Design Interactive: A Nonlinear, Multimedia Approach for Teaching Introduction to Visual Communication and Principles of Design

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Abstract: As online teaching techniques continue to evolve, new opportunities surface for research and insight regarding best practices for the development and implementation of interactive, multimedia teaching and learning tools. These tools are particularly attractive for courses that lend themselves to a rich media approach. Such is the case for visual communication curricula due to the visual nature of course content and the fact that students in visual communication courses tend to be very open to tactile visually oriented learning tools. To test these notions, a team of multimedia developers at a Midwest university created a media interface for educational multimedia. Then, a text titled "Design Interactive" was developed within this framework and administered in several sections of a 100-level visual communication course for journalism students. Students' attitudes about the text were solicited, and test scores were compared to previous iterations of the course in which "Design Interactive" was not used.

Introduction

The number of online courses and degree programs at institutions around the world is rapidly increasing. And the appeal of using the web as a course delivery mechanism is multifarious. Its consumer-centric approach to delivery (Larkin & Belson 2005), potential for interactivity and multimedia integration, and ability to reach large audiences (Fearing & Riley 2005) are primary reasons universities around the world make efforts to increase online teaching and learning experiences. With this comes an opportunity to study the affects of interactivity on learning and the integration of specific multimedia tools in the online and hybrid course environments.

Educators have begun to experiment with new ways to use digital, multimedia–from interactive teaching and learning tools, to serious games–in the classroom. And the Millennial generation (those born between 1980 and 2000) has made it clear that technology plays a central role in everything they do, including how they learn. At the same time, online learning has sometimes gotten a bad rap. Criticized for lack of academic rigor and providing small snippets of information, rather than a well-rounded educational experience (Coats 2008), online learning is a far cry from widely accepted. Thus, as online teaching techniques continue to evolve, new opportunities surface for research and insight regarding best practices for the development and implementation of interactive, multimedia teaching and learning tools.

These tools are particularly attractive for courses that lend themselves to a rich media approach. Such is the case for visual communication curricula, for a few significant reasons. First, the very visual nature of the course content is perfect for alternative digital displays. Video, interactive galleries, and image slideshows–to name a few–are some of the methods that make perfect sense in a visual communication class. Second, online teaching and learning tools often allow professors the opportunity to spend more of their in-class time focused on hands-on design projects and less time lecturing about design theory. Third, students in visual communication courses tend to be very open to tactile, visually oriented learning tools.

This research was predicated on the notion that the integration of an interactive, multimedia teaching and learning tool might provide visual communication educators with an effective method for conveying course content online. To test this notion, a team of multimedia developers at a Midwest university created ViziSwap. ViziSwap is a media interface that acts as an interactive shell for educational multimedia, including video, images, text, stills and

interactive information graphics. Then, a text titled "Design Interactive" was developed within the ViziSwap framework and administered in several sections of a 100-level visual communication course for journalism students. The report that follows provides the results of a study focused two key research questions:

RQ1: What will students' attitudes be about "Design Interactive" and the ViziSwap interface?
RQ2: Will students' test scores be at least as good or better than those who did not use ViziSwap?

Literature Review

A number of studies have addressed specific types of interactivity, multimedia as a teaching tool, and visualization as a means for simplifying complex educational materials. Stocks & Freddolino (2000) found that the incorporation of interactivity into a website made it easier to create an active learning environment for students. Likewise, Durrington, et al. discovered that students demonstrate more positive attitudes and higher levels of performance when online classes are highly interactive (2006). Finally, a 2004 *Distance Education Report* asserted that incorporating audio, video, and other interactive elements into online courses allow students to perform tasks to assist them in learning. The report cites the University of North Carolina, Greensboro, which currently offers two totally online degree programs, and incorporates interactive Flash elements into its course wherever appropriate.

