

## **AC 2007-1853: INTRODUCING ART AND VISUAL DESIGN CONCEPTS TO COMPUTER SYSTEMS TECHNOLOGY STUDENTS**

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# **Introducing Art and Visual Design Concepts to Computer Systems Technology Students**

## **Abstract**

Computer systems technology students attending Kansas State University at Salina are typically focused on technology and have minimal exposure to art and graphic design concepts. In the “Fundamentals of Web Design” course, we attempt to broaden student knowledge and experience by introducing art and design concepts that are not available elsewhere in the Engineering Technology curriculum. Although many students embrace this shift in emphasis, some are very resistant because the ideas presented appear foreign and irrelevant to a computer technology curriculum.

The challenge has been to discover ways of connecting art and design concepts to the needs and interests of computer technology students. For example, most computer students understand the theory of mixing red, green and blue pixels on a computer display to create any color, but few are familiar with the technique of optical color mixing used in Pointillism.

Throughout the course, students are introduced to design concepts and theory that can be used to develop visually pleasing websites and other graphic oriented content. Along the way, well-known artists are introduced to illustrate various design fundamentals that are applicable in both art and web design. On several occasions, projects that reinforce key concepts are assigned; some computer based and some that involve traditional paper and pencil. One of the most pleasing aspects of this course is when students begin to discover hidden artistic talents they did not realize they possessed.

This paper will highlight some methods of connecting visual design to computer systems technology. It will also discuss some of the successes and failures experienced thus far in teaching a Fundamentals of Web Design on a campus oriented more towards technology than towards design.

## **Introduction**

While universities aspire to interdisciplinary thinking and cooperation, the size of institutions and pressures upon individuals has often led to isolation rather than collaboration.<sup>1</sup> Interdisciplinary thinking is important and beneficial while excessive compartmentalization of thought ignores the realities and interconnectedness of the world. Some writers such as Peter Blewett have expressed dissatisfaction with “professional programs that treated humanities and social sciences as an after-thought at best and an onerous irrelevancy at worst.”<sup>2</sup> Others call for each discipline to recognize and appreciate the value of disparate fields of thought. “Scientists would doubtless be better people if they were culturally literate, and ditto for humanists if they were scientifically informed.”<sup>3</sup>

The importance of a broad based education is reflected in current ABET curriculum requirements for engineering and engineering technology programs. According to ABET, engineering students must demonstrate “the broad education necessary to understand the impact

of engineering solutions in a global, economic, environmental, and societal context.”<sup>4</sup> Engineering technology students must demonstrate “a respect for diversity and a knowledge of contemporary professional, societal and global issues.”<sup>5</sup>

One approach to interdisciplinary studies is the development of specialized courses and seminars designed to appeal to a given discipline. Courses with themes such as “Biology for Art Students,” “Humanities for Engineering Students,” and “Technology for Non-Technology Students” are a common method of exposing students to interdisciplinary thought. These courses can be successful if they are well designed, however they can take significant time and resources to develop. Examples include Drexel’s “Personal and Professional Enrichment Program,”<sup>6</sup> the Colorado School of Mines “Paradoxes Of The Human Condition,”<sup>7</sup> the University of Indianapolis “Biology for Artists”<sup>8</sup> and the University of Texas “Steam Power and Electricity Generation”<sup>9</sup> courses.

Another approach to consider is integrating interdisciplinary concepts directly into existing courses. By integrating selected projects and topics for discussion, the desired interdisciplinary, broad-based learning can happen on a smaller scale without the need for semester-long course development. It is possible to integrate humanities related topics within technical offerings if we will take the time to explore the possibilities and if we will recognize the importance of doing so.

