Art in Perspective
A Making Connections Cluster at Clarion University

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Abstract

Prof. Steve Gendler and Prof Jim Rose taught a pairing of two courses in Clarion's Making Connections Program. The courses, an introductory studio course in art, and the mathematics course for liberal arts students were selected primarily by freshman art majors. They stressed the commonality between art and mathematics to inspire students who didn't like mathematics to want to learn more about it. Computer experiences and web-based assignments further enriched the experience.

Introduction

About ten years ago, Clarion University established a program called Making Connections in which two courses in different disciplines are linked. The students are required to sign up for both of the courses so that the classes would have identical enrollments. Then connections are drawn between the material in the two courses, students see different perspectives of the topic, or subject matter from one is used in the second. Students begin to see the interrelationship between different fields and learn that the same ideas are expressed and used differently in two different disciplines.

Two years ago, Profs. Gendler and Rose met and decided to jointly develop a course pairing to address the age-old problem of making the required course in mathematics meaningful to students in seemingly unrelated disciplines such as art, and hopefully to show students how to use mathematics to become better artists.

To prepare to teach these courses, Gendler and Rose attended the summer workshop Viewpoints with Marc Frantz and Annalisa Crannell of Franklin and Marshall College in Lancaster PA. Prof. Gendler learned about this summer program when he attended a NSF sponsored conference in Mathematics across the Curriculum at Indiana University Bloomington. Gendler also spent a day visiting with Prof. Paul Calter of Dartmouth and Vermont Technical College. After Rose and Gendler met over lunch weekly for more than a year the course was approved in Spring 2000. Finally Gendler attended Bridges in summer 2001 and discovered a whole community of artists and scholars working in the field, and obtained software and ideas to integrate into the course.

Background Information

The class of twenty students, nineteen of whom were art majors, was recruited during freshman orientation in the summer. This attempt to choose a homogeneous group of new students with math-phobia was not wholly successful. Two or three who were double majors in Computer Science and somewhat stronger in mathematics, and one strong Computer Science major added during drop-add, but the rest were the students we wanted. Clarion has open admissions, and some of the students entered quite weak in mathematics The only filter was the Mathematics Placement Exam, which places the weakest

students in the remedial Basic Algebra course. In addition, Mr. Rose was a confirmed math-phobic and not afraid to share it with the students, and Dr. Gendler said he only knew how to paint by the numbers. Gendler and Rose had a fourteen week syllabus in both courses, but were prepared for a give and take to address student needs in the mathematics, where it was not at all clear how well the students would do.

Highlights of The Course

The actual courses were presented in two separate "smart" computer classrooms, the Math-Physics classroom with fifteen state-of-the-art Gateway computers and the Multimedia Studio in Art with a mixture of new and aging Macintosh and PC computers. A third location, the Mathematics Computer Laboratory, with Power MACs and G-3's was also used so that some of the software could be accessed easily. For each topic in mathematics, the topic was introduced in a lecture-discussion format and then computer exercises or manipulatives were used to reinforce the concepts. Finally, the concepts were tied together in the studio course with projects that used the mathematical concepts.

As an example, students talked about basic lines and circles in geometry. They then learned the basics of Geometer's Sketchpad and drew circles and lines to find the perpendicular bisector of a line segment to construct a square. The exercise led to a works of art based on a construction in the Geometer's Sketchpad workbook.
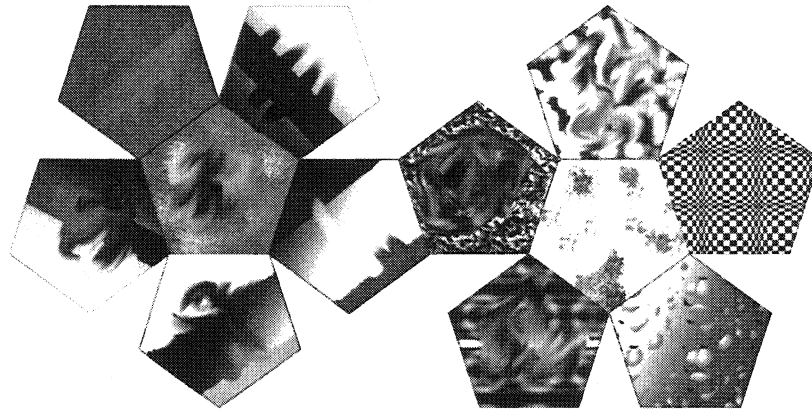

In art, students used color and innovative take-offs from the mathematica construction to produce art projects.

