Motivations behind the Use of Web-Based Tutorials

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ABSTRACT
Tutorials have been heavily researched in classrooms as a learning tool. However, little research has been done on tutorial use outside of class. Since most tutorials are used by students not to learn in class but rather to solve specific problems, the current theory behind tutorial usage is dubious. We assert that the way tutorials have been studied is impractical. Analysis of interviews with tutorial users led to a more relevant theory of why and how tutorials are used. The new theory is used in this paper to derive recommendations for creating effective tutorials and deciding when tutorials should be used instead of other problem-solving methods.

Author Keywords
Tutorials, step-by-step guides, instructions, screencasts, video demos, reference manuals, learning by example

INTRODUCTION
Why do people use online tutorials?

We explored the reasons behind using tutorials, and the answer was obvious: people use tutorials to solve a specific problem. This is different from the general assumption that tutorial authors and researchers make: that people use tutorials to learn. What is the distinction between solving a problem and learning? A problem solver finds only the necessary information to overcome an obstacle. A learner is expected to retain that material more completely and for a longer period of time.

Typically, tutorial users simply remember the location of important content and then refer back to it when they need it again. By giving a more accurate picture of how tutorials are actually used, we are able to question the traditional role of tutorials as a learning tool and provide a framework for further research based on practical reality instead of an environment confined to the classroom.

First we present some background information and explain how related works have not examined this same subject before. Then we describe our methods for gathering data. Our results are shown as a list (ordered by importance) along with supporting quotes. We conclude with an analysis of the results, some closing remarks, and suggestions for future work.

RELATED WORK

Definition of Tutorial
The noun 'tutorial' has two definitions. Traditionally, a tutorial is a small class in which students are tutored on a subject. It is a form of synchronous interaction, where students and teachers can communicate in real time. With the rise of the Internet, tutorials took on a new definition. As Hrycaj notes, "in computer science, a tutorial is a 'program that provides instruction for the use of a system or of software'. This usage of 'tutorial' has extended to the point where the subject matter of a tutorial can be virtually anything, e.g. Boolean searching and government documents, as well as how to use particular databases. A Google search of web definitions of 'tutorial' indicates that tutorials have a step-by-step structure" [18]. This type of tutorial is a form of asynchronous interaction, where the student (the tutorial user) cannot communicate with the teacher (the tutorial author) in real time.

Current Research
Tutorials have been extensively researched, most often as a method of learning. By contrast, our study shows that tutorials are mainly used to solve problems. A survey of relevant papers (Table 1) shows that researchers concentrate on how effective tutorials are as a learning device. Most papers mention tutorials as problem-solving tools but only in passing or as a secondary conclusion. In fact, many of the researchers worried that students only used tutorials to solve a specific problem without remembering the information. "Were the undergraduates on campus merely rushing through the tasks, or do the tutorials better serve adult students? We observed some students working quickly through the exercises, which may have affected their performance" [22]. Two other studies noted that students given a tutorial were more likely to enter the commands by rote, without slowing down and thinking about what they were typing, than students given a problem to solve without a step-by-step walkthrough [7] [10]. It is apparent that the goal of those researchers was to help students learn; solving problems was a benefit of learning. However, according to students interviewed, solving a problem was the primary objective while learning was the side effect.

