

Modeling Art History: Exploring Edward Hopper's *Nighthawks* Outside and ...IN!

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1. Abstract

How can teachers get students to explore art and art related fields and have or learn the process of critical analysis and critical thinking in an educational curriculum that is heavy on the engineering and technology courses? Inevitably these students are asked to be artistic and to have knowledge of disciplines outside computer graphics technology. Indeed, they will seek employment in the entertainment industry, where they will work on films that have an artistic, literary and historical component. Additionally, how can we expose them to the working methodologies of group or collaborative learning while still advancing their knowledge base in computer graphics-specifically three dimensional modeling, texturing and lighting. This paper outlines and describes one approach that is immersive in the outside disciplines while still utilizing the tools of computer graphics to solve the visual problem. It also contains the collaborative learning elements and critical thinking components that students need to be successful in these endeavors.

2. Broad Overview

The basic approach for this class was for the final project to use an artistic discipline for the subject matter and create a problem that can use modeling technology to achieve a solution. Using a group project model that included collaborative learning elements, the students formed a team and developed a workflow plan for project management. This approach also allowed this team to explore software modeling and rendering technologies not directly covered in class, but technologies that were the more appropriate to solve the particular problems of the subject matter that was assigned for their exploration.

Expose and insist on research methods and critical thinking for a freshman computer graphics class using a 3D modeling tool to solve an art history problem. Additionally, the project and working methodology challenged the group to explore modeling technology not yet learned and to create a series of documents to archive the project and process.

3. Collaborative Learning and Interdisciplinary Teaching and Learning

3.1 Collaborative Learning

In addition to the inherent Computer Graphics and Art History Interdisciplinary aspect to this project, there was the additional dimension of the collaborative learning (CL) approach. CL has been researched and written about in any number of respectable journals on education and it has been for the most part advocated and championed by the educational field. It is widely believed that by working in small groups, the students' interest in the topic or process increases and that the process promotes critical thinking. (Gokhale, 1995). Additionally, according to Johnson and Johnson (1986) there is strong evidence that cooperative teams think at higher levels and have a greater and stronger retention rate than students working solo. Certainly, the CL method allows for engaging discussions, tangential thought and for the opportunity to exist that students will take ownership of their own learning and that of their teammates.

For the purposes of this project, we used the following definitions:

Collaborative Learning-students working in groups toward a common academic goal and toward a solution to a proposed problem or task.

Critical-thinking tasks-items and knowledge that required analysis, synthesis and evaluation or comparison of theories, concepts or processes.

In the CL approach to learning, there are basically three ways in which a group can be formed. Groups can be self-selected, a method where the students choose the make up of the group. Groups can be formed randomly, by counting off or some other random selection technique. The other way in which a group can be formed would be based on the problem and method of approach to solving the problem. Students are identified by their strengths and/or weaknesses and the groups are created with some attention to balancing the skills throughout the groups. Optimal group size is around four to six students. Rau and Heyl (1990) indicate that smaller than four would result in a possible

deficiency in divergent thinking styles and varied expertise. Larger groups can become a management liability and allow some students to opt out of participation.

CL isn't just about forming the team, the instructor has to craft the tasks, problems and empower the students to achieve. It's important that the tasks or problems to solve have a high degree of student interdependence built into them. Barbara Gross Davis advocates that the students must perceive that they "sink or swim" together, that each member is responsible to and dependent on all the others and that one cannot succeed unless all in the group succeed. (Davis, 1993). This knowledge, that your peers are reliant upon you and you upon them serves as a strong motivator for accomplishing assigned tasks and working at a level higher than they might if working solo. Knowing that the work is to be scrutinized and possibly judged by their teammates, often raises the quality of the work performed.

CL often increases the professor's load due to the fact that one basically becomes the Project Manager (PM), meeting extra with the team leaders or the groups as needed. The PM often has to deal with personnel issues that arise within groups-certain team members not contributing as expected. But, with care, this one on one time can actually be some of the best teaching and learning that occurs in the educational environment. A professor that enjoys and is suited to CL teaching and learning can have some of the most rewarding experiences within this context. It certainly requires an extraordinary amount of pre-planning to avoid the pitfalls of assigning busy work and other kinds of tasks that the students might feel are irrelevant.

This type of learning requires much pre-planning on the professor's part. Milestones and check in dates need to be carefully considered. The PM needs to work with each group to design the work plan and map out how each group can proceed. A plan of action should be developed by each team detailing the timeline for accomplishing the major and minor aspects of the project. A list of tasks and assets necessary for success needs to be detailed along with a notation of who has ownership of shepherding each item to completion and a note about how it can and should be accomplished. Once the work flow and timelines are established, daily, twice-weekly or weekly meetings should suffice for contact and oversight on the part of the PM.

