Article

Journal of Educational Computing Research
2018, Vol. 56(7) 1056–1075

DOI: 10.1177/0735633117732961
journals.sagepub.com/home/jec
SAGE

Online and Classroom Simulations: Does Video Use Inspire Interest, Comprehensibility, or Achieve Learning Outcomes?

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Abstract

This study examined whether a video illustration of a complex phenomenon promoted learner interest, perceived comprehensibility, and better learning in online- and classroom-based contexts. In the first study, undergraduate participants ($N = 101$) viewed learning materials which contained a video only, a video and textual explanation, or a textual explanation alone. Participants rated the interestingness and comprehensibility of the instructional materials and completed a learning outcomes test. The second study ($N = 56$) included the same learning materials in a classroom context. The video presentation of the material did not improve learning outcomes, in either context. Participants in the computer-delivered context who only viewed the text learned the material better than those who had viewed the video. In the classroom-delivered context, the video neither helped nor hurt the learning outcomes, but it also did not significantly boost learners' interest. Taken together, findings from the present study indicate potential limited utility of including video material within these instructional contexts.

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Keywords
learning, media, cognitive, memory, comprehension, undergraduates

For over a century, psychologists have discussed the importance of curiosity and interest to the process of learning (James, 1899), but the effective inclusion of interesting details in multimedia instructional design has been challenging (Park, Moreno, Seufert, & Brünken, 2011). Despite these challenges, there are benefits to piquing student interest (Kang et al., 2009). Curiosity promotes approach toward novel information or stimuli, and behavioral and neuroscientific research indicates that it facilitates the learning process across the lifespan and increases the likelihood of knowledge acquisition and recall (Berlyne, 1954; Kang et al., 2009; Kidd & Haden, 2015; Litman, Hutchins, & Russon, 2005; McGillivray, Murayama, & Castel, 2015). Neurological research suggests that an individual's reported level of curiosity is associated with activation in memory processing areas of the brain, particularly when subjects have given the wrong answer in response to questions posed by the researchers. Behavioral research corroborates these findings; questions eliciting higher rates of curiosity were more likely to be answered correctly when asked a second time a week or two later, particularly if participants guessed incorrectly on the first test (Kang et al., 2009).

Findings from these research programs are increasingly suggesting that curiosity (or interest, a term often used to describe this construct) can be categorized as an emotional state; in this way, curiosity accounts for whether individuals *approach* new information with interest, as emotions largely account for our inclinations toward something or away from it (Haidt, 2006). Moreover, curiosity may influence the efficiency with which cognitive resources are deployed by helping learners focus their efforts on this new information (Kidd & Haden, 2015) or serving as a motivational tool that helps aid self-regulation toward a goal (O'Keefe & Linnenbrink-Garcia, 2014). One of the most important underlying perceptions that has been associated with the evocation of interest are appraisals of *comprehensibility* (Silvia, Henson, & Templin, 2009). In other words, when people perceive a stimulus to be new or novel, as well as potentially comprehensible with a reasonable amount of effort, they are more likely to be interested in the topic. Even infants prefer stimuli that are moderately discrepant from their existing level of knowledge, showing a preference to this kind of stimuli compared with stimuli that are either too simple or too complex. Researchers suggest that this preference helps them to be more efficient in managing the process of learning (Kidd & Haden, 2015). To further investigate the roles of interest and comprehensibility, researchers have manipulated participants' ability to comprehend a stimulus and have found participants' ratings of interest in the stimulus rise and fall in response. For example, researchers asked participants in two groups to read a complex poem (Silvia, 2005). As part of the protocol, the researchers manipulated participants' perceived ability to understand the poem by providing an experimental group with information about the general topic of the poem while withholding that information from a comparison group. Participants in this experimental group found the poem more interesting compared with participants in the other condition who had not been informed directly about the poem's meaning.

Research on the benefits of interest in learning text-based information is fairly robust (Schiefele & Krapp, 1996; Silvia, 2006). Examining the relationship between perceived interest and learning from text, Schraw, Bruning, and Svoboda (1995) measured readers' overall interest in the text with questions like, "I thought the story was very interesting, and I would read this story again if I had the chance" (p. 3); this 10-item measure of perceived interest in the text accounted for a significant portion of variability in recall. Additionally, they measured six possible sources of interest for the text, including "ease of comprehension, text cohesion, vividness, engagement, emotiveness, and prior knowledge" (p. 3). Of these six possible sources of interest, ease of comprehension and vividness emerged as the most important predictors, accounting for 45% of the variability in perceived interest. Subsequent analyses showed that, once perceived interest in the text had been controlled for statistically, only ease of comprehension accounted for a significant portion of recall beyond this overall interest in the material (Alexander & Jetton, 1996; Schraw et al., 1995).

