

# **AC 2010-303: PROMOTING AN INTEREST IN ENGINEERING THROUGH ART**

**Craig Gunn, Michigan State University**

## Promoting an Interest in Engineering Through Art

### Abstract

The project presented in this paper is designed to draw connections between engineering and the creative arts, especially for high school students in 9<sup>th</sup> through 12<sup>th</sup> grades. The idea is supported by the literature of the time that states that the current generation of students both in high school and college are no longer looking simply for a technical education. They are looking to pursue engineering with an ever increasing focus on creativity and the liberal arts. A number of years ago an abstract for a paper espousing the use of liberal experiences to further engineering studies began with "Variety's the spice of life that gives it its *flavor*." These lines in "The Task, I" by William Cowper (English poet 1731-1800) reflect an attitude that must be fostered in the minds of engineers. No man is an island, and no field of study can divorce itself from the activities, interests, and positive reinforcement of divergent areas of instruction. Many activities in the Department of Mechanical Engineering at Michigan State University have been pursued to foster liberal activities within engineering from poetry writing to novel production. It was thought and has been shown to have a positive effect upon the students and their studies from freshmen through graduate students. When carrying on casual conversations with these engineering students, especially when their guard is down, one can discover a wealth of information about their technical interests and abilities; but one can also learn about their interests in wider ranging fields such as art, music, and literature. In these more comfortable times, the ties to acting in plays, writing poetry, and creating works of art is evidenced. With these conversations, an idea was born in the Department of Mechanical Engineering at Michigan State University to utilize these interests to help engineering students move through their education. A variety of activities involving poetry and novel writing, musical composition, and art projects were investigated. These projects were highly successful with the undergraduates, providing many with both relaxation and actual valuable interest in better text production. While these were good activities, there was a concern that we were only making contact with the students already in the College of Engineering and not addressing their counterparts in high school, students good in math and science, possibly aiming toward engineering, but possibly more interested in the arts. The immediate thought involved capturing the attention of the high school students through art and not directly through math and science.

This paper describes a novel approach that involves students in two local high schools being introduced to engineering, especially automotive engines and energy, through their own efforts to create personal impressions of technical areas. The students worked through a semester art class, producing a wide range of paintings depicting their impressions. Their reactions to the experience, a survey given to undergraduate and graduate students on their assessment of pursuing humanities oriented areas in engineering will be presented, along with educational literature aimed at the furtherance of engineering and arts and letters collaboration.

## Introduction

As background it is important to note that many individuals who work in engineering believe that “In America, aesthetics has come to be regarded as a specialist's concern. Too often, aesthetics is viewed as an "extra" consideration that can only receive attention after the important "functional" requirements have been met and which can always be added on afterwards like a coat of paint.<sup>1</sup> During much of the past century, our buildings, roads, bridges, and other public facilities have been built without much consideration for aesthetics, or so it appears. It seems as though engineers have not been aware of the psychological effects of their designs. This lack of feeling for the value and essence of beauty leads to an unattractive built environment. For most people, their environment is the built environment. It is built by architects and engineers who are therefore responsible for its aesthetic qualities<sup>2</sup>.”<sup>3</sup> Wolfe took this idea into his classroom and decided to address the need to connect Art and Engineering. Over the years he has been successful in reaching his students and moving their thoughts from the pure fundamental nature of engineering into a mindset that “integrates the process of design with aesthetics considerations.” Wolfe, a civil engineer, believes that “with more attention to visual stimulation and human emotions in design, we will be able to revitalize our cities and recapture the spiritual aura that once made cities the place to be. Understanding the role of aesthetics in good design will help civil engineering students understand their place in society.”<sup>3</sup> Wolfe’s beliefs in the need to expose engineering students to art are vital to the profession.

This same thought trail unwinds in the mind of David Snider, University of South Florida, who uses the fine arts to broaden his students’ engineering perspectives. The National Science Foundation in its press release 06-127 comments that “On a college campus, it would be difficult to find two subjects more different from each other than art and engineering. Yet on the campus of the University of South Florida, one engineering professor responsible for teaching classes about differential equations and electromagnetism has created a popular course that merges his research world with the world of fine art.”<sup>4</sup> Snider is able to utilize the principles of engineering through detailed looks at the world of art. “Snider draws students in with topics that span from general interest--such as early theories of light and the structure of the eye--to more engineer-centric topics including a detailed exploration of the wave nature of light and the creation of cameras, from pinhole to digital.”<sup>4</sup> Instead of staying with traditional approaches to engineering education, he is out on the cutting edge of engineering education that utilizes areas that may not only be of educational interest to students but areas in which they truly are drawn but have been encouraged to ignore because they have no importance to engineering.