Then they used what they had learned to generate the Fibonacci spiral, which had been discussed in class.

In mathematics, the students learned about Pythagorean Theorem using manipulatives and Platonic solids using straws and pipe cleaners, then used the ideas to create mobiles as wall hangings to decorate the Multimedia Studio.
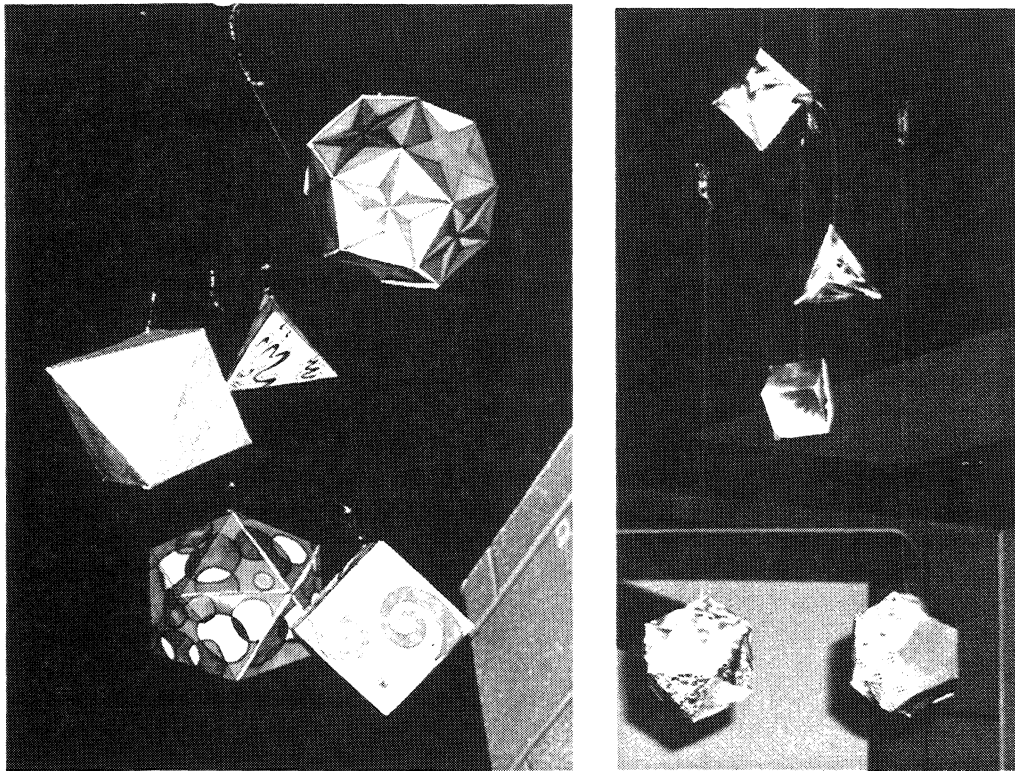
Platonic solids mobiles created by students and displayed in the Multimedia Studio

After a brief introduction to symmetry, including finding subgroups of the symmetries of a hexagon, following a suggestion from A. Crannell, students used Kaleidomania to explore symmetries in the plane in a puzzle environment and asked to draw symmetric and non-symmetric pictures in art.

In my art class I assigned the students to go outside and draw a tree. This was a welcomed relief from the mathematical thinking in the previous mathematics class. Upon returning to class with their drawings Professor Rose asked them to put the drawings on a light box and just trace half of the tree; after that Rose had them fold the paper and trace the one side which resulted in a perfectly symmetrical tree. This gave them a hands-on example of symmetry and asymmetry.