Research Paper	How can tutorials be used to teach better?	How can tutorials be used to solve problems better?
Transporting good library instruction practices into the web environment: An analysis of online tutorials [12]	"Web-based instruction is created for the purpose of reaching distance education students who wish to learn library skills at times and places convenient to them."	"Interaction is usually between the isolated student and the computer, and the outcome is a student who has learned library skills and concepts at the time he or she seeks those skills for an individual or assignment-based purpose."
Library instruction and online tutorials: developing best practices for streaming desktop video capture [35]	"We have found that using video desktop screen capture technology, delivered through streaming media, can offer a useful way of providing instruction in the online environment."	"Through usability testing of our tutorials, we had learned that our users were not interested in committing much time to lengthy tutorials, and wanted information on how to use the library in a quick and succinct fashion."
Improving Learning and Reducing Costs [37]	"Tutorials have taken over the main instructional role: 84 percent of the students reported, 'The computer presentations explain the concepts well.' Students at UB also found the self-paced tutorials provided by the textbook publisher to be effective and easy to use, and they reported that the materials enhanced their learning."	"Students found these online tutorials to be very helpful; they particularly liked the ability to link directly from a problem they had difficulty with to a tutorial that helped them learn the concepts needed to solve the problem."
Elements of active learning in the online tutorials of ARL members [18]	"The hypothesis for this study was that the percentage of tutorials that used active learning in the ARL sites would be greater than this percentage in Dewald's sites, since a fair amount of time has elapsed since Dewald's study and active learning is a feature that is known to enhance teaching effectiveness."	"Tutorials could by themselves convey a lesson, e.g. using an online catalog, Boolean searching, using a particular database, etc. This is the idea of tutorials being pedagogically self-sufficient or 'stand-alone'."
Online tutorials for library instruction: an ongoing project under constant revision [34]	"…The creation of online library instruction tutorials has come to be regarded as almost a panacea to the ever-growing need for user instruction with limited human resources."	"The biggest theoretical problem we faced was precisely resolving the tension between teaching concepts and teaching skills and making the learning problem-based rather than system-based."
Are online tutorials effective? A comparison of online and classroom library instruction methods [30]	"Analysis of the test scores indicated that there was no significant difference in the learning outcomes between in-person and online library instruction."	"Students enrolled in PSY 3213 are required to conduct a literature review for a topic they have either chosen or been assigned. Faculty members who teach the course encourage students to attend a library orientation session that is specifically geared to the class."
If you build it, will they learn? Assessing online information literacy tutorials [22]	"Even with low quiz scores, our project was a success in several ways. Numerous students learned about key library resources, and they recommended that the tutorials be used more widely."	"The results from the assessment project make it difficult to ascertain whether student learning was successful. While confidence levels rise in all tutorials and viewlets from pretest to posttest, key quiz questions had very low scores after the tutorials were observed. For instance, the Griffin tutorial's Boolean search question averaged 35 percent correct, with only 9 percent correct for the question addressing the difference between keyword and subject searching."

Table 1. Existing research about online tutorials. Most papers provide support for tutorials as teaching solutions. Some briefly mention that tutorials act as tools for solving problems of relatively narrow scope.

Most importantly, tutorials are studied in the context of schooling. Every paper in Table 1 specifically addressed how well students learned for class or formal training. Nonetheless, there are signs that classrooms may not be the best environment in which to evaluate tutorials in general. In one study, students reported that they would not use the given tutorials unless they were required for the class [6]. This detail was not investigated further, and our work aims to clarify the issue. While there is plenty of research concerning the value of tutorials as a learning method in class, "there are fewer items available that examine assessment of student learning while using tutorials for individual use, rather than being linked specifically to a course or library instruction session" [22].

This rarely recognized difference may explain why studies of whether online tutorials are more effective than lectures often present conflicting conclusions. Noe's study of Auburn University's library instruction tutorial is an example of such a result. Lecture-instructed students consistently achieved higher quiz scores when compared to tutorial-instructed students taking identical quizzes. Noe says, "Originally, the purpose of online tutorials was to allow students to 'do-it-themselves', to provide an opportunity for students to learn at their own pace. Do students understand the purpose of the tutorial? While open-ended survey comments indicate that they do, the tutorial is not interesting enough to hold their attention" [24]. By our hypothesis, the lack of interest can be attributed to the fact that the tutorials were not being used the same way students normally use them: to solve problems. According to our research, students use tutorials to gain a basic understanding of the subject and refer back to the tutorial when they don't remember a particular step. Noe, on the other hand, expected students to recall the content of the tutorials without seeing it again; students were expected to learn.

Do tutorials actually teach?

According to several pieces of research, tutorials actually are helpful in teaching. In an engineering class, the section with access to CAD tutorials performed better than the section without access [17]. Tutorials were also used to teach simulation tools in an electrical engineering course; students who used tutorials claimed to understand the simulations better than those who did not use tutorials, although there was no measurable effect on grades [6]. Studies about using tutorials to increase library information literacy demonstrated that basic skills were gained [34] [24]. In another case, cardiovascular physiology was taught through tutorials instead of lectures, and no significant drawbacks were found [13]. This implies that, as teaching tools, tutorials are just as effective as lectures. From these we can conclude that tutorials can indeed teach the user about the topic of interest.