An excellent example of integrating the arts and humanities into a Chemistry course is K-State at Salina Chemistry professor Jung Oh’s periodic table project. In this project, students must “convey the information about the element in a creative report, such as a short story, poem, song, poster, pamphlet, model, mobile, CD, video clip, etc.” According to Oh, student projects “have included Power Point presentations, short stories, poems, rap songs, posters, pamphlets, models, mobiles, video clips, wind chime, quilt, computer programming, games, puppet shows, and others.”<sup>10</sup>

In “Teaching Computer Graphics Visual Literacy to Art and Computer Science Students” Eber and Wolfe describe a process of visual analysis for teaching art concepts to computer students and teaching computer technology to art students in computer graphics courses. Through collaboration between Computer Science and Art faculty, integration of ideas from both fields becomes possible.<sup>11</sup>

### **Fundamentals of Web Design Course Overview**

The Fundamentals of Web Design offered at Kansas State University at Salina is a course recently added to the associate degree Web Development curriculum to satisfy the urgings of our industry advisory committee. In one sense, this course follows the previously mentioned model of developing a specialized course to fill a specific need. However, it also follows the integration model by including important non-technical humanities aspects within a technology course.

The primary aim of the course is to introduce art and design concepts to students studying web development. Historically, the Web Development degree program at our institution has been very technology oriented, focusing on issues related to development of web applications with very little or no emphasis on aesthetic considerations for these applications. With the

introduction of this course, our web development students are entering completely new arenas of thought, to the delight of some and the dismay of others.

The course introduces the basics of visual design as they are applied to new media technologies using the computer and World Wide Web. As they learn about elements of design such as space, line, shape, value, texture and color, students begin to see the world through new eyes. By becoming aware that these elements exist, the students start to notice the use of these elements throughout their daily lives.

Eventually, students begin to combine the elements of design in complex ways as they study the concepts of composition, layout, balance, rhythm, contrast and artistic styles. In one section, students learn about using type as a design element. In another section, time, motion and interactivity are investigated.

Because the course is still new, we are still in the process of experimenting with the appropriate amount of time spent investigating new design concepts and the amount of time spent with mastering the design software tools. One thing that is becoming increasingly clear is that the students tend to have widely varying degrees of experience with the design software tools and therefore have vastly different instructional needs.

The first semester the course was taught, more emphasis was placed upon learning about the elements of design and how to integrate them together than on the creation of actual websites. That semester, some students failed to see the relevance of what they were learning to the web design process because it was not explicitly outlined for them.

In subsequent semesters, we have taken extra care to include analysis of actual websites and the use of the design elements in them. In addition, for extra practice in web page creation, all assignments throughout the semester are submitted in the form of a web page, even if it is only a written report or a hand made drawing.

## **Art and Art Theory**

The instructor of this course, having a background in computer science and in art knows intuitively through experience and education that concepts of visual design and communication are often best explored through study of the works of the great master painters. Throughout the course, the works of several artists are introduced and explored in an attempt to connect the fundamentals of web design to these masters of visual communication. For example, the work of Pablo Picasso is useful because “he handles perspective, shape, color and light as masterfully as he handles meaning, semantics, memory, context, form and even sociopolitical history.”<sup>12</sup>

The works of Picasso are often referred to throughout the semester to illustrate various elements of design. Exploring paintings such as “Girl before a Mirror” affords the opportunity for students to witness masterful use of important visual design elements such as composition, balance, color, line, value, shape and texture. In addition to learning the basic design elements, by studying Picasso, students are exposed to the work of one of the most important artists of the twentieth century.<sup>13</sup>

Perhaps one of the best concepts in art theory that can be directly and simply related to computer technology is the artistic style known as Pointillism. In the late nineteenth century, French painter Georges Seurat began reducing his paintings to discrete points of paint pigment. See Figure 1. When the viewer of the painting stands a few feet away, these discrete points of color begin to optically blend together, resulting in new colors becoming apparent that do not physically exist on the canvas.

