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Developments and Trends in Learning with Instructional Video

1. Introduction

This special issue contains 7 empirical papers and 2 commentaries based on the EARLI SIG 6 (Instructional Design) and 7 (Technology-Enhanced Learning and Instruction) conference organized at the University of Burgundy, Dijon, France in 2016. All papers focus on learning with instructional video, a topic that continues to arouse an important interest among researchers and educational professionals. Instructional videos differ from videos watched for entertainment in that they have the objective to help someone learn about specific concepts or procedures. This special issue provides an overview of some of the main topics addressed in contemporary research on learning with instructional video. The aim of the contributing papers is to take the field of learning with instructional video a step further so as to better understand the circumstances under which instructional videos do and do not improve learning and how instructional videos can be more optimally designed to support learning. The overarching goals of this are, on the one hand, to inform researchers and educational professionals about what works and what does not in learning from instructional videos, and, on the other hand, to offer a research agenda for (supporting) learning from instructional video. Together, the papers represent examples of research directions currently explored in using instructional video to support learning, which we have divided into three categories: (1) extending 'traditional' design principles that have been shown to support learning with instructional video, (2) investigating the effectiveness of 'novel' design principles that supplement the existing repertoire of design principles, and (3) incorporating learner attributes in the study of learning with instructional video. It should be noted that overlap between categories is possible and that papers have been categorized on the basis of their most prominent research focus. Before we will describe each of the contributing papers according to this categorization, this editorial starts by describing some prominent developments concerning learning with instructional video to put the papers in this special issue in perspective.

2. Learning with instructional video

In the past decades, the use of instructional video in education has increased massively and therefore, instructional video is currently considered as one of the most popular ways of delivering instruction. Learners of all educational levels watch instructional videos such as short knowledge clips, web lectures, and how-to demonstration videos for informal learning purposes on websites such as YouTube and Vimeo (Hoogerheide, Loyens, & van Gog, 2016; Kay, 2012). Also, in formal learning environments instructional videos are increasingly being used. For example, instructional videos are often embedded in traditional courses, typically serve as a key component in blended courses, and are the primary means for presenting information in massive online open courses (MOOCs) and flipped classrooms (e.g., DeLozier & Rhodes, 2017). It is particularly this greater reliance on instructional videos and the large scale at which they are used nowadays that stands out (for a similar point, see van Gog, 2013). Yet, it is important to note that using instructional videos for educational purposes itself is by no means a new development, because first (limited) uses of instructional video dates back to the early 1900s. It would take until the second half of the previous century for videos to become more mainstream and researchers to start to become interested in investigating the effects of instructional video on learning. From around the 1960s onwards research on the learning effects of instructional video really started to take off, with a primary focus on modeling example videos to investigate the extent to which model's behavior and characteristics affected learning and self-efficacy (e.g., Bandura, Ross, & Ross, 1963). With the development of more powerful computers and new tools to record and play videos (e.g., invention of the video recorder), the use of instructional videos further increased. Ever since, the popularity of instructional video (as well as instructional animation) in education has grown enormously, enabled by rapid technological advances in hardware (e.g., computers, video cameras, smartphones) and software (e.g., video recording apps, video-editing programs) as well as increasing access to fast Internet, allowing instructional videos to be created relatively easily and at low costs, and shared with others in online learning environments with minimal effort (van der Meij & van der Meij., 2013). Thus far, however, most of the instructional videos are still created based on the authors' or designers' intuitions instead of relying on documented principles derived from scientific research (Fiorella, van Gog, Hoogerheide & Mayer, 2017) and/or theoretical considerations from instructional design theories, such as Cognitive Load Theory (Paas, Renkl, & Sweller, 2003) and the Cognitive Theory of Multimedia Learning (Mayer, 2014), observational learning theories such as Social Learning Theory (Bandura, 1977), and basic cognitive processing theories such as theories of embodied cognition (Barsalou, 2008). So, there is an urgent need for more knowledge to build research-based principles for designing instructional video and understand why these principles work as well as sharing these insights with the relevant target population (see Schwan, 2013).