It is perhaps for these reasons that educators have long worked to elicit interest about a topic in order to promote learning (James, 1899). Others, however, have advised caution when introducing stimulating details to boost interest in multimedia content unless they are inherently important, because unnecessary elements in instructional materials can often harm students' abilities to learn core content (Mayer, Griffith, Jurkowitz, & Rothman, 2008). Even in the early 1900s, John Dewey cautioned against the inclusion of "seductive details" as way of securing student attention (Dewey, 1913; Silvia, 2006). It is because this process of inducing interest, without distracting the learner with unnecessary details, is so delicate that research on the best ways to include multimedia content into instructional design is vital. Much of the research on technology-assisted learning has focused on cognitively driven factors that predict better learning. In particular, researchers have investigated the extent to which extraneous details (like unnecessary pictures or unrelated facts) undermine the learning process (Mayer, 2014a; Mayer et al., 2008). The reasons that these extraneous details harm learning is related to limitations in working memory, both in the number of items that can be processed at any moment and the length of time learners can hold new information in their working memory stores. This limited capacity for new information means that humans can only effectively manage a restricted amount of incoming information at any one moment (van Merriënboer & Sweller, 2005). In both print and multimedia learning materials, extra details lead learners to more quickly reach their cognitive load capacity, resulting in reduced learning (Harp & Mayer; 1998; Mayer, Heiser, & Lonn, 2001). Those instructional designs that effectively reduce levels of extraneous processing (cognitive processing activities which are not in line with the instructional goals) and better manage "essential" processing (features which help learners efficiently manage the cognitive processes that are associated with representing incoming information) help support the learning process (Mayer, 2008, 2014a).

Additionally, instructional materials which foster generative processing—cognitive processes by which a learner makes sense of the incoming information by organizing it effectively and integrating with previous knowledge—also should result in increased learning (Mayer, 2008, 2014a). This is important when designing multimedia instructional materials for coursework because there are, of course, individual differences in how much a person can effectively process. Experts tend to have better developed schemata, which allow them to effectively group new information into larger and more complex elements of information. As a result, this allows more experienced individuals to manipulate new information more efficiently (van Merriënboer & Sweller, 2005). These schemas are sets of organized information, and when individuals have developed more complex understanding of a phenomenon, the strains on working memory when learning new information are reduced, because it allows individuals to integrate complex information into a smaller number of units, freeing up the limited capacity of working memory to process new information (Sweller, van Merriënboer, & Paas, 1998). Because individuals with more experience have more developed schemata, the efforts to learn new information draw less heavily on the limited processing capacity of working memory. This interplay between an individual's level of expertise and how easily they learn new material puts novices at a relative disadvantage. In some cases, well-developed "advance" material can help novice learners better understand new material, allowing them to learn more than they would have otherwise learned because it helps learners build better "proto-schemata" (Gurlitt, Dummel, Schuster, & Nückles, 2012). Helping students to perceive incoming information as more comprehensible may be associated with better learning, as research from learning from text suggests (Schraw et al., 1995).

Although instructors have a great deal of access to visually engaging and comprehensible video content, there is still much to be learned about its appropriate use for instruction (Greenhow, Robelia, & Hughes, 2009). Despite the wide array of online resources available to instructors, comparatively little has focused on whether learner interest in video-based content containing related information promotes better learning outcomes. Mayer et al. (2001) did, however, examine the effects of video-based extraneous details included in instructional materials. Results indicated that in those protocols which included videos with content that provided interesting images, but without information that directly pertained to the learning goals of the lesson, students performed less well than those students who encountered the content with no supporting video illustrations. It is currently unclear, however, whether video content which includes details that are *directly* relevant to the overall information presented promotes interest and promotes a learners' perceptions of the comprehensibility of new material and the associated learning outcomes. Instructors sometimes present material in video format, and both students and instructors report an affection for this delivery (Chan et al., 2010; Cleveland, 2011), but it is not clear whether it also promotes perceived comprehensibility or increases interest.