A Comparison of Tutorials and Other Learning Methods

Destructive criticism consists of general, inconsiderate remarks delivered after a delay [1]. An example of it would be, "I don't think you even tried to work on that paper last week. You are stupid!" In two studies involving students and one involving a factory, subjects exposed to destructive criticism were more likely to be tense and angry, avoid the criticizer, and plan to seek "revenge" against the criticizer, none of which is conducive to learning [1]. Critics usually resist using destructive criticism until frustrated or disgusted [1], but this is still an issue with personal communication. It means that while personal tutoring and over-the-shoulder learning can be the quickest ways to teach, they can become slow and even detrimental if destructive criticism is used. In Baron's study, using even the "worst" tutorials without feedback turned out to be more beneficial than any other method involving some form of destructive criticism [1]. Tutorials eliminate the possibility of destructive criticism by offering no opportunity for personal interaction.

Several studies show that tutorials are as effective as lectures in terms of teaching [30] [2] [13] and more convenient for students and teachers. Tutorials can replace lectures, freeing faculty for other activities [38]. Tutorials are also seen as a way to reach more students with fewer teachers [30] [34] [18] [39] [12].

The idea of discovery learning, or learning by experience, gained popularity in the early 1960s, supported by Jerome Bruner's work. Unguided discovery learning was shown to be less effective than an explanation of what to do (i.e., a lecture) [23] and tutorials [10]. Guided discovery, however, was shown to be more effective than lectures [23]. Mayer defines guided discovery learning as a lesson where the student receives "problems to solve, but the teacher also provides hint, direction, coaching, feedback, and/or modeling" [23]. This fits Charney's definition of 'problem-solving' [10] as well as one of our interviewee's definition of 'personal tutoring'. That interviewee, a teaching assistant at the University of Illinois at Urbana-Champaign, said, "Even when a student tells me he just wants the answer, I only give them hints about how to solve it so they understand it." One might be quick to consider tutorials as guided discovery since users supposedly go through the same steps as the instructions provide, but other studies lend support to our distinction between the two. In tests administered immediately after a study session, tutorials proved to be more helpful for instant results; otherwise, guided discovery learning is better for remembering things in the long term [33] [10].

Another notable phenomenon is students' preference of live tutors over static tutorials. Several students interviewed for this study stated that they sought personal tutoring before searching for tutorials on the web. In a previous study, most students rather attend a live lecture than watch a tape recording [2]. In observations of learning and work environments, peers commonly worked together to solve technical problems. According to Twidale, "Online help functions, tutorials, and so forth, imply that help-giving or problem solving is a straightforward exercise in knowledge transfer: One person encountering a problem looks up the

answer in the online help index; another sends e-mail to the help desk and the return e-mail solves the problem" [36]. Many real-world problems are not so straightforward. In those cases, consulting peers is a fast and effective way to resolve the issue: "Collaborative problem solving between peers and with technology experts, drawing on a thorough understanding of the context of use of the technologies concerned, allows people to cope and to come up with solutions" [36]. Peer tutoring uses this same notion with the advantage that it can be specifically and quickly modified by the help provider to suit the particular task [11].

Web-based tutorials' advantages include persistent availability (as opposed to humans who may be occupied), wide access, and lack of potentially harmful emotional feedback. Due to their increasing popularity [18], it is important to develop effective online tutorials.

METHODOLOGY

A descriptive empirical study was performed through semi-structured interviews.

The Interviews

The authors of this paper conducted interviews that started with the same basic question: "What was the last tutorial you used? Please walk through how you used it." Several more questions were asked based on the interview subject's answers. Additional context-specific questions were asked spontaneously to potentially stimulate relevant and insightful responses, but the interviews were otherwise based on a set of guiding questions to spark conversation. Some examples follow:

- What was the last tutorial you used?
- Why do you use tutorials?
- What types of tutorials do you use (text, video, etc.), and why?
- Do you prefer consulting a person for help or learning from a tutorial?

The Interview Subjects

Since most existing research targets the use of tutorials as learning tools for students, analyzing the reasons and ways students used tutorials would allow us to corroborate or refute current theory.

Our group of interview subjects consisted mostly of acquaintances and friends who would be interviewed for ten to thirty minutes. The conversations took place in environments where the students would normally use tutorials (such as houses, offices, and public areas). While the inclusion of friends possibly skews the results on the basis of interviewer/subject familiarity, the group represents a large range of disciplines, skills, and academic performance.

The wide demographic covered by our pool of subjects also serves to broaden the application of our findings. While our conclusions are limited to college students, the variety we interviewed allows us to generalize more within that group.

