Less is more when developing PowerPoint Animations

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Abstract

Over the last decade PowerPoint has become the medium of choice for many instructors. The software provides animation options for the emphasis, entrance, or disappearance of text and figures. Many instructors use these options regularly with the intuition that such effects enhance student learning by allowing concepts to be introduced incrementally. This research explores the impact of custom animation in PowerPoint lectures and examines the idea that custom animation may in fact negatively impact student learning. To test this hypothesis two versions of a PowerPoint lecture were recorded in Camtasia Studio. The presentations differed only in the presence of animation to incrementally present information. To assess the impact of custom animation on student learning, students were shown either the animated or non-animated recordings and tested on the information presented. Computational results show a significant difference ($p<0.001$) between the means of overall student performance after viewing lectures with non-animated and animated PowerPoint slides suggesting that static slides allow students to retain more information than their dynamic counterparts.

Keywords: pedagogy, computer based training, instructional technology

1. Introduction and Related Literature

Recently the need for PowerPoint and other web based teaching resources has increased as traditional teaching approaches (e.g., an instructor 'lecturing' to a classroom of students) have expanded to include new instructional methods (e.g., on-line courses, blended web/traditional courses, etc.). Today's incoming university students have grown up using the Internet. They are accustomed to learning in multimedia environments and expect to be entertained as well as educated in their classes. As a result, instructors in traditional, web-based, and large auditorium sections are finding the need for additional stimuli and teaching methods to keep students engaged in the learning process.

One popular and commonly used method of adding stimuli to a presentation is

PowerPoint. The software provides animation options for the emphasis, entrance, or disappearance of text and figures. Since the inception of PowerPoint, its potential benefits for both traditional and web presentations has been considered by many researchers. Past studies have focused on student preference of the medium and its ability to enhance student learning. Although students tend to prefer PowerPoint lectures to those using transparencies (Cassady 1998; Perry & Perry 1998) it is unclear whether the medium enhances student learning (Chan Lin 1998, 2000; Lowry 1999; Szaba & Hastings, 2000; Bartlett, Cheng, Strough, 2000).

Although the aforementioned studies provide valuable information for practitioners choosing between PowerPoint and transparency based lectures, they fail to differentiate for the complexity of the presentations (pictures, sound, visual effects, etc.). In practice PowerPoint presentations vary widely in their quality and interactivity, ranging from those in which transparency text is merely copied into a presentation to those with incorporated sound and streaming video clips.

Further, despite the apparent benefits of using custom animation in PowerPoint presentations, the growing preference for its use has been based on little more than intuition (Lowe, 2003). Many educators and students intuitively feel that integrating the computer (with its interactive capabilities) into a classroom or learning experience enhances learning and the student's ability to apply knowledge and skills to future problem solving situations (Alavi, 1994). However, according to Murray (2003, 1998), web-based and computer based educational materials are generally poor in educational content. Furthermore, web-based learning presents concerns as well as opportunities (Ahn et al., 2005). Early adopters of technology based instructional materials tend to be skilled in technology, but not necessarily knowledgeable about educational concepts. Conversely those professionals who are experts in learning theories (traditional teachers) often lack the technical skills to implement technologically advanced learning modules. To this end, Haugen and Behling (2006) suggest that colleges and universities establish and maintain standards to ensure the delivery of high quality online education. In related research, Bork (2001) reports that many computer-based educational offerings provide poor learning opportunities and fail to provide 'interaction' between the materials and student learning. Schank (1998) concurs and recommends that modules be based more on learning concepts and notes. This suggests the need to let aspects of learning theory guide the design of computer based/developed offerings. Pedagogy approaches to computer based learning materials include behavioral (contiguity, repetition, and feedback), constructivism (build on prior learning), and resource based (present materials in a variety of methods) learning theories (Gagne, Briggs & Wager, 1988; Brandt, 1997; Rakes, 1996).

Pedagogically, integrating custom animation in a PowerPoint learning module can incorporate aspects of each of these theories. Presenting on a floating canvas gives instructors the opportunity to easily establish associations among how the ideas and skills learned in a course interrelate with one another (and with skills and ideas from other courses). For example, with a click of a mouse the same z-table seen in last semester's statistics course can easily be made to appear in a corner of the projection screen, highlighted, and removed (leaving behind the needed z-score). This example would follow the constructivism learning theory where learners "construct" knowledge by making sense of previously learned experiences (Brant, 1997). Similarly in PowerPoint presentations the stimuli can be varied with the introduction of animation, sound and videos (behavioral), while the use of alternate presentation methods allows information to be 'discovered' rather than packaged (resource based).

