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Student preference for tutorial design: a usability study

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Abstract

Purpose – This article aims to report on a usability study to assess whether students performed better after working through a screencast library tutorial or a web-based tutorial with screenshots.

Design/methodology/approach – This qualitative study asked 21 students from diverse backgrounds and learning styles to take two learning style inventories prior to a usability study. The students then went through two short tutorials (a static web page tutorial with screenshots and a Camtasia screencast (video) tutorial, as well as a pre- and post-test and debriefing for each. The "think aloud" protocol was used as their movements and voices were recorded using the Camtasia software.

Findings – The results of this study indicate that across all learning preferences students performed much better in recreating tasks when they used a static web page with screen shots than they did after viewing a screencasting tutorial.

Practical implications – Suggestions are offered for ways to create tutorials that are effective for multiple learning styles that will fit into a student's workflow.

Originality/value – Results of this study may help inform other librarians in ways to effectively design tutorials and learning objects to meet student needs.

Keywords Tutorials, Library instruction, Online learning, Diversity, User studies, Learning styles

Paper type Research paper

Introduction

In an effort to provide online library instruction in a variety of formats, librarians have been proactive in exploring various tools to create tutorials that can be used at point of need, including in instruction and reference interactions. Very common now are tutorials made with screencasting tools such as Camtasia, Captivate, Wink, Jing, Camstudio and Screencastomatic. Online tutorials can facilitate a teachable moment at the point of need, and can be embedded within course sites, web pages, online guides, online catalogs or other databases to provide instructions on specific tasks. Closed captioning features can assist students who may be non-native English speakers or who have auditory disabilities. Depending upon the interactivity available in these tutorials, they have the potential to engage visual, auditory and kinesthetic learners, as well as to accommodate students who learn best through observation, listening, or by engaging in hands-on activities.

Tutorials can be "captivating" and if designed in a pedagogically sound way can provide valuable active learning experiences. However, the incorporation of multimedia takes extra time and expertise as far as learning the software, scripting, storyboarding, capturing, adding call outs, hotspots, captioning and recording. With demands on time at

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a premium it is important to evaluate whether the efforts result in the desired goals. Do students learn better with this type of platform/presentation of material or would they learn just as well, or better, with another? To test this, a usability study of two types of tutorials was conducted with 21 students representing diverse cultures and learning styles. The International Organization for Standardization, ISO 9241 (ISO, 1998, Bevan, 2006), defines usability as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. Using this standard, the usability of an application can be accessed through the three key quality criteria namely:

(1) effectiveness – a measure of how well the user is able to use the application to achieve his/her goal;

(2) efficiency – measures the speed with which the user can complete tasks; and

(3) satisfaction – which is a subjective measure of how pleasant it is to use the system.

A simplified definition of site usability is the way that the user actually navigates, finds information, and interacts with the site (Wood, 1998; Goto and Cotler, 2002).

Four hypotheses were tested to determine if tutorials made with screencasting software or those that that were static web pages with screenshots resulted in better comprehension for the task at hand.

Hypotheses

The hypotheses were:

H1. Students, in general, will prefer going through tutorials created with screencasting tools such as Camtasia or Captivate than those that are static web pages with screen shots.

H2. Students, in general, will be better able to recreate steps after going through screencast tutorials that were created using multiple modes (such as video, audio, text) than with only text and images.

H3. Students who have a high visual or auditory learning style preference will perform better after viewing a tutorial creating using screen casting software.

H4. Students who have a high sequential learning preference will prefer the static web page with step-by-step instructions and screen shots.

These hypotheses were generated as a result of an extensive literature review pertaining to effectiveness of screencasting tutorials, as well as literature on learning styles (Mestre, 2012). The assumption in hypothesis one was based on previous literature that concluded that students enjoy the screencast tutorials and suggest that librarians should move past the static web page tutorials. *H2* through *H4* were based on learning style literature that argues that instruction should match students' learning preference. Because screencast tutorials offer multiple presentation modes (visual, aural, text), it was assumed that students would perform better after going through these types of tutorials because they could focus on their preferred intake mode. It was assumed that students with high sequential learning preference would prefer a static web page because they could more easily see the steps to take (*H4*).

The first three hypotheses could not be proven. In fact, this study indicated that students, across all learning styles, performed much better in recreating tasks when they used a static web page with screen shots than they did after viewing a screencasting tutorial, that they preferred the static web page tutorials with screenshots, and that they preferred the static images over text.

Literature review

This study investigated two types of tutorials; a static web page with screen shots; and a video tutorial (produced with screen casting software). A screencast is generally referred to as the method for using software such as Camtasia, Captivate, Jing, Wink, or CamStudio to select and capture anything on a screen (a series of click throughs on a web page, PowerPoint, or video, with the option to add text, call outs, captions, audio, voiceover narration, quizzes and hotspots to link out to other material). The screen can then be sent to a file, or instant messaged, e-mailed, published in a Flash or other format. For example, librarians can create a tutorial on searching a database from start to finish, record the process, save the file, and have students play it using any common browser plug-in like Flash, Quicktime, or Windows Media Player.