The use of interactive digital textbooks is also increasing. With the introduction of tablet devices, such as Apple's iPad, publishers and educators alike are looking for ways to capitalize on digital publishing opportunities. Digital texts have a number of advantages, including interactivity and embedded media (Guasco 2003). However, the potential for interactivity during learning has also been scrutinized for its tendency to lead to increased disorientation (Conklin 1987; Thuring, Hannemann, & Haake 1995) as users often struggle to determine where they are and where they have and haven't been in a nonlinear environment (Eveland & Dunwoody 2001; McDonald & Stevenson 1996). According to Sundar (2000), audio, video, and other visual imagery can also have a negative effect on a user's perception of coherence. At the same time, participants in Sundar's study reported those elements to be some of the site's best content. Several studies have also shown that as disorientation increases, learning is likely to suffer (Beasley & Waugh, 1995; Tripp & Roby 1990). In spite of these concerns, many studies have shown that interactivity positively influences learning outcomes, satisfaction and time-on-task (Brady 2004).

However studying the effectiveness of multimedia teaching and learning tools come with a novel set of challenges. One important issue deals with the identification of appropriate measurement tools–ones that take into consideration the differences between traditional linear tools with nonlinear multimedia tools like interactive books, websites and other hypermedia. Thadani et al. (2009) developed a set of methods to measure and study teaching while teachers used multimedia intervention for promoting scientific problem solving. And Kay (2011) found that the WBLT Evaluation Scale demonstrated good internal reliability, construct validity, convergent validity and predictive validity for web-based learning tools used among 800 middle and secondary school students.

Study Rationale

Online teaching and learning tools that make good use of the rich multimedia potential of the web can take many forms. Thus, it is important to understand that this study examines how one approach works in the visual communication classroom. At the outset, we hoped that this study would provide a foundation for others, as well as yield positive results for the ViziSwap "Design Interactive" module. However, it was *not* our intention to replace student-instructor interaction with virtual tools and online courseware. Instead, we seek ways to provide instructors with a new tool for the delivery of visual communication course content and students with a broader range of learning modes. Studies like this one are important as traditional educational models evolve and blend with online environments.

The study is driven by two main goals: 1) compare learning assessment test scores between students who were enrolled in the course prior to the use of the ViziSwap module and those enrolled after implementation of the tool; and 2) examine student feedback regarding their enjoyment of the ViziSwap module as well as their perceptions of that learning experience compared to courses that employ traditional textbooks. To achieve the first goal, data collected over three years (between 2007 and 2010) and for a total of 210 student subjects provides a comparative analysis between students' performance in the same course before and after "Design Interactive" was integrated. To achieve the second goal, a survey was developed using best practices and was given to 552 students in a variety of departments including the students who used "Design Interactive."

Course & Instrument Overview

The course in which the aforementioned tool was implemented is titled "Introduction to Visual Communication." Required of all journalism and news majors at a midsized midwestern university, this course focuses on visual communication theory and basic design principles. The provides all journalism majors with a basic appreciation for the role of design in the mass communication and news environments, as well as a basic understanding of color theory, Gestalt theory, typography, data visualization and basic layout and design techniques. "Introduction to Visual Communication" is a 100-level course taken primarily by freshmen and sophomores.

Since 2007, the professors who regularly teach this course have been experimenting with blended learning approaches. For example, in addition to meeting twice a week for an hour and 15 minutes and making use of a traditional graphic design textbook, the course has included a significant online presence. Administered through Blackboard content management system, online components have included video lectures, podcasts, and an early iteration of an online ebook that provided basic click-through interactivity. In 2010, this early ebook was replaced with the ViziSwap module, "Design Interactive."

"Design Interactive" is comprised of seven units: Color theory, basic design principles, Gestalt theory, presentation genres, typography, data visualization and information layering. Each unit begins with an introductory video that provides a general definition of the concepts at hand. Then, each unit is broken into a number of chapters that provide videos, animations, interactive galleries, interactive timelines, instructive graphics, interactive exercises, and text-based narratives. Each unit also includes an interactive quiz that provides immediate feedback and a frequently asked questions gallery. The ViziSwap interface allows the student learner to navigate all of this content in a nonlinear fashion. Likewise, the term "ViziSwap" refers to the ability to swap media in and out of the main viewing area. For example, if a student is watching a video and decides to "swap" the video out in favor of an interactive gallery, the video pauses, moves into a different area of the screen, and the gallery takes its place in the main content viewer. When she is ready, the student may swap the video back in and resume watching where she left off. This method combines a high level of interactivity with an equally high level of nonlinear path control through the entire "Design Interactive" module.

