Do Visual Aids Really Matter? A Comparison of Student Evaluations Before and After Embedding Visuals Into Video Lectures

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ABSTRACT

Educational webcasts or video lectures as a teaching tool and a form of visual aid have become widely used with the rising prevalence of online and blended courses and with the increase of web-based video materials. Thus, research pertaining to factors enhancing the effectiveness of video lectures, such as number of visual aids, is critical. This study compared student evaluations before and after embedding additional visual aids throughout video lectures in an online course. Slide transitions occurred on average every 40 seconds for the pre-treatment group with approximately 600 visuals total, compared to slide transitions every 10 seconds for the post-treatment group with approximately 2,000 visuals total. All students received the same audio recordings. Research questions addressed are: (1) Are student perceptions of the effectiveness of examples used to illustrate concepts affected by number of visual aids? (2) Is the extent to which students feel engaged during the lectures affected by number of visual aids? (3) Are students' perceived overall learning experiences affected by number of visual aids? Surprisingly, results indicate that for questions #1 and #3, student ratings of those who viewed videos with *fewer* visuals rated their experiences *higher* than students who viewed more visuals. There was no significant difference found for question #2. Conclusion: Although some visuals have been shown to enhance learning, too many visuals may be a deterrent to learning.

Keywords: video lecture, instructional video, visual aids, e-learning, student evaluations

INTRODUCTION

Educational technology, specifically in the area of visual aids, has dramatically enhanced teaching and learning. For decades, visuals have typically included illustrations, photographs, videotapes, slides, movies, diagrams, and animations and have been used to supplement text-based information. These types of visuals have generally resulted in increased recall of text information (Issing, 1990; Levie & Lentz, 1982; Pressley, 1977; Rusted & Coltheart, 1979; Schallert, 1980; Stone & Glock, 1981; Brigman, Cherry, Reese, & Dokey, 2003; Carney & Levin, 2002).

Educational webcasts and video lectures as a teaching tool and a form of visual aid have become widely used with the rising prevalence of online and blended courses and with the increase of web-based video materials. Thus, research pertaining to factors that enhance the effectiveness of video lectures is critical. Furthermore, much of the literature regarding video usage in higher education shows that videos have been largely used to *supplement* materials in face-to-face classes or used in teacher training programs (Krammer, et.al, 2006). The significance of this research study is based on the fact that the following factors have yet to be explored: (1) The educational effectiveness of videos used as an autonomous method of disseminating information as opposed to a supplemental method; (2) The impact of the number of visual aids within a video as opposed to the type of visual aids; And 3) The effectiveness of videos within the field of stress management.

LITERATURE REVIEW

A plethora of research indicates a variety of visual aids enhance learning in a variety of disciplines and in a variety of ways. Kim and Gilman (2008) investigated the use of visual text, spoken text, and graphics in a web-based self-instruction program to increase learners' English

vocabulary at a middle school in Seoul, South Korea. A total of 172 middle school students in five classes participated in the study. The effects of six methods of instruction were evaluated: visual text (Group A), visual text and added spoken text (Group B), visual text, and added graphics (Group C), visual text, added graphics, and added spoken text (Group D), reduced visual text and added spoken text (Group E), and reduced visual text, added graphics, and added spoken text (Group F). Each student completed testing instruments such as a pretest, posttest, retention test, and attitude inventory. Results revealed students in Groups C and D learned better. In other words, learning was enhanced when students received instruction via (1) visual text and added graphics and (2) visual text, added spoken text, and added graphics. The researchers concluded that an effective way to improve learning of English vocabulary is to offer graphics illustrating the meaning of the vocabulary.

In addition to language acquisition, the field of marketing may be another discipline in which visuals enhance learning. Clarke, Flaherty,and Yankey (2006) investigated the use of visual summaries as an instructional technique for visual learners. Visual summaries are diagrams summarizing linkages between material and topics based on organizing information via hierarchies and categories. The sample consisted of students enrolled in one of two concurrent principles of marketing courses. Traditional teaching materials of a textbook, class handouts, lectures, and PowerPoint presentations of the lectures were provided in one section to 34 students. Visual summaries to supplement topic discussions in addition to the aforementioned teaching materials were provided in the other section, which consisted of 35 students. Both sections had the same instructor, covered identical content, and used the same course materials and exams. Findings reveal students in the visual summaries class performed better on all three exams and significantly higher on the cumulative final exam, were more satisfied with their

professor, rated the value of the course significantly higher, and reported significantly higher levels of subject mastery for 13 of the 16 marketing topics.

