



A comparison of paper-based and video tutorials for software learning



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ARTICLE INFO

Article history:

Received 21 February 2014

Received in revised form

2 June 2014

Accepted 4 June 2014

Available online 12 June 2014

Keywords:

Computer-mediated communication

Teaching/learning strategies

Tutorials

Video

ABSTRACT

Instruction on software usage has long been dominated by the paper-based tutorial. This dominance is now being challenged with the rise of facilities for producing and publishing recorded demonstrations (video). Typically, each instructional medium has its own qualities. The present study aimed to optimize the design of a video tutorial for software training by attending to both its strengths and its weaknesses vis-à-vis a paper-based tutorial. Based on a distinction between two functionally different components in software tutorials, four tutorial configurations were compared: Paper-based, Mixed A (paper-based preview and video procedure), Mixed B (video preview and paper-based procedure), and Video. The 111 fifth and sixth grade participants (mean age 11.8) received instructions about Word's formatting options. The findings indicated significant and substantial improvements from pre-test to training in all conditions. In addition, participants in the Mixed A, Mixed B, and Video conditions outperformed those in the Paper-based condition. Significant and substantial learning gains were found from pre-test to post-test. Both the Mixed B and Video conditions outperformed the Paper-based condition. The success of the Mixed A, Mixed B, and Video tutorials is ascribed to the use of design guidelines for software training that direct the designer to optimize video's strong qualities and moderate or reduce its relative weaknesses.

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1. Introduction

Until recently, paper-based tutorials were the primary means of supporting procedural knowledge development by software users (van der Meij, Karreman, & Steehouder, 2009). Video is increasingly challenging this dominance, as technological barriers to its production and distribution have been removed. Websites from companies such as Adobe, Apple, HP, Microsoft, Samsung, Sony, Dell and the like now feature dozens upon dozens of 'How to' videos for their clients. The arrival of YouTube on the Internet in 2005 also marked the debut of the user as designer. As a result, there are now several specialized websites with thousands of user-made 'How to' videos (e.g., eHow, Howcast, Videojug, and Wonderhowto).

With video fast becoming the primary medium for instructing users about procedures, questions arise as to its design and effectiveness. Is a video tutorial a good alternative for the paper-based tutorial? In this paper we investigate this question for procedural knowledge development for software tasks. The most suitable video instruction for this purpose is considered to be the screencast or recorded demonstration in which a screen recording is coupled with narration (Lloyd & Robertson, 2012; Mestre, 2012; Plaisant & Shneiderman, 2005). In this paper we will use the generic term video to refer to such demonstrations.

We begin by reviewing the theoretical and empirical research on paper-based and video tutorials. This is followed by an empirical study comparing paper-based, video, and mixed tutorials on formatting tasks with Microsoft Word.

1.1. Theoretical arguments in favor of paper-based tutorials

Important arguments favoring a paper-based tutorial over a video tutorial for procedural knowledge development are its structure, accessibility, pace control, and active processing. The structure of a paper-based tutorial is such that it easily provides the user with an

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overview of the contents of the training. A table of contents shows how the instructional material is organized. In addition, the user can quickly skim the pages to get a first impression of the nature of the task instructions. Moreover, the table of contents makes it easy for the user to find information on a specific task or step. This facility is especially important when the user wants to recap a procedure or step, and when task execution breaks down. A paper-based tutorial does not dictate the speed of processing. The pace is set completely by the user, who can decide to move quickly with task instructions that are easily understood, and to move slowly with complex instructions. Another advantage of paper-based tutorials is that they invite active processing by the user. They are attuned to the user's tendency to act, and they call upon self-explanatory processes. Good tutorials are aligned with people's inclination to be active and to work toward meaningful goals when becoming familiar with software (Carroll, 1990, 1998). Such tutorials quickly get the user to where his interests lie, namely to instructions for task completion. The user must interpret these instructions for what they say about what needs to be done and about what happens in the human–computer interaction. According to Bovair and Kieras (1991), procedure comprehension in a paper-based tutorial engages the user in three vital processes, namely acquisition monitoring, immediate transfer, and procedure construction. In these processes the user actively monitors task progress, oversees the steps that still need to be taken, connects a new procedural step to one already acquired, and integrates the information from the instructions with what is already known. More generally, one could say that a paper-based tutorial stimulates active learning because it requires users to interpret instructions, and to produce self-explanations during task execution (see Catrambone & Yuasa, 2006).

