attempts both in the lab and during the take-home phase.

##### In-Lab Study

*Subtask Completion and Triggers for Seeking Help.* We divided our main task into 10 subtasks based on the key components of the model (e.g., the table top, legs, material used) and matched participants' attempts with subtasks in the reference design (Figure 1). We found that, on average, the newcomers were able to complete only a low percentage (19.6%) of the main task. This finding does not surprise us since we had planned for the task to be difficult to encourage help-seeking attempts.

In attempting the subtasks, our participants tried to find help 4 times on average (range: 1-9 attempts, variance: 4.5, standard deviation: 2.1). There were various triggers for these help-seeking activities, but most commonly they included challenges in understanding the 3D space, figuring out the user interface, and knowing modeling terminology, as have been shown in other studies of 3D modeling [29, 30]. We observed a wide range in the initial help-seeking needs: from not knowing how to even start using the application to figuring out specific problems with 3D features (e.g., Extrude).

*Sources of Help.* We categorized different types of help resources that the participants visited from either official or unofficial websites mainly as: 1) built-in application help, 2) video tutorials, 2) text-based tutorials, 3) forums, and 4) other (such as the Fusion 360 technical installation instructions). Each participant visited 5 distinct resources on average (range: 1-14) and the most used resources were videos (58.2%), followed by text-based tutorials (19.9%), forums (14.8%), and built-in help (7.1%).

*Help-Seeking Attempts: Successes and Failures.* We defined a help-seeking attempt as a participant's effort to go through the three key stages: find, recognize and apply relevant help for a particular purpose, to complete some aspect of the task at hand. The help-seeking attempt was classified as being successful if the participant was able to succeed in all three of these stages.

Overall, participants engaged in 102 help-seeking attempts (NT: 32, T: 38, DE: 32), but only 39 out of 102 (38.2%) of these help-attempts were successful (NT: 6, T: 18, DE: 15). More generally in terms of their overall success rates, technical (47.3%) and domain expert newcomers (46.8%) had the highest help-seeking success rate, whereas the non-technical newcomers had the lowest success (18.7%).

We further investigated the stages (summarized in Table 1) where the unsuccessful attempts (63 out of 102) stemmed

**Table 1: Distribution of failures in help-seeking attempts (63 out of 102) at different stages of help-seeking and among different participants**

	Finding Help	Recognizing Help	Applying Help	Total
NT	11.1%	19%	11.2%	41.3%
T	1.6%	23.8%	6.3%	31.7%
DE	0%	17.5%	9.5%	27%
<b>Total</b>	<b>12.7%</b>	<b>60.3%</b>	<b>27%</b>	<b>100%</b>

from and synthesized several variations and challenges experienced by newcomers based on their levels of expertise (NT, T, and DE). At the stage of finding help, almost all failed attempts (which accounted for 11% of the total failed attempts) came from NT newcomers. The stage of recognizing relevant help was the main stage of failure for all groups of participants. We shed light on these failures and variations among newcomers in the rest of our results.

##### Take-Home Diaries

In the take-home diaries, overall, all participants attempted at least two of the five suggested modeling tasks and submitted 134 Eureka reports (on average, 6 per participant, range: 2-13). Based on these reports, the success and failure rates in the diary phase were similar in magnitude to the lab study phase. For example, participants reported failing at a large number of their help-seeking attempts (39.6% of attempts, compared to 61.2% in the lab study). The follow-up interviews and Eureka reports revealed that having more time for the take-home tasks and being outside of the lab environment did not impact participants' general approaches to help-seeking, particularly in terms of the resources they consulted. We discuss their overall perceptions of help resources that they used in the lab and at home in a later section.

In the rest of the results we focus on participants' differences in deciding when and how to seek help, challenges in recognizing relevant help, and in navigating and applying found help to the application.

#### 5 DECIDING WHEN AND HOW TO SEEK HELP

For all of our participants, we did a second-by-second analysis of their usage of the application during the task and different help resources, as shown in the Figure 2 timeline. We considered both the location and timing of the help-seeking activities of each participant. On average, participants took about 3 minutes to initiate their first help-seeking activity. However, there was a wide range: on one extreme, some participants started the help-seeking without even tackling the task; on the other extreme, some participants spent as

**Table 2: Types of Queries initiated by participants**

Query Type	Count
General Help (e.g., <i>introduction to fusion 360</i> )	13 (11.3%)
UI Help (e.g., <i>fusion 360 copy object</i> )	22 (19.1%)
Example Model (e.g., <i>create a table with fusion 360</i> )	6 (5.2%)
3D Help (e.g., <i>extrude sketch fusion 360</i> )	32 (27.8%)
Reformulation (e.g., <i>how to create a glass effect in fusion 360 reformulated to how to change item texture in fusion 360</i> )	36 (31.3%)
Other (e.g., <i>google.translate</i> )	6 (5.2%)

long as 13 minutes exploring the application before seeking help.

Although some newcomers (19.2%) started their help-seeking process by clicking on the built-in help, in most cases, newcomers initiated help-seeking by searching on Google (73.1%) and YouTube (7.7%).