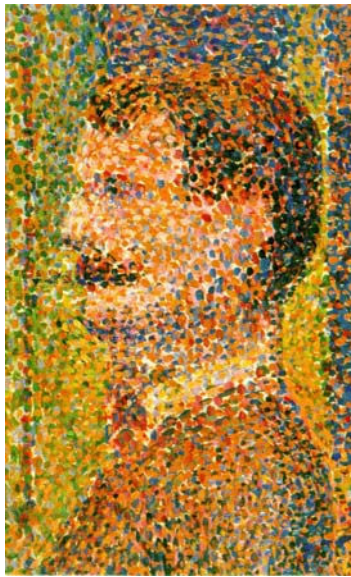


Figure 1. “*The Side Show- Detail*” by Georges Seurat, 1881 <sup>14</sup>

This process of optical color mixing is exactly how a modern computer display represents a wide gamut of color. Computer monitors have the ability to physically display only red, green and blue pixels. Thousands of tiny pixels mixed within the eyes of the viewer result in millions of potential colors appearing on the computer screen. A similar process occurs in digital camera photography only in reverse. A digital camera is capable of recording millions of red, green and blue pixels, but by blending the three when we view the stored image, we can see the world’s colors in all of their glory. Students are often amazed to learn that modern digital displays have roots in theories developed long before the advent of the digital computer.

Another interesting concept introduced in the course is the color wheel. The color wheel is a device used by artists and designers to help understand the relationships between colors. Sir Isaac Newton is credited with being the first to publish colors arranged in a circle. <sup>15</sup> A discussion of the Newtonian color wheel along with topics such as the placement of visible light in the electromagnetic spectrum and visible color wavelengths provides an opportunity to “approach the subject of fine art from a perspective where technology oriented students would have an advantage.” <sup>16</sup>

Space is a design element that is often abused within the world of web design and considerable effort is expended on discussing ideas related to space. Web page designers untrained in visual communication typically have a tendency to fill every ounce of space available on the computer

screen. Usability experts and artists agree that careful and deliberate use of white space or negative space is beneficial to improving the viewer experience.<sup>17</sup>

There is possibly no better artist to consider when exploring the design element space than Georgia O'Keefe. O'Keefe is well known for her large format paintings of flowers and her paintings display a mastery of the use of space. O'Keefe once stated, "I'll paint it big and they will be surprised into taking time to look at it – I will make even busy New Yorkers take time to see what I see of flowers."<sup>18</sup>

### **Collaboration: Value Study Project**

The engineering technology program resides on a campus separate from the main Kansas State campus and few arts and humanities faculty can be found locally. A key to the successful development of this course has been ongoing interaction with graphic design faculty from other campuses and institutions in the region. Through networking with experts in visual design from other institutions in the vicinity, we are in an ongoing process of developing meaningful projects and course content that will benefit everyone involved.

In one such collaboration, the Web Design instructor on our campus shared a visually interesting website, "<http://www.typorganism.com/>" with graphic design colleagues on other campuses. One of the other instructors found the typorganism.com ASCII-O-Matic feature interesting. ASCII-O-Matic converts a digital photograph into a two dimensional array of single value squares.

The graphic design instructor expanded upon the typorganism.com idea, creating a value study exercise for his students to complete. His graphic design students created self-portraits in the style of the ASCII-O-Matic, by painting small squares of single values with acrylic paints.

Upon seeing this activity, the original Web Design instructor devised a similar value study exercise for his web students, but by using Adobe Illustrator software instead of acrylic paints to create the value squares. Instead of self-portraits, the Web Design instructor created a large grid of gray squares depicting the Mona Lisa, then divided the small sections equally among the web design students without letting on what the squares represented. Each student was assigned a different section to reproduce. See Figure 2 for a sample section and Figure 3 for several sections together.

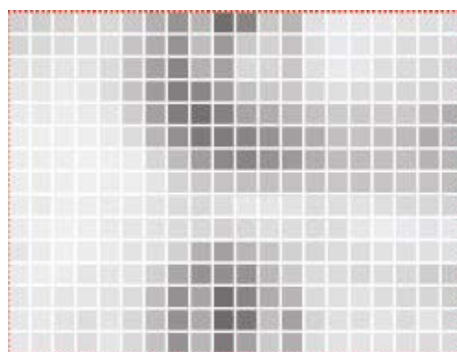


Figure 2.