1.2. Theoretical arguments in favor of video tutorials

Important arguments favoring a video tutorial over a paper-based tutorial lie in the affordances that video offers for multimedia representations, congruity, and modeling. Presenting instructions on video has the advantage that information can be presented in multiple modalities. According to dual coding theory (Clark & Paivio, 1991; Paivio, 1986), auditory and visual information can strengthen each other, and their combined use can partially overcome the processing demands with a single modality. Another advantage of a video tutorial is that it can display a task sequence just as the user would see it on his computer screen. There is congruence between the screen capture animation and real-life task execution (Tversky, Bauer-Morrison, & Bétrancourt, 2002). As the video dynamically visualizes screen changes it assists the user in perceiving temporal changes, or movements in a software system. A further advantage of video is that it provides the user with an easy-to-follow model. When learning about software from video instructions the user can easily (learn to) mimic the observed actions.

1.3. Empirical studies comparing a paper-based and video tutorial

Empirical research has rarely studied the effectiveness of a paper-based versus a video tutorial for procedural knowledge development. In their meta-analysis on static versus dynamic representations, Höffler and Leutner (2007) reported having found only two such studies for procedural knowledge development. This research (i.e., Michas & Berry, 2000; Spangenberg, 1973) did not contrast a paper-based and a video tutorial, however. Our literature search revealed the presence of three recent empirical studies. In addition, we found two early studies on software training that we describe below along with the newer ones.

Payne, Chesworth, and Hill (1992) conducted an experiment in which participants received instructions on how to use MacDraw for drawing, moving and deleting figures on the Macintosh. Four conditions were compared: no instructions (control), paper, video, and paper with video. The paper-based tutorial consisted of a set of seven independent cards. These “Exploration Cards” (see Carroll, 1990) presented the user with a generic goal (e.g., “Drawing objects”) and a small set of similarly generic task descriptions (e.g., “Point and click to select the required figure from the column on the left of the screen”). There were no screenshots on these cards. The video was 2.5 min long. It was an animated demonstration without commentary that showcased the manipulation of discrete figures. There were 8 participants in each condition. The only difference found between conditions concerned task completion time. Participants in the control condition were significantly slower than in the other conditions, which did not differ from each other.

Palmiter and Elkerton (1993) conducted an empirical study in which participants received instructions on how to use HyperCard. Three conditions were compared: paper without screenshots, video without narration, and video with narration. Training involved a series of 18 programming tasks. There were 16 participants in each condition. The main findings were as follows. Participants who viewed a video tutorial completed training significantly faster than those reading instructions on paper. The video tutorials also yielded significantly more accurate training performance. On a retention test taken one week later, the performance scores had decreased for video and increased for paper, resulting in an absence of a significant difference for condition. Task completion time was significantly faster for the paper-based tutorial, however. Palmiter et al. ascribed these outcomes to mimicry. That is, the video demonstrations may have induced superficial processing, with users more easily falling into the trap of an illusion of understanding.

Lloyd and Robertson (2012) conducted two consecutive studies on tutorials that taught students how to enter data and perform a *t*-test in SPSS. A paper-based tutorial with screenshots and a 12 min video tutorial with narration were developed for these tasks. The first study, with 31 participants, found that the video tutorial yielded significantly better results on a post-test than the paper version, with more tasks completed in a shorter time. In the second study, the 22 participants were given more time to complete training. In addition, they were allowed to review the tutorial during testing. The findings showed that the video group still completed significantly more tasks, but no longer had a time advantage.

Mestre (2012) conducted an experiment in which participants received instructions on how to find articles in ERIC, or Online Research Resources. A static webpage tutorial (the near equivalent of a paper-based version) and a video tutorial were created for each database. Video length was either 2 or 3 min. The 21 participants in the study were trained in both tasks, receiving a static webpage tutorial with screenshots in one and a video tutorial in the other. After training, a large majority (76%) of the students expressed a clear preference for the static webpage tutorial. In addition, the static webpage tutorials yielded substantially higher performance success on a post-test. Participants in the video condition had difficulties finding the right steps even though the video had chapter markers. They preferred to use the static webpage to find the information needed quickly. They did not want to take the time to watch the whole video. In addition, several participants suggested adding small video clips to the static webpage to demonstrate a feature.

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