All of the interviewees were students or recent graduates of the University of Illinois at Urbana-Champaign. All but the teaching assistant were between 20 and 25 years of age. The group consisted of:

- 1 female art student
- 3 male computer science students
- 1 male film student
- 1 male computer science graduate student/teaching assistant
- 1 female computer science student
- 3 male electrical engineering students
- 1 female photography & graphic design graduate
- 1 general engineering student

According to Bury, meaningful and accurate results can be obtained from a small sample in usability testing [5]. Our study tests the usability of tutorials in the sense of how they are viewed by the students. Though our sample size was too small to decisively rule out relationships between college major, sex, race, and age, there did not seem to be significant correlation in the information we received.

The interviewees were randomly assigned a number **1** through **12**, and the numbers are used to distinguish between different responses in quotations.

INTERPRETATION OF RESULTS

Based on a qualitative assessment of the interview transcripts, we found four major elements to be consistent throughout the bulk of our dialogs:

1. Tutorials are most often sought out and used when people have specific problems to solve.
2. Users prefer videos to explain motion, text-based tutorials to explain precise details, and pictures to understand spatial relationships between tangible objects or concepts. Different media are suitable for solving different problems.
3. Novice users tend to follow example scenarios, documents, code, etc. exactly. Advanced users generally skip through and use what they need.
4. For many people, tutorials are used only when there is no available help from friends.

The following subsections explain these results in greater detail and include notable quotations.

Function as a Problem-Solving Tool

The foremost of our observations is the strong trend of tutorials being used to solve very specific problems. Every interviewee used their mentioned tutorials to solve a clear problem, no matter how well- or ill-defined (e.g., to creatively apply a Photoshop filter or to correctly repair a bicycle part). Those problems varied wildly, but they always occurred before the tutorial was used.

4: "*If I got to the tutorial in the first place, it was because I had some problem to solve.*"

Interviewer: "*When do you usually use [tutorials]?*"
6: "*When I can't figure out how to do it myself. Usually I mess around, and I find something workable…*"

3: "*Usually when I'm trying to find how to do something, I find how-tos or tutorials that deal with the same subject.*"

Students didn't go looking for tutorials until they had an issue to resolve. This is in direct contrast to teachers' expectations for tutorial content to be remembered. In practice, students follow tutorials on subjects with which they are unfamiliar; afterwards, tutorials essentially become reference material.

9: "*[Tutorials are] definitely reference. Well, half and half; depends on what it's for.*"
Interviewer: "*Let's say something not required for class.*"
9: "*Probably more first-time learning, then. Subsequent uses would be reference.*"

8: "*We had a homework assignment that used PSPICE – I mean HSPICE, so we used the tutorial as a reference. But I'd never used HSPICE before, so it was for learning how to use it first, and then reference later…. I forgot how to do it already; it was only for one assignment.*"
Interviewer: "*Did you learn how to use HSPICE well?*"
8: "*Not really, because I just took their sample code and changed the parameters.*"

Of the 12 students interviewed, only one brought up a tutorial used exclusively for a class. Subject 8 had almost forgotten most of the pertinent material, including the name of the program. Another student used a tutorial in the context of school but in a different way:

5: "*Well, it is for class, but I'm doing it for class because I might as well get credit for it.*"

Subject 5 was already interested in the Django framework and conveniently used it as part of a class project. The longer, more detailed description of Django in the interview compared to the brief mention of HSPICE indicated greater enthusiasm for tutorial topics which actually interest the user. The last mention of tutorials in an academic setting referred to a graphic design class. Teachers encouraged the use of tutorials to help solve technical problems. The teachers did not write specific tutorials; instead, they posed problems and expected the students to find solutions on their own.

1: "*The first day of class, the teacher's like, 'OK nope. We're not going to teach you anything, you just look at tutorials online – there's tons of them.' ….[Teachers] make you learn – teach yourself to seek out resources on your own, by yourself.*"

Desirable Media

The usefulness of a tutorial often depends on the media through which it is presented. This is obvious when one first considers it, but many tutorial authors inadvertently ignore it.

Video & Audio

Problems involving movement or freeform manipulation (either with hands or a computer mouse) typically benefited from explanation via video tutorials. These included activities like bicycle repair, filming video, drawing in Photoshop, and learning how to use a stock trading website. The main characteristics of videos, which make them preferable to text-and-picture instructions, are the guided pace at which author goes through the tutorial and roughly the same visual perspective taken by the camera or screen capture. These convey the general workflow (motions, speed, procedure, and angle if necessary) of the task better than text is able to.