The affection that students have for video itself may also contribute to better learning of the material. Increasingly, researchers are recognizing that emotional and motivational features are important factors to consider in developing multimedia materials that support learning, and they have begun to call for a deeper investigation into the role that these elements play in the proper design of technology-assisted learning (Leutner, 2014; Mayer, 2014b; Moreno, 2006; Moreno, Mayer, Spires, & Lester, 2001; Park, Flowerday, & Brünken, 2015; Park, Knörzer, Plass, & Brünken, 2015; Schneider, Nebel, & Rey, 2016; Um, Plass, Hayward, & Homer, 2012; Wang & Adesope, 2016). For example, Um et al. (2012) found that multimedia instructional materials that generated positive emotions improved comprehension of the learning material, and they also reduced the difficulty of learning the material, as perceived by the learners. Several studies have investigated the extent to which emotionally inducing features of multimedia design can facilitate learning. Taken together, several of these studies suggest that instructional materials that have visual appeal, are expressive, or evoke positive emotions are associated with better learning outcomes (Mayer & Estrella, 2014; Plass, Heidig, Hayward, Homer, & Um, 2014; Schneider et al., 2016; Um et al., 2012).

The current study, therefore, addresses three critical gaps in our understanding of the inclusion of relevant video in multimedia instructional materials. First, while research on multimedia learning is well established, particularly empirical research based in a memory and cognitive theoretical paradigm, more research on the affective components of learning in multimedia format is needed. Moreover, much of this research has focused on effective ways to include text, narrative, and static pictures in multimedia design, but less is known about more elaborate and multifaceted multimedia learning environments. Finally, much of the research has been conducted in laboratory conditions, and more research in authentic settings is necessary (Ayres, 2015). Examining whether the use of video in multimedia instructional materials sparks learners' interest, without overloading their cognitive resources and thus undermining learning, is important to our understanding of the best way to incorporate computer-based learning materials.

Present Study

Whether video content that includes a relevant illustration of the phenomenon, presented in an evocative and interesting manner along with the textual explication of the phenomenon, improves the comprehensibility of the material, promotes interest, and increases learning outcomes is currently unclear. The current study included two experiments to address these gaps. Through self-delivered, computer-based administration of the learning materials, Experiment 1 focused on whether the presence of video promoted appraised interest and comprehensibility. In addition, Experiment 1 assessed whether the video content, designed to provide an illustration of the described phenomena and introduced prior to the instructional materials, promoted better learning. We also considered whether the effects of such video content might be context dependent, and in Experiment 2, we examined the impact of the inclusion of video in a classroom-like situation in which instructors delivered the same material using a multimedia, computer-based, instructional format.

Experiment 1

Participants

One hundred and one participants were recruited from the undergraduate population at a residential, Northeastern college campus. Undergraduates were invited to participate through classroom announcements, posted ads, and invitations provided through other clubs and organizations. Participants were given a variety of incentives including extra credit in a course, candy, or entering into a drawing offering a $100 Visa prepaid gift card. Before observing the presentation, participants were provided with informed consent. The Institutional Review Board approved these procedures.

Materials

The materials consisted of three sets of computer-delivered slides. All three versions included a first slide that stated the title of the presentation, "Cuttlefish: Camouflaging Cephalopods." Those participants assigned to the Video + Text (VT) condition viewed a following slide that linked to a short (lasting 1 minute and 3 seconds) related video excerpt of a "Technology Entertainment Design" talk (https://www.youtube.com/watch?feature=player_embedded&v=PmDTtkZlMwM). The video showed underwater footage of a cephalopod camouflaging in the sea, and it was narrated by the individual originally presenting the talk. Subsequently, they were presented with nine content-rich slides without illustrating pictures or photographs that presented information on the process by which cephalopods enact this camouflage.

The video was determined to be ideal because it presented a visual illustration of a complex phenomenon of the camouflaging process of cephalopods without providing informational content. In this sense, it was anticipated that this visual illustration would help promote novice learners' interest in the material and enhance their perceptions of the comprehensibility of the complex process by which cephalopods enact their camouflaging abilities. This video stimulus included in the current study was also considered appropriate because the material on cephalopod camouflage is somewhat obscure and it was expected that most students would not have been introduced to this material through previous coursework or outside scholarship. The Text Only (TO) condition included all the same text-based description of the phenomenon without the video prompt. The Video Only (VO) version included only the video without any of the text-based explanation of the materials.

Measures

Three outcomes were measured through the course of the study.