Screencast tutorials that include interactivity have the potential to engage many learning preferences because of the use of multiple sensory perceptions (typically visual, auditory and kinesthetic). Their value has been evaluated by many (e.g. Michel, 2001; Nichols *et al.*, 2003; Bury and Oud, 2005; Tempelman-Kluit and Ehrenberg, 2003; Betty, 2008; Mestre, 2010) who indicate that if designed well, they have the potential to promote student independence in their learning. Much of the work of creating a screencast or other tutorial occurs in the planning and content development of the script. Scripts are critical in providing structure and clarity to online tutorials (Bailin and Peña, 2007). One of the most important aspects of designing tutorials is to be consistent, especially in terms of navigation (both internal and external). Consistent internal navigational aids such as terminology, buttons, fonts, colors, icons, and text links allow users to review material, move between and within sections as needed, and receive additional explanations if desired. Standardization of these features can also help students when moving between tutorials so that they can recognize options.

Learning styles

The term "learning style" is sometimes used interchangeably with terms such as "learning preferences", "thinking styles," "cognitive styles," and "learning modalities." Research on learning styles evolved from psychological research on individual differences, which was widespread in the 1960s and 1970s (Curry, 1987). Learning style research has resulted in the development of more than 70 models and instruments that have been used to understand how individuals approach learning. Fleming (2005) described learning styles as individuals' characteristics and preferred ways of gathering, organizing and thinking about information. Keefe (1979) working with The National Association of Secondary School Principals (NASSP) described learning styles as "characteristic cognitive, affective, and psychological behaviors that indicated how learners perceived, interacted with, and responded to the learning environment" (p. 4). Christison (2003) distinguishes between cognitive style (field dependent versus field independent, analytic versus global, reflective versus impulsive); sensory style (visual versus auditory versus tactile versus kinesthetic) and personality styles (tolerance of

ambiguity, right brain versus left brain dominance). The following learning style theories and models are only a few of the most frequently used or cited by individuals as they design online learning environments and tutorials. For a comparison of similarities between learning style models see: "Styles of learning and thinking matter in instruction and assessment" (Sternberg *et al.*, 2008). Hawk and Shah (2007) review six well-known and widely available learning style instruments offered by Kolb, Gregorc, Felder-Silverman, Fleming, Dunn and Dunn as well as the Entwistle and Tait Revised Approaches to Studying model. In each review, they describe the learning styles that emerge from each instrument and review the instruments' validity, reliability, and student performance research, where available.

Pedagogical considerations

Regardless of the format of a tutorial, effective pedagogies should be considered along with the content, design and technology used (Lindsay *et al.*, 2006; Lechner, 2005). Results from a survey (Mestre *et al.*, 2011) with 92 librarians engaged in online learning and/or creation of learning objects indicate that librarians had very little training in pedagogy or learning styles. A learning object is a reusable instructional resource, usually digital and web-based, that is developed to support learning. Tutorials are considered learning objects, as are videos, games, quizzes, or other resources that can be embedded or accessed digitally. The findings of the study suggest that when designing learning objects, librarians are generally not aware of best practices or of how to design pedagogically sound projects. Only 28 percent of the respondents had previous coursework or a degree related to teaching and 68 percent indicated that in order to learn how to develop a new tool or learning object, they had to figure it out on their own. This is relevant in that it may mean that librarians possess little knowledge about the importance of methods for adapting a learning object to be effective with learners having different learning styles.

Tutorial instruction should not only be task based, such as training students in the mechanics of searching for information; it should also be concept based so that students recognize that the process discussed or used in that tutorial is transferrable and can be applied to other contexts. Dewald (1999a,b) states that one of the fundamental indicators for a tutorial to be effective and to help students develop higher-order thinking skills is that it should teach concepts, not just the mechanics of searching. This is especially relevant for students to be able to transfer information to other applications. Library instructors typically emphasize concept training so that students can begin to understand that there are certain elements or features or strategies of one database that they can apply to others. Various studies evaluated tutorials and concluded that the most successful tutorials (as far as results) included concept training for both lower-order and higher-order information literacy instruction (Kaplowitz and Contini, 1998; Dewald, 1999a; Fourie, 2001; Tancheva *et al.*, 2005). Concept training can facilitate cognitive transfer.

Students can also benefit from examples presented in multiple contexts. The exercises used should give students opportunities to apply the skill in novel situations and should provide substantive corrective feedback. The multimedia learning environment should approximate the situation in which the skill or concept is to be applied as closely as possible, and then have the learner practice as many potential variations as much and as often as possible.

One strategy for providing concepts is to make use of chunking or modular design. Modules that provide information in small blocks, breaking it up into parts and subparts with summaries and reviews, help learners organize the material in their own minds. Splitting longer or more complex content into small segments and arranging content in logical sequences also help reduce content-related memory load in multimedia tutorials.