### Newcomers Mostly Search for Help, But for Different Reasons

Overall, participants initiated 115 queries (Table 2). Participants issued 4.4 queries on average, with a range of 1 to 13 queries (one participant did not initiate any queries).

To characterize the nature of participants' queries, we used an inductive analysis approach. Two researchers manually inspected the search terms, discussed common themes, and classified each query into one of the 5 main groups (summarized in Table 2). We observed several variations across participants in terms of how they approached their search process. We observed that half of both the technical and non-technical newcomers started by learning the application basics (searching for beginner tutorials or asking for basic UI help) to familiarize themselves with the application. In contrast, most of the domain experts used a more bottom-up approach and sought answers to specific 3D functionality questions (e.g., *“how to pull an object”*).

Interestingly we saw that all newcomers (NT, T, and DE) struggled not only in formulating queries, but also in reformulating queries once they realized that their initial query was not yielding the desired results. As seen in Table 2, more than 30% of the overall issued queries were reformulations. Additional analysis revealed that about 50% of reformulations were rewordings (explaining the same problem using other words), but sometimes participants added (23.7%) or removed (18.4%) details from the queries (the rest of the reformulations were spelling errors).

### Non-Technical Newcomers Face More Challenges in Expressing Help Needs

As seen in Table 1, non-technical newcomers faced the most failures in the finding help stage. One key issue that we observed with this newcomer group was that they did not seem to have enough awareness that they were not making progress and did not feel the need to seek help. As an extreme case example, it took P16 as long as 13 minutes to seek help for the first time and she said that, *“I’m not sufficiently frustrated yet!”* (P16-NT), not realizing that her design was wrong (2D instead of 3D). We also observed that on average, it took non-technical newcomers 2.5 minutes longer than technical and domain experts to seek help for the first time: P7-NT: *“I don’t even know what I’d have to Google to get this [shape]!”*

Once the non-technical newcomers realized that they needed help, a big challenge they faced was in not being able to articulate their help needs. The post-task questionnaire revealed that they had the most frustration in finding help (4.7 average on a 7-point Likert scale compared to overall average of 4.3).

One of the participants, P18, had a specific question about rotating a cylinder that she created within the first 5 minutes and for the remainder of the time she was not able to find an answer. She did not initiate any queries, and just clicked on built-in help and got lost between the text tutorials. Later in the interview she said:

P18-NT: *“I thought [built-in help] would lead me to a place that is also by the [creators of the app] so I thought it would be more credible as opposed to Googled answers [...] I also did not know what to search for in the beginning.”*

## 6 CHALLENGES IN RECOGNIZING RELEVANT HELP

When users were able to successfully locate a relevant resource by formulating appropriate queries, they had to recognize whether or not the resource was relevant. Inability to recognize relevant help was the major reason for failure (60.3% of failures) for all participants. We synthesized three main reasons for this, as explained below.

### Struggles with Unfamiliar Jargon

Most newcomers struggled in recognizing relevant resources that contained domain-specific and application-specific jargon. For example, two participants closed a text tutorial with the title *“Edit a solid or surface face using T-Splines”* immediately after they saw the word T-Spline. Another participant came across the Fillet tool in help resources and commented: P24-NT: *“I know how to fillet a fish. But I’m not sure what they mean when they say that word!”*

And in some cases, participants had to spend at least a

couple of minutes experimenting with a demonstrated tool in the application to figure out whether or not it was worth spending more time on the resource. For example, P3 initiated the query “*add thickness to sketch in fusion 360*” and the help resources led her to the Offset tool, and she then tried to use the Offset tool in the application, however, what she actually needed for the task was the Extrude tool. P1 also got confused between Join, Combine, and Stitch tools even though he read the instructions in a text tutorial explaining the tools, the tutorial did not provide him with sufficient guidance on which tool to use.

### Quick Exploration of the Resources and its Content

Most participants in our study did not fully explore search results and help resources in detail (even when they were directly relevant to the task). Most of the time participants instead skimmed over important details and tried to optimize the overall time they were spending in the resource. For example, one participant explained: P8-T: “*There are keywords in my mind that I’m trying to find, if I find it in the text in the first couple of seconds, I continue reading. Otherwise, I just close it.*”

We suspected this to be a problem because of the time limit of the in-lab study.

P12-T: “*Under the time limit, I felt pressured and started to panic. But I believe if I had more time, I could probably finish the task easily.*”

However, diary study results and interviews showed that participants had a similar experience at home and wanted to be efficient and optimize their overall experience.

### Negative Learning Transfer from Other Applications

Although domain experts often experienced positive learning transfer (e.g., in finding help) because of their previous 3D modeling experience, in some cases, they also experienced negative transfer, especially in recognizing relevant help. For example, participants had difficulty knowing if the found help was actually relevant because they had a workflow in mind and some of the retrieved results’ content was not matching what they expected based on their use of other 3D applications, such as Blender, Maya, and AutoCAD:

P9-DE: “*Basic operations like translate, move, scale, extrusion, I expect to be very prominent, always there [...] I was looking at Blender specific ways of doing things and perhaps I was making too many assumptions in that regard.*”

While working with the application, they reflected on their feelings of confusion and some of them said that they could have completed the same task within the time limit in another 3D modeling application that they are more comfortable with: P21-DE: “*I know how to do this in Maya! This is killing me!*”

## 7 NAVIGATING BETWEEN THE APPLICATION AND HELP RESOURCES

When participants recognized that they had landed on a relevant resource, they showed different strategies for going back-and-forth between the application and the resource and struggled in applying the help to the task.