8: "*[A tutorial is] ideally someone streaming his screen and saying what he's doing while he's doing it.*"

10: "*[The tutorial video] is in a different window. I let it play on the side and watch and listen to it while I follow the steps they say.*"

2: "*It's very useful to watch one part several times, individually... I popped one of my [bike] tires… first I watched the part about how to take the outer rubber off of the rim, which, unless you actually know how to do it, you couldn't quite figure it out.*"

Only one mentioned a general dislike for videos:

5: "*[With a video tutorial] you can't go back as easily as if you were just reading it.*"

Most interviewees indicated that videos were usually short enough (2 to 5 minutes) to skip to appropriate parts without much difficulty.

Text & Images

Subjects who favored text-based tutorials were often attempting to solve something more text- and/or data-oriented. They described those tutorials to be most helpful as references for programming, markup, and styling languages. The ability to 'copy & paste' was very important. It's easy to see why this capability presents an advantage when working with sample code or snippets.

7: "*Yeah, I do like when there are diagrams. They help me get the concepts down, and I guess they can be a nice reference if necessary. I also really like the code samples. For this kind of programming introduction, I'd rather have the code samples. I think you can usually figure things out from the code.*"

(In the context of video vs. text for coding tutorials)
6: "*A lot of the time it's easier to have the text for something like that because then you can copy and paste.*"

Text-based programming tutorials have a major weakness: it's rare for introductory sample code to function perfectly as well as suit the user in further situations without tweaks and additions.

8: "*The screenshots were only helpful in that they showed if our plots were correct. It didn't tell you how to label points on the plot, so I had to figure it out.*"

4: "*In the case where something is weird, the tutorial's not going to have enough information, inevitably, because it's trying to focus on the simple case. It's not going to have enough debugging information: 'By the way, if this goes wrong at this step, you did blank wrong. Here's how to fix it.' That's usually the sort of detritus that is distracting from the simple example.*"

Deviation from Given Examples

The fact that tutorials were being used to solve specific problems also influenced the way students used them. Novices had broader problems to solve. The broader and more ill-defined the problem, the more likely the person was to follow the tutorial from beginning to end (the way tutorials are assumed to be viewed). Conversely, "experts" sought answers to more specific questions. They were more likely to search for a tutorial solution to a similar problem and then adapt it to fit the original situation.

Beginners

For example, when the objective in mind was to 'learn HTML', the user fully read the first few tutorials in the way the author intended in order to get a sense of the subject. Before independent experiments are conducted, most users find it beneficial to at least become acquainted with things like syntax or data structures.

3: "*…If I'm trying to learn something, then I might actually go through the tutorial top-to-bottom.*"

Novices also liked to have background information on what they were doing:

1: "*I like things that explain why…. Things that explain why will help you better retain it, because you know, at least for me, if I understand why something is the way it is, it'll help me appreciate it better.*"

3: "*I like the step-by-step [tutorials] as long as they explain the steps are they aren't just blindly inputting stuff.*"

8: "*I liked how they gave us sample code and explained each parameter. I wished there were more instructions on the CosmoScope Viewer, but overall it was good.*"

Experienced Users

Many interviewees were counted as experienced users. This means that while they weren't necessarily experts, they exercised more freedom in solving their problems. This isn't to say that the tutorials became useless; they were just treated more like reference material than step-by-step guides. In these cases, the problems were well-defined. Largely, people with more general knowledge of the working environment are more inclined to skip through parts of tutorials or to use steps out of order.

3: "*…Usually I go to the [most relevant] section, and if I don't understand the section I just start backtracking.*"

9: "*My 'artwork' in Photoshop doesn't coincide with the end products of any tutorial, but when a result turns out to my liking, I call it a success.*"

5: "*I knew nothing about Django, so I had to have somewhere to get started. So this walks you through a simple app, so I just went through the tutorial, working along, writing the beginnings of my app. So where they explained how to do theirs, I just used my own names and adapted it.*"

4: "*I suppose the way the tutorial was probably meant to be used was you start at the top, scroll down towards the bottom doing the things that it tells you to do along the way, and I didn't really do that.*"
Interviewer: "*So how did you do it instead? Skip around?*"
4: "*I kind of read some of the first part of it, realized that the example that they were going to walk you through creating something already existed, and then went and paid more attention to that. So the part that I actually stole from the tutorial was none of the directions, and sort of all of the highlighted parts that were, 'These are the important parts that you have to have' (code samples).*"

In summary, experienced users did what they felt was necessary to find the appropriate information and accomplish the task in the quickest manner. One subject even stopped using tutorials altogether.