Figure 1: Interactive gallery on the psychological implications of color.

Figure 2: Video clip that explains the concept of synesthesia. When the user chooses this video from the navigational panel on the right side of the screen, the gallery moves into the upper-right corner. When the student is finished watching the synesthesia video, she can return to where she left off in the gallery.

Methods

Participants

The experimental group was comprised of 113 undergraduate students using ViziSwap in the aforementioned "Introduction to Visual Communication" class. Four of the ViziSwap units were used in all of these courses. All of students in the experimental group were required to take standardized department exams as part of course assignments. They were also asked to volunteer to complete a survey. A small number were asked to come

back the following semester to participate in focus groups. The focus group participants were offered pizza as an incentive to attend the group. There were two different control groups. For comparison of performance on exams, the comparison group was composed of 97 students who had taken the same course in previous years. Test scores for students in the fall and spring semesters were compared to determine the consistency of test performance over time. The two groups differed by less than .1 item on the four exams. For comparison of ratings on the survey instrument, the comparison group was 439 undergraduate volunteers from the same institution, taking introductory courses in Psychology, Biology, Criminal Justice and Personal Finance.

Stimuli

The Journalism Department developed standardized departmental multiple-choice test on a variety of topics in 2007. These standardized exams were used to test students who used the new ViziSwap modules with no changes in questions. The tests were machine scored. There were four exams used across the courses: basic design principles, Gestalt Theory, typography, and color theory.

Also, a new survey instrument was developed for this study. Although there are many survey tools about teachers and classes, we were unable to find an appropriate tool for student ratings of educational materials used in courses. As a first step, we ran a number of focus groups with undergraduate volunteers. Students were asked to think about what characteristics of educational materials really helped them learn. Summaries of the focus groups indicated general agreement about the importance of clear objectives; that the materials were appropriate, up to date, interesting and provided feedback quickly; and that the students found them relevant to their goals, held attention and helped them learn. Based on the focus groups, two similar initial surveys were created, one for courses using ViziSwap and one for courses not using ViziSwap. Both versions included an item for each dimension students agreed were important. The Likert items asked students to compare the course in which they were using the ViziSwap module to a course that used a modern textbook. The response scale for each item was a 5-point Likert scale, ranging from strongly disagree to strongly agree. In addition, the instrument had two open-ended items designed to let students provide information beyond the Likert scales. These initial versions of the survey were given to a number of experts on surveys and communication and revisions were made based on their recommendations. Several professors who had developed educational materials evaluated the revised survey and modifications were made. The resulting survey was piloted on a small sample of students. Students found the survey to be short, contain reasonable items, and reported that it was easy for them to complete quickly.

Procedure

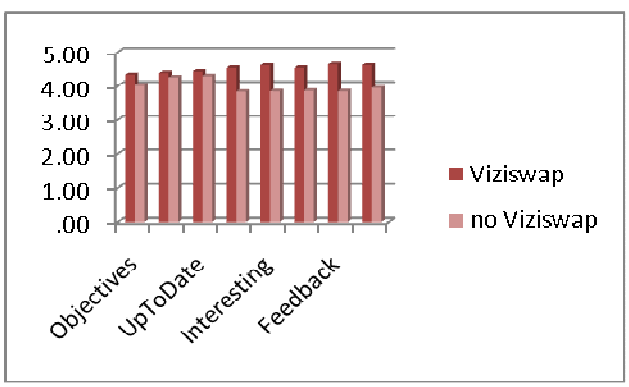
All procedures were approved by IRB and U.S. Department of Education. Students took exams in their courses following the same procedures faculty used in previous semesters. In an effort to get students to complete the survey, a research assistant visited all but one class in the middle of the semester to inform students that we were doing an evaluation and would appreciate their participation. Faculty members teaching the classes were also asked to add a link to the survey as part of their online course presence and make a reminder announcement in class. In addition, students in the courses were sent an email by one of the researchers providing a link to the survey. Open-ended items were analyzed by graduate students who had not participated in teaching the courses. The following semester, after initial data analysis was complete, students were invited to participate in focus groups. Researchers who had not participated in teaching the courses ran the focus groups.