### Difficulties in Applying Found Relevant Help in the Application

Approximately, 27% of failures in help-seeking happened at the stage of applying relevant help.

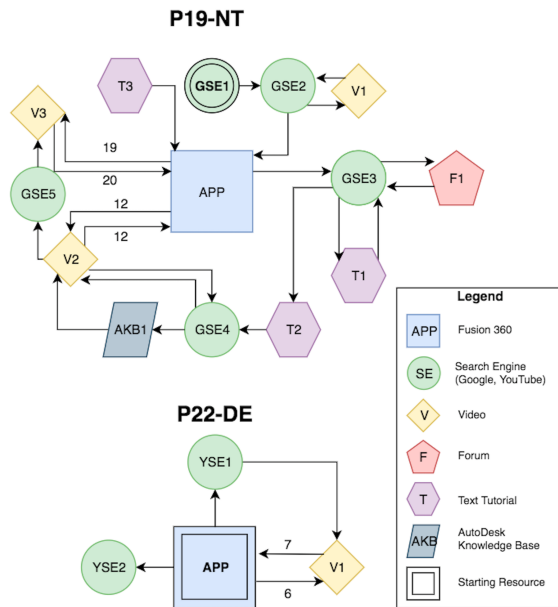
There were several reasons why participants had a hard time in applying relevant help to the application task. For example, in some cases, participants forgot which tools were shown in the video that they had just been watching before going back to the application. Sometimes they were unable to locate referenced commands in the application user interface because similar tools were grouped together, and newcomers were not be able to differentiate between them.

The application’s unique modeling approach presented another problem. Being in different workspace modes like Sculpt, Model and Render changed the availability of commands in the interface, causing 6 out of 26 participants to fail at applying help resources. This feature made help resources for Fusion 360 difficult to comprehend and apply even for professional 3D modelers.

P13-DE: “*I’m not sure what the differences between each modeling type [referring to objects workspaces] are [...] not sure what sort of system Fusion 360 is using, whether its b-spline interpolation [...] it says they use a lot of t-splines but I’m not sure if the objects I was making are actually even t-splines [...]*”

A detailed analysis of two newcomers (Figure 3) demonstrates the level of extremes possible in help-seeking behaviors for the exact same task. For example, P22-DE achieved the highest success rate with Task 1, and P19-NT had among the lowest of success rates. Both P19-NT and P22-DE initiated an Example Model query at the beginning of the task. P22-DE found a video for creating a table, stuck to the same resource and went back and forth between the application and the video at regular intervals. He was able to make connections between the instructions in the video to the task specifications and conducted self-exploration to further understand the application’s features. Although P19-NT had the same help-seeking approach and initiated some Example Model queries similar to P22-DE, he was not able to make use of the help resources. Though he returned to the application 33 times after seeking help, he had no actual success in his help-seeking attempts.





**Figure 3: Comparison of two newcomers: P19-NT (a) who switches back and forth 33 times between the resources and the application (with only 16.7% help-seeking success rate); Vs. P22-DE (b) who only uses 1 help resource (video) and is highly successful in progressing through the main task.**

### Technical Newcomers Made more Coordinated Use of Help Resources and the Application

Some users of feature-rich software are known to make coordinated use of the application and web resources by going back-and-forth constantly [17, 20]. We compared this behavior across the newcomers in our study and found some interesting differences. For example, on average, technical newcomers visited the application two times more than non-technical and domain expert newcomers. The technical newcomers went back and forth more often and applied relevant help more regularly, even though they had never done any 3D modeling before. Furthermore, we observed that the non-technical newcomers failed at most of their help attempts (81%) whereas the technical newcomers failed only in about half of their help-seeking attempts (52%). One of the technical newcomers explained how his programming experience and use of web-based debugging resources influenced his help-seeking activities:

P23-T: “When I was [doing the in-lab study] I tried some Stack Overflow-type resources, some help forums and things like that because that’s what I do when I’m programming [...] search engines are very good.”

In contrast, most non-technical newcomers did not recognize when progress was made or how they should be switching back and forth between the application and help

resources. In fact, many of the non-technical newcomers (40%) gave up after their first unsuccessful attempt of using a help resource.

## 8 PERCEPTIONS OF HELP RESOURCES

To assess participants’ perceptions of different help resources and whether or not these perceptions changed between the lab and diary components, we present results from the analysis of our final interviews where users reflected on both experiences.

Overall, participants’ perceptions did not seem to change, and they described similar struggles with different help resources in both phases of the study. In both phases, participants reiterated the need to “optimize” their experience in using help resources and remained very task-focused, as has been shown in other studies [36].

We present users’ perceptions of the most widely used resources in both phases: videos, built-in help, text-based tutorials, and forums.