Science is another field in which visuals, specifically diagrams, have been shown to enhance learning. Cromley, Perez, Fitzhugh, Newcombe, and Wills (2013) examined whether students can be taught to better understand conventional representations in diagrams, photographs, and other visual images in science textbooks. The authors developed a teacher-delivered, workbook and discussion-based classroom instructional method called Conventions of Diagrams (COD). The researchers trained one experienced teacher to deliver COD to 31 tenth-grade biology students and compared gains in diagram comprehension from COD to those from a control group of 30 students taught by the same teacher. Students in the COD group showed statistically significantly greater growth in comprehension of literal and inferential biology diagrams.

Both knowledge and behaviors pertaining to chemical safety practices appear to be enhanced with the use of visual aids as well. Saleh (2011) investigated the effectiveness of chemical safety-related visual aids to enhance learning. A total of 172 undergraduate students enrolled in a general chemistry laboratory class participated in the study: 89 in the experimental group and 83 in the control group. Both sets of students received the same safety materials except students in the experimental group were also given visual aids such as safety-related video presentations and photographs. Since visual aids were used in the experimental group, the time spent on providing theoretical explanations was less than the time spent with students in the control groups. A comparison of post-exam responses showed students who were provided visual aids achieved significantly higher scores than those who were not provided visual aids. Additionally, safe work practices in the laboratory were observed and evaluated with a standard checklist. Students provided with visual aids were observed exercising safe work practices more

often than those who were not provided with visual aids. Also, although subjective in nature, the authors observed that students in the experimental group asked more and deeper safety-related questions than students in the control group.

Mayer, Bove, Bryman, Mars, and Tapangco (1996) examined the effects of using a multimedia summary, which is a sequence of annotated illustrations depicting the steps in a process, in explaining a scientific process. In a series of three experiments, students who read a summary containing a sequence of short captions with simple illustrations depicting the main steps in the process of lightning recalled these steps and solved transfer problems as well as or better than students who received the full text along with the summary or the full text alone. In Experiment 2, taking away the illustrations or the captions eliminated the effectiveness of the summary. In Experiment 3, adding text to the summary actually reduced its effectiveness. These results suggest a verbal summary is not as effective as a multimedia summary combining both visual and verbal formats and that a multimedia summary is more effective when it contains a small amount of text rather than a large amount.

So visual aids in general have been shown to enhance learning in a variety of disciplines. Assessing types of visuals, however, may be significant in determining quality of learning. Dwyer (2015) explored the effectiveness of three types of visual illustrations used to complement oral tutoring in an English class. A total of 108 students were randomly assigned to one of four groups. Students in Group 1 (n=30) received oral symbols throughout the entire presentation from a tape recorder with no visual illustrations. Students in Groups II (n=27), III (n=26), and IV (n=25) received the same oral instructions as students in Group I. However, Group II received abstract linear visual illustrations depicting form and relative locations of parts of the heart, Group III viewed detailed drawings representing parts of the heart, and Group IV viewed realistic photographs of the part of the heart being descripted orally. Their achievement

was evaluated in terms of total criterion test scores and in terms of four individual criterion tests designed to measure specific educational objectives. Results indicate all visual illustrations are not equally effective. Surprisingly, the abstract linear presentation proved to be the most effective medium used in complementing oral instruction with the shaded drawing presentation being second. Nevertheless, students who received visual illustrations performed better than those who did not receive any visual illustrations.

In addition to still images, animated clips may enhance learning and understanding. Specifically animated clips may help increase and maintain students' attention and motivation (Gurvitch & Lund, 2014). Similarly, videos have become increasingly popular and have been shown to enhance learning. Video is a rich and powerful medium especially in e-learning because information can be presented in an attractive and appealing manner. Studies have investigated the effect of instructional video on learning outcomes.