Interestingness. Students' appraised interest was measured through the mean of three 7-point Likert-type scale questions adapted from previous studies. Two items were adapted from Silvia et al. (2009) and asked students to rate whether the presentation was *boring* versus *exciting* and *interesting* versus *uninteresting*. A third item was also added: *unengaging* versus *engaging*.

Comprehensibility. Appraised comprehensibility was also assessed using the mean of three 7-point Likert-type scale items including whether the topic was *hard-to-understand* versus *easy-to-understand*, *incomprehensible* versus *comprehensible*, and whether it was *incoherent* versus *coherent* (adapted from Silvia et al., 2009's measure).

Learning outcomes. To measure the extent to which the participants learned and retained the material presented, they completed a brief 10-item, multiple choice or true/false test of their understanding and recall developed using the content of the material administered in the presentation. Students answered true or false questions like, "Leucophores have no color but are able to reflect white light," and multiple-choice questions including, "What is the process by which cuttlefish camouflage their color to match their environment?"

Procedure

Participants were randomly assigned to one of three groups. The first of two groups (TO and VT) both included the text-based explanations of the material; the VT ($n = 42$) condition included the video prompt and the TO ($n = 41$)

condition did not. A third, smaller, control group did not include the text-based explanation, VO ($n = 18$), and participants in this group were shown the video without the subsequent explanatory material. Because the video was chosen based on its visual illustration of the phenomenon without any explanation of the underlying scientific processes, we anticipated that the effect sizes would be large enough to assign fewer participants to this control group, and it was included to allow for an assessment of individual interest in, and learning from, the video on its own. To control for the manner in which the material was presented, all participants viewed the presentation on a computer located in a small room on campus. Upon arriving in the computer lab, a researcher provided informed consent and explained to participants that they would be asked to watch a presentation and then be brought to a link where they would answer a series of questions. Participants were asked to follow all links, complete the questions, and press "submit" to record their responses. A researcher remained outside the door during the administration of the protocol.

Results for Experiment 1

Using Analyses of Variance, with condition as a between-subjects variable, we examined whether there were differences in the reported interestingness, comprehensibility, and learning outcomes between the three groups. As can be seen in the Table 1, those participants in the VO group rated the material as significantly more interesting and comprehensible than those in the VT or the TO groups; yet, this group performed significantly worse on the learning outcomes measure than participants in the other two groups. Participants in the VT and TO group did not differ in their ratings of the interestingness or comprehensibility of the material, but participants in the TO group scored higher on the learning outcomes measure than participants in the VT group. To investigate

Table 1. Means and Standard Deviations for Three Conditions of Experiment 1.

	Computer-delivered testing condition					
	Video only *M* (*SD*) $n = 18$	Text only *M* (*SD*) $n = 41$	Video and text *M* (*SD*) $n = 42$	$F(2, 98)$	η^2	Bonferroni contrasts
Interestingness	6.35 (.73)	5.20 (1.03)	4.89 (1.34)	10.73***	.18	VT < VO ***; TO < VO **
Comprehensibility	6.11 (.78)	5.11 (1.24)	5.21 (1.16)	5.26**	.10	TO < VO **; VT < VO*
Quiz	.38 (.12)	.77 (.14)	.65 (.23)	29.96***	.38	VO < TO; VT***; VT < TO**

Note: $N = 101$. Values for *F*, η^2, and Bonferroni Contrasts for group differences were given. VT = Video + Text; VO = Video Only; TO = Text Only.
*$p < .05$. **$p < .01$. ***$p < .001$.

whether the impact of video on learning differed for students who had been previously unexposed to the material, we conducted the analyses a second time, including only the 79 participants who reported that they had not learned the material before. The results in this analysis were similar to those for the complete sample of 101 participants, indicating that previous exposure did not alter the relationship between these variables.

Using only information from the 83 participants in the VT and TO groups (who were provided with the text-based explanation of the camouflaging process), we also investigated whether perceptions of interestingness and comprehensibility were related to one another or to the learning outcomes. As expected, perceptions of interestingness and comprehensibility were significantly correlated $r(81) = .72$, $p < .001$. Perceptions of comprehensibility and interestingness were not associated with learning outcomes.