Breaking down instruction tutorials into manageable sections (modules), while remaining linear and allowing for the step-by-step acquisition of skills, prevents the user from becoming overwhelmed with information. Studies have shown that making short segments instead of longer videos or tutorials helps students learn better and reduces the effort it takes for them to process information (Collins and Takacs, 1993; Dewald, 1999a,b; Vishwanatham *et al.*, 1997; Nguyen and Clark, 2005; Lusk *et al.*, 2008). Modules can facilitate self-directed learning by providing users with the option of either approaching the tutorial one section at a time or jumping between sections. This degree of choice is empowering to the user, but also serves to accommodate students with varying levels of knowledge and comprehension. Additionally, shorter tutorials are more likely to be viewed in their entirety, and thus more likely to fulfill their aim.

Whether a tutorial is designed as a static web page with screen shots and links, a screencast tutorial, a flash tutorial, or some other tutorial, the same pedagogical and design elements should apply. Through usability testing this study explored which type of tutorial (static web page with screenshots or screencast) was preferred by students and how effective these tutorials were for helping students understand how to perform various library searches.

Methodology

After getting approval from the Institutional Review Board, undergraduate and graduate students who were United States citizens were recruited (especially through various cultural houses and programs) to individually participate in this hour long usability study. They were given a gift card to a local coffee shop for their time. The goal was to recruit students from different ethnicities and cultures. After signing the appropriate consent forms the process below was followed.

Step 1: student learning style inventories

At the beginning of each interview each participant took two short learning style inventories. Each took about five minutes. These are and the Index of Learning Style Questionnaire (ILS) and the VARK Questionnaire (How Do I Learn Best). These inventories test for different preferences in learning so were useful during the analysis stage to determine if individuals with a particular learning style preference performed better on any particular type of tutorial. The results of these inventories were not discussed with the students until they completed the usability study:

- *The Index of Learning Style Inventor (ILS).* The first inventory students took for this study was *The Index of Learning Style Inventory* (ILS*)* by Felder and Soloman (1997). It categorizes learners as: Active/Reflective Learners; Sensing/Intuitive Learners; Visual/Verbal Learners; and Sequential/Global Learners. More information is available from the following websites: www.engr.ncsu.edu/learningstyles/ilsweb.html and www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/styles.htm

- *VARK Questionnaire*. The second inventory was the VARK Questionnaire (Fleming, 2001) which measures the ways students want to take-in and give-out information; whether Visual, Aural, Read/Write, or Kinesthetic. More information can be found at the following sites: "VARK Questionnaire how do I learn best)" at www.vark-learn.com/english/page.asp?p = questionnaire and "Helpsheets for study practices based on preferences": www.vark-learn.com/english/page.asp?p = helpsheets The instrument contains 16 multiple-choice questions and participants can choose more than one answer for each question. Although learners are not restricted to only one of four modes, they may show a strong preference for one particular mode. An individual's preference may range from a single mode to all four modes (Fleming, 2005; Hawk and Shah, 2007).

Step 2: usability interviews with students

There were two sets of tutorial evaluations and students went through only one of them, with the goal to have equal number of students going through each set. They each asked students to go through the ERIC and Online Research Resources tutorials. The difference was that set one asked them to use the ERIC tutorial that was a static web page with screen shots and the Camtasia tutorial of Online Research Resources and set two was the reverse: the static web page with screen shot tutorial of Online Research Resources and the Camtasia tutorial of ERIC. The purpose of mixing up the static tutorials and the Camtasia produced tutorials was to assess whether students would have difficulties with "Online Research Resources" regardless of platform since it is a very complex interface to use. The screencast tutorials that students viewed had been created with Camtasia. Camtasia software (by TechSmith) allows for capturing of screens and inclusion of animation, voice, call outs, captioning and testing. The final product can be converted to a number of format and file types to be viewed in multiple ways, including quicktime, flash, and mp4 (for podcasts). These are often described as videos because the movement is fluid.

Tables I and II provide the step by step process for both sets.

Set one	Tasks
Learning style inventories	Asked to take the ILS and the VARK inventories
Tutorial 1	Pre-test scenario – find articles in the ERIC database about the "impact of television violence on children" ERIC tutorial (static web page with screen shots) (~3 minutes) ERIC tutorial (static web page with screen shots) (~3 minutes) Post-test scenario- find articles in the ERIC database about the "impact of television violence on children" Debrief
Tutorial 2	Pre-test scenario – find articles in a general database about sports and drugs at the college level Online Research Resources (Camtasia Version) (2.04 minutes) Pre-test and post-test scenario – find articles in a general database about sports and drugs at the college level Debrief
Debrief	Questions asked regarding the tutorials, process, suggestions and demographic information

Table I.
Set one for student usability study

Set two	Tasks
Learning style inventories	Asked to take the ILS and the VARK inventories
Tutorial 1	Pre-test scenario – find articles in a general database about sports and drugs at the college level Post-test scenario – find articles in the ERIC database about the "impact of television violence on children" Online Research Resources (static web page with screen shots) (2.04 minutes) Post-test scenario – find articles in a general database about sports and drugs at the college level Debrief
Tutorial 2	Pre-test scenario – find articles in the ERIC database about the "impact of television violence on children" ERIC tutorial (Camtasia Version) (~3 minutes) Debrief
Debrief	Questions asked regarding the tutorials, process, suggestions and demographic information