### Paradox of Using Videos

The majority of participants (17/26) clicked on videos first in the search results during the in-lab component. And most participants (20/26) reported in the in-lab and final interviews that videos were their favorite type of resource. Some participants (e.g., P22-DE) were able to make a lot of task progress using only video tutorials.

Despite their preferences, participants were not always successful in using videos during their help-seeking attempts. The interviews revealed more insights into the drawbacks of using videos.

All participants said that videos are useful because they visually demonstrate workflows and techniques, which participants felt helped them appraise the suitability of the videos for their task. At the same time, because of the rich availability of different video tutorials related to the application, participants found the process of locating a relevant video frustrating. This was even more problematic when the videos were lengthy. With lengthy videos, participants faced a “risk-reward” situation: it was easier to move on to another video or search result rather than risk watching a video that might be low quality or irrelevant:

P2-T: “[Video tutorials are] Long, many parts that are not relevant, and everyone can upload a video [...] it’s hard to find the most suitable video.”

P9-DE: “You have to scrub through [videos] to see what you want, and very often when you are searching you are looking for keywords. You can’t do that with a video, you can visually scan for certain words you are looking for if you are looking through written resources.”

Participants had several challenges navigating videos. In some cases, the videos were filled with unnecessary details

(especially if they were unofficial) and it was hard for participants to discern what parts were even relevant. In other cases, a tool's functionality would be demonstrated too quickly, and participants would struggle in figuring out what actually happened and what would be the next steps.

### Tradeoffs in Using Built-In Application Help

The majority of participants had negative perceptions of using built-in help and 80% of the participants did not use it at all, which is in line with other studies [48]. However, interestingly, half of the non-technical newcomers, and 23.1% of all newcomers did consult the built-in help at least once. One participant explained that trusting the source played a big role in her decision to try out the built-in help:

P24-NT: *"I feel like it's more certain that I will get a good answer [with built-in help]. Whereas on Google I don't know if I'll get the right answer or not and I don't want to have to also figure out if it's authoritative. I don't want that extra layer, so it just removes that layer for me. I don't have to worry about whether or not it [Google] will work ... it probably would work, but I don't trust it."*

In the interviews, most participants explained that they felt comfortable with online search and relied on it during their daily life. But, there were still concerns about forgetting where they were in the task, and about getting distracted on the web with the volume of material available:

P17-NT: *"I think Google search is usually almost always really useful. It's just there is too much information on there, so you just have to go through and find out."*

In addition, they would often encounter outdated or unofficial user-generated material, which would be difficult to reconcile:

P19-NT: *"One video was 2 years old, so I don't know if they have a new version or anything."*

### Text-Based Resources are Useful if they have Visuals

Even though text-based tutorials and forums are popular on the web, surprisingly, we did not find much usage of them in our study. This was perhaps because 3D modeling is a more visual and spatially-oriented application than other domains, such as programming. Most participants who landed on these materials felt that they were only useful if they provided some visual cues to show task relevance:

P17-NT: *"It [forum] didn't really show like exact thing I wanted ... unless I post something online and then wait for [someone] to answer, right?"*

Forums were the preferred type of resource of only two participants (one technical and one domain expert). These two participants explained that if you can find someone on a forum with a similar problem, there is a good chance that you will be able to follow their solution steps to reach the desired result. However, they also pointed out the need to

often wade through incomplete or even conflicting answers:

P14-DE: *"The least useful [resource] was probably the forums ... sometimes you would get multiple answers, and some would be conflicting."*

## 9 DISCUSSION

Although HCI research on designing help and learning systems spans over three decades, to the best of our knowledge, our study contributes the first empirical insights into modern use of software help from the perspective of newcomers.

We now reflect on our key results, their generalizability, and highlight areas where prevalent assumptions should be revisited in the design of future help and learning support tools to better support a range of newcomer backgrounds.

### Summary of Key Commonalities and Differences

All newcomers in our study struggled in their help seeking. Those without technical or domain knowledge, however, had distinctly lower success rates than the other two groups in their help-seeking attempts. All newcomers had vocabulary challenges, but the nature and impact of those challenges differed according to existing domain or technical expertise. For example, vocabulary challenges contributed to non-technical newcomers having difficulties even initiating search queries and seeing more potential advantages to built-in help than the other groups. Non-technical newcomers also exhibited less coordinated help and application use than the technical newcomers. All newcomers made heavy use of videos, despite some of their clear limitations. We elaborate on a number of these findings and their implications below.

### Generalizability of Results

Our task-centric, multi-phase study method was influenced by prior work showing that users often approach learning software with a specific task in mind [30, 35, 36, 48, 49]. We elected to prescribe tasks in this manner to provide consistency among participant experiences, and to help with quantifying observations. Nonetheless, there are many other non-task based approaches to learning software (e.g., [14, 35]) and these should be explored in future work.