3.2 Interdisciplinary Teaching and Learning

The question always arises, "What is Interdisciplinary Learning?" and there are many answers depending on your point of view. For the purposes of this paper and as used in the classroom projects detailed below, Interdisciplinary Teaching and Learning (ITL) will be defined as it was by Klein (1990) as the synthesis of two or more disciplines, establishing a new level of discourse and integration of knowledge. ITL can be viewed as a method, process or way of knowing and investigating one discipline through or by the use of another. In the case below, as with the Rutgers cases, and others mentioned here, computer graphics tools and technology will be used to explore Art and Art History.

Armstrong (Klein 1996) identifies four levels of ITL from level 1-students taking courses in different disciplines without any formal opportunities to connect the learning in the areas. Level 2 provides some opportunities for students to participate in a capstone course, where synthesis and the sharing of insights gained in these other courses is part of the overall plan in this type

of course. Level 3 in team taught courses, where faculty from different disciplines come together and teach a course. Often, though, this falls short as the faculty often remain focused on their discipline. Level 4 entails a conscious effort on the part of all parties to integrate material into a coherent framework based on real understanding of the individual disciplines being brought together. The hope is that some Unity will happen and the whole new exploration will be greater than the sum of the parts.

ITL is but one way to more fully engage students in the learning process. It challenges their critical thinking capacity, it challenges their assumptions not only about the added discipline, but their own chosen field of study as well. If a faculty member is not fortunate enough to have a multiple disciplinary background, a carefully chosen collaborator can be an excellent way to put together a project, a course or a whole new field of study.

4. Our Project Overview

The Art History portion of this project was inspired by a number of factors in the authors' ranges of experiences. Firstly, the authors come to computer graphics technology and to three dimensional modeling and animation from the disciplines of Theater, Fine Art, Graphic Design and Instructional/Educational Technology. This breadth and depth of experience predisposes the faculty to look to other disciplines for ideas and methods by which to enhance learning and understanding. The perception is that engineering and technology focused curriculums and faculty are not as likely to seek these resources. Liberal and Fine Arts based programs are by nature, more inclusive of a broader range of topics than math, science and engineering based programs.

The impetus for the specific content for these projects was validated by Rutgers University' SIGGRAPH 2002 Educator's presentation entitled and the follow up presentation in 2003 called *Animating Art History*. In *Animating Art History for Teaching* (Tarbell & Tan 2002) and in *Animating Art History: Building a Bridge Between Disciplines* (Tan, Tarbell and Wuilfe 2003) the team from Rutgers describe a process where animators and art historians come together and build tools-animated art works-that can be used to teach Art History. The three dimensional aspect of the tools developed add a level of visualization and appreciation that doesn't necessarily exist experientially in the original work, but can affect how a student views and perceives the work with these newly developed tools. Additionally, the animated Vermeer exploration from the SIGGRAPH Computer Animation Festival, created by Interface Media Group, Washington, D.C., shows the painting, *The Music Lesson* by Johannes Vermeer. Using computer graphics tools and visualization techniques, the Vermeer work was deconstructed to show changes made by the artist and also allowed exploration of the space in which the painting subject exists. It added a thoroughly new appreciation of the work of this master and how his process for a painting might change over the life of the process of creation.

This idea was validated in March of 2006 at the Japan Media Arts Festival where student artist and technologist, Takahiro Tsushima displayed a stereopticon installation using Vermeer's *Allegory of Painting*, three dimensional modeling and animation technology to allow the viewer to travel in and around the artist and the artist's studio. It was a striking example of Art History and three dimensional modeling coming together to greatly enhance the

study of an artwork. This project can be investigated on the World Wide Web at <http://www.idd.tamabi.ac.jp/d46080/>. Takahiro Tsuchida is a student at Tama Art University in Japan.

The visual exploration and narrative descriptions of these famous works of art indicate that the possibility exists to use three dimensional modeling and rendering to enhance the way in which art is viewed, and explored and the assumption is that it could be any piece of art from any artist in any era. The choice for the specific class project in the Purdue class needed to add to the base content of art and art history explorations utilizing technology.