"The course gives engineering students the opportunity to think more creatively about the impact of their field and the relationship between the arts and engineering," said Sue Kemnitzer, the deputy division director for education in the National Science Foundation (NSF) Division of Engineering Education and Centers. "We also expect that more students with these broader interests will be attracted to engineering careers."<sup>4</sup> This new approach to engineering appears to be viable because the student of the 21<sup>st</sup> century is much closer to the earlier Renaissance men who would never have separated engineering and the arts. It was important for these men to be rounded in their educations. As Snider puts it, ““At first, many of the students' attitudes are coarse and unsophisticated: 'All Renaissance paintings look alike. Somebody actually paid money for this drawing?' But most of the great artists are acquired tastes, like scotch or retsina, and it's so rewarding to watch their level of

sophistication and appreciation mature. I'm teaching them a new form of recreation, giving them something to do in their off time when their jobs take them to new cities." <sup>4</sup> But I think even more important is the door that is opened to those students who really do see art as something of importance along with their desire to be engineers. They want permission to study engineering while still being able to follow their pursuits in art.

"A report for The Ove Arup Foundation, by David Gann of the Science Policy Research Unit at the University of Sussex, notes, among other things, that bright young people today have quite different aspirations from those of 20 years ago. Then, in what Gann describes as the machine age, they sought careers and perhaps some structure to their working world. Today, in the digital age they seek opportunities and perhaps fluidity. They would like opportunities to be creative. They enjoy technology and are computer literate. Many also like the idea of having an opportunity to do something good for the environment in which we live." <sup>5</sup>

Lastly, Jeffrey Brainard in his article, "Make Engineering a Liberal Art With Social Relevance, Report Suggests" reflected on the words of James J. Duderstadt, president emeritus of the University of Michigan that "the pace of change in engineering education is "glacial" and needs to accelerate greatly for American engineers to compete economically and solve society's pressing problems." <sup>6</sup> Duderstadt also offered a rather revolutionary statement when he said, "In particular, engineers should receive a liberal-arts education as undergraduates and then pursue graduate degrees as a standard route into the profession." <sup>6</sup> This belief that the liberal arts are an integral part of the engineer's education makes the attempts to keep the focus of high school students on both engineering and the liberal arts a compelling argument.

## **The Project**

The project that began our collaboration with local high schools from an arts standpoint started with a fairly standard architectural and engineering activity. A new 30,000 sq.ft. building was nearing completion and two issues were being addressed: an outdoor art piece needed to be placed in front of the building as per requirements by the university to provide 1\2 percent of the building's construction cost to visible public art work. This was accomplished through the purchase of a vibrant sculpture created by Charles McGee, a prominent artist from the Detroit area and shown in Figure 1. As with the artwork placed across campus since the mid 1990s, the McGee sculpture presented a clear statement that there were definite ties between various disciplines across campus, especially with engineering and art. The visible nature of the art displays made it clear to all entering non art oriented buildings that art was something to be considered by all majors. Instead of being hidden away in dark alcoves, the immediate visibility of the art helped to bring this message into the minds of all passing and entering these buildings.



Figure 1. Charles McGee Sculpture

The second issue involved the decoration of the main hallway that runs the length of the building. After much discussion with ideas that ranged from photographs of old cars to simply letting the walls stand bare, it was decided that continuing the focus that began with the McGee sculpture at the entrance was logical. Original art work that reflected the research going on in the building would be an appropriate way to enhance the building's walls and foster the connections between art and engineering. More discussion ensued and after it was decided that instead of simply going out and buying professionally created art work, the conclusion was to approach local high schools and ask for their student's artistic contributions. This approach would serve three distinct purposes: produce art for the walls, give high school students a chance to express themselves within an engineering context, and open up possible avenues for students who had never thought of engineering as a career path. The last issue addressed the current high school students who would like to be able to delve into engineering without leaving their fine arts interests behind.

Taking an engineering approach, we thought about problem solving from an engineer's perspective and applied it to the art project. Our problem definition was simple. We had a large hallway that could provide a suitable display area for a fairly large collection of art. Floors had to be kept clear, therefore artwork that could hang on the walls was required. One of the first tasks was to decide what the focus would be for the students. Providing them with simply a hallway and saying, "Go for it!" was far too broad. We thought up a variety of themes from automobiles to wind powered generators. Luckily we had a cutaway of a Jeep engine that had just been delivered and decided that this could serve at least as a focus for the project. The engine became the concrete object and the challenge to the students was to use their imagination to create pieces of artwork that focused on energy since the new building was called the Energy and Automotive Research Laboratory.