In the past years, research on learning from instructional video has flourished and much progress has already been made to better understand when an instructional video does (not) produce learning benefits. The majority of this research (including research on instructional animation) has primarily focused on how information should be presented in an instructional video (e.g., spoken vs. written text; e.g., Hoogerheide, Loyens, & van Gog, 2014), to what extent instructional videos have an added value over static visualizations (e.g., Hoffler & Leutner, 2007), and how learning from instructional videos could be

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supported by encouraging learners to engage in meaningful cognitive activities (e.g., self-explaining; De Koning, Tabbers, Rikers & Paas, 2011). This past work has produced highly useful insights into the conditions under which learning from instructional video is effective or could be further optimized, and several evidence-based design principles (e.g., segmentation and transience effect, pacing principle, signaling principle; Boucheix & Forestier, 2017; Mayer, 2014; Sweller, Ayres, & Kalyuga, 2011; Wong, Leahy, Marcus & Sweller, 2012) have been formulated for effective learning from instructional videos. Inspired by this established knowledge base, an increasing number of researchers have recently started initiatives to move beyond such 'traditional' approaches in an attempt to deepen our understanding of currently identified design principles and/or to investigate novel ways to use or support video-based learning. Additionally, the ever-increasing number of subject-domains where instructional video is applied has spurred interest in testing the usefulness of instructional video and applicability of instructional design principles in contexts not explored before. For instance, researchers are taking into account embodied aspects of learning (e.g., showing a hand in the video or not; De Koning & Tabbers, 2011, 2013), emotional and social effects videos might have on learners (e.g., congruency between learner's mood and emotional valence of the video; Beege, Schneider, Nebel, Häßler & Rey, 2018), or focus on practical applications involving instructional video (e.g., deciding how to add practice to an instructional video; van Gog, 2011). Other interesting novel approaches that recently emerged include instructing learners to generate their own videos as a learning activity (e.g., Hoogerheide, Renkl, Fiorella, Paas & van Gog, 2018) and identifying boundary conditions for effectively showing an instructor's eye movements superimposed on the video to guide learners' attention (e.g., van Marlen, van Wermeskerken, Jarodzka & van Gog, 2016). This emerging work so far shows promising, but not always consistent, findings. So, we are at a point in time where it is necessary to consider the work that has been done up till now so as to be able to identify effective novel ways of (supporting) learning from instructional video and provide suggestions for advancing the field of video-based learning research.

The papers contributing to this special issue represent a selective set of topics identified in contemporary video-based learning research investigating novel approaches to (support) learning with instructional video. Of the 7 empirical papers, 2 papers focus on extending 'traditional' design principles to deepen our understanding of designing effective instructional videos, 3 papers focus on investigating novel design principles for effective learning with instructional video, and 2 papers focus on investigating the role of personal attributes in learning from instructional video.

3. Contributions

3.1. Extending 'traditional' design principles

Prior research on learning with instructional video has produced various research-based principles for effective design of instructional video. The goal of these principles is to enable easier processing of the to-be-learnt information in the visual and/or cognitive system or to encourage learners to construct more accurate and richer mental representations of the presented information. Easier processing of instructional video could, for example, be realized by inserting natural breaks in the video that learners could use to mentally organize the presented information or to integrate it with existing knowledge structures (e.g., van der Meij & van der Meij., 2013). Thus far, however, researchers have mainly concentrated on demonstrating that learners studying instructional videos that are designed according to such design principles outperform learners who study the same information from instructional video that are not optimized according to these principles. Two studies in this special issue take this a step further and extend this prior work in novel directions.

The study by Merkt, Ballmann, Felfeli, and Schwan (2018) aims to dig deeper into the 'why' of an existing design principle by attempting to unravel the cognitive basis for the beneficial effects of pauses in instructional video. In two experiments, they aimed to investigate why pauses benefit learning by testing whether this is because inserting pauses reduces the amount of information that needs to be processed simultaneously (i.e., transience explanation) or because pauses structure the content presented in the video (i.e., structuring explanation). Another noteworthy feature of this study is that the authors tested the effects of pauses in instructional videos that lasted longer than most of the videos used in prior research.

The paper by Biard, Cojean, and Jamet (2018) also relies on existing design principles, but moves beyond 'traditional' research by studying the effects of combining two design principles and investigating this in a context in which these design principles have not yet been studied before. Specifically, they asked occupational therapy students to learn a professional skill (orthotic fabrication) from an instructional video that was segmented by short pauses in-between key procedural steps. Simultaneously, they offered learner-paced control of the video. It was investigated whether combining these aspects led to better learning compared to a condition in which learners only could interact with a non-segmented video, and a condition without any pauses and interactive possibilities. Another aim of the study was to investigate whether and how learners use the interactive features that were available to students in the interactive conditions.

3.2. Novel design principles

We are currently living in a time where technological developments follow each other at lightning speed. This also concerns instructional video as the way videos can be recorded, edited, and broadcasted is proliferating. At the same time, instructional videos are increasingly incorporated into broader (technology-enhanced) educational programs as one of many other educational activities. Whereas educational professionals are eager to adopt the emerging trends in their educational programs, to effectively use the new possibilities of instructional video novel design principles are needed given that 'traditional' principles do not fully suffice in these new situations. There is, for example, hardly any guidance on whether learning from instructional videos is dependent on the camera viewpoint that is chosen, whether or not the instructor should be visible, and how to sequence instructional videos with other educational activities (for exceptions, see Fiorella et al., 2017; Kizilcec, Bailenson, & Gomez, 2015; van Gog, 2011).