Lents and Cifuentes (2009) examined web-based lecture delivery into a majors-level introductory biology course. Prerecorded Voice-Over PowerPoint video lectures were introduced on a limited basis to an experimental section while a control group, with the same instructor, received standard in-class lectures. Select lectures were delivered to the experimental section via videos, replacing in-class attendance of live lectures. A detailed analysis revealed the video lectures prepared students for exams as effectively as live in-class lectures. This finding indicates students can learn complicated biology course material through prerecorded, web-delivered lectures much as they do through in-class attendance of those same lectures. The researchers suggest that although further careful study is needed, these results warrant further experimentation in web-based teaching methods in the sciences. Additionally, Hahn (2012) demonstrated that an information literacy course was enhanced through the use of video lectures

to deliver course content. Students' feedback indicated a majority of them used the video lectures, at least partly, and found them helpful.

He, Swenson, and Lents (2012) examined the incorporation of video tutorials as a supplement to learning in an undergraduate analytical chemistry course. The concepts and problems in which students faced were first identified by assessing students' homework assignments and exam responses. Then, a tutorial video clip aimed at that specific knowledge point was uploaded to the course Web site portal. To assess the effectiveness of the tutorials, students' oral and written feedback, pre- and post-video-tutoring exam performance, and data from previous classes taught by the same instructor were examined. Results indicate online video tutorials are a valuable, flexible, and cost-effective tool to improve student mastery of chemistry problem solving.

Wieling and Hofman (2010) examined the extent to which a blended learning configuration of face-to-face lectures, online on-demand video recordings of the face-to-face lectures and the offering of online quizzes with appropriate feedback have a positive impact on student performance compared to the traditional face-to-face course approach. A total of 474 students (161 men and 313 women) enrolled in a European Law course participated. Results indicate the number of online lectures they viewed, along with several other factors such as grade point average, was a significant predictor of students' final grade in the course. Students who attended few lectures had more benefit from viewing online lectures than students who attended many lectures. The researchers suggest offering recordings of face-to-face lectures is an easy extension of a traditional course and is of practical importance because it enables students who are often absent from the regular face-to-face lectures to be able to improve their course grade by viewing the lectures online.

Merkt, Weigand, Heier, and Schwan (2011) compared the usage patterns and the effectiveness of interactive videos and illustrated textbooks when German secondary school students learned complex content. For this purpose, two videos affording different degrees of interactivity and a content-equivalent illustrated textbook were used. Two complementary studies, one in the laboratory and one in the field, were conducted. Results of both studies showed in contrast to previous studies working with non-interactive videos, the effectiveness of interactive videos was at least comparable to print, probably due to the possibilities provided for self-regulated information processing. The interactive features of the videos were used spontaneously. However, features enabling micro-level activities, such as stopping the video or browsing, seemed to be more beneficial for learning than features enabling macro-level activities, such as referring to a table of contents or an index. So type of visual, such as an interactive video and the type of interaction of the video may determine its effectiveness in terms of learning outcomes.

Zhang, Zhou, Briggs, and Nunamaker (2006) also examined the influence of interactive video on learning outcome and learner satisfaction in e-learning environments. Four different settings were examined: three were with interactive video, one with non-interactive video, and one without video all within an e-learning environment. The fourth was the traditional classroom environment. Results showed the value of video for learning effectiveness was contingent upon the provision of interactivity. Students in the e-learning environment that provided interactive video achieved significantly better learning performance and a higher level of learner satisfaction than those in other settings. The findings suggest it may be important to integrate interactive instructional video into an e-learning environment.

So video lectures appear to enhance learning in many cases. However, results are somewhat mixed. Jordan and Sanchez (1994) examined whether the use of short video clips in

the classroom enhanced students' ability to learn and retain basic concepts in an introductory American government course. A total of 117 freshmen undergraduate students were placed into either a treatment or video section or a traditional or control section. In the video sections, many of the concepts in the course were presented through video clips. In the traditional sections, traditional methods of classroom instruction were used, specifically lectures and discussions. Results revealed students in the video sections on average scored 9.3 percentage points higher on the first exam than the students in the traditional sections with a significance level of 99.8%. However, no significant differences were found on the second exam and final exam. Also, no significant differences were found among the groups on graded written work. The researchers conclude video augmentation may not be helpful in enhancing student understanding in this case.

Webcasting, in which live or recorded videos are used, refers to streaming audio or video broadcasts over the Internet and has been shown to be an effective educational tool. Traphagan, Kucsera, and Kishi (2010) investigated the impact of lecture webcasts on students' attendance and learning. One section had access to webcasts and one section did not. Results indicate the availability of webcasts negatively impacted student attendance but webcast access appeared to nullify the negative effects absenteeism had on student performance. And more webcast viewing was associated with higher performance for performance measures based on lecture content. Also, most students in the webcast section reported positive learning experiences from using webcasts.