12: "*I mostly like to experiment by myself for improving techniques, but occasionally I'll browse some random sites for inspiration. I don't know if they'd all be considered tutorials, though. [It's not as if] they're step-by-step. Plus, you can't really do that for photography where you have to capture [a moment].*"

Preference for Human Help

It can be claimed that since students are trying to solve specific problems, pre-written tutorials are not the optimal form of help. Problems outside of the classroom are often case-specific and very situational, so "perfect match" tutorials are highly uncommon. Several interviewees mentioned that human assistance is better because it's far easier and faster to learn from a person than from a static collection of information. Precisely, people prefer to learn from their friends. Friends may be more convenient to access than information only found through potentially futile web searches, and they are able to give intelligent answers that closely match the problem scenario. Besides providing key advice in solving the problem, humans can also hold conversations and jointly work towards finding a suitable solution to a creative problem.

3: "*If I'm in the office, yeah, I'll probably just ask someone because it would be much faster and much more precise of an answer.*"
4: "*Umm… I go talk to people first. The nice part about actually interacting with people is that when [expletive] breaks, the deviation from the tutorial is much, much easier to accomplish than, 'Oh, now I have to write the author of the tutorial, and go ask him what happened'…. It's much easier if you were just talking with someone because inevitably they went through exactly the same thing. They've seen this library missing or they've seen that misconfigured.*"

1: "*It's probably always better to learn from a person, especially someone who knows what they are doing, because they're right there and they've been through the learning process so they have empathy. If they're a helpful teacher, you can ask them questions right off the bat versus learning. Even though the W3 is laid out really nicely… it's not the same as that human factor.*"

6: "*Uh, probably, yeah. Somebody I know who has done something with it before, versus somebody who just claims to have done something online.*"

5: "*Sometimes you can ask people and even if they don't know what the stuff is, they can still kind of help you.*"

(A Photoshop document was sent to the interviewee and operations were performed and explained.)
11: "*I could understand you better when you were actually showing me how to make it. But once I only had the example, I became lost again.*"

Human help, which is often deemed more useful than codified information sources like tutorials, is normally sought out among friends. Nevertheless, an intriguing supplementary remark made by a couple of interviewees told of occasions where it was actually avoided. These occurred when the "help giver" clearly communicates (whether intentionally or not) that he/she feels like the time spent teaching the "help seeker" is being wasted.

4: "*I have run into this problem before… Some people respond to a question by saying, 'Ah, here's how you do this.' Some respond to questions with an amount of scorn which is basically, 'You're wasting my time by asking me these questions when you could've just researched the answer for yourself.' I know that I learn faster from other people. This is the most efficient way for me to absorb this knowledge. But some people… if you ask them the general question, they are going to tell you to 'read the friendly manual.'*"

Interviewer: "*Do you ask teachers for that sort of help?*"
1: "*No…*"
Interviewer: "*Why not?*"
1: "*'Cause it makes me nervous (laugh)… Although I should ask for help, because I know teachers always like that when they feel needed. So…*"
Interviewer: "*So is it kind of like terrifying to walk up to a teacher and say, 'Hey, I don't know this. Could you help me out?'*"
1: "*No… well, I guess – I mean that's only part of the reason. I feel like with this stuff you can just Google it. So I usually just do that anyhow. Why should I bother him when I could learn it myself?*"

6: "*Professors tend to talk about this from a 'I have a PhD in this, I do this for research all the time' sort of really theoretical, confusing way whereas TAs are like, 'Yeah, I took this class a couple of semesters ago.'*"

Interviewer: "*Were you satisfied with [the tutorial], and do you usually read tutorials?*"

9: "*Nah, I need training in the field from the master himself, but he's always too 'busy'.*"

While people prefer to seek help from others over using tutorials, there are some risks involved. It should also be noted that most subjects were acquaintances or friends with the interviewer or otherwise had solid groups of friends who could be asked for help.

DISCUSSION AND RECOMMENDATIONS

We translated our four observations into tutorial design implications for authors and a piece of advice to users.

1. Address a specific problem.

Many tutorials are written as all-encompassing standalone information sources. In Noe's library literacy study, students remembered very little of what the tutorials contained [24]. Those tutorials attempted to teach general concepts without directly relating them to the research question which the students were required to answer for the class. "Information literacy best practices indicate that successful information literacy occurs when practices can be applied to a specific assignment or task" [24].

This is not to say that broader concepts should not be documented in tutorials. A brief explanation of the larger context around the problem is indeed helpful. As suggested in recommendation 3, the reasoning behind each step/action should be stated if it may not be immediately obvious.

