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Effects of creating video-based modeling examples on learning and transfer

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Two experiments investigated whether acting as a peer model for a video-based modeling example, which entails studying a text with the intention to explain it to others and then actually explaining it on video, would foster learning and transfer. In both experiments, novices were instructed to study a text, either with the intention of being able to complete a test (condition A), or being able to explain the content to others (condition B and C). Moreover, students in condition C actually had to explain the text by creating a webcam-video. In Experiment 1 ($N = 76$ secondary education students) there was no effect of study intention on learning (A = B), but explaining during video creation significantly fostered transfer performance (C > B; C > A). In Experiment 2 ($N = 95$ university students), study intention did have an effect on learning (C > A; B > A), but only actual video creation significantly fostered transfer performance (C > A).

1. Introduction

Example-based learning is an effective instructional strategy that has been studied from different perspectives. Research from a cognitive perspective (e.g., cognitive load theory; Sweller, 1988; Sweller, Van Merriënboer, & Paas, 1998) has mainly focused on observational learning from *worked examples*, which consist of a written, step-by-step worked-out procedure for completing the learning task. This is usually an “ideal” or “didactical” procedure, reflecting how a student should learn to complete a task, which may differ from how an expert would actually handle it, since experts sometimes can skip or chunk steps (Ericsson & Staszweksi, 1989). Research from a social-cognitive perspective (e.g., social learning theory; Bandura, 1977, 1986; cognitive apprenticeship; Collins, Brown, & Newman, 1989) has focused on observational learning from *modeling examples* in which a human model or humanoid agent demonstrates and explains how to complete a task (see Van Gog & Rummel, 2010). These models sometimes demonstrate an ideal, didactical procedure for the task, but they may also display “natural” behavior, which entails making and correcting errors (e.g., Braaksma, Rijlaarsdam, & Van den Bergh, 2002). In modeling examples, the model can be either an adult (e.g., Schunk, 1981; Simon & Werner, 1996) or a peer student (e.g., Braaksma, et al., 2002; Groenendijk, Janssen, Rijlaarsdam, & Van den Bergh, 2013a, 2013b; Schunk & Hanson, 1985).

Research inspired by the cognitive perspective has demonstrated the effectiveness and efficiency of example-based learning. For novices, instruction consisting of example study (alternated with problem solving) leads to better learning outcomes with less investment of time and mental effort than instruction consisting of problem solving only (Atkinson, Derry, Renkl, & Wortham, 2000; Paas & Van Gog, 2006; Renkl, 2011; Sweller et al., 1998; Van Gog & Rummel, 2010) and instruction consisting of tutored problem solving (Salden, Koedinger, Renkl, Aleven, & McLaren, 2010). Research inspired by the social-cognitive perspective has not only demonstrated that example-based learning can be effective for learning, but also that it can increase learners' self-efficacy, which is the perceived belief a learner has for learning, or performing a task at a certain level (Bandura, 1997; Schunk, 1987).

As mentioned above, peer students are known to be effective modeling examples, improving learning of students who observe them (Groenendijk et al., 2013a, 2013b; Schunk, 1987). For educators, an interesting question is whether there would also be potential benefits for learning, for the peer students who act as models in the examples (i.e., for the students who explain and/or demonstrate a task). However, despite the fact that a lot of research has investigated the effects of *observing* modeling examples, little is known about the effects on learning and transfer that *acting* as a

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peer model might have. Therefore, this study addresses that question.

1.1. Acting as a peer model for video-based modeling examples

Nowadays, video-based modeling examples (e.g., Braaksma et al., 2002; Groenendijk et al., 2013a, 2013b; McLaren, Lim, & Koedinger, 2008; Van Gog, 2011; see also www.khanacademy.org) are increasingly used in education as they have become easier to create and store in online (learning) environments. It seems that video-based modeling examples are also increasingly being used for informal learning purposes. Research has shown that many students (age 12–17) watch videos on websites such as YouTube and Google Videos; moreover, an increasing number of students also indicate they create and share videos (Lenhart, 2012; Spires, Hervey, Morris, & Stelpflug, 2012). While not all of those would qualify as video-based modeling examples, it is likely that these form part of the videos watched and created.

If students have to act as a peer model for a video-based modeling example and are not yet experts on the topic themselves, they first have to study learning materials on the subject. These learning materials are studied with a different intention than the common intention of studying for a test. That is, the materials are *studied with the intention of being able to explain the task to others*. Secondly, the peer model *actually explains the task* during the creation of the video-based modeling example. Both steps may affect students' learning outcomes (with better outcomes being reflected by higher retention and transfer test performance reached with equal or less effort investment on those tests) and beliefs about their own capabilities.