However, results pertaining to the effectiveness of webcasts are somewhat mixed. Giannakos and Vlamos (2013) compared traditional learning with educational webcasts. A total of 66 middle school students were placed in two groups based on a pretest. Results showed the effectiveness of the webcasts appeared to be particularly high when applied to tasks requiring simple comprehension. Conversely, the effectiveness of the webcast appeared to be poor in the

consolidation of complex tasks. In simple comprehension tasks, webcasts seem to have much better performance compared with traditional learning. In tasks where a greater degree of comprehension is required, webcast and traditional learning seem to have the same performance. With complex tasks requiring additional comprehension and a great degree of consolidation, webcasts had very low performance and few of the students coped with the complex task. In other words, knowledge that has to be comprehended and consolidated and used in combination with other knowledge for solving complex tasks, webcasts may not be recommended because its performance in this area appears to be very poor. So similar to still images and animated clips, the effectiveness of webcasts may also be determined in part on the type of material and type of learning objectives.

Similar to webcasts, podcasts appear to be an effective teaching tool. Unlike webcasts, podcasts do not involve live streaming of media. So a podcast is a non-streaming webcast that has taken the name of Podcast because of the popularity of the iPod. Podcasting involves downloading a series of audio or video broadcasts onto a digital media player, which then can then be watched or listened to when, where and as often as students choose. Regardless of podcast or webcast format, videos are typically used. Schreiber, Fukuta, and Gordon (2010) examined undergraduates' experiences, information recall, and preference for video lectures versus face-to-face live lectures. Results indicate traditional teaching methods are still the preferred method of learning, however the video lectures provide convenience to review at their leisure and to be able to stop and review as needed. The researchers indicated video lectures do have value in learning, however they feel video learning or podcasts are less engaging than face-to-face lectures. Thus, the question arises as to potential factors, such as number of visual aids, that increase student engagement with video lectures.

Evans (2007) evaluated the effectiveness of podcasting as well. A separate group of just under 200 first-level students were given a series of revision podcasts after completing a course in Information and Communications Technology. As part of the subscription process, they were required to complete an online survey about their experience. The survey utilized a five-point Likert scale comparing their attitudes to lectures, podcasts, notes, textbooks and multimedia e-learning systems. Results indicate students believe podcasts are more effective revision tools than their textbooks and they are more efficient than their own notes in helping them to learn. They also indicated they are more receptive to the learning material in the form of a podcast than a traditional lecture or textbook. The study suggests the use of podcasts as a revision tool has clear benefits as perceived by undergraduate students in terms of the time they take to revise and how much they feel they can learn. The researcher suggests that coupled with the advantages of flexibility in when, where and how it is used, podcasting appears to have significant potential as an innovative learning tool.

Conversely, Dupagne, Millette, and Grinfeder (2009) examined whether the use of video podcasts as a revision tool would improve test scores of undergraduate students enrolled in an introductory communication theory course. Twelve podcasts were created from videos presented in class and made available online to students for optional viewing prior to completion of three tests. Results indicated students who viewed the podcasts did not score higher on the test questions related to the videos than their non-viewing classmates. So the results regarding podcasting, which again involves students watching videos, are mixed.

A growing amount of evidence of the impact of visuals aids, including videos, webcasts, and podcasts as evidenced by the aforementioned studies, indicates a variety of visuals are generally effective and enhance learning and student satisfaction. Relative to current literature, the importance of this study is: (1) Despite much of the research indicating that visuals are

effective, the results are mixed. Additional research is needed in order to shed light on possible reasons for these mixed results. Disciplines, learning objectives, number of visuals, and types of visuals may influence the effectiveness of visual aids as a teaching tool. (2) Research regarding function and effectiveness of visual aids within the unique field of stress management is currently non-existent. (3) Much of the literature involves assessing impact of visuals on academic performance (grades, scores, total points, etc.). In a stress management course, students' psychosomatic ability to achieve a relaxed state may be considered to be just as important, if not more important than scores on traditional cognitive measures such as exams. In other words, learning to affect physiology is very different than learning typical cognitive tasks. Research is needed in order to better understand the influence of visuals on this type of learning. (4) Additional research is needed to document the effect of videos as an autonomous primary source of instruction, as opposed to a supplemental source. The primary purpose of this study was to compare student evaluations before and after embedding visuals throughout video lectures in a fully online course.