Table II.
Set two for student usability study

Process

Starting from the Library Home Page students were first given a pretest scenario task to show how they would find articles on a specific topic. The topics are included in the above tables (Pre-test Scenario and Post-test Scenario). The participants were asked, wherever possible, to demonstrate and talk about any information seeking behaviors they choose to describe on a provided networked computer with Camtasia software. The program recorded their mouse movements and voice. After the pretest each student was asked questions to assess his/her prior knowledge of ERIC or Online Research Resources. They then went through their designated static web page tutorial and after finishing, they did the post-test and then were asked a series of debriefing questions to get feedback about the tutorial, and to discuss elements that were helpful or not helpful (see Appendix). The pre-test and the post-test had identical questions. The same occurred for the second tutorial done in Camtasia.

Results

Student demographic information

There were 21 students participating, 15 were undergraduates (two sophomores, seven juniors, six seniors) and six were graduate students. English was the predominant native language (57 percent) of the participants, 28 percent were native Chinese/Cantonese speakers, and 19 percent were native Spanish speakers. One participant reported both Chinese and Spanish as her native languages, thus the percentage is more than 100 percent. Anglo American students accounted for 38 percent of the students, and 62 percent were from other predominant ethnicities (see Figure 1):

H1. Students, in general, will prefer going through tutorials created with screencasting tools such as Camtasia or Captivate than those that are static web pages with screen shots.

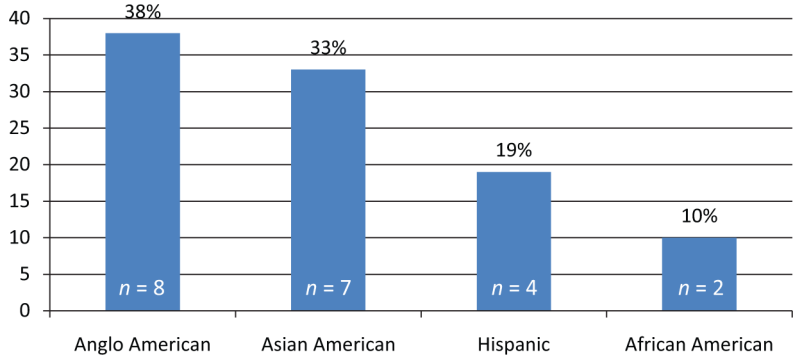

Figure 1.
Breakdown of ethnicity

Of the 21 participants for this study five indicated that they preferred the screencast Camtasia tutorial over the static web page with images. Below are representative comments grouped by topic:

- Ability to see the steps in action: "On the video tutorial I liked seeing the mouse actually move and click, and the highlighting and the pop-ups."
- Ability to listen to steps: "I would rather have someone tell me what to do and follow the directions with like visual pictures, rather than just reading it – it sticks with me better, especially with the voice that explains it to you."; "I just learn more easily when I have verbal instructions."; "I would rather listen to someone tell me how to do something."; "I liked listening and remembered what she said."; I think the audio in the video helps me to remember. I like being told while I'm seeing the information.
- Enjoyed being passive: "I liked the video tutorial because I didn't have to use any motor skills. I didn't have to move. I could just sit back and take in the information. I didn't have to scroll."; "The video was more accessible. I didn't have to go back and forth. I could just watch it."

The other 16 students preferred the static tutorial. Most of their reasons can be summarized by the following bullets:

- Ability to quickly find a section. Students remarked that they prefer the static tutorial because it was easier to go back to a section, point or instruction on how to do something. Some comments include "I can choose what I need to know and go directly to it"; "And then if I messed up I was able to go back to the picture and read it again if I needed to (not like in the video)." "Although I liked the video tutorial I would probably actually choose the first one [static web page] because I could get to the information I need quicker."; During the post-test of the screencast tutorial one student remarked "this one is harder because you can't remember. You don't have pictures to go back."
- Ability to pick and choose a section: "the static tutorial because it gives the information step by step in chunks and I can go back to the section I want, rather than the whole tutorial."; "I like to be able to pick and choose and go step by step.

I would have to normally go back in case I missed a step or didn't understand something. But if I could pick and choose I could not go over the things I already know about using a computer or searching databases and I just click on the things I'm not sure about."

- Easy to follow step-by step instructions and images. "I think all you need is the images with some step by step bullets to clarify if needed. The video isn't needed. We can just go to the web page and find the step we need."; "I would prefer it be presented the first way we did it [static web page with screen shots] where I would actually have to read it and see the pictures and then do it on my own. "if something is important it should be presented sequentially, like in the first tutorial [static web page]"
- Value of doing the searches along with the tutorial. "I prefer the first one with the step by step instructions, images and me having to do it. I retain the information better that way"; "I would prefer it be presented the first way we did it [static web page with screen shots] where I would actually have to read it and see the pictures and then do it on my own.";
- Ability to get the big picture. "I also liked the first one because I could scan the whole page and get the big picture of what I needed to do. I couldn't do that with the video."; "the text based one is easiest to go back and forth with and to get the whole picture and then the details."