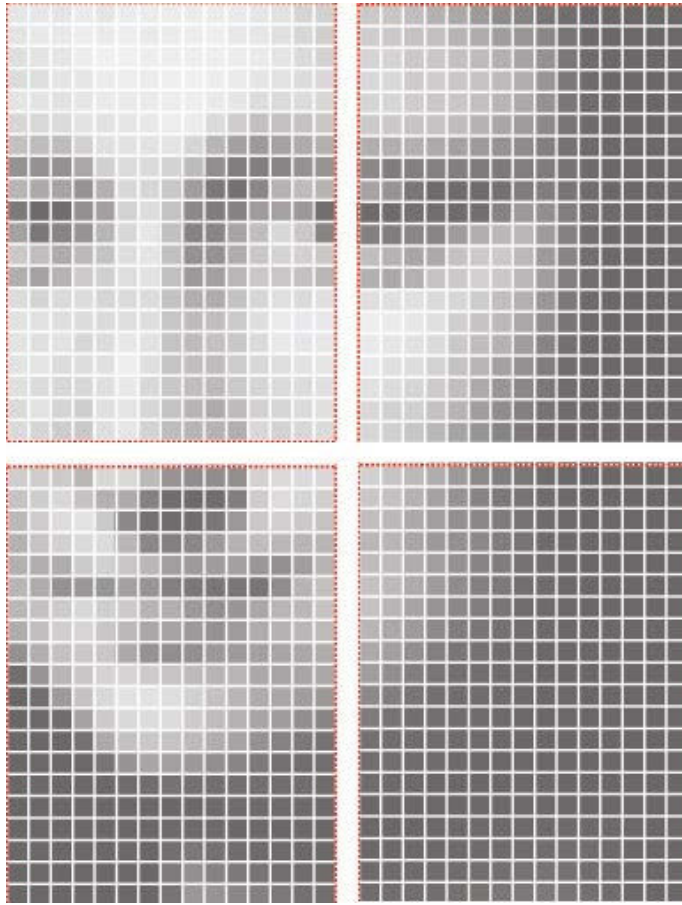


Figure 3.

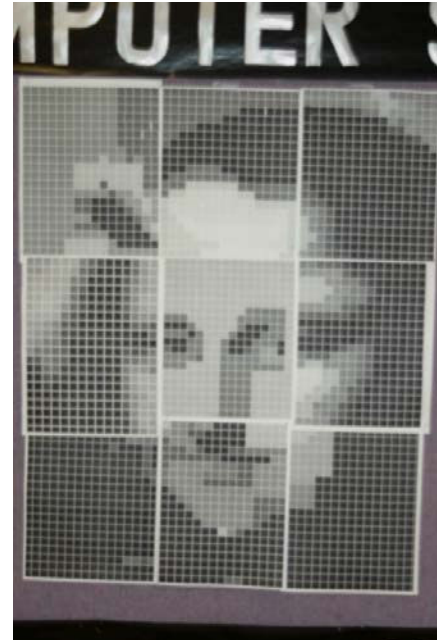


Figure 4.  
*Completed Mona Lisa*

The purpose of the assignment is for the student to begin to understand value as a design element. The assignment breaks values down into manageable and abstract pieces so even the non-artist is able to contribute to a work of art. Each student reproduced his or her grid of squares using Adobe Illustrator and printed their work on a full sheet of paper. The student pages were reassembled and the results were posted on the bulletin board. See Figure 4.

### **Color Scheme Scavenger Hunt**

In this assignment, student groups visit local retail merchants and look for intentional uses of the color schemes they have been studying. Using a digital camera, the students photograph products and product displays that use typical designer color schemes mentioned in their textbook. This activity promotes teamwork and demonstrates that the real world pays attention to color and often follows the design rules covered in the course.