Although we looked at only one 3D modeling application, many insights from our study should apply to a broad range of feature-rich software that have a similar range of commands, tools, menus, modes and rely on niche domain-related vocabulary. Many such software applications have traditionally been designed for users with formal training in a domain, for example, full-featured image-editing applications, video-editing software, and statistical analysis packages. For such application types, new consumer and cloud-based versions are becoming available, reducing barriers to initial entry and opening up the door for different

types of application newcomers. These packages have similar web-based help resources available as Fusion 360 (e.g., videos, built-in help, tutorials, forums, etc.), in comparable quantities.

Beyond target application, we had initial concerns about how our findings might generalize if they stemmed only from a lab study. For example, we wondered if participants might feel more comfortable exploring a range of help resources, and show more persistence with a resource when not under the eye of an experimenter. This prompted us to include the diary component in our study. To our surprise, participants' strategies and perceptions were relatively stable across both the lab and diary phases. Participants continued to pursue the same types of resources at home and expressed hesitance to stick "too long" with a resource that was not helpful. This increases our confidence in the generalizability of our findings, but more longitudinal work (with repeated application and resource exposure) would be valuable.

### Individual Differences in Software Help-Seeking

As the barriers to accessing software lowers, newcomers are increasing in both their quantity and their diversity. Our study is only one step towards teasing out individual differences based on newcomers' technical and domain expertise. For example, the newcomers in our study mostly represented an educated segment of the population. Future research is needed to tease out the impact of other individual characteristics on help-seeking and software learning including, gender, age (e.g., [30]), education, and learning styles [19, 24, 33].

Help-seeking is only one component of becoming proficient with a feature-application, yet, it is considered to be one of the most important stages of the overall learning process [2, 23]. Our findings confirm that some insights into software help-seeking behaviors from the older literature continue to hold for many newcomers (e.g., dealing with technical jargon), even in light of the current volume and diversity of external resources available. However, our work challenges some prior findings as well as prevalent assumptions. For example, contrary to earlier findings that built-in application help is utterly ineffective and not used by users [48], half of the newcomers without a technical background did consult the built-in help and perceived it to be a useful way to access vetted help. The findings motivate continued efforts in designing informative built-in help that will be meaningful to newcomers, particularly those seeking to understand basic application vocabulary and tool function [25].

### Reconsidering Search-Based Help

There has been an underlying motivating assumption in prior work that users will seek external help for their software

needs via search and go back-and-forth between search results and the application to complete tasks (e.g., [6, 17, 20, 40]) Our findings show that this behavior was more prevalent among the technical newcomers and suggests that search is a poor gateway for many newcomers, particularly those who are not from technical backgrounds. These newcomers struggled the most in formulating targeted queries (even with search term suggestions from Google Suggest) and in assessing the relevance of the returned search results.

Part of the challenge in *formulating* queries is the vocabulary problem [21]. Similar to prior work in information-seeking behavior research [3, 12, 43], we found that our newcomer participants had difficulty mapping application terminology to vocabulary they understood [4]; and, we found that this was the case for domain terminology as well. Our results go beyond prior work, however, by highlighting the extent to which these vocabulary challenges persist in the different phases of seeking help (participants' equivocal queries that misguided them towards usage of unwanted tools). Even our domain experts had vocabulary challenges, as they tried to reconcile terminology from their more familiar (and highly-related) tools. Given the diversity of help resources available online, it is probable that there are some external resources that express help in a way that is more understandable to newcomers; however, such resources were not easily located by the newcomers in our study.

Another important part of the challenge is *recognizing* relevant results from a search—we saw the highest number of help-seeking failures among newcomers at this stage. This suggests further opportunities to explore tutorial and search result annotations that filter the data based on users' expertise in 3D modeling, resource preferences (videos, forums, etc.), time constraints, as well as resource credibility. Some annotation schemes have been proposed in the literature [16, 33], but they are highly command oriented, which is a representation that would likely not help users who are just beginning to familiarize themselves with the application's vocabulary. To address these issues, there are also opportunities beyond search to explore more automated means of recommending resources to newcomers within the application. Automated approaches could involve resolving challenges in recognizing newcomer intent (e.g., reasoning about user interaction data that involves a mix of trial and error and task progress) and in determining the suitability of different resources for newcomers.

### Reconceptualizing the Onboarding Experience

It is also worth considering entirely new and personalized approaches to software onboarding within the application. Although "tip of the day" overviews or "getting started" guided tutorials have become popular in consumer software today, they do not take into account the diversity in newcomer

experiences, as shown in another recent study with children [29]. The majority of the onus is often placed upon the users to onboard themselves. Our findings motivate further research into the design of informative and engaging onboarding experiences that are personalized to a newcomer's background. For example, based on the differences we observed, perhaps newcomers could set up initial profiles in the software based on their technical and domain expertise. The system could then generate personalized guided tutorials that vary in the level of domain terminology explanation, user interface explanation and have differing suggestions for follow-up resources.

### Improving the Utility and Usability of Tutorial Videos for Newcomers

Of the different resources available, the newcomers in our study made the most use of videos and expressed the highest degree of preference for the video help format, particularly in light of the highly visual and spatial nature of the 3D modeling domain. However, many of the non-technical newcomers commented on a number of frustrations with videos, such as locating relevant snippets within lengthy videos and actually recognizing how the demonstrated tools and features could apply to the task at hand. In fact, we observed several instances of users spending long periods of time going back and forth in videos that ultimately did not help them make task progress. More research is needed to both consider how to encourage the creation of the videos equivalent of Carroll's minimalistic approach to software documentation [6], as well as better tutorial video summarization techniques already being explored (e.g., [51]).