Recently researchers have provided some insight into the value of using such "custom animation" techniques for guiding concept development by distinguishing those attributes that enhance student learning. An initial step toward understanding the impact of these complexities was examined by Moreno & Mayer (2000) and Mayer (2001). Results of the study indicate that irrelevant sounds or pictures in a presentation can reduce student comprehension. More recently, Bartsch and Cobern (2003) showed that students performed worse on quizzes when PowerPoint presentations included non-text items like pictures.

Animations may be incorporated into a presentation in various ways. Lowe (2003) classifies animations according to the type of change incorporated into graphic entities; form change (alteration to the properties of graphic entities), position change (movement of entities from one location to another), or inclusion change (appearance or disappearance of entities). Results of the study illustrate that learners taught weather prediction with animations using primarily form and position changes made superior forecasts in some respects than students taught with static graphics. However, the findings indicate selective processing of animation and raise questions about the intrinsic superiority of its application. Possible reasons for varying benefits of animations include excessive processing demands on learners and reduced engagement of learners.

This research fills a gap in the literature by addressing how the added complexity of using custom animation in Microsoft PowerPoint for inclusion changes impacts student learning (or recall) of information. The research extends the ideas presented in Bartsch and Cobern (2003) to settings where information is incrementally introduced on a slide, as opposed to having all information shown on the slide at the same time and extends the results of Lowe (2003) to focus on inclusion change. Specifically, we posit that using custom animation to present information incrementally in a PowerPoint presentation may have a negative impact on student learning. Although the objective of a given lecture may range from conveying descriptive information/facts to illustrating specific problem solving techniques, this research deals with using custom animation to convey information. Future research will consider whether the same results hold when the medium is used to teach a problem solving technique.

The knowledge gained from this study provides valuable insight for instructors, particularly those teaching online web-based courses. Section 2 states the research hypothesis. Section 3 details the experimental testing and methods. Data is then presented and analyzed in section 4. Sections 5 and 6 present our results and discuss implications, limitations, and direction for future research.

2. Hypotheses

This study tests the idea that incrementally introducing information on PowerPoint slides via custom animation decreases student learning over having all information shown on the slide at the same time. We focus on how the added complexity of custom animation impacts student learning (or recall) of information. For clarity we define "animation" as the incremental inclusion of information on PowerPoint slides.

Extending the ideas presented in Bartsch and Cobern (2003) and Lowe (2003), we hypothesize that average student recall of information presented in non-animated presentations exceeds average student recall of information presented in animated presentations, or

$$H_0 : \mu_{\substack{without \\ animation}} - \mu_{\substack{with \\ animation}} \geq 0$$

3. Experiment

93 students in the Introduction to Management of Information Systems (MIS) class at a midsized public university took part in this study. The students were enrolled in one large introductory section instructed by one of the authors. The class was designed to have separate lecture and lab meetings. At the beginning of the semester the section was divided into separate lab subsections. Once a week, the entire class met in a large auditorium for group lecture. In addition, each subsection met separately in a computer lab once a week.

The environment provided a controlled setting where all students received identical conceptual instruction throughout the course of the semester. The lab sessions were used to test our hypotheses. Each lab classroom was arranged identically. No significant difference was discovered when comparing the average test scores of students in the sections. Two versions of a PowerPoint lecture on the information security topic were developed using Camtasia Studio software. The software enabled the addition of a "voice over" to explain the concepts presented via PowerPoint. The 'voice over' narration was exactly the same for both sets of PowerPoints. The only difference between the two presentations was the presence of custom animation to incrementally present information. Students were shown either the animated or non-animated recordings depending on their lab section via a projection screen located in the front of the classroom. After viewing the presentation, students were asked multiple choice survey questions to gauge their recall of the material presented. The average number of animations per slide in the animated recording was 3.4.

3.1. Methods and Procedures

Five weeks prior to the experiment all students were given a pre-test in the lecture class to assess their understanding of information security and privacy issues. Data was collected using Interactive Student Response Pads from Turning Point (i.e., "clickers"). These clickers were used regularly throughout the course to allow the instructor to take attendance, give pop quizzes, as well as collect anonymous feedback on the class' understanding of a topic. For this exercise data was collected anonymously.

Prior to the experiment students were divided into lab groups (according to the lab section they were enrolled in). For the experiment, one of these groups was treated as the test group and the other was treated as the control group. All groups were shown a PowerPoint lecture (with sound) dealing with the information security and privacy component of the course. The "control" group was shown the custom animated slides (dynamic case). In these slides, words/bullets/images entered the slide at different times to introduce concepts incrementally. The "treatment" or "test" group was shown the non-animated slides (static case). In these slides, all words/bullets/images entered the slide immediately together to introduce concepts simultaneously.