5. Project Specifications

5.1 Team Selection

The students in this class were assigned to groups based on the needs of each project-Art History, Theater Design or Architectural Visualization. Each of these projects required the following skills: modeling, lighting, rendering, texturing, research, organization, project management, so students were placed based on previously divulged interest in the three areas presented and then balanced against the task based needs of the project. Each team then discussed, with the PM selecting a team leader who would be the primary point of contact with the PM. This person was generally the more organized of the team and each team was seeded with at least one person with the administrative skills to carry this position. The students are very aware of who should do what tasks by the middle to two thirds of the way through the semester. They are also very frank about it if they are capable or not capable of some aspect of the assignment. It was important to let them sort it out among themselves.

5.2 Content Selection

In a more perfect world, or perhaps in a third or fourth year class, students would pick their own painting or dramatic work or architectural project to work on. In this freshman level, second semester course, the teacher selected the content for each of the areas to be explored. In the Art History area the particular exploration was to be of Edward Hopper's famous painting, *Nighthawks*. In the Theater Design area, the play *Extremities*, by William Mastrosimone was chosen. This group received a previously designed set, complete with designer and technical drawings and a rendering sketch of the set, was given to the group. In the area of Architectural Visualization, a building was identified in the community as a possible asset for redesign to be a new university building. The students obtained a plot plan of the building and land and then measured the inside and outside of the existing building. For each area the students were asked to research as many aspects of their content area as they could. In the case of *Nighthawks*, they would certainly research the painter, the historical period, society of the time of the painter and the subject, as much as they can about the painting as they could. In the area of Theater Design, the students needed to find a venue for the production, read the play, engage in dramaturgical research on the past production history, other sets that had been designed, the movie of the play and any reviews or critical work done on the piece. All of this critical thinking work was to assist in the production of a 3D model of the world of the painting, the *Extremities* set or the building visualization was to be created.

5.3 Student Work

The CL approach has been used by each of the authors in numerous classes throughout their curriculum. We are focusing on the Art History themed project because it seemed the most appropriate for this discussion and the most information about it's process and success exists beyond the semester in which it was completed.

Adhering to the principles of CL, the professors oversaw the groups of students specified here. In addition to the work flow and tasks and timeline mentioned above, it occurred to the faculty that the students should keep a time and task log. Essentially a billable hours report on the tasks they were assigned, the time and dates it took to complete the tasks and a running tabulation of the total time for their parts and pieces of the project. This tool helped the students continue to refine their goals and expectations as they went along, measuring yet to be completed portions of the project against already completed similar tasks. Then, in the daily group meeting, the TL and/or PM could very easily assess where the project stood and if necessary, detail compromises that would need to be made to meet the target goal. With this kind of data, it made the choices of cutting, a thoughtful and informed process, rather than a panicked, last minute thing. Ultimately, the cuts didn't undermine the integrity of the stated goals of the project and actually made a great deal of sense from a production stand point.

5.4 *Nighthawks*

The *Nighthawks* group goal was to create the diner in the painting and as much of the surrounding environment as possible with the ultimate goal of being able to enter the painting and the diner and see what the subjects in the painting are seeing. *Nighthawks* was chosen for the architectural nature of the subject matter and the time period in which the painting was done, the building was constructed and the availability of resource material on the painter, painting and the subject of the painting. It would be erroneous to think that this one choice of a painting will influence any student to become a consumer of art and art history or more specifically of only American Realism. Any painting from any period could be chosen, but the authors stepped right into the situation described by Komar and Melamid in their less than scientific study of art conducted by their traveling exhibition "People's Choice: The Polling of America," in which they determine that Americans prefer some sort of Disneyesque Americanization of "ART". Care should be taken to expose any group of students, in our case engineering technology students, to the breadth and depth of Art History as explored in books like Gardner's *Art Through the Ages*. Nonetheless, *Nighthawks* has an appeal that fit the needs of this group of students and thus was the choice for this incarnation of this project in the Introduction to Geometric Modeling class in the spring semester.

5.5 Progress

The students took this project to heart and worked extremely diligently on all the administrative tasks outlined in the pre-planning meetings with the team and the PM. They also, very early, sought ways to go beyond the minimum requirements of the project. They realized early on that to achieve the visual results the painting deserved, that they would have to employ rendering technology beyond what was included with the Rhinoceros

modeling software they had been using all semester. One of the group members had some limited previous experience with 3D Studio Max and it was decided that this software would be the rendering technology they employed for the final rendering. Each member of the team was modeling parts of the painting-general architecture, interior furniture, dishes and other diner accoutrements, light fixtures and the outside environment separate from the diner. The students realized through analysis and discussion that they would have to include and model, many items that weren't evident in the 2D painting by Hopper. Once they realized that a viewer could come into the world of the painting, essentially enter the diner, they should be able to see things like the floor and the ceiling and behind the counter. This sparked their curiosity as to what does the rest of it look like if we could see it. Additional research and modeling was outlined and assigned and they continued production.