METHODS

Research Questions

This study was designed to answer the following research questions: (1) Are student perceptions of the effectiveness of examples used to illustrate concepts affected by number of visual aids? (2) Is the extent to which students feel engaged during the lectures affected by number of visual aids? (3) Are students' overall learning experiences affected by number of visual aids?

Participants

Participants included undergraduate students enrolled in an online, upper division stress management course. This course fulfills a general education requirement at a large, public west

coast university in the United States. The university is on a quarter system, which involves 10 weeks of instruction and one week during which final exams are given. Students from all majors across campus typically enroll in this course. No demographic information was available because the data consisted of responses from student evaluations, which do not include questions pertaining to demographic information. The total number of students who were invited to complete the survey for the pre-treatment group was 1,260 and the total number for the post treatment group was 1,125. However, as is often the case with online courses, the response rate for completing student evaluations is relatively low. The participant sample for the pre-condition group consisted of 257 students who were enrolled during Fall, Winter, or Spring quarters of the 2013/14 academic year, and the participant sample for the post-condition group was 404 enrolled during Fall, Winter, and Spring of 2014/15 academic year.

Procedure

This study compared pre and post outcome data obtained from student evaluations. The pre-group consisted of students enrolled in one of 20 online sections of *Stress Management for Healthy Living* during the academic year 2013-14, and the post-group consisted of students enrolled in the same course during the following academic year 2014-15. Students in both the pre and post-treatment groups listened to 27 audio/visual recordings of lectures and 20 audio recordings of relaxation techniques throughout the quarter. All students received the same audio for both the lectures and relaxation techniques. The format of the lectures for both groups consisted of (1) an introductory quote, an anticipatory set or "attention-getter" (i.e. question, cartoon strip, images, etc.), and key points at the end of the lecture or a synopsis of the material covered in that particular lecture. Students in both groups completed the same assignments. The only difference between the groups was the number of slides and images in the video lectures. Students in the pre-group were provided with just over 600 slides (611), and students in the post

group were provided with just under 2,000 slides (1,993). Transitions occurred roughly every 40 seconds for the pre-treatment group and roughly every 10 seconds for the post-treatment group.

Instrumentation

At the end of each quarter, data was collected via an online survey consisting of items on the student evaluation form used by the department in which the course was offered. Approval from the campus Institutional Research Board (IRB) committee was unnecessary because the data was comprised of responses from the university approved instructional assessment form (i.e. student evaluation form), which are completely anonymous and are collected and tabulated by the university, not the instructors. The items on the student evaluation form are approved at the department, college, and university levels and include a 1 to 5 Likert rating (1=Very Good; 2=Good; 3=Satisfactory; 4=Poor; 5=Very Poor). The following items are included on the student evaluation form:

1. Rate the effectiveness of the examples used to illustrate points provided in the lectures.
2. Rate how clear the course requirements were communicated.
3. Rate how well the instructor kept you engaged during the lectures.
4. Rate how helpful instructor feedback was on assignments, quizzes, or exams.
5. Rate your overall learning experience from this course.

It was anticipated the items that would be affected by visual aids were #1: Rate the effectiveness of examples used to illustrate points, #3: How well did the instructor keep you engaged during the lectures, and #5: Rate your overall learning experience.

Data Analysis

In order to test the research questions, a comparison of differences in pre and post ratings was mainly done with Chi Square test. In addition, as the categories of the variable have a clear

ordering, M-Square test was examined along with Chi-Square test. For ordinal categorical variables, M-square test assigns proportional weights to each category. In our analysis, the weights of 3, 2 and 1 were assigned to (Very Good and Good). Satisfactory, and Poor and Very Poor, respectively.

RESULTS

Research Question #1 ascertained if differences exist in student ratings of the effectiveness of the examples used to illustrate concepts provided in the lectures. Results indicate there was a significant difference in pre and post ratings. Students in the pre-group rated the effectiveness of examples significantly higher than the post group. Thus, the findings suggest affirmative response for Research Question #1, differences exist among students' ratings of the effectiveness of examples used to illustrate points. Students who received *fewer* visuals rated effectiveness of examples significantly *higher* than students who received more visuals (refer to Table 1 below).