Care was taken to control for aspects of the presentation not dealing with custom animation. Both treatment and control lectures were developed in Techsmith's Camtasia Studio to ensure that both presentations progressed at the same pace and contained the same script of concepts from the same voice. Camtasia is currently one of the most widely used animated screen capture tools that allows instructors to capture visual activity occurring on the screen while narrating in the background (Gill, 2007). Both presentations had duration of 17:30 and used the same sound track.

Practically, the control (animated) PowerPoint presentation was developed and recorded first. The treatment (non-animated) slides were then created by removing all custom animation from the animated presentation. The same dialogue (.mp3) track (i.e. script) was used in both the control and treatment Camtasia recordings.

At the end of each presentation (control or treatment) students were presented with multiple choice questions (built into the end of the presentation slides to collect test results immediately and anonymously using student response clickers). The questions were the same multiple choice questions covered in the pretest (see Appendix A). Results were used to assess the impact of the custom animation treatment on student learning.

4. Data and Analysis

This study measured the learning experience using animated PowerPoint slides. A set of multiple choice questions were prepared to assess the knowledge gained on concepts delivered with the experiment. Five weeks before the experiment was conducted, the students' apriori knowledge of the material was tested using the prepared questions. On the day of the experiment, students were subjected to the same set of questions. The impact on student learning, i.e. the change in student knowledge, was evaluated by comparing student performance before and after the concepts were taught via the pre-recorded lectures (lectures using animated and non-animated slide sets).

4.1. Data and Analysis

Student understanding of the information security concepts in the experiment was assessed earlier in the semester by asking nine survey questions using clickers. The questions are given in Appendix A. Each question was designed with four different answer choices. Student responses were collected anonymously. If a student chose to skip or not to respond to a question, the response was recorded as an unsuccessful attempt for both pre-experiment and post-experiment tests. The average pre-experiment test score for all the subjects was 38.39%, which indicated a potential for learning, in pre-treatment responses. The percentage for correct answers varied roughly between 4 to 78%.

The student responses for the same set of questions were collected immediately after the recorded lectures were shown. The percentage of correct answers was 81.98% for the test group and 71.43% for the control group. The detailed plot with the correct responses is given for pre-treatment and experiment groups in Figure 1 in Appendix B.

The comparison of means for student test scores was conducted using a one-tailed t-test. The success rate of the students shown non-animated slides was significantly higher (p-value=0.0004) than the success rate of students shown the animated slides.

5. Results

Overall average student test scores under pre-experiment and post-experiment indicate that student learning took place for both the test and control groups. Specifically, student performance increased by 43.59% after viewing the lecture with static slides and by 33.04% after viewing the lecture with the dynamic slides. The percentage of correct answers pre-treatments and post-treatment are given in table 1.

Furthermore, there is a significant difference (p<0.001) between the means of overall student performance after viewing lectures with non-animated and animated PowerPoint slides. This difference suggests that static slides allow students to retain more information than their dynamic counterparts, and proves the hypothesis stated in section 2. For example, the difference between pre-treatment and post-treatment correct student responses for question 4 for both lectures (with animation and with no animation) points to successful learning. We observed a 17% increase in correct answers for animated slides while this increase was about 37% for the static slides.

Figure 1 (Appendix B) illustrates that the students shown non-animated slides improved their performance for each question. This trend is not observed for the animated slides for all the questions. Students shown dynamic slides had deteriorating performance for some of the questions after the lecture. For Question 5 results, we observe a decrease in the correct student responses for the group shown the dynamic slides. This deterioration may be due to the fact that this was the first time the students were exposed to the higher level information security terminology.

Question	Pre_ Test	with-animation	w/o animation
1	13.58	83.93	91.89
2	11.11	58.93	56.76
3	70.37	87.50	94.59
4	41.98	58.93	78.38
5	77.78	62.50	86.49
6	60.00	69.64	78.38
7	20.99	80.36	91.89
8	46.00	50.00	64.86
9	3.70	91.07	94.59
avg	38.39	71.43	81.98

Table 1 - Percentage of correct answers for each question.

Interestingly, the overall percentage of correct answers for the group shown the dynamic slides was slightly higher than the overall percentage of correct answers for the group shown the static ones for Question 2. This observation may be due to the students' familiarity with the concept tested in this particular question. Lowe (2003) suggests that if custom animation is used to deliver a topic known to the subjects, the animation has a positive impact in student learning.

6. Discussion, Implications, Limitations, and Future Research

The results of this study show that conveying concepts in lectures via custom animation can create a disadvantage for students' learning experience. Even though the use of custom animation allows the introduction of new information incrementally the technique can adversely impact student learning experience when factual information is conveyed in the presentation. Subjects shown the static slides had better recall of graphics and text on the slides due to prolonged exposure to the information. The incremental introduction of concepts in dynamic slides' was designed to prevent student exhaustion caused by visually presenting all concepts at once. However, the dynamic slides lead to excessive processing demands and limited exposure time. The results are consistent with Lowe (2003) who observed varying benefits of animations and listed excessive processing demands on learners and a reduced engagement of learners as possible causes of diminishing expected benefits of animations.