Taking advantage of the availability of Photoshop and Clarion's Multimedia Studio, I then had them scan in the drawings and create snowflakes using the two types of trees that they created. Snowflakes evolved which gave them a perfect introduction to fractals and commonalities in nature.

After discussing chaos and chaotic behavior, students played the "Chaos Game" and examined how fractals are formed on Fracta-sketch. Students then drew pictures that involved fractals like trees using what they had learned.

After a brief introduction to tessellations and some introduction to Escher, students made their own wallpaper using the principles they had explored on the computer.

The main topic in the course, however, was definitely, as stated in its name, Perspective. In mathematics, materials due to Marc Frantz were followed and built upon successfully. These included such varied approaches as a blackboard demonstration to demonstrate how to draw in perspective, and a computer animation, along with the traditional constructions used in art for one and two point perspective, to double and half a line, etc. The theory was, of course, too much for the students, but the animations of perspective and the Sierpinski gasket proved popular. Students showed how creative they

could be when they used EXCEL following Frantz's exercise to draw a house in perspective, and then adorned the house.
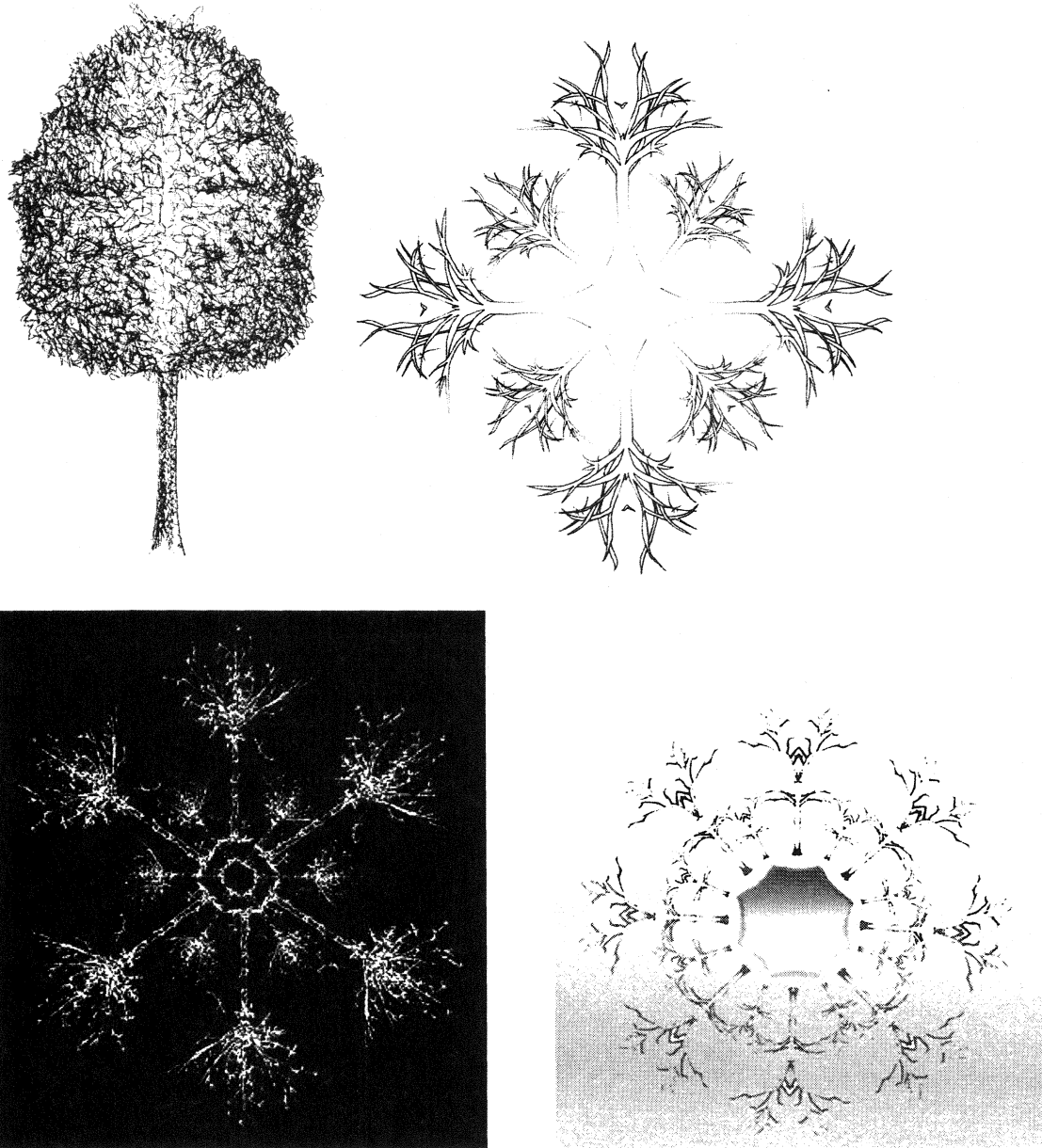