The contributions of Boucheix, Gauthier, Fontaine, and Jaffeux (2018) and van Wermeskerken Ravensbergen, and van Gog (2018) both work towards such novel principles that target the design of instructional videos. Boucheix et al. (2018) investigate new ways of recording instructional videos in the context of learning a professional manual procedure (inserting a catheter in the body). Using a pretest-posttest design, nursing students learned the procedure from a video that showed the teacher performing the procedure as seen from the front, standing opposite to the learner (i.e., face-to-face perspective), as if looking over the shoulder, standing behind the teacher (i.e., over-the-shoulder perspective) or using both perspectives in an alternated fashion (i.e., mixed perspective). The goal of the study is to investigate the effects of camera viewpoint on learning to perform the taught medical procedure.

The study by van Wermeskerken et al. (2018) addresses the question whether instructional videos in which an instructor demonstrates and/or explains how to perform a task (video modeling examples; Renkl, 2014; van Gog & Rummel, 2010) should actually show the instructor or not. Participants studied a video-modeling example about probability calculation in which the instructor was present or absent. Using eye-tracking methodology and a pen-and-paper test they examine the effects of studying a video modeling examples with a teacher visible versus studying the same video example without the teacher visible on attention allocation and learning.

The work described in the paper by van der Meij, Rensink, and van der Meij (2018) takes a broader approach by contributing to novel design principles focused on how to use instructional video as part of a more comprehensive set of learning activities. In their study, they investigate how instructional video and practice of the to-be-learned skill can best be sequenced. Students (5th and 6th Grade) studied a demonstration video showing how to perform formatting actions in Microsoft Word by just watching the video (video-only condition), by first engaging in hands-on practice with formatting actions and then watching the video (practice-video condition) or by first watching the video and then practicing the learned formatting actions (video-practice condition). The goal of the study is to establish the usefulness of practice for software training and to identify the most optimal sequence for combining instructional video with hands-on practice.

3.3. Personal attributes

Another recent development within research on learning with instructional video is to take into account the role of personal attributes in relation to learning outcomes. Relevant personal attributes in this regard are for example gender, age, spatial ability level, and experience with online learning. It obviously makes most sense to focus on how the learner can be characterized based on such personal attributes that s/he brings to the learning process. However, the increasing use and investigation of instructional videos showing an instructor modeling a task or procedure also invites for studying the characteristics of the learners' personal attributes or preferences and their interaction with the video model.

The study by Wong, Castro-Alonso, Ayres, and Paas (2018) focuses on gender and spatial ability of the learner in learning from instructional animations. They report 3 experiments in which participants learn hand-manipulative tasks from animation or static visualizations under different experimental conditions. In all experiments, spatial ability is measured using a variety of standardized spatial ability tests (e.g., Mental Rotation Test; Peters, Laeng, Latham, Jackson, Zaiyouna & Richardson, 1995) and self-rated spatial ability and mental rotation. The aim of the paper is to examine the relations between gender, spatial ability, and learning from animation.

The contribution of Hoogerheide, van Wermeskerken, van Nassau, and van Gog (2018) not only considers the gender of the learner, but also the gender of the video model shown in the instructional video. In their study, students learned how to troubleshoot electrical circuits by watching video modeling examples with either a male instructor or a female instructor. They tested the model-observer similarity hypothesis, which argues that male and female students always learn more from a same-gender instructor than an opposite-gender instructor. Moreover, they tested the task-appropriateness hypothesis, which postulates that both male and female students benefit more from a male than a female instructor when learning a task that is perceived as more appropriate for males such as electrical troubleshooting.

4. Discussion

The final two papers of this special issue summarize the 7 empirical contributions and discuss these within broader theoretical and practical contexts. The commentary by Fiorella and Mayer (2018) distinguishes between, on the one hand, instructional characteristics that make learning with video effective and, on the other hand, instructional characteristics and learner attributes that do not support learning with video. In the commentary by Betrancourt and Benetos (2018), explanations are provided for when and why instructional videos benefit learning based on three perspectives referred to as the representational-, cognitive-perceptual-, and instructional approach. Together, both commentaries provide a critical analysis of each of the contributing papers, offer constructive recommendations for how to design effective instructional videos for practical use, and identify promising future research directions within the field of learning with video.

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