Instructing learners to study with the intention of being able to successfully explain a task to others might invoke a more active study approach and cause learners to focus less on absorbing new facts and more on interpreting and integrating new knowledge (Benware & Deci, 1984). Some studies have shown that instructing learners to study with the expectation of teaching to another student (i.e., teaching expectancy) can invoke an active study approach, and enhance learning processes and/or outcomes when compared to the more passive approach of studying to complete a test (e.g., Bargh & Schul, 1980; Benware & Deci, 1984; Renkl, 1995). Moreover, the study intention of being able to explain to others could result in different comprehension monitoring processes (e.g., asking oneself: "Why is it that … ?"; "Do I understand … ?"; "Can I explain … ?"), and could invoke self-explanation processes, both of which have been shown to foster deep learning and understanding (comprehension monitoring: Graesser, Baggett, & Williams, 1996; Sternberg, 1987; self-explaining: Chi, Bassok, Lewis, Reimann, & Glaser, 1989; Chi, De Leeuw, Chiu, & LaVancher, 1994; Renkl, 1997, 2002; deep questions and explanations: Craig, Gholson, Brittingham, Williams, & Shubeck, 2012; Craig, Sullins, Witherspoon, & Gholson, 2006). Enhanced understanding should be particularly beneficial for transfer performance (e.g., Van Gog, Paas, & Van Merriënboer, 2004).

Next to the effect an explanation study intention might have, *actually* explaining the learning materials to another (non-present) person during the creation of a video-based modeling example might further improve learning outcomes. It has been shown that generating explanations can foster learning more than rereading or receiving explanations (Lombrozo, 2012). For example, asking learners to generate explanations can help them to identify and then repair knowledge gaps (Chi, 2000), to integrate new knowledge with prior knowledge (Chi et al., 1994; Lombrozo, 2006), and to transform declarative knowledge into applicable procedures (Chi et al., 1989, 1994). Whereas these studies only prompted students to explain to themselves (i.e., self-explanation), explaining with the intention of providing instruction that can be shared with others (as one would do when creating a video) can be seen as what Leinhardt (2001) refers to as providing instructional explanations.[1] According to Leinhardt, providing instructional explanations differs from simply stating or describing a concept or procedure, by more carefully examining it. That is, providing a full explanation of the concept or procedure in which key features are identified, connections to prior knowledge are made, and effective and important examples are provided. In other words, providing such explanations would foster deeper processing and elaboration of the learning materials, which might foster the explainer's learning outcomes and especially, transfer performance.

Indeed, actively providing such instructional explanations to others during small group discussions (Van Blankenstein, Dolmans, Van der Vleuten, & Schmidt, 2011) and during tutoring (Cohen, Kulik, & Kulik, 1982) has been shown to aid learning. The finding that tutoring is not only effective in terms of the tutee's learning, but also in terms of the tutor's learning (Cohen et al., 1982), is interesting because tutors also prepare by studying learning materials with the intention of being able to explain those to others, and subsequently explain what they have learned to the tutee. The tutor learning effect not only applies when the knowledge and age gap between tutor and tutee is large (e.g., Juel, 1996; Sharpley, Irvine, & Sharpley, 1983), but also when that gap is small (e.g., Coleman, Brown, & Rivkin, 1997; McMaster, Fuchs, & Fuchs, 2006; Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003).

These findings suggest that acting as a peer model may also have beneficial effects on learning. However, peer tutors' learning gains may stem from other factors than an explanation study intention and actual explaining: peer tutors' learning may also be affected by the interaction with the tutee, who may ask questions that stimulate the peer tutor's reflective knowledge-building in the process of formulating an answer to those questions (Graesser, Person, & Magliano, 1995; Roscoe & Chi, 2007). Peer models in video modeling examples, on the other hand, are explaining to fictitious peers who are not physically present.

To the best of our knowledge, the only study that has investigated the effects of acting as a peer model by a) preparing and studying learning materials and b) explaining what was learned by creating a video-based modeling example, was conducted by Spires et al. (2012). As part of a collaborative learning course, secondary education students were asked to create a 5 min long video. The authors concluded, based on students' self-reports, that the video creation process fostered both motivation and learning. However, because of the lack of experimental control (e.g., no control group for study intention and actually explaining) and reliance on self-reports, no conclusions can be drawn from this study regarding the effects of study intention and video creation on learning and motivation.

1.2. The present study

The purpose of the current experiments was to investigate and disentangle the effects of acting as a peer model on learning and transfer and explore potential effects on self-efficacy and perceived competence. A study intention of being able to explain a task to others, and actually explaining that task during video creation, may not only affect learning and transfer, but also how peer models view and assess their own capabilities to perform that task. Again, it has been shown that observing models may enhance self-efficacy (Bandura, 1997; Schunk, 1987), but whether the process of *acting*

[1] Note that other authors have used the term 'instructional explanations' in a somewhat more restricted sense (e.g., Wittwer & Renkl, 2010).