With that we approached the local schools and two, Okemos and Williamston High Schools, took up the challenge to create these works of art in one semester. The project involved all the students enrolled in art classes at Williamston High School, approximately 100 students and the senior art students at Okemos High School, approximately 25 students. Discussions with the teachers and students allowed us to talk about the creativity of engineering the way that engineers work through problems and how that problem solving can be utilized in many other disciplines. Many of the students remarked on how posing a problem definition – create a work of art for an engineering building that focused on energy, looking at the many possible solutions, choosing the best solution, working through that solution, testing it, and improving it worked well when thinking about what they wanted to do with the project.

Students remarked on how they lay out a number of designs before they settled on the specific design they would take to completion. After a semester's efforts were completed with 24 pieces of artwork being created, the works were framed, hung, and readied for a gala opening night. Students, parents, teachers, faculty, staff, and interested parties were invited to attend the official unveiling of the students' work. One of the most interesting things about the display was the wide varieties of interpretation that came from the students. As can be seen in Figure 2, Grace Obrien Hickey took the focus of her work to be the Jeep engine itself, taking a literal view of energy.



Figure 2. Grace Obrien Hickey – Okemos High School

While Anna Pathak, Figure 3, created a very abstract take on energy.



Figure 3. Anna Pathak – Okemos High School

All the students put different spins on the theme of Energy, and this made the display of all their work all the more impressive. Most of the students had not seen the other's work and both they and the audience that attended were able to see a broad look at a topic that they might not have considered when thinking about energy itself. Other examples of the student efforts are shown in Figures 4-7.



Figure 4. Brett Thorpe - Williamston High School



Figure 5. Sam Bayerl - Williamston High School

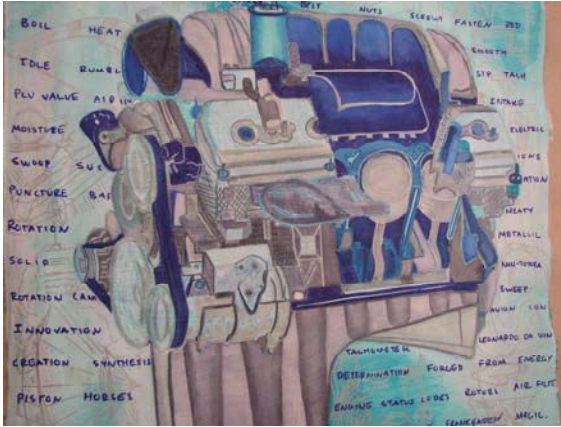


Figure 6. Dan Doktor – Williamston High School



Figure 7. Katy Gibson – Okemos High School

Listening to the conversation of the students with engineering faculty one quickly understood the student's pride in creating these works of art. They explained why they had done what they had done. They listened as members of the audience gave their impressions of the more abstract pieces and clearly stated their praise for the work presented. Perhaps one of the most interesting comments came from a young lady who commented that she was planning on following a career in engineering, but what really put her over the edge was being able to work on a love of her life - art - in the context of engineering, as she had just done. She had never thought of being able to combine the two disciplines of art and engineering. This may not be a deep and enlightening idea, but it speaks to the necessity to form bridges between a variety of disciplines, especially when dealing with younger students, students who may be lost to engineering because they saw no connections during their early years of education.



## Assessment

At this point, the majority of our assessment of the project has involved a large amount of anecdotal responses from the students involved, along with comments from visitors to the research facility, faculty, and university students. But in order to get a rudimentary understanding of the student's reactions to the project we asked the following:

1. Did you enjoy the project?
2. Did the project give you a different perspective on engineering in the world?
3. Did you research any engineering topics for your work?
4. Was the project worthwhile? (Figure 8)