Digitally enhanced drawings that show symmetry and asymmetry using Photoshop

The students used Prof. Frantz's activity to see perspective hands-on using tape on the display windows near the multimedia studio. Again they drew trees and other adornments on their drawings and really seemed to get involved in this exercise involving ladders, tape, and teamwork. An accidental visit by the Dean was certainly helpful. So were the pictures on Prof. Calter's web-site.

To reinforce the experience, two separate activities were appended to the course: a visit to the Cleveland Museum of Art where students used their knowledge of perspective and "optimal viewing distance," which gives the viewpoint of the artist in the painting, could be used on real paintings. Students

discovered that the very first painting we saw was not hung at the right height, but that many others were. The art show, juried by the Chairman of the Art Department provided an alternative final examination for both courses. To enter, students needed to produce some work of art for display in the "Empty Set Gallery"(it was named before our course was designed) and attach a description of how mathematics was used in the art. The contest was open to all undergraduates, and thirty entries were received including nineteen from the class.
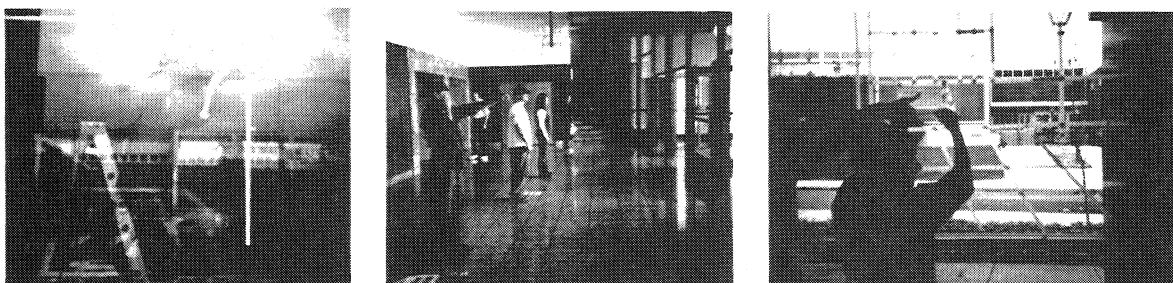
Hands on student project to help visualize perspective

What We Learned, What We'll Do Differently

There were some things we would do differently however. We will teach the 3 1/2 hour course in one rather than three rooms. The computers in the Multimedia Studio will be strong enough to do the Mathematics, and the studio will be free of other competing classes. Trying to get the students to use computers in PC and MAC formats in three different laboratories was a distraction. The size of the Math-Physics Lab made lectures difficult. We will be using a drawing studio in addition to the Multimedia Studio, which is better equipped for a "lecture."

Gendler will have a better idea of how to explain some of the unfamiliar material after having done it once already. But most significant, being in one room will allow us to integrate the courses...talk about mathematics, draw, and then talk about mathematics again. Also, this will mean that Gendler attends the drawing studio and takes part. Rose attended almost every mathematics class and acted as a cheerleader for the students, asking some of the questions that needed to be asked and giving his perspective on what was covered, but Gendler, who has no talent as an artist did not attend the drawing classes. The students said he should so that he would see their experience there. Nineteen of twenty students completed it successfully, and one a very few got grades of C or less in either class. Students were not awarded grades for attendance, but actually learned more in both classes and did better as a group on tests on similar material than students who took the courses the semester before. All considered, for a first offering, The University felt that the results were quite successful and we do intend to try again as soon as it is practical to do so.