The difficulties these participants encountered with the screencast tutorials were mainly that they did not feel they could easily go back and find the spot that would help them with a step, even with chapter markers, and that it was difficult to do the steps along with the tutorial. Many students did not want to spend the time viewing the video or listening to it. They preferred to quickly scan the web page and get to the task at hand. One student remarked "I just wanted to get the video over with so I could do what I needed to do." However, several students did suggest that small video clips could be added to the static web page for students who did want to see or hear a concept displayed. Another student mentioned the concern about videos done in Flash and if they could be accessed and rendered correctly on students' computers.

Comments for video screencast use included "I think that a video tutorial really is only needed if you want to teach the complex things, but if it's to illustrate simple information you don't need to do it. In this case a regular web page with added images and multimedia is all you need. I guess it also depends on the difficulty if you need hands-on activity too."; "Videos work well if you want to show something about a system, like comparison of features, not how to do something or use software. To teach how to do something a slower or static one is better and you can go back and go at your own pace". Another student suggested that a static web page tutorial is "good for individuals who want to stop and go back" whereas "the video could be useful for a classroom setting for students to watch and follow along (if on a big screen)":

H2. Students, in general, will be better able to recreate steps after going through screencast tutorials that were created using multiple modes (such as video, audio, text) than with only text and images.

Table III summarizes the results by either the ERIC database or the Online Research Resources portal.

The results above show that students performed better after going through a static web page tutorial with screenshots (19 out of 21 able to complete the post-test) than they did after going through a screencast tutorial (six out of 21 students able to at least semi complete the post-test). Semi-complete means that students were able to get to the initial page, but had difficulties continuing. This is true for both the tutorial explaining how to get to and use the ERIC database and the tutorial explaining how to get to and use the Online Research Resources (ORR) portal:

H3. Students who have a high visual or auditory learning style preference will perform better after viewing a tutorial creating using screen casting software.

The Table IV includes those students who scored high for a visual and verbal learning preference in the ILS inventory (those scoring in the 9-11 range with 11 being the highest) or in the VARK inventory (those scoring 10-16 for Visual or Aural with 16 being the highest). It also includes how they did for the various tutorials.

In this study there were 11 students who scored high on one or both learning style inventories for either verbal or visual preferences. The results of their post-tests follow:

- Static web page tutorial eight out of 11 students completed or partially completed the post-test.
- Screencast tutorial: four out of 11 students completed or partially completed the post-test.

Type of tutorial	Post-test results
ERIC tutorial (static web page)	All ten students completed post test
ERIC tutorial (Camtasia screencast)	Five of the 11 students semi completed the post-test
Online Research Resources (ORR) tutorial static web page)	Nine out of 11 students completed the post-test
Online Research Resources (ORR) tutorial (Camtasia screencast)	One out of ten students completed the post-test

Table III.
Results by type of resource

Student	Visual and verbal learners (ILS)	Visual VARK	Aural VARK	Ability to recreate static	Ability to recreate screencast
3	9 visual	15	9	ORR no	ERIC no
6		11	8	Eric yes	ORR no
9	9 visual			ERIC yes	ORR no
10	9 visual	13	4	ERIC yes	ORR yes
11	11 visual	11	11	ERIC yes	ORR no
12		12	9	ERIC yes	ORR no
13		4	10	ORR partially	ERIC partially
15	11 visual			ORR partially	ERIC yes
16	11 verbal			ORR yes	ERIC partially
18		8	11	ORR yes	ERIC no
20		10	12	ORR yes	ERIC no

Table IV.
Students with high verbal or visual learning preferences

Students overall, regardless of learning style were more successful after going through the static tutorial (19 out of 21 students able to complete the post-test) compared to the screencast tutorial (6 out of 21 students able to complete the post-test):

H4. Students who have a high sequential learning preference will prefer the static web page with step by step instructions and screen shots.

Results: The ILS inventory includes a continuum for sequential versus global learners (1-11). No student scored in the high (9-11) range for sequential preferences. Therefore, Table V includes those students who had a moderate (5-7) preference as a sequential learner. The last two columns include if they were successful in the various tutorials.

All but one of the five students with a moderate sequential learning preference was able to complete the post-test after going through the static web page with screen shots. One of the students was partially able to complete the process. That same student was the only student who was able to recreate the process after viewing the screencast tutorial. None of the other four students were able to complete the process after viewing the screencast tutorial.