Table 1
Effectiveness of Examples

	Very Good & Good	Satisfactory	Poor & Very Poor
Pre-Treatment	257 (92.11%)	20 (7.17%)	2 (o.72%)
Post-Treatment	404 (87.26%)	40 (8.64%)	19 (4.10%)
Chi-square	p-value=0.0185		
M-square	p-value=0.0094		

Research Question #2 determined if differences exist in student ratings of the extent to which the video lectures were engaging. Results reveal there was no significant difference in pre and post ratings. Students in the pre-group rated the lectures to be just as engaging as students in the post-group. Thus, the findings do not support an affirmative response for Research Question #2, no differences exist among student ratings of the extent to which the video lectures were engaging (refer to Table 2 below).

Table 2 *Engaging Lectures*			
	Very Good & Good	Satisfactory	Poor & Very Poor
Pre-Treatment	228 (81.72%)	32 (11.47%)	19 (6.81%)
Post-Treatment	333 (78.72%)	61 (14.42%)	29 (6.86%)
Chi-square	p-value=0.5234		
M-square	p-value=0.4948		

Research Question #3 questioned if differences exist in student ratings of their overall learning experience with the class. Results indicate there was a significant difference in pre and post ratings. Students in the pre group rated their overall learning experience significantly higher than the post group. Thus, the findings suggest an affirmative response for Research Question #3, students who received *fewer* visuals rated their overall learning experience significantly *higher* than students who received more visuals (refer to Table 3 below).

Table 3 *Overall Experience*			
	Very Good & Good	Satisfactory	Poor & Very Poor
Pre-Treatment	244 (86.52%)	30 (10.64%)	8 (2.84%)
Post-Treatment	377 (82.14%)	44 (9.59%)	38 (8.28%)
Chi-square	p-value=0.0115		
M-square	p-value < 0.0001		

The following two questions from the student evaluation form were not included in the research questions because of their questionable connection to visual aids: “Rate how clear the course requirements were communicated” and “rate how helpful instructor feedback was on assignments, quizzes, or exams.” However, data analysis was completed for these two items. Results indicate there was a significant difference in pre and post ratings for both items. Students who received fewer visuals rated the clarity of course requirements and the helpfulness of

instructor feedback significantly higher than students who received more visuals (refer to Tables 4 and 5 below).

Table 4
Clear Course Requirements

	Very Good & Good	Satisfactory	Poor & Very Poor
Pre-Treatment	266 (94.33%)	12 (4.26%)	4 (1.42%)
Post-Treatment	363 (80.31%)	54 (11.95%)	35 (7.74%)
Chi-square	p-value < 0.0001		
M-square	p-value < 0.0001		

Table 5
Instructor Feedback

	Very Good & Good	Satisfactory	Poor & Very Poor
Pre-Treatment	231 (82.21%)	35 (12.46%)	15 (5.34%)
Post-Treatment	320 (72.56%)	74 (18.78%)	47 (10.66%)
Chi-square	p-value=0.0072		
M-square	p-value=0.0017		

DISCUSSION

It was anticipated that students who viewed videos with more visuals would provide higher ratings on the three items pertaining to the research questions compared to students who viewed videos with fewer visuals. The researchers are perplexed that the significant difference found on two of the three items indicate the opposite – students who viewed fewer visuals rated their experiences higher than those who viewed more visuals. In other words, a higher number of visuals appeared to negatively affect students' perceptions of the effectiveness of examples used to illustrate points as well as their perceptions of their overall learning experience.

Of the three items, the one the researchers anticipated would definitely be positively correlated with number of visuals pertained to the extent to which the videos were engaging. However, no significant difference was found. In other words, number of visuals did not affect

students' perceptions as to the extent to which the videos were engaging. These results point to the notion there may be "too much of a good thing" in this case.

It should be noted that results of this study are consistent with results of research conducted by Cronin and Myers (1997) who investigated the pedagogical effects of visuals versus no visuals in interactive multimedia instruction (IMI). Two versions of an IMI program were presented to 140 students randomly assigned to two treatment groups. Results indicated no significant difference on cognitive test scores or listening test gain scores for students using IMI with visuals versus IMI with no visuals. These findings, as well as the findings of the current study, suggest further investigation is necessary in order to shed light on why visuals are effective in some cases but may not be effective in other situations.