Appendices

Mathematics Course Outline (Abridged):
MATH 112:Excursions in Mathematics: 3hr. 3sc. MWF(1P)
Prof.S.Gendler 54 Pierce

We will tentatively cover an array of topics designed to make Mathematics and Art blending together. Topics like geometry, symmetry, perspective, fractals, tessellation's, data analysis, and mixing problems will be covered in an atmosphere that encourages computer exploration and Web usage. You may find homework exercises in other textbooks. If you find an answer in another text, I will give you extra credit.

Grading: Midterms(2)-20% ea.(tentatively); and a final exam(40%) CUMULATIVE, class work/homework/projects(20%), and the instructor's judgment(5%)up or down.

1. Basic geometry with Geometer's Sketchpad …drawing with sketchpad and Photoshop
2. History of geometry through perspective
3. Pythagorean theorem with classical proofs and manipulatives
4. Fibonacci numbers, gnomons and the Fibonacci spiral
5. Euler's formula in the plane, three dimensional figures, and Platonic solids, and Euler's formula in three dimensions
6. Perspective:
    b) a) Finding vanishing points and viewing distances
    c) Doubling and halving figures and drawing fence posts
    d) Using proportion to draw a house in EXCEL
    e) Hands on window project to illustrate perspective
7. Symmetries of the triangle and hexagon and in the plane: Translations, reflections, and rotations using Kaleidomania
8. Tessellations with Tesselmania
9. Fractals and Chaos
    a. The Chaos Game of Devaney
    b. Building Fractals with Fractasketch
    c.Fractal dimension and some surprises
    d. Sierpinski's gasket
    e. Chaotic behavior and iterations in the plane
10. Visits by Paul Calter, Annalisa Crannell and Marc Frantz
11. Trip to the Cleveland Art Museum
12. Juried art exhibition on Art and Mathematics with substantial prizes as Final Exam.
13. Animations demonstrating perspective and the Sierpinski gasket

Art Course Outline (abridged):
Color and Design and excursions in math cluster
Course NUMBER: ART -125-01 making connections course 100-01
Fall 2001-Tuesday and Thursday 2:00-4:30-Room 121 and 108

Course Description:
Color and Design is a beginning course where emphasis is placed on compositional construction and variations in lines, forms, and colors. Individual sensitivity to design in nature and art materials is stressed. A relationship between art and math will be established.

Assignments
Monthly evaluation of your assignments. The assignments will grow as we develop a stronger sense of design. The assignments will be due every four weeks.

Final Examination: The final will be worth 10% of your grade. It will be a review of all assignments presented in an Itoya portfolio. Examples will be shown.

Optional sketch book
You should keep your own personal sketchbook. They can range from small hardcover to larger 11"x 14" hard cover. Any style is acceptable. I will collect sketchbooks each month. A great sketchbook can replace a poor grade in one or more of the projects or gain you extra credit. Sketchbook review is totally voluntary.

General Objectives:
1) To introduce a variety of design techniques.

2) To explain methods and techniques of design projects.
3) To understand the creative potential of Design.
4) To understand the relationship between Art and Math

Terminal Behavioral Objectives:
1) Understand and use design vocabulary
2) Demonstrate good design fundamentals leading to sound composition.
3) Develop a system of personal problem solving.
4) Participate actively in classroom discussion and critiques.
5) Grow through creative experimentation.

Course Content:
1) Techniques and Processes:
   a) Typography b) General Design c) Design Vocabulary d) Creative approach
2) Material Experience:
a) Pen and ink b) sketch pads c) tracing paper d) mechanical pencil e) triangles

Method of Evaluation:
1) Quantity-objective: evaluation of amount of work completed.
2) Quality-subjective comparison between past and present students to determine a standard that typifies beginning level design projects at the college level.
3) Growth - subjective evaluation of improvement during the semester.
4) Creativity - subjective evaluation of student's originality.
5) Attitude-objective and subjective measure of participation in class.