Comments from students during the debriefing of these tutorials revealed that students, even those who did not score high for read/write or as a sequential learner valued the step-by step process. Some of the aspects they thought were helpful in the static tutorial were the screenshot images, which provided a step-by-step process, in addition to the bullet points that were included under the images. Students tended to focus on the images first and then the text (17 out of 21 students). Although the static tutorial had bullet points under the pictures for the steps, students tended to skim the page and glance at the pictures and followed the steps based on the pictures. When they needed clarification they would read the text. Following are two comments by students from the debriefing that were representative of many students:

> I read the text, but the visual was really what was helping me through because when I actually went to do it myself, like the picture, I just go back to what it looked like and go 'Oh that's what I have to press' or the arrow or stuff like that really did help. And if I didn't understand, the second time I went back I would read it again. But I'd go by the picture first. It's good, because the picture is what people are going to be seeing because it shows where to choose and stuff and the text enforces it.

> The images showed me exactly where I need to click and to type. It not only gives me directions of what to do, but visually points me to where to click and what to type … I focused on the images at first and then went back to read the text to see if what I thought of was right.

Table V.
Students with moderate preference as a sequential learner

Student	Sequential (ILS)	Ability to recreate static	Ability to recreate screencast
1	5	ERIC yes	ORR no
5	5	ERIC yes	ORR no
11	7	ERIC yes	ORR no
16	5	ORR yes	ERIC partially
22	5	ORR partially	ERIC yes

Discussion

This usability study asked students to take two learning style inventories and then to go through and evaluate two tutorials: a static web page with screenshots, and a screencast tutorial, in addition to taking a pre- and post-test. Students were asked to "talk aloud" as they went through the pre- and post-tests to describe what they were doing and why they made the choices. Their movements and voice were recorded for later analysis. There were four hypotheses for this study with two of them pertaining to student results based on their learning styles. The first part of this discussion provides some summary information about how the learning style inventories were used in this study. That section is followed by a summary of the results of the four hypotheses and then suggestions for creating effective tutorials to accommodate multiple learning styles.

Value of learning style inventories in this study

First inventory: index of learning styles (ILS). During the analysis of the usability studies particular attention was given to assess whether the students portrayed their dominant learning preferences during their session. For example, was student 1, who scored high as an active learner, able to recreate the process after only viewing a passive visual/aural tutorial or was she better able to recreate the process after going through the tutorial that included involvement on her part? Did the students who rated very high as visual learners (especially students 11 and 15) encounter difficulties with text or audio elements in the tutorials? During the debriefing of the usability studies, students were asked questions to help assess how they approached the tutorials, such as: describe your thoughts regarding this tutorial. Comment on, text, visuals, organization. They were asked many follow-up questions, such as if they focused on the image first or the text.

Second inventory: VARK. The results of this inventory were valuable in the usability studies of tutorials to help understand approaches to the text in the tutorials. In this study 3 of the 21 students tested with a single learning preference on the Learning Style Inventory, that of a Read/Write Learning style. In the usability study, this preference was evidenced as they first read the text on the page, before looking at the visuals. The only other single learning preference was that of a kinesthetic learner. The remaining 17 students tested as multimodal learners; however, overall, the percentage of students (who were multimodal) who scored with a high read/write preference was almost the same as those who scored with high preferences for kinesthetic (even if it was not their single preference). This finding was not expected. It was expected that most students would have high kinesthetic preferences. Even with many students scoring high for read/write preferences, their strategy for finding information in the tutorials was to look at the visuals first and only look at the text if the visuals were not clear enough.

For this study it was very important to gauge the read/write preferences of students to better understand the amount and type of text to incorporate into a tutorial. As with the ILS inventory results, the VARK results were taken into consideration during the analysis done in the study in order to compare actual results of the study with their results in the learning style inventory. This information was useful for drawing conclusions about effectiveness of various learning activities, tutorial design and presentation with students who have strong preferences for particular learning styles. During the debriefing with these students, it was informative to get a sense of how important each mode was for them in order to understand the information, process it, and replicate it.

By comparing preferences from both the ILS and the VARK Inventories it was possible to get a more global and consistent picture of a student's preferred style of learning. This was very relevant when analyzing how they did on the pre- and post-tests for the tutorial usability studies.

The four hypotheses revisited

The analysis of the usability study revealed that only the fourth hypothesis could be supported:

H1. Students, in general, will prefer going through tutorials created with screencasting tools such as Camtasia or Captivate than those that are static web pages with screen shots

The results indicated the reverse. Of the 21 participants for this study 5 indicated that they preferred the screencast Camtasia tutorial over the static web page with images. Two of those five students also admitted that although they preferred the screencast tutorial, they would probably choose the static tutorial if they actually needed to figure out how to do something. Students said they preferred the static tutorial because it was easier to locate the specific information needed to proceed, rather than hunting through a video to find it. With chapter markings in screencast tutorials it does become easier to locate sections, but is still not the same as skimming through a text page to find the term or heading that is needed. They thought the video tutorial was done well, especially with the narration and elements that drew attention to important features, such as the call out boxes, arrows, highlighting and zoom features. However, they remarked that the student has to learn at the narrator's pace, unless s/he paused the tutorial in order to actually do the search along with the tutorial. Students repeatedly said that they would not want to go back to the video to search through it to find a particular step. They thought the images and bullets in the static tutorial provided the visual information they needed to quickly access needed information. Having an outline or ability to see the sections and quickly go to them was important, especially for the global learners, those who were more advanced, and those who wanted to pick and choose a section. Students tended to focus on the images first and if they needed more explanation they would read the text under the image. Students for the most part, were active learners in this process because they performed the search as they went through the steps in the static tutorial:

H2. Students, in general, will be better able to recreate steps after going through screencast tutorials that were created using multiple modes (such as video, audio, text) than with only text and images.