Discussion for Experiment 1

The VO group rated the material significantly higher than participants in the other two conditions, indicating that it provoked interest, as intended. Additionally, the VO group performed significantly worse on the learning outcomes test, as anticipated, because the video was chosen for its lack of explanatory material. Strikingly, the video did not seem to increase the interestingness or the comprehensibility above the text-based presentation of the material. The video also failed to promote better learning. There are several possible reasons that the TO group performed better than the VT group. While the video in this study was intended to help learners quickly develop a better schema for the principles being communicated, the additional stimuli may have overloaded the cognitive capacity of the participants in the VT condition, without providing the anticipated additional scaffolding (van Merriënboer & Sweller, 2005).

Alternatively, it is possible that viewing the video on a computer evoked the wrong schema for learning (Harp & Mayer, 1998). Participants may have anticipated a more "lighthearted" event but were surprised by the difficulty of the material and failed to invest the necessary effort to learn the material (Salomon, 1984). It is also possible that these findings may be isolated to computer-based viewing experiences, and the effects of the video may be different when presented by a skilled professor within a classroom-style environment. Within the more serious classroom-based context, the video may be more likely to help students view the material as comprehensible and interesting, and learners may be more likely to gain a better understanding from the additional visual prompt.

Experiment 2

It was unclear whether participants in the VT condition might have benefited more from the video if it had been presented within the more serious context of a classroom by a skilled instructor. Because it is important to understand the connection between findings identified in laboratory conditions and those found in a classroom-like context (Richland, Linn, & Bjork, 2007), we conducted a second experiment using the same learning materials and measures in a situation that simulated classroom conditions with the computer-based materials projected onto a screen.

Participants

Participants for the second study were drawn from a similar population as Experiment 1; 56 undergraduates were recruited for the study. They were recruited through undergraduate courses and were offered extra credit as an incentive for participation. Prior to observing the presentation, participants were informed of the study details and provided with informed consent; these procedures were approved by the Institutional Review Board. Of these, 25 were randomly assigned to the TO condition and 31 were assigned to the VT condition.

Materials

The slides used in Experiment 2 were the same as in Experiment 1, except that the VO group was eliminated. Because this experiment was designed to approximate normal classroom conditions, we included only the two conditions regularly found in class-based work, VT and the TO. The materials were, otherwise, the same as those used in the computer-delivered experimental procedure. Information on cephalopods and the processes by which they camouflage to their environments were presented to all participants using computer-delivered materials projected onto a screen in a classroom. In the TO condition, the professor introduced the topic in the title slide and proceeded directly to the content of the material. In the VT condition, the instructor introduced the title slide, and then asked the participants to watch a short YouTube video delivered through an Internet connection, followed by the same text-based, content-rich slides.

Measures

Measures were the same as those used in the first experiment.

Procedure

Students participated in small groups in a regular classroom setting. After being given time to review the consent form and ask any relevant questions, they were presented with the content projected from a computer onto a classroom screen, by one of two professors who were blinded to the purpose and hypothesis of the study. Each professor presented the VT and the TO conditions to half of the participating groups; in both conditions, participants were informed they would be answering questions at the conclusion of the presentation.

To ensure that the groups were receiving similar information, the professor read the text, making certain to align closely to the content of each slide while still being engaging and maintaining eye contact. They did not elaborate beyond the material printed on the slide, nor did they refer back to the images included in the video. After the instructor presented the last slide, participants received a pencil and paper version of the measures.

Results for Experiment 2

Using Learning Condition as a between-subjects variable, we conducted analyses of variance to examine whether there were differences in the reported interestingness, comprehensibility, and learning outcomes between the TO and VT groups (see Table 2). Participants in the VT group rated the content as slightly, but not significantly, more interesting and comprehensible. The two groups also did not differ significantly in their learning outcome scores. In the post-experiment questionnaire, 46 participants reported never having learned the material. When analyses were conducted including only these 46 individuals, the findings were again similar to those including the entire sample. The groups did not differ in their perceptions of the instructional material or in their performance on the test of learning outcomes. Examining the correlations between the three measures for the original sample of 56 participants, we found that perceived interest and comprehensibility were, again, significantly associated with one another $r(54) = .31$, $p < .05$, but neither was significantly associated with learning outcomes.

Discussion for Experiment 2

The video neither helped nor harmed participants' interest in the topic or the extent to which they learned the content. Participants scored similarly in their

Table 2. Means and Standard Deviations for Two Conditions of Experiment 2.