This study considered the impact of custom animation on learning of a new topic. However, teaching a problem-solving technique differs from teaching a conceptual topic. When a technique is taught, each new step builds on the previous steps covered in the lecture. Use of dynamic slides might have a different impact on learning in the presence of such dependency. For example, benefits of constructivism may offset the drawbacks of increases in processing demands for learning exercises that emphasize knowledge construction in domains of increasing conceptual complexity. Future research is needed to investigate any possible disparity.

7. References

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Appendix A – Survey Questions

1. Criminals frequently can talk a computer password out of an individual; a practice known as:

    a. Biometrics
    b. Password Sniffer
    c. Dumpster Diving
    d. Social Engineering

2. What indicates that a web page is secure to permit you to safely transmit your credit card information?

    a. https: - in the address line
    b. Your firewall is active
    c. Your virus scan is up to date
    d. All of the above

3. A Dept of Defense agency frequently auctions off computers to the public; later the agency learns that sensitive information is still on the hard drive, this is known as:

    a. Residual data
    b. Unauthorized access
    c. Compromising emanations
    d. Malicious code

4. You open an email attachment from an unknown source; later you discover all files with a .doc ext are unreadable; this is

    a. Unauthorized access
    b. Damage
    c. Theft
    d. Malicious codes

5. A disgruntled employee secretly installs a program that will allow him to access sensitive information at home, what security problem does this illustrate?

    a. Theft
    b. Unauthorized access
    c. Residual data
    d. Malicious code

6. Which of the following limits your exposure to a computer virus?

    a. Having your own flash drives for multiple machines
    b. Give it a “flu” patch
    c. Disconnect from the Internet
    d. Download music

7. Most computer crime is attempted by:

    a. Competitors
    b. Employees
    c. Outside Hackers
    d. Foreign Governments

8. Which of the following is NOT a commonly used means for access control?

    a. Auditing
    b. Locks
    c. Passwords
    d. Fingerprints

9. Encryption:

    a. Would permit all users to read your documents
    b. Would permit NO users to read your documents
    c. Turns a document into a series of letters and numbers
    d. Writes your documents to your hard drive

Appendix B

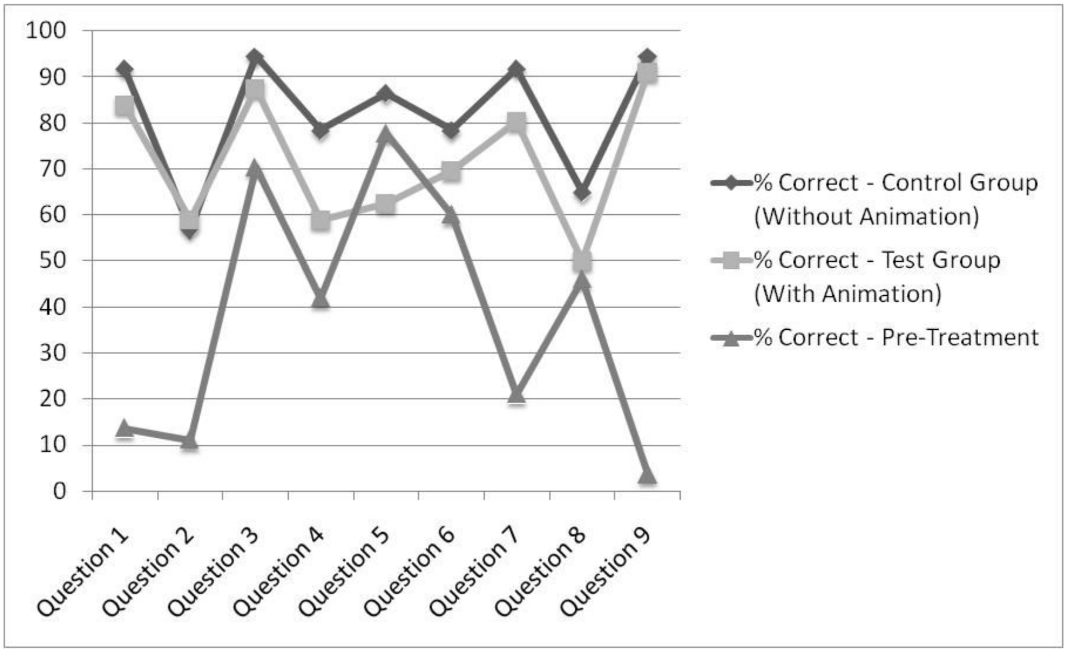

Figure 1 - Student responses for pre-treatment, control and test groups