Results

Likert Survey Items

Response rate for the survey was 35 percent for the students taking the design courses. Students using ViziSwap in the design courses gave higher average ratings to all of the Likert scales than did students who did not use ViziSwap, although some of the differences were not significant. The results are summarized in Figure 3. The differences between the students using ViziSwap and the students not using ViziSwap were compared using independent groups t-tests. Generally students in both conditions thought that the objectives were clear, but the mean for ViziSwap was significantly larger ($t(476) = 2.30$, $p<.05$). The ViziSwap materials had higher means than the non-ViziSwap materials for appropriateness and being up to date, but neither of these differences was significant (appropriate, $t(476) = .89$, n.s. and up to date, $t(476) = 1.01$, n.s.). For the other five dimensions, the differences between ViziSwap materials and other materials were quite large (average difference of .72 on the 5 point scale) and

significant (relevant, t(476) = 4.53, p<.0001; interesting, t(476) = 4.71, p<.0001; held my attention, t(476) = 3.86, p<.0001; provided rapid feedback, t(476) = 5.24, p<.0001; helped me learn, t(476) = 4.39, p<.0001).



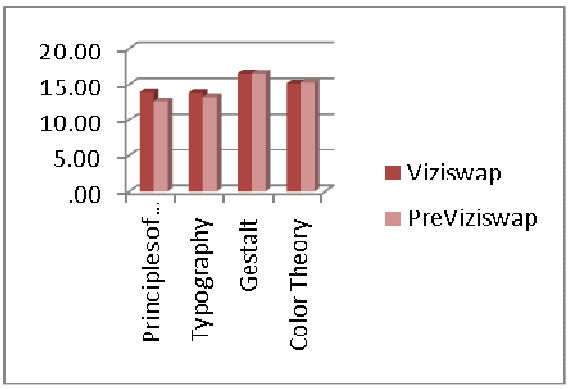


Figure 3: Mean Ratings on Survey as a Function of Question and Whether Students Used ViziSwap

Figure 4: Number Correct on Multiple Choice Exam as a Function of Topic and Whether Students Used ViziSwap

Two other analyses were undertaken to rule out alternative hypotheses for the differences obtained between students using ViziSwap and students who did not. The first analysis compared students taking courses in different departments that did not use ViziSwap materials. Independent, one-way ANOVAs were calculated for each rating scale comparing the ratings for students in the four undergraduate departments. None of the ANOVA's were significant. The second analysis compared two departments using very different ViziSwap units. One other department on campus, Criminal Justice, had created a ViziSwap lesson. The ViziSwap lesson for Criminal Justice was somewhat different in that it emphasized video and did not include interactive graphics. Thirty-five students (response rate of 50 percent) in Criminal Justice completed the survey and the results were compared to the students using ViziSwap in the design courses. The ratings were quite similar for the two groups. The only significantly different rating was for speed of feedback (t(72) = 2.33, p<.05) and that is undoubtedly related to the fact that there was not as much feedback in the ViziSwap materials used in the Criminal Justice module.

Open-ended Survey Items

Two graduate students conducted content analysis. Many of the comments re-iterated the same kinds of ideas as in the Likert items. However, there were some comments that went beyond the Likert scales.

Some of the comments were negative. One student described technical issues with ViziSwap, including that it is slow-to-load at times. Some students indicated that the nonlinear nature of the ViziSwap structure made it difficult to keep track of which parts they had engaged with and which parts they still needed to visit. One requested a printed version to help keep track. Another suggested that a checklist built into ViziSwap would help. One student found ViziSwap a bit overwhelming and described it as "busy."

However, there were many more positive comments, 19, than negative, 4. Most of the positive comments were general, such as "I liked it" or "liked format" and were consistent with the Likert data. However, several students suggested that ViziSwap materials made the learning process more efficient, fun and engaging.