	Classroom-delivered testing condition			
	Text only *M* (*SD*) $n = 25$	Video and text *M* (*SD*) $n = 31$	$F(1, 54)$	η^2
Interestingness	4.28 (1.26)	4.82 (1.22)	2.61	.05
Comprehensibility	5.17 (1.13)	5.43 (.89)	.91	.02
Quiz	.64 (.18)	.68 (.19)	.45	.01

Note. $N = 56$. Values for *F* and η^2 for group differences were given.

performance on the learning outcomes test. The two groups also did not differ in their rating of how interesting the material was or in their overall learning outcomes; participants in both groups rated the instructional materials as both comprehensible and interesting.

General Discussion

This study examined whether a video illustration of a complex phenomenon would promote more interest in the topic and help learners to better understand complicated material in both online and classroom-based contexts. In neither circumstance did the video promote better learning of the material. The video itself, however, was rated as interesting and comprehensible, particularly by participants who were not asked to invest deeper effort into learning the material. The group of participants who only viewed the video gave it very high marks on both interestingness and comprehensibility; both ratings were over 6 on a 7-point scale. Among participants asked to learn the material through expositional text, however, the video did not promote interest in the content above and beyond the nature of the written materials provided. Moreover, the video introduction of the material did not improve learning outcomes, in either the computer-delivered or classroom-based delivery of the curriculum. Indeed, participants in the computer-delivered condition who only viewed the text learned the material better than those who had viewed the additional video. In the classroom-delivered context, the video neither helped nor hurt the learning outcomes, but it also did not significantly boost interest or perceived comprehensibility of the content. While perceived interest and comprehensibility were significantly correlated with one another in both experiments, neither were significant predictors of learning outcomes. Taken together, findings from the present study indicate limited utility of including video material in instructional design as a way of promoting interest in complicated material.

There are several possible explanations for why participants in the computer-delivered context may have performed more poorly on the test of learning outcomes. These findings are consistent with cognitive load theory, which suggests that the extra video content may have taxed the student by increasing cognitive load (van Merriënboer & Sweller, 2005) or, paradoxically, because the increased interest in the material reduced students' efforts to learn the information presented (Clark & Feldon, 2014; Salomon, 1984). Cognitive load theory suggests that the capacity of individuals' working memory is bounded. When individuals expend cognitive resources processing unnecessary stimuli, their learning of relevant information deteriorates (Clark & Feldon; 2014; Mayer, 2008, 2014a; van Merriënboer & Sweller, 2005). While the video provided in the current study was intended to help learners quickly develop a *better* schema for the principles being communicated, perhaps the additional stimuli evoked the unintended consequence of overloading the cognitive capacity of the participants in the

VT condition without providing the anticipated additional scaffolding. Research examining the insertion of high- versus low-interest seductive details in science-related materials suggests that more interesting details inserted in slide- or paper-based learning materials decreases cognitive processing and disrupts learners' abilities to build a deep understanding of the material (Mayer et al., 2008).

Findings are also consistent with previous research on the association between student interest and learning outcomes which suggest that learners perceive video-based instructional materials as requiring fewer resources and consequently reduce their efforts to learn the material (Clark & Feldon, 2014; Salomon, 1984). In other words, perceptions of video-based media may have an impact on the extent to which learners invested effort into processing new information (Salomon, 1984). Because the computer-based VT condition began with the video presentation of the phenomena, learners may have perceived lower demand characteristics of the presentation, and consequently, they may have invested less effort into processing the new information. This explanation is supported by the findings from Experiment 2 in which the content was delivered in circumstances simulating regular classroom-based delivery. The two groups of students in this experiment performed similarly, perhaps because the classroom-based delivery of the material by a full-time faculty member properly prompted a similar degree of required effort.

Limitations and Future Directions

Whether and how to integrate video into instruction materials is complicated and requires further investigation. Research by Sitzmann and Johnson (2014) highlights the complex relationship between the inclusion of extraneous details into training material and students' attitudes and performance in long-term courses. They employed a within-persons design to examine the effects of including seductive details in the form of cartoons in a series of online training modules to examine their effects on student performance over time. These extra details had the positive impact of reducing negative affect during the training but also, unfortunately, decreasing the amount of time learners spent with the material. In the current study, the amount of time spent in instruction in the classroom context was controlled and therefore similar across the video and non-video conditions, but we did not include a measure of the amount of effort learners invested in understanding the content. It is also possible that the effects of the video could have differed according to individual perceptions of the relevancy of the material to personal goals (Eccles & Wigfield, 2002), and future studies should evaluate the influence of these kinds of individual differences.