2. Use the appropriate media, not just the most attractive.

Although many interview subjects preferred watching videos, the problems they had in mind required animated demonstrations which could best be shown through screencasts or video of actual hand movements. Mismatches between tutorial content and media can cause severe usability issues. In the case of problem solving, this means slower reading/viewing of the tutorial and thus a delayed arrival at the solution to the problem. For example, text-based tutorials hold the 'copy-and-paste' advantage when large chunks of code are involved. A wholly video-based tutorial would require the user to manually view and type out all of the code, possibly making mistakes along the way. One must also be careful in categorizing tutorial content; showcasing a program skeleton generation feature in an integrated development environment is not the same as programming a 'Hello world' application.

Our interview subjects did not direct us towards any mismatched tutorials, but librarians attempting to develop an information literacy tutorial made such a mistake during Tancheva's 2003 study – "The first iteration of the system was heavily visual, relying on animation that subsequent usability tests with library staff determined to be distracting from rather than adding to the accomplishment of the learning objectives. In our enthusiasm to produce a visually pleasing system, we had fallen into the trap of 'using technology for its own sake' and had initially produced a system that was visually and graphically overloaded" [34].

We speculate that those librarians will not be the last to fall into this trap. Thanks to easier-to-use bundled authoring software (e.g., iMovie and Windows Movie Maker) and distribution channels (e.g., YouTube), creating and publishing videos has become a nearly trivial task. The progression towards animating everything is somewhat expected as web technologies develop, but using the newest format may not always be the best for conveying all kinds of information.

3. Include plain, step-by-step instructions, and organize the tutorial into clearly labeled sections.

Surprisingly, many popular web-based tutorials contain either vague or verbose instructions, or are too long without proper partitioning. We know from our interviews that beginners are uncomfortable with without a procedure of exact actions to perform and that experienced users appreciate short, relevantly titled sections.

A common problem with the typical online tutorial is that it assumes the audience to be new to the topic. In a study of usability of an information literacy tutorial, students said that the tutorial was too basic, overly long in places, but also too detailed [5]. Since the majority of tutorials is not written by librarians with the budget for usability testing, many of the problems go unnoticed by most authors. However, effects of different styles of tutorial have been observed. Grabler et al. have established a measurable performance increase in task execution when simple steps are listed along with screenshots of relevant UI elements [16]. As noted earlier, users tend to rush through these tutorials and do not learn much [7] [10]. When our previous assertion of tutorials' role as a problem solving tool is taken into account, it becomes clear that the shorter time required to follow the tutorial is entirely beneficial.

By including simple step-by-step directions and cleanly separating chunks of instructions (not simply dividing the tutorial into numbered pages based on length), both novices and experts can use the tutorial effectively. In any case, the ability to reuse the tutorial as reference material is important. Navigability across different modules/sections is of utmost importance.

4. Do not attempt to emulate human help.

A quality of tutorials is the inability to give feedback. While it prevents destructive criticism of users, it also means that users must be able to go through the tutorials or adapt them to different situations. Rather than try to cover all possible questions, caveats and common mistakes should simply be noted in corresponding steps or sections.

Many people use tutorials only when there is no available help from friends. Therefore, authors should keep in mind that a tutorial is used considerably less often than a friendly tutor. The interviewees who discussed human help said that they normally chose to start solving a problem by asking knowledgeable friends rather than referring to a tutorial. A friend with experience in the topic could be a resource for specific, useful advice that pertains closely to the problem at hand, acting as instant technical support when something went wrong. Even if the friend knows nothing, he/she can still provide intelligent ideas and opinions. Students also mentioned that solving problems with friends generally took less time than solving problems using tutorials.

Studies have shown that students prefer interactive tutorials over simple text tutorials for library instruction [18]. However, our results seem to conflict with Hrycaj's. Only one interviewed student found interactivity within or between tutorials very instructive. Subject 1 had no prior experience with HTML at the time of using the W3Schools' tutorials. The rest of the students only looked for necessary information within the tutorials.

7: "*Those might help if you want to check, but I think for most programming [exercises] the code samples are enough help on their own. You should know how to check results on your own anyway, if you're reading this stuff.*"

Hrycaj wonders if creating interactive learning tutorials is worth the time and effort it takes [18]. We actually recommend against it. Even though interactivity helps users to learn, they are a distraction [34] to the majority of tutorial users anyway, who use tutorials not to learn but to solve a specific problem.

Examples

We evaluate a couple of examples of web-based tutorials using the criteria defined by our four main results.