Regarding the two questions on the student evaluation pertaining to how clear the course requirements were communicated and helpfulness of instructor feedback, it was anticipated there would be no significant difference among the two groups because these items don't pertain to the video lectures. As such, they were not included in the official research questions. It is unclear as to why students who received fewer visuals rated the clarity of course requirements and the helpfulness of instructor feedback significantly higher than students who received more visuals. However, that these two items were also found to be significant is indicative that students enrolled in one particular quarter (Winter 2014) may have been disgruntled because of a significant event that occurred which may have affected students' overall experience with the course.

A significant percentage of students enrolled during this quarter failed to submit an important assignment by the deadline. This assignment comprised half the total points in the course. Students were allowed to submit this assignment up to three days after the due date. Points were deducted for every 24-hour period that they submitted late. Those who missed the

deadline failed the course or received a poor grade (e.g. D-). Only one or two students each quarter at most typically fail to submit their assignment by the end of the grace period. One possible explanation for the dramatic increase in this number is the reminder message posted on Blackboard did not get emailed to the students. So students would have had to log into Blackboard in order to see the reminder message. During the other quarters, the appropriate box was checked, which enabled the announcements to be emailed. Students who failed to submit their assignments were disgruntled, which may have affected their responses on the student evaluation form. Additional analysis after removing this particular quarter would shed light on this issue.

Another possible reason that might explain the results is a limitation with the study design. Because student evaluations were used, it was necessary to use two different groups of students for the pre and post conditions. One group of students was used for the pre condition and a different group was used for the post condition. So students exposed to videos containing fewer visuals were never exposed to the video with more visuals and vice versa. If the study were repeated, results may be different if the same cohort of students were used for both the pre and post conditions. That is, results may be different if the same group of students viewed videos with few visuals for the first half of the quarter and then videos with more visuals the second half of the quarter. Using the same sample for pre and post groups is recommended should this study be repeated. Exposing the same group of students to both types of videos (one with few visuals and one with several visuals) would most likely elicit more accurate responses depicting a better comparison.

This study examined the impact of *number* of visuals in video lectures on student learning. Further research is needed in order to determine if *type* of visual (e.g. animations, still images, charts, graphs, images of people, etc.) is a stronger determining factor of student

learning and student preference in comparison to number of visuals. For example, are animations better than still pictures in terms of enhancing learning?

Similarly, additional research may help shed light on whether particular visuals are more effective for particular learning outcomes. For example, animations may be more beneficial for depicting a scientific sequence or process whereas still images may be more powerful at touching on the affective domain of learning or altering feelings and emotions in a psychology class. For example, is learning and preference affected by the type of content or the type of class such as hard sciences (e.g. physics) versus social sciences (e.g. psychology)?

This study examined video lectures used as the primary source of information dissemination, rather than a secondary or supplemental source. The vast majority of literature pertains to the effectiveness and impact of videos used largely to supplement face-to-face classes. Visuals in *supplemental* videos, where students have the opportunity to hear the same lesson again, might have a different effect on students' perceptions of their effectiveness in comparison to students in a fully online course who receive all information via videos.

Visuals are clearly important in the learning process in many cases. However, little research exists documenting the consequences of including too many visuals. Additional research should examine a potential rate of diminishing return. In other words, can too many visuals, just as too few visuals, impede learning? Is there an optimal number of visuals that enhance learning? And, similar to type of visual, does this optimal number of visuals depend on the subject matter?

Because ratings on student evaluations were used, demographic information could not be ascertained. Demographic information is not included on student evaluations at this particular institution. It is recommended future research use a survey in which demographic data can be

collected and analyzed. Assessing age, gender, and ethnicity with regards to preference for and impact of visuals may be helpful for instructional designers and faculty.

CONCLUSION

The results of this study suggest that too many visuals may negatively affect learning. However, it is suspected that ratings may have been skewed by disgruntled students during one particular quarter. Because two items on the student evaluation form were thought to be unrelated to visuals but were found be affected, further investigation is necessary. Regardless, use of visuals within video lectures, whether posted online or used as a webcast or podcast, is becoming more prevalent in higher education and warrants further research. Based on this research, faculty may want to hold off on spending an excessive amount of time embedding additional visuals into video lectures.

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