## 10 CONCLUSION

We conducted in-lab observations and diary studies with 26 software newcomers to investigate their help-seeking strategies in using a feature-rich 3D modeling application. Our study contributes novel insights on how newcomers make use of modern help resources on the web and highlights important variations across newcomers with different technical skills and domain expertise. We discuss implications for moving beyond “one-size-fits-all” help resources towards more personalized, and curated help and learning materials that suit individual help needs.

## 11 ACKNOWLEDGMENTS

We thank the Natural Sciences and Engineering Research Council of Canada (NSERC) and Autodesk Research.

## REFERENCES

- [1] 2019. Cloud Powered 3D CAD/CAM Software for Product Design | Fusion 360. <https://www.autodesk.com/products/fusion-360/overview>
- [2] Vincent Aleven, Elmar Stahl, Silke Schworm, Frank Fischer, and Raven

- Wallace. 2003. Help Seeking and Help Design in Interactive Learning Environments. *Review of Educational Research* 73, 3 (2003), 277–320. <https://doi.org/10.3102/00346543073003277>
- [3] Oscar D. Andrade, Nathaniel Bean, and David G. Novick. 2009. The Macro-structure of Use of Help. In *Proceedings of the 27th ACM International Conference on Design of Communication (SIGDOC '09)*. ACM, New York, NY, USA, 143–150. <https://doi.org/10.1145/1621995.1622022>
- [4] Nicholas J. Belkin, Robert N. Oddy, and Helen M. Brooks. 1982. ASK for information retrieval: Part I. Background and theory. *Journal of documentation* 38, 2 (1982), 61–71.
- [5] Matthew Brehmer, Joanna McGrenere, Charlotte Tang, and Claudia Jancova. 2012. Investigating Interruptions in the Context of Computerised Cognitive Testing for Older Adults. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12)*. ACM, New York, NY, USA, 2649–2658. <https://doi.org/10.1145/2207676.2208656>
- [6] Andrea Bunt, Patrick Dubois, Benjamin Lafreniere, Michael A. Terry, and David T. Cormack. 2014. TaggedComments: Promoting and Integrating User Comments in Online Application Tutorials. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14)*. ACM, New York, NY, USA, 4037–4046. <https://doi.org/10.1145/2556288.2557118>
- [7] John M. Carroll. 1990. *The Nurnberg funnel: designing minimalist instruction for practical computer skill*. MIT press.
- [8] John M. Carroll and Caroline Carrithers. 1984. Training Wheels in a User Interface. *Commun. ACM* 27, 8 (1984), 800–806.
- [9] John M. Carroll and Mary Beth Rosson. 1987. *Interfacing Thought: Cognitive Aspects of Human-Computer Interaction*. MIT Press, Cambridge, MA, USA, Chapter Paradox of the Active User, 80–111.
- [10] Parmit K. Chilana, Andrew J. Ko, and Jacob O. Wobbrock. 2012. Lemon-Aid: Selection-based Crowdsourced Contextual Help for Web Applications. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12)*. ACM, New York, NY, USA, 1549–1558. <https://doi.org/10.1145/2207676.2208620>
- [11] Parmit K. Chilana, Andrew J. Ko, Jacob O. Wobbrock, and Tovi Grossman. 2013. A Multi-site Field Study of Crowdsourced Contextual Help: Usage and Perspectives of End Users and Software Teams. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)*. ACM, New York, NY, USA, 217–226. <https://doi.org/10.1145/2470654.2470685>
- [12] Andrew Dillon. 2004. *Designing usable electronic text: Ergonomic aspects of human information usage*. CRC press.
- [13] Andrew Dillon and Charles Watson. 1996. User analysis in HCI—the historical lessons from individual differences research. *International Journal of Human-Computer Studies* 45, 6 (1996), 619–637.
- [14] Volodymyr Dziubak, Patrick Dubois, Andrea Bunt, and Michael Terry. 2016. Switter: Supporting Exploration of Software Learning Materials on Social Media. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems (DIS '16)*. ACM, New York, NY, USA, 1209–1220. <https://doi.org/10.1145/2901790.2901827>
- [15] Dennis E. Egan. 1988. Individual differences in human-computer interaction. In *Handbook of human-computer interaction*. Elsevier, 543–568.
- [16] Dennis E. Egan and Louis M. Gomez. 1985. Assaying, isolating, and accommodating individual differences in learning a complex skill. *Individual differences in cognition* 2 (1985), 174–217.
- [17] Michael D. Ekstrand, John T. Riedl, and Joseph A. Konstan. 2011. Collaborative filtering recommender systems. *Foundations and Trends® in Human-Computer Interaction* 4, 2 (2011), 81–173.
- [18] David K. Farkas. 1993. The Role of Balloon Help. *SIGDOC Asterisk J. Comput. Doc.* 17, 2 (May 1993), 3–19. <https://doi.org/10.1145/154425.154426>