The results indicated the reverse. Students performed better after going through a static web page tutorial with screenshots (19 out of 21 able to complete the post-test) than they did after going through a screencast tutorial (six out of 21 students able to at least semi complete the post-test). This is true for both the tutorial explaining how to get to and use the ERIC database and the tutorial explaining how to get to and use the Online Research Resources portal:

H3. Students who have a high visual or auditory learning style preference will perform better after viewing a tutorial creating using screen casting software.

This could not be proven. Students who scored high as visual or auditory learners performed better on the post-tests after going through the static tutorial (eight out of 11 students. For the screencast tutorial only four out of 11 students were able to partially complete the post-test. One consideration regarding the term "visual" is that the screencast tutorial also had images embedded, so these students were able to focus on the visuals in that tutorial to complete their tasks. The screencast tutorial provided a narration and students who preferred to listen to the process did comment that they appreciated that aspect. However, in analyzing their results, they did just as well, and usually better after the static tutorial as with the screencast tutorial:

H4. Students who have a high sequential learning preference will prefer the static web page with step by step instructions and screen shots.

This hypothesis could not truly be tested because there were no students with a high sequential learning preference in the study. However, after analyzing results for students who had moderate preferences as sequential learners, the indication is that even students with a moderate sequential learning preference performed better after going through the static tutorial (four out of five students). Additionally, most students in the study commented about the ease of using the static tutorial because it had step-by-step images, bullets and sections that guided them, regardless of whether they had a sequential learning preference. It would be important to test a larger base of students with this preferred learning preference before making conclusions on this hypothesis.

General suggestions for creating effective tutorials to accommodate multiple learning styles

Students suggested that the best type of tutorial would be one that is a static web page, good navigation, and structure that has screenshots detailing the steps and links to other information (such as short 30 second video clips to demonstrate a feature, pop-ups for more information, links to extra explanations and examples). They also recommend providing the option to click once to open up a new browser window to do the search along with the tutorial. By including various multimedia add-ins on the web pages (along with the ability to quickly see and jump to sections) students of all learning styles could pick and choose the options that best fit their preferences and needs. Following are some of the key suggestions that incorporate both the suggestions from students in this study and previous tutorial research studies (e.g. Nguyen and Clark, 2005; Mayer, 2006, Reece, 2007; Betty, 2008, Mestre, 2012):

(1) *Create a good outline and navigation.* Students want consistent navigation and sections that are visible so that they can skim or jump to the section they need. Allow students to easily see options, such as a linked table of contents, site index, available links to extra information, progress in tutorial, ability to move forwards and backwards, toggle buttons, or opening new windows. Use storyboarding to organize and outline the text, images, illustrations, interactive exercises, navigation, and evaluations that will be used in each sequence.

(2) *Provide clear and detailed images.* In this study 18 of the 21 students first focused on the images and then consulted the text if needed. They commented that they want to be able to skim and quickly find what they need. Therefore they suggested that the images be clear, crisp, large, and zoomed to the critical

features. They would prefer that the steps be numbered inside the image, rather than having to look beneath the image for the steps, although some students needed to see the bullets listed because they relied more on text. Images should also match what they will see when they get to the real product (step-by-step) or what is listed in any steps provided under the image.

(3) *Use appropriate multimedia.* Remove unnecessary graphics, text, and audio. Use simple, large, clear graphics and images. Check for pacing in screen, image and narration (how quickly screens and images advance). To reduce overload include text within images and put corresponding words and graphics near each other and cease narrating if a call out bubble or new feature appears so that the student can focus on and process the new information.

(4) *Highlight salient points.* Use voice, tone, volume, pitch, body language (if video or photo), expressions, large font, italics, bolded text, color schemes, icons, arrows, circles, call out bubbles, and repetition of main points. When using color check on accessibility for screen readers and color blindness.

(5) *Keep text to a minimum.* Be concise with instructions and text. Students preferred bullet points with the key terms in bold. Check for clarity in language, terminology, directions and instructions. Use text in conjunction with pictures, diagrams, photos, definitions, contrast, metaphor, and visual models. Include additional options for students who want to learn more as a choice, rather than as a default. Students suggest that any narrative or explanation could be accessed by a link to a video clip, extra page, or pop-up box with a phrase to alert students such as "See More; Hot Tip etc". With that method students can choose whether or not to explore the extra information. Through this option the main page would not be "cluttered".

(6) *Provide an easy way to work along with the tutorial.* Most students were multimodal learners with mild to high preferences as kinesthetic learners. They performed much better in the post-tests when they had been able to work along with the tutorial. Even with static web pages there are easy ways to open up a new browser window to provide some active learning. Students also liked the option of "quick checks" that asked them a question based on what was just covered in the tutorial, as long as there was immediate feedback.