Focus Groups

In the focus groups, students were asked their opinions about several topics. The topics concerned some of the negative comments (in what ways did the ViziSwap lessons seem busy, how could note taking be improved, and what else could be done to improve it) as well as positive ones (what did you like best?) The students noted that sometimes there were too many regions on the screen all containing something important. The students could imagine how some people would be overwhelmed. Students were also critical of popups they said occasionally appeared and that they were very distracting. A number of comments reiterated the need to better ways to take notes, but no clear ideas about how to do that were offered. Students also thought adding a search capability would be helpful. One student talked about multi-tasking. She liked listening to the ViziSwap will doing dishes or driving. She wondered if mp3's would be easy to offer.

Students agreed that the biggest strength of ViziSwap was the ability to interact and get rapid feedback. Their biggest criticisms were about characteristics they wanted to control, but could not. In other words, they wanted even more interactive capabilities. Secondly, the students agreed that the highly visual multimedia was the second major strength.

Exams

Only a few students did not complete all exams. Overall, students using the ViziSwap materials performed better on the departmental exams than students who had not used the ViziSwap materials. Results for the four exams are shown in Figure 4. Overall, students using ViziSwap materials got two more answers correct than students who had not used the ViziSwap materials. Figure 4 illustrates that the biggest difference in test scores was for the unit on basic design principles ($t(206) = 3.32$, $p<.001$). Students using the ViziSwap materials did better on typography than students who did not use ViziSwap, but the difference of .6 questions was not significant ($t(208) = 1.29$, $p<.20$). ViziSwap did not affect scores on the Gestalt exam ($t(208) = .06$, n.s.) nor on the color theory questions ($t(208) = .38$, n.s.).

Discussion

This research indicates that students have more positive attitudes about ViziSwap than about more traditional course materials and that ViziSwap facilitated learning more than previously used course materials. Additionally, professors received a great deal of informal feedback that was, for the most part, quite positive. One student sent this email to her professor at the completion of the course:

> "I loved the course textbook! It was the perfect supplement to News 130. I used it to review prior to exams, and I truly believe that it helped me get a better grade in the class. The interactives were my favorite part of the ViziSwap textbook. I am a visual learner, so that is just what I needed. … I hope the department continues to use it!"

Although unsolicited comments like this are ancillary and anecdotal, they help illustrate the clear enthusiasm students have for an interactive multimedia text of this nature.

Professor's Perspective

The primary professor of record has been teaching "Introduction to Visual Communication" for nearly 20 years. Her observations represent an experienced and knowledgeable perspective regarding best practices in the introduction to visual communication classroom. She reported that "Design Interactive" was a useful tool for learning. She noted that organization of the module and the fact that it was easily accessible to students online had a direct affect on their learning and their perceptions of the course. The variety of approaches to the material such as a video introduction and overview to each unit, interactive galleries, and slideshows made it possible for the material to be individualized with respect to each student's needs and abilities by letting them work at their own pace, she said. It increased student motivation and interest and provided students with rapid visual feedback.

She also noted that the multimedia nature of the text ensured that students engaged with content in several different ways. Its variety of approaches to the material allowed for different types of learners to excel. Knowing that each student had access to the material in the same way and that they were more engaged than they would have been by simply "reading" a textbook, allowed the professor to have extended lab time and one-on-one time with students. She was also able to eliminate the "formal" lecture format and better integrate the content of the course into class discussions. "Students seem to be held more accountable for their learning with this type of class format structure," she said.

"Design Interactive" also allowed the professor to focus on class discussions and critiques of student work. Students were able to use the language they had learned through "Design Interactive" and apply it to the class discussions. Written and verbal discussion remarks were candid, informative and thoughtful. Students seemed to be more comfortable and willing to state their "educated" observations out loud. "Design Interactive" allowed the professor to use more class time for one-on-one instruction and focused on each student's needs and problems. "With the new class structure, students were able to execute assignments under the professor's supervision, enabling them to receive rapid feedback, which is so important with students in this generation," she said.

The researchers, “Design Interactive” author and ViziSwap developers are encouraged by this feedback. They believe that “Design Interactive” had a positive affect on the way the visual communication course was delivered and that the ViziSwap model can be successfully implemented in other courses that have the potential for multimedia delivery.