- [19] Richard M. Felder and Linda K. Silverman. 1988. Learning and teaching styles in engineering education. *Engineering education* 78, 7 (1988), 674–681.
- [20] Adam Fournery, Benjamin Lafreniere, Parmit K. Chilana, and Michael Terry. 2014. InterTwine: Creating Interapplication Information Scent to Support Coordinated Use of Software. In *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology (UIST '14)*. ACM, New York, NY, USA, 429–438. <https://doi.org/10.1145/2642918.2647420>
- [21] C. Ailie Fraser, Mira Dontcheva, Holger Winnemoeller, and Scott Klemmer. 2016. DiscoverySpace: Crowdsourced Suggestions Onboard Novices in Complex Software. In *Proceedings of the 19th ACM Conference on Computer Supported Cooperative Work and Social Computing Companion (CSCW '16 Companion)*. ACM, New York, NY, USA, 29–32. <https://doi.org/10.1145/2818052.2874317>
- [22] George W. Furnas, Thomas K. Landauer, Louis M. Gomez, and Susan T. Dumais. 1987. The Vocabulary Problem in Human-system Communication. *Commun. ACM* 30, 11 (Nov. 1987), 964–971. <https://doi.org/10.1145/32206.32212>
- [23] Sharon Nelson-Le Gall. 1985. Chapter 2: Help-seeking behavior in learning. *Review of research in education* 12, 1 (1985), 55–90.
- [24] Sabine Graf and Kinshuk. 2006. An Approach for Detecting Learning Styles in Learning Management Systems. In *Sixth IEEE International Conference on Advanced Learning Technologies (ICALT '06)*. IEEE, 161–163. <https://doi.org/10.1109/ICALT.2006.1652395>
- [25] Tovi Grossman and George Fitzmaurice. 2010. ToolClips: An Investigation of Contextual Video Assistance for Functionality Understanding. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10)*. ACM, New York, NY, USA, 1515–1524. <https://doi.org/10.1145/1753326.1753552>
- [26] Tovi Grossman and George Fitzmaurice. 2015. An Investigation of Metrics for the In Situ Detection of Software Expertise. *Human-Computer Interaction* 30, 1 (Jan. 2015), 64–102. <https://doi.org/10.1080/07370024.2014.881668>
- [27] Tovi Grossman, George Fitzmaurice, and Ramtin Attar. 2009. A Survey of Software Learnability: Metrics, Methodologies and Guidelines. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '09)*. ACM, New York, NY, USA, 649–658. <https://doi.org/10.1145/1518701.1518803>
- [28] Tovi Grossman, Justin Matejka, and George Fitzmaurice. 2010. Chronicle: Capture, Exploration, and Playback of Document Workflow Histories. In *Proceedings of the Annual ACM Symposium on User Interface Software and Technology (UIST '10)*. ACM, New York, NY, USA, 143–152. <https://doi.org/10.1145/1866029.1866054>
- [29] Nathaniel Hudson, Celena Alcock, and Parmit K. Chilana. 2016. Understanding Newcomers to 3D Printing: Motivations, Workflows, and Barriers of Casual Makers. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. ACM, New York, NY, USA, 384–396. <https://doi.org/10.1145/2858036.2858266>
- [30] Nathaniel Hudson, Benjamin Lafreniere, Parmit K. Chilana, and Tovi Grossman. 2018. Investigating How Online Help and Learning Resources Support Children's Use of 3D Design Software. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. ACM, New York, NY, USA, Article 257, 14 pages. <https://doi.org/10.1145/3173574.3173831>
- [31] Caitlin Kelleher and Randy Pausch. 2005. Stencils-based Tutorials: Design and Evaluation. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '05)*. ACM, New York, NY, USA, 541–550. <https://doi.org/10.1145/1054972.1055047>
- [32] Juho Kim, Phu Tran Nguyen, Sarah Weir, Philip J. Guo, Robert C. Miller, and Krzysztof Z. Gajos. 2014. Crowdsourcing Step-by-step Information Extraction to Enhance Existing How-to Videos. In *Proceedings of the Annual ACM Conference on Human Factors in Computing Systems (CHI '14)*. ACM, New York, NY, USA, 4017–4026. <https://doi.org/10.1145/2556288.2556986>
- [33] Aleksandra Klačnja-Milićević, Boban Vesin, Mirjana Ivanović, and Zoran Budimac. 2011. E-Learning personalization based on hybrid recommendation strategy and learning style identification. *Computers & Education* 56, 3 (2011), 885–899.
- [34] Nicholas Kong, Tovi Grossman, Björn Hartmann, Maneesh Agrawala, and George Fitzmaurice. 2012. Delta: A Tool for Representing and Comparing Workflows. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12)*. ACM, New York, NY, USA, 1027–1036. <https://doi.org/10.1145/2207676.2208549>
- [35] Benjamin Lafreniere, Andrea Bunt, Matthew Lount, and Michael A. Terry. 2013. Understanding the Roles and Uses of Web Tutorials. In *Proceedings of the 7th International AAAI Conference on Weblogs and Social Media (ICWSM '13)*. AAAI, 303–310.
- [36] Benjamin Lafreniere, Andrea Bunt, and Michael A. Terry. 2014. Task-centric Interfaces for Feature-rich Software. In *Proceedings of the 26th Australian Computer-Human Interaction Conference on Designing Futures: The Future of Design (OzCHI '14)*. ACM, New York, NY, USA, 49–58. <https://doi.org/10.1145/2686612.2686620>
- [37] Benjamin Lafreniere, Parmit K. Chilana, Adam Fournery, and Michael A. Terry. 2015. These Aren't the Commands You're Looking For: Addressing False Feedforward in Feature-Rich Software. In *Proceedings of the 28th Annual ACM Symposium on User Interface Software & Technology (UIST '15)*. ACM, New York, NY, USA, 619–628. <https://doi.org/10.1145/2807442.2807482>
- [38] Benjamin Lafreniere, Tovi Grossman, and George Fitzmaurice. 2013. Community Enhanced Tutorials: Improving Tutorials with Multiple Demonstrations. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)*. ACM, New York, NY, USA, 1779–1788. <https://doi.org/10.1145/2470654.2466235>
- [39] Matthew Lount and Andrea Bunt. 2014. Characterizing Web-Based Tutorials: Exploring Quality, Community, and Showcasing Strategies. In *Proceedings of the ACM International Conference on The Design of Communication CD-ROM (SIGDOC '14)*. ACM, New York, NY, USA, Article 6, 10 pages. <https://doi.org/10.1145/2666216.2666221>
- [40] Lena Mamykina, Bella Manoim, Manas Mittal, George Hripcsak, and Björn Hartmann. 2011. Design Lessons from the Fastest Q&A Site in the West. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*. ACM, New York, NY, USA, 2857–2866. <https://doi.org/10.1145/1978942.1979366>
- [41] Justin Matejka, Tovi Grossman, and George Fitzmaurice. 2011. IP-QAT: In-product Questions, Answers, & Tips. In *Proceedings of the 24th Annual ACM Symposium on User Interface Software and Technology (UIST '11)*. ACM, New York, NY, USA, 175–184. <https://doi.org/10.1145/2047196.2047218>
- [42] Jakob Nielsen. 1993. *Usability Engineering*. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.
- [43] David G. Novick, Oscar D. Andrade, and Nathaniel Bean. 2009. The Micro-structure of Use of Help. In *Proceedings of the 27th ACM International Conference on Design of Communication (SIGDOC '09)*. ACM, New York, NY, USA, 97–104. <https://doi.org/10.1145/1621995.1622014>
- [44] David G. Novick, Oscar D. Andrade, Nathaniel Bean, and Edith Elizalde. 2008. Help-based Tutorials. In *Proceedings of the 26th Annual ACM International Conference on Design of Communication (SIGDOC '08)*. ACM, New York, NY, USA, 1–8. <https://doi.org/10.1145/1456536.1456538>
- [45] David G. Novick and Karen Ward. 2006. Why Don't People Read the Manual?. In *Proceedings of the 24th Annual ACM International Conference on Design of Communication (SIGDOC '06)*. ACM, New York, NY, USA, 11–18. <https://doi.org/10.1145/1166324.1166329>