Calendar for the first eight weeks
Week 1
One Dimensional Geometry
Create a drawing using geometric shapes to create realistic objects and be conscious of how they relate to the four sides of your paper or the picture plan.
Assignments:
1. Draw five pictures using geometric shapes
2. Create and image using geometric shapes that relate to the four sides of the picture plane
Digital Work: Learn PhotoShop 6, fill in your geometric shape design with color
Week 2
Three dimensional Geometry
Various subjects addressed: Depth of field, Going into the picture plane, Tonal perspective, Chinese philosophies, World philosophies on space, Introduction to light sources on three dimensional geometric forms and how to render them in two dimensional. The great lie, Introduction to stippling, cross hatching, and large black shapes
Artists to look at: Rockwell Kent, Aubrey Beardsley, and Rembrandt
Assignment:
Illustrate the week two-math paper or something relating to week two in Math class such as:
The great pyramids, Golden section, Gnomons
Digital Work: Learn PhotoShop 6
Week 3
Artistic perspective--one and two point
View video Masters of Illusion
Assignments:
1. Illustrate a subject using one point perspective
2. Illustrate a subject using two-point perspective
3. Create a mystical Machine that has wheels and dials and animal like characteristics drawn in perspective
Digital Work: Learn PhotoShop 6, Fill in your geometric shape design with color
Week 4
Perspective and how it works and Advanced perspective techniques
Introduce to artists such as: Thomas Eakins, Leonardo DaVinci, Piero Difrancesco, and

Frank Lloyd Wright

Introduction of negative and positive space, relate perspective to geometry and nature, how do we draw railroad tracks and picket fences?

Video- Falling Waters

Assignment:

1. Design a building relating it to its environment in which it exists and render it in pen and ink

Week 5

Three dimensional Geometry-Dimensional Form and Space

Create a drawing using tape and glass to exemplify how the scale of an object changes with positioning of the viewer

Review of lines, letters and shapes, familiar objects, unfilled area of shapes, implied shapes, holding shapes together, overlapping, abutting (tangent), interlocking edges, from shape to form

Assignments:

1. Draw a picture using the process of perspective used to draw railroad tracks or picket fences in two-point perspective.
2. Complete your Platonic Solids mobile. Fill in your geometric shape design with color
   Digital Work: Learn Photoshop 6

Week 6

Creating simple logotype designs and incorporating them into a tile design

Actual Texture, Simulated Texture, Built up media Repetition of Design elements, Type as Texture, Prints a s texture, Computer Textures, Review of basic typographical terms

Assignments:

3. Create a simple design using your first and last initial in black and white
4. Create a well-designed color logo
5. Create a wallpaper design
6. Create a small, box covered with the design that you created using your first and last initial design
7. Another logo design Assignment: Create a full color logo for the AGES Department. Information will be supplied

Week 7

introduction to classical proportions and the concept of proportion and how shapes change in thier environment

Assignments: Projects may be done in the computer or by hand

8. Do problems: Changing the identity of a shape-Chapter 4 Page 110 Problem #4•1
9. Do problems: Metamorphosis -Chapter 4 Page 119 Problem #4•8
   In a series of steps change one shape into another. In a second series, change one form into another.

Week 8

Words and how they work

We will explore negative and positive space in paragraphs and pages when using typography. Relate typography to geometry and nature

Assignments

10. Create a design using only words to convey a feeling. Using content, style, and color
11. Attend presentation October 22, in room 120 --3:15 to 4:30 "Explorations in Art and Mathematics" Write a one page paper about the presentation

References:

Burger, Edward and Starbird, Michael, The Heart of Mathematics, Key Publishing, 2000

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Frantz, Marc,

Zelanski, Paul and Fisher, Mary Design Principles and Problems,

Harcourt Brace College Publishers, 1996