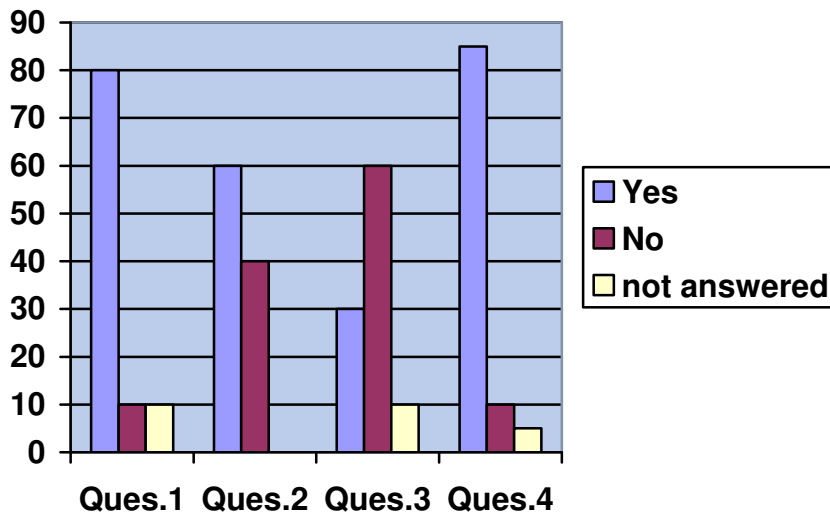


Figure 8. Project assessment results

We were pleased that the high school students found the work that they did was interesting, enjoyable, and worthwhile. From the comments we have received from individuals who have viewed the efforts of these students, we have accomplished what we wanted in the first round of efforts with local high school students. From comments like, "It was very rewarding to see high school students whose interests might not initially lie in engineering be so creative in their impressions of engineering," to "I am glad to see efforts being made to listen to this new breed of students, maybe we'll see more students direct their efforts to careers in an engineering field." One student response was quite telling about what students seem to have missed in their education, "I never realized that Michelangelo and DaVinci were both artists and engineers." The more that they investigate the two areas, the more they should find that will make it both correct and beneficial that engineers should be involved with art.

## Future Work

We are hoping to convince other school districts to participate in future Engineering and the Arts projects. We would like to broaden our efforts to include elementary schools and change the production to poetry writing and novel production. Also included in our future plans are more

visitations to schools to talk about engineering as a stimulus to excite K-12 students in the creative efforts that can include engineering in the arts. Added in the scope of future activities would be visits by undergraduate and graduate engineering students who could take the project from the portrayal of energy in relation to an engine to a much broader scope involving many aspects of engineering and the ways that these engineering topics could be expressed in art. The current project was limited to flat portraits in acrylics to sculpture and beyond.

## References

1. U.S. Department of Transportation, *Aesthetics in Transportation*, (Washington D.C.: U.S. Government Printing Office, November 1980), pp. vi-xii.
2. Leonhardt, Fritz, "Developing Guidelines for Aesthetic Design," *Bridge Aesthetics Around the World*, Committee on General Structures--Subcommittee on Bridge Aesthetics, Transportation Research Board (Washington D.C.: National Research Council, 1991), pp. 32-57.
3. Wolfe, U., "The Need for Aesthetics in Civil Engineering Education," <http://tc.wisc.edu/UER/uer96/author4/index.html>.
4. National Science Foundation, "The Art of Engineering," Press Release 06-127, [http://www.nsf.gov/news/news\\_summ.jsp?cntn\\_id=107990](http://www.nsf.gov/news/news_summ.jsp?cntn_id=107990).
5. Haryott, R., "Time to Push the Secret Art of Built Engineering," *Times Higher Education*, <http://www.timeshighereducation.co.uk/story.asp?storyCode=168066>, 29 March 2002.
6. Brainard, J., "Make Engineering a Liberal Art With Social Relevance, Report Suggests," *The Chronicle of Higher Education*, <http://chronicle.com/article/Make-Engineering-a-Socially/326>, December 14, 2007.

## Bibliography

- Bordogna,1. et al, "Manufacturing and Engineers' Education", *Issues in Science and Technology*, 7, no.1 (fall 1990): 20(3).
- Booth, W., "Curriculum Sparks Debate at MIT", *Science*, 236, (1987): 1515(2).
- Filho, M., "Humanist Education for the Lives of Today' Engineers", *IEEE Communications*, 30, no.11 (1992): 72 (3).
- Florman, S., "Learning Liberally", *Prism*, 3, no.3 (1 993):18(5).
- Kirkely, 1.L., "Our Industry Could Lead a Liberal Arts Renaissance", *Datamation*, 29, no.3 (1993): 29.
- Kranzberg, M., "Educating the Whole Engineer", *Prism*, 3, no.3 (1993): 26(6).
- Billington, David P., *The Tower and the Bridge: The New Art of Structural Engineering* (New York: Basic Books, Inc., 1983), pp. 3-15.
- Gottemoeller, Frederick, "Aesthetics and Engineers: Providing for Aesthetic Quality in Bridge Design," *Bridge Aesthetics Around the World*, Committee on General Structures--Subcommittee on Bridge Aesthetics, Transportation Research Board (Washington D.C.: National Research Council, 1991), pp. 80-88.

Harbeson, Paul C., "Architecture in Bridge Design," *Bridge Aesthetics Around the World*, Committee on General Structures--Subcommittee on Bridge Aesthetics, Transportation Research Board (Washington D.C.: National Research Council, 1991), pp. 105-121.

Liebenberg, A.C., "Aesthetic Evaluation of Bridges," *Bridge Aesthetics Around the World*, Committee on General Structures--Subcommittee on Bridge Aesthetics, Transportation Research Board (Washington D.C.: National Research Council, 1991), pp. 1-9.

Specter, David K., *Urban Spaces* (New York: New York Graphic Society Ltd., 1974), pp. 16-34.