Of course, student feedback is also important, and the researchers are equally enthusiastic about the largely positive response from students enrolled in “Introduction to Visual Communication.” One student commented that the videos were helpful in introducing each unit's content. Another student stated that the program was easy to navigate and liked that each unit was similarly structured. Students also commented on the convenience of accessing course materials at any time given that “Design Interactive” was available online and through their course Blackboard accounts. This enabled students to study at their own pace, jump around from unit to unit, pause the video, rewind to hear it again, and review as often as they wished.

Of course, there is clear room for improvement in the module. The research and development team found the constructive criticism offered by students to be quite useful and will examine ways to implement changes in future versions. For example, some students commented that they would like to see a schematic or map layout of the entire “Design Interactive” module. This feature will be added, as will a print companion that students can use for note taking and reference. Likewise, developers intend to add even more nonlinear navigational capabilities after a number of students commented that they would like the freedom to move from one whole unit to another as a means for making connections between concepts. Finally, it is clear that students enjoyed having options regarding how a particular piece of information was learned. For example, one student said, “I learn well if I can hear the information at the same time that I am looking at the examples. That helps me focus.” Yet another said he liked the text only option because he was distracted by all the visuals. He preferred to read the text completely, then view the visual examples, and then engage in the interactivity afterward. Thus, in future versions of the “Design Interactive” module, developers intend to add even more variety of presentation formats for students regarding each of the most significant learning points.

Students and professors also noted that some information–such as the content found in the data visualization unit–could be broken into two units of study. The material is vast and might be easier to retain if it were offered in smaller chunks. Additionally, it was suggested that links be provided for visually impaired students that would activate audio narration of text-based elements within the text. And one professor suggested that an increased number of interactive exercises would also be helpful. Finally, some suggested that the ViziSwap framework for “Design Interactive” is visually busy, which may also lead to distractions. A simpler interface may alleviate some of these issues.

Limitations

Although ViziSwap students did at least as well or better on learning outcome tests, only one ViziSwap unit–basic design principles–led to a significant improvement in test scores. We have two hypotheses for why this occurred. The first hypothesis is that units differed in some important ways. One difference was in navigation. Navigation for the design principles unit was a bit simpler than navigation for the other three units. Another difference is that the units that positively impacted learning had more interactivity relative to the educational materials that were used previously. Our second hypothesis has to do with time on task. We were not able to get good estimates about how much time students spent with their learning materials. However, we do know that these students are quite busy. They may have spent adequate time with ViziSwap the first week, but as their schedules became busier, students using ViziSwap may have reduced their time on task more than other students. Determining whether either of these hypotheses is correct will take more research.

However, the researchers believe the only true failure would have been if test results were lower for those who used the ViziSwap module. Again, it was not our intention to replace the instructor or traditional teaching methods. Rather, we hope to offer a new and valuable option for visual communication educators who wish to experiment with hybrid course models. Therefore, although we will strive to improve “Design Interactive” in ways that will also improve learning outcomes and test scores, its debut was deemed a success.

Conclusion

Dismissing online learning or considering it less valid than traditional teaching methods is unfair and inaccurate. In fact, the web provides educators with a number of rich multimedia options that can both enhance learning and satisfy the digital natives that populate our classrooms. The study outlined here offers a glimpse of how

one tool has been successful in doing so. Of course, the hybrid nature of the course studied here still provides students with a strong connection with their instructors and a significant amount of face-to-face interaction. Therefore, future studies should look at how this module fares in a completely online course. Regardless, it's clear that when the rich multimedia potential of the web is used properly, a number of positive outcomes, from student engagement to improved learning outcomes are possible. Likewise, it's worth noting that because "Design Interactive" is a digital tool, the development and distribution of updated versions is much simpler than it is with traditional texts that have to go through a print publishing cycle. This is a huge advantage when it comes to keeping up with trends in the industry; correcting errors; and adding new units, chapters or segments to the text. Thus, multimedia teaching and learning tools like the one developed for this study are capable of enriching the online learning experience–an important contribution to a rapidly changing educational environment–and providing teachers and learners with a more efficient and engaging experience.

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