## Drawing Assignments

Students are often concerned that they lack the artistic ability needed to be successful in this course. We try to have them do some fun things that require little skill, but a lot of imagination and a willingness to try. One assignment, students create line drawings simply by using a source photograph and tracing it in Illustrator making decisions about where lines should go. It is good practice for learning the vector drawing program, as well as good practice at learning how an artist thinks and makes decisions. See Figure 5 for a student vector drawing.

Figure 5.



Figure 6.



*“Vector Man” by Charles Hernandez, 2006      “Charcoal Face” by Lexie Bellamy, 2006*

Another drawing activity does not even involve a computer. Students make a value study drawing of another student’s face using willow charcoal purchased at an art supply store. They are encouraged not to draw a face as they know it to be, but instead simply study the light and dark values of a face and try to represent the shapes they see in these different values. See Figure 6 for a charcoal value study. This technique is adapted from those suggested in Betty Edwards’ classic book “Drawing on the Right Side of the Brain.”<sup>19</sup>

Painting a color wheel is another non-computer based activity that reinforces the concept of color relationships. Many students have not mixed primary color pigments together since elementary school, but this project forces them to consider color and color schemes in ways that a computer based project could not. See Figure 7 for color wheel painting.

Figure 7.





It is amazing to see self-professed technology degree non-artists come up with these successful results. In nearly every class that these assignments are given, at least one student surprises themselves with what they are able to accomplish. One of the incredibly rewarding parts of this class is witnessing artistic success in students that struggle in many of their other classes due to physical or learning disabilities. Many students discover hidden artistic talents and interests they did not realize they had.

## **Brain Based Learning**

One important aspect of the Fundamentals of Web Design course has been the purposeful application of brain-based learning theories. Because we are dealing with a subject area that is completely new to most of the students enrolled in the course, it is particularly important to present material in ways that are palatable, even fun. According to Eric Jensen, novelty is an important method of capturing student attention and beginning to build the neural pathways that become the storehouse of new information.<sup>20</sup> In order to both create some novel ways of learning and to demonstrate that the instructor is also constantly growing and learning in new areas, several games and simulations were created specifically for the students of Web Design.

## **Color Scattergories**

One game devised is called “Color Scattergories,” modeled after the Milton Bradley-Hasbro game Scattergories®. In Color Scattergories, students are divided into pairs, with one student playing the game and the other student acting as the referee. The current player receives a printed color wheel, and individual color swatches representing each of the twelve colors of the color wheel. On each round of play, the name of a specific color scheme is displayed on the projector screen, while the players place three color swatches side by side in an attempt to match the current color scheme. Examples of these color schemes might include analogous, alternate analogous, split complement, etc. One student asked to display an analogous color scheme might select swatches of red-violet, red, and red-orange, while another student chooses to display swatches of yellow, yellow-orange, and orange. Both have correctly selected analogous colors on the color wheel.

Figure 7.  
*Color Scattergories*



The referee's role is not to serve as teammate, but to check the work of the player. The referee notifies the instructor if the player has correctly displayed the current color scheme, and if correct tells the colors used. A player who correctly displays a version of the color scheme that does not exactly match any other player's color scheme receives a point. Players who are incorrect, or use the same color combination as another player receive no points. Although as with the original game Scattergories® the number of possible concurrent players is limited, the game enhances the learning of color theory because both player and referee are forced to consider the possibilities with the different color schemes they have been learning in class.

## Flash Football

One effective method of teaching and communicating the importance of life-long learning is to share with students insights into the intellectual pursuits of the instructor. One example of this approach is the creation of a Flash-based football game simulator developed for review sessions. The football game is a Flash game modeled after a football scoreboard and a football playing field that introduces friendly competition during exam review sessions.

Figure 8.