- *Provide flexible models of skilled performance.* Include various exercises, such as multiple choice options, fill in the blank, pop-up windows to allow students to practice in a live context, and tasks to be competed outside the tutorial. Within the tutorial provide examples of an expert performing the task (through video clip, flash or screencast). Show a before and after example.
- *Provide opportunities to practice with supports.* Within a tutorial provide guided practice and scaffolding. Include options to "learn more" or "try it." Provide options for linking back to content for reinforcement. Include options for connecting with live chat support and sending responses to an instructor. Include "help" links within the tutorial and glossaries.
- *Make activities easy to complete without help or explanation; and use worked examples for novices.* Sequence content logically – start with simple and

work up to more complex. Give learners control and provide multiple opportunities to practice.

(7) *Make the experience personal and relevant.* Include features (or examples) that personalize the experience (such as choosing a scenario, or character if in a flash based tutorial). Use examples that students will encounter in their daily life. Include interactions or activities that simulate a realistic context.

(8) *Present information in chunks and in multiple formats.* Create small chunks of content rather than one lengthy tutorial with options to view more through links, video clips, or pop-ups. Make use of video, graphs, text, audio, kinesthetic and reflective exercises. Provide options for students to follow along in a linear approach (step-by-step) or to pick and choose sections.

(9) *Provide options for novices and advanced learners (reinforcement examples or explanations).* If possible, include opportunities to evaluate their previous knowledge and then provide branching options to proceed, based on that information. Providing multiple paths for users allows them to determine the material that is relevant to them. Provide a static web page with screen shots, video clips, and exercises for those who want to quickly scan. Provide captioning in a screencast tutorial, as well as a pdf or text version. Convert screencasts to additional files so that they can be easily downloaded to mobile devices.

(10) *Provide ongoing, relevant feedback.* Use frequent checks, such as periodic multiple choice questions. Include scenarios or simulations that require an action with periodic questions that require a response from the student.

The students in this study demonstrated that a screencast tutorial with images can be more effective than a screencast video tutorial. The results also indicated that regardless of learning style, students prefer static tutorials with screenshots over screencast tutorials. They want the ability to control their pace and progress and to see options at a glance, especially through visuals. Static web page tutorials are generally easier and faster to create and to update than the screencast tutorials. However, to create a balance, as well as to continue to provide multiple options for students, it is recommended that librarians incorporate a variety of multimedia into their tutorials. Students want to be able to pick and choose what is relevant for them and that may change depending upon their needs. By mixing it up and including multiple learning objects (either with links or embedded) on a page (images, charts, video clips, quick games, exercises, scenarios etc) it may be possible to reach a wider range of students. With multiple options included, the novice and expert can decide how much information they want or which sections they need to review. The kinesthetic learner can try something out, while the aural learner can choose to listen to the process.

If learning objects and tutorials are well designed to meet the needs of multiple students they can provide students options to decide what kinds of strategies they might want to use and what course of action to take in each phase. Students can then focus on the particular piece of information that is most useful to them in relationship to their academic work or to learn of their information needs or of resources and strategies that will help them meet those needs.

All of these goals can be met by incorporating various multimedia options into a tutorial, but it is important that the tutorials be evaluated by students to assure that

they are meeting their needs and use patterns. For examples of learning object resources and tools see the Learning Objects Libguide done at the University of Illinois at Urbana- Champaign (http://uiuc.libguides.com/learningobjects). Some of the categories are: audio, games, mashups, music, images, quiz/surveys, repositories, screencasts, teaching, video, and simulation/animation tools.

This study might serve as a pilot for a larger study with larger numbers of students from various ethnicities and languages. With a larger subject base it may be possible to get a broader picture of whether or not there are commonalities within ethnicities on the intersection of preferred learning style and tutorial design and other variables that may be important.

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Further reading

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Appendix. Debriefing questions

Critique of Tutorial (Show tutorial again). Some of these are suggested questions to get responses:

- Was the purpose of this tutorial clear? Did you know what the expected outcomes should be?
- Describe your thoughts when viewing this tutorial. Comment on, text, visuals, organization ...
- What was your favorite part of the tutorial?
- What was your least favorite part of the tutorial?
- Comment on the amount of text (explanation used). Was it the right amount, too much, too little?
- Were the images used helpful?
- Did you read the text as you went along, or just focus on the images?
- How understandable was the language and terminology used in the tutorial?
- Comment on the information. Was it clear, understandable? Is there another way that the information could be presented?
- What were the most troublesome areas you had in terms of understanding?
- Did you feel at any point that this module was too long or too boring, or you felt your attention drifting? If so, where?
- Is there something else that would help make this tutorial more understandable, clear?
- Which type of tutorial was most helpful for you? Explain how.
- Now that you have gone through a couple of tutorials give your views on how you prefer to learn (by doing as the instructor explains, by hearing/seeing/reading and then doing, by figuring it out on your own).
- Do you prefer to have the information presented in a sequential manner or do you prefer to pick and choose the information?

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