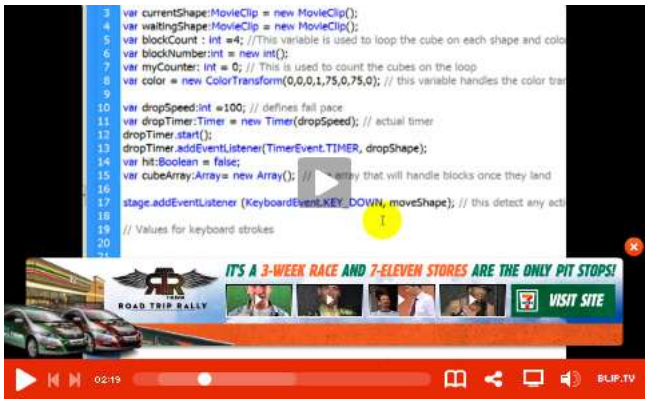

Figure 1. A video tutorial involving ActionScript code.

Figure 2. A text-and-image tutorial to manipulate an image.

Figure 1 shows a screenshot of a video tutorial which involves a fair amount of code. This tutorial fails to use the proper medium for text, and cross-section navigation is not easy. Since there is no textual supplement to this video, all code must be inspected and then manually typed. Users can't copy text from the video. In fact, users can't even see all of the text at this point because an obtrusive advertisement is in the way. Unless exact timestamps are memorized, skipping to certain points in this 10-minute video is difficult because there are no section/chapter markers. Additionally, this player requires the remainder of the video to be downloaded before skipping is allowed. To this tutorial's merit, Adobe Flash requires mouse actions which are demonstrated nicely through video. Steps are explained in detail and narrated at a slow, beginner-friendly pace. It is also part of a larger multi-part walkthrough. However, an improved version of this tutorial would still separate the video segments into shorter and more manageable chunks as well as provide textual code samples whenever modifications or additions were made.

Figure 2 is example output from Grabler et al.'s photo manipulation tutorial generator [16]. This tutorial performs one overall manipulation of the image. The generator mechanically conforms to listing out each step involved in the process but does not feature a function for dividing and naming the different chunks of the process. This tool is meant to generate a relatively short list of instructions for sections of a larger, complete tutorial, and it only separates content into different pages based on length. Its use of screenshots to provide a visual guide helps out newer users. An improved version of the tool could generate and embed optional video playback of mouse cursor movements over dialog boxes. Finally, although authors using this tool can annotate each step with a small remark, the default output contains no human element.

CONCLUSIONS

The most widespread misconception is that people use tutorials to genuinely learn. Because of this, relatively few tutorials are written in such a way that they can be used as easy reference material. Our research shows that tutorials are used to solve a narrow problem. Only a vague understanding of the topic is required, and the crucial elements users retain are the solution to their problem and the approximate location of that solution.

Based on the fact that our interview responses indicated more common usage of online tutorials outside of schoolwork, we can rebut the traditional assumption under which past research was done. Our theory is that students use tutorials to find a specific solution. Tutorials, then, are not true learning tools but rather problem-solving tools. This dichotomy frequently leads to poorly designed tutorials and usage of tutorials in situations where less expensive or faster solutions exist.

We provide design recommendation to tutorial authors:

1. Solve one specific problem. This is most likely how the tutorial will be used.
2. Teach through media most suitable for the subject matter. Videos demonstrate motion. Images show spatial relationships. Text presents precise data.
3. Provide step-by-step instructions for novices. Organize the tutorial into titled sections so that relevant information can be quickly located.
4. Tutorials don't replace in-person help. People prefer to ask friends for help first, and tutorials are, at best, a good backup resource when nobody is available.

Since personal communication is far more interactive than a tutorial could be, we do not recommend building interactivity into tutorial programs. Namely, quizzes and games should be avoided for quick problem-solving tutorials because they end up distracting the user.

Tutorials are more useful as a reference than as a primary method for learning. Users excel at adapting them to solve or work around specific problems, and tutorials become less useful when treated as learning tools.

FUTURE WORK

Since we only interviewed college-level students, further testing could be performed to see whether the general population agrees with our findings on tutorial usage and to examine the possible presence of the same misperceptions about the purpose of tutorials.

An interesting direction for future research is the design, implementation, and testing of tutorials meant to be used by small groups. Such tutorials would ideally address the shortcomings of both human help and codified knowledge at the same time. Interactivity in single-user tutorials has been explored, but none of the tutorials featured in a study of 19 library tutorials included collaborative elements [12].

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