The football game play is straightforward and not difficult to follow so even non-sports enthusiasts can catch on and enjoy the fun. The class is divided into two teams, the home team and the guests. The offensive team has the first chance to answer a question. If they answer the question correctly, the instructor clicks on the “offense” button and the computer will execute a play that favors the offense. If the question is incorrectly answered, the defensive team gets a chance to answer and have the computer execute a play in their favor. If both teams cannot answer the question, a coin toss play runs leaving it to the computer to randomly generate a play. If a team is able to answer enough questions correctly, eventually they will score a touchdown and have six points added to the score. An hour review session quickly passes using this format. For more information on the football review game and other learning games, visit <http://www.sal.ksu.edu/faculty/billgx/flash/>.<sup>21</sup>

With the football game program, students were able to see their instructor involved in the process of learning new software skills as they were learning the graphics software. Technology students are being asked to expand their horizons into the world of art and computer graphics, why not demonstrate that the web design teacher can also expand into new knowledge areas as well; in this case into the arena of Flash ActionScript programming? Not only is there the benefit of having the teacher serve as a role model learning new material, but then there is also the benefit of having a fun new way of reviewing course material.

## Course Assessment

In the most recent iteration of the Fundamentals of Web Design course, eight students were given a day-one pre-assessment of their art and design knowledge and this information was compared to a post-assessment given to the remaining six students on the last day. The results indicated some student learning occurred, but there is still room for improvement. Some example question topics and results are provided in Figure 9.

Question Topic	Pre Assessment	Post Assessment
Complementary color	3 of 8	5 of 6
Value	1 of 8	4 of 6
Negative Space	4 of 8	6 of 6

Figure 9.

The pre and post assessments invited students to draw a portrait of a face. In the pre-assessment, one student did not attempt to make a drawing, and six of eight students drew simple line drawings of limited technical ability. One student already demonstrated drawing proficiency in the pre-assessment. In the post-assessment, five of six students showed technical improvements to their drawings, including the student who made no attempt to draw in the pre-assessment. The one student who showed no improvement was the student who already showed significant drawing ability in the pre-assessment. The pre and post assessments have provided valuable information about student learning and these assessments will be continued in future versions of this course.

Some anecdotal evidence also exists confirming the students are learning these concepts. One faculty member teaching an advanced web projects course comments, “They talked about the use of color schemes, graphics, and design to help convey what the web site is all about...your effort in teaching a little art to technology students is having a positive effect.”<sup>22</sup>

After three semesters of teaching this course, a review of student evaluations reveals the need for a better explanation of the relevance of art and art theory to web design. Some recent student comments are, “We only have three semesters to learn all we can about web design, why are we wasting time learning about Picasso?” and “This is a web design course, not an art course.” Instead of simply introducing design concepts such as color, shape, value, texture, rhythm and demonstrating the use of these concepts within works of fine art, the instructor must find ways of illustrating how this is relevant to the needs of the student.

However, our approach seems to resonate with other students who say, “The class feels more like something you would want to do, instead of feeling like a requirement for the degree,” and “I really enjoyed this class because he was willing to explore different methods to teach concepts that were hands on instead of entirely computer based. I think it helped to clarify some of the techniques... It was more than just another computer class or art class, but a good blend of the two.”

Perhaps a discussion of ideas such as those of Rikakis might be helpful in making better relevance connections. Rikakis states “It is clear that the fast evolution of technology and its effects on society have produced a discontinuum between development of media technology and media content and consequently a discontinuum between our means of acquiring information and our means of acquiring knowledge. The result is that our society is highly informed, has access to lots of data, but suffers from a lack of deep experiences and true knowledge.”<sup>12</sup> Simply put, students cannot afford to ignore the knowledge that art and visual literacy provides to humanity. It is not enough to be technologically literate; we must know what it means to be human. In other words, a background in art can help students be better web designers!

Technology students who enroll in Fundamentals of Web Design receive education in ways that no other class in our technology college can offer. Students learn about art and artists that may not be discussed in any other course on campus. Students frequently discover hidden interests and abilities they did not realize they had in this class. This course is an exercise in interdisciplinary thought and hopefully opens new ways of thinking for students.

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