This particular group of students included in their work flow, a social aspect that we haven't seen in other groups or to as great a degree. This group spent social time together visiting other museums and looking at other art or going to movies that were related in some context to the Hopper painting. When it was discovered by the group that the actual painting hangs in the Chicago Art Institute (which was only 90 miles from campus) the group took a trip to see the work they had become intimate with over the weeks of the progress. This particular revelation and subsequent trip to Chicago, served to cement the group and keep them focused. It also raised their internal expectations as they now had been in the presence of the original and it mattered more that they get it right. The group even went so far as to photograph themselves, in costume and composite themselves into the final rendering-a move that would make Marcel Duchamp smile.

5.6 Results

The final piece produced for this Modeling Art History project was actually quite good. The students found the modeling fairly easy, but they ran into some trouble in the rendering aspect of their project. Since rendering is a whole different semester long course, they had only rudimentary knowledge of the processes they would need to have success with *Nighthawks*. This group rose to the challenge and researched the problems they were having, specifically with window glass and light and reflection/refraction and how to overcome cloudiness problems in this situation. In the end, the group far out performed the expectations of themselves and of the other groups in the class. Though each of the other groups' products was exceptional for a freshman level class, the *Nighthawks* group went far beyond the minimum and the results reflect this. Anecdotally, this group has continued to stay together, even though after they earned their Associate of Science in CGT, they each went to other majors on the campus where they studied. Two of the team members went to other schools to complete their study, one in a different state, but all remain in contact with each other. One of the team members would be considered a non-traditional student, much older and returning to school and it mattered little to the group and was not a hindrance in the production process, the communication process or on any other aspect of the project.



Fig. 1. Final rendering of the 3D model of Edward Hopper's famous painting, *Nighthawks*.

The following URL will take you to an image of the original by Edward Hopper so you can compare the results:

http://www.artic.edu/artaccess/AA_Modern/pages/MOD_7_lg.shtml

5.7 Student Response-Jerry Banik, Team Leader

The *Nighthawks* project required us to extrapolate from data we could observe in Hopper's painting to data not visible in the painting. It was necessary to infer things such as the possible look and texture of the diner's floor, the lighting fixtures, and the back side of the counter. That type of thinking, using inference, or projection from "what we know" to "what we conjecture" is always a good learning process.

The team process required that individuals assess and acknowledge both their own strengths and weaknesses and those of their teammates, and to collectively manage that information in a way that would produce the best overall result. Our team composition was absolutely as good as I could have hoped for. Each member made solid contributions and interacted seamlessly with the others. I would add that this was by far the most enjoyable and beneficial of the many team projects in which I participated while at Purdue.

I was floored when the team took me up on my offer to drive us to Chicago to view Hopper's original painting at the Chicago Art Museum and to examine the many examples of excellent art deco architecture that I knew of in the city (art deco being the style we felt would most influence our decisions about creating the things our 3D project needed but were not visible in the painting). I thought the group's initial enthusiasm for the trip would wane, but to my surprise it did not, and every member not only found the time and followed through on their commitment to go, but also fully participated in the learning process while in Chicago (in addition to having a blast). I think Adam became a confirmed art deco buff on that trip.

The task of creating and rendering the model was appropriately challenging. We had to make many decisions about the complexity and detail that would go into each element of the model, giving careful consideration to our individual and collective limitations as modelers and to other constraints (like

having other, full-time college course work obligations, and, in some cases, jobs). The project forced us to demonstrate our ability to master the modeling and rendering techniques taught to us in the coursework up to that point, and it improved our mastery of them in addition.

5.8 Conclusions

The CL approach to teaching and learning can be a very rewarding experience for both the student and the teacher. The teacher is a much bigger part of the process in a CL situation, but the distance that the process brings the students in terms of their knowledge, skills and attitude is a major reason to include it in some way, shape or form in any curriculum. So many Engineering or Computer Science based Computer Graphics programs are so science and math based, that there is very little room for Art, Art History or Humanities based electives. But as some research has shown, the Humanities disciplines core knowledge and skills is often the critical component that furthers the math and science student to greater discovery. Alternative teaching methodologies and interdisciplinary study in any curriculum will more likely be a positive and rewarding experience for the students than some of the traditional, engineering and math based visualizations that we find in our traditional curriculums. The authors highly recommend this approach and will continue to include variants of it in their courses.

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