Future research should examine whether and how video content can effectively be used to promote sustained effort that learners invest in processing information. These investigations should examine those video manipulations of content and presentation that promote deeper processing of material and those which disrupt the learning process. When individualized learning is possible, as it was in the computer-delivered experiment, providing students with control over the delivery and repetition of the video may increase their ability to learn from it (Schwan & Riempp, 2004). The current study did not encourage learners to replay the video to help build a stronger understanding of the material, and future studies should include that in the design. When individualized instruction is not an available option, requiring students to generate their own content-related questions or complete a brief quiz of the material at the conclusion of the video may also increase learning outcomes (Mercier, Orlando, Stroud, Shaw, & Hardway, 2013). Future research should examine whether well-designed, advance organizers that require learners to engage in this generative processing allow them to extrapolate useful information from the video and build a more coherent proto-schemata of content (Gurlitt et al., 2012).

Sitzmann and Johnson (2014) also found that additional details decreased the negative affect associated with online training, and in the current study, we did not assess students' affective states during instruction, but there are likely important differences in the way that individual characteristics influence the process of learning (Ayres, 2015; Paas & Ayres, 2014). Student's emotional attitude toward learning, in particular, is not inconsequential. Learner's ratings of positive and negative affect about studying are important predictors of their overall performance in their courses and therefore should be considered when designing curriculum (as either targets of the intervention or appropriate warning signals) when developing interventions designed to improve student performance (Rogaten, Moneta, & Spada, 2013). The effects of video could be different within the context of a regular classroom instruction, and the occasional video may increase positive affect for the overall course. Indeed, students report fondness for video-based learning materials (Cleveland, 2011).

The similarity of interest ratings and learning outcomes between students who observed the videos and those who did not in the current study may suggest that including such content in a live classroom situation may not undermine students learning, even in the short term. It is possible that within the context of a semester-long course, the video might be used effectively to cue and prompt students' deeper understanding through continued referencing of this visually striking material. An experienced educator may provide this necessary cuing to focus students' attention on relevant details, and there is a substantial body of research which suggests that "cueing" provides benefits in text and multimedia learning (de Koning, Tabbers, Rikers, & Paas, 2007). Even when the cues may not have an immediate impact, it is possible that continued reference across several instances during the course may promote a deeper understanding. We did not assess recollection over a longer period of time, and it is possible that the visually striking details of the video might have facilitated better long-term recall for participants who had viewed the video compared with those who had only seen the text. Future studies should include a second assessment of recall in their study designs after a delay of several days or weeks. We also did not include a test assessing how well the learners were able to transfer the content to a related domain, and future research on this topic should incorporate this learning outcome as well.

Conclusions

Despite the limitations of this research, there are several contributions it makes to the growing field of cognition, motivation, and instructional design. Although a substantial amount of research has identified benefits of individual interest in text-based learning (Silvia, 2006), little has been focused on other mediums of communication and their impact on reported interest and subsequent learning outcomes. Based on these findings, more research needs to be completed regarding the best way for instructors to integrate video content effectively in their learning materials. These findings suggest that, even when the visual content of the video is chosen to specifically enhance a student's ability to comprehend incoming information, the cognitive processing required for this material may mean that this video illustration has, at best, no impact or, at worst, degrades the overall learning that occurs. Moreover, video itself does not necessarily boost overall perceived interest in the content of the instruction, even when it has been rated as quite interesting by others who are not asked to engage in deeper learning of the material.

The current study heeds the call to examine the connection between investigations in the laboratory and those which better approximate learning in the classroom. Recent reviews of literature on cognition and instruction suggest that research should bridge the gap between laboratory-based studies and those within classroom-like conditions. These reviews suggest that to truly understand the process of learning, a valuable rapprochement between laboratory-based and classroom-based research must be enacted (Richland et al., 2007). The current study represents a step forward in the process of bridging the described laboratory-based findings with research enacted in a classroom setting. In this study, the same video was presented in classroom-like conditions by an experienced educator as well as delivered through self-directed computer review. The video had a different impact on student learning in these two contexts and these differences provide fertile ground for future research into promoting the efforts that students invest in learning.

Acknowledgments

The authors thank Matthew Aboukhalil, John Doherty, Adriana Estevez, and Desirae Messina for their invaluable work on this project.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by a Ciejek Summer Fellowship and Merrimack College.

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