- [46] Angela Patrick and Andy McGurgan. 1993. One Proven Methodology for Designing Robust Online Help Systems. In *Proceedings of the 11th Annual International Conference on Systems Documentation (SIGDOC '93)*. ACM, New York, NY, USA, 223–232. <https://doi.org/10.1145/166025.166084>
- [47] Suporn Pongnumkul, Mira Dontcheva, Wilmot Li, Jue Wang, Lubomir Bourdev, Shai Avidan, and Michael F. Cohen. 2011. Pause-and-play: Automatically Linking Screencast Video Tutorials with Applications. In *Proceedings of the 24th Annual ACM Symposium on User Interface Software and Technology (UIST '11)*. ACM, New York, NY, USA, 135–144. <https://doi.org/10.1145/2047196.2047213>
- [48] Marc Rettig. 1991. Nobody Reads Documentation. *Commun. ACM* 34, 7 (July 1991), 19–24. <https://doi.org/10.1145/105783.105788>
- [49] John Rieman. 1996. A Field Study of Exploratory Learning Strategies. *ACM Trans. Comput.-Hum. Interact.* 3, 3 (Sept. 1996), 189–218. <https://doi.org/10.1145/234526.234527>
- [50] Anselm Strauss and Juliet M. Corbin. 1990. *Basics of qualitative research: Grounded theory procedures and techniques*. Sage Publications, Inc.
- [51] Sarah A. Weir. 2014. Learnersourcing Subgoal Labels for How-to Videos. In *CHI '14 Extended Abstracts on Human Factors in Computing Systems (CHI EA '14)*. ACM, New York, NY, USA, 945–950. <https://doi.org/10.1145/2559206.2579416>
- [52] Erik Zachte. 2018. Wikipedia Statistics - Tables - English. <https://stats.wikimedia.org/EN/TablesWikipediaEN.htm>