Extended Abstract - FYE for Engineers Lab Course The Mini Rose Float Project

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***Abstract* – This paper discusses how Cal Poly Pomona integrates the Cal State's "learn by doing" philosophy into the curriculum by combining both a lecture and lab to prepare students for careers in engineering through hands on activities. Each Winter Quarter, a lab for the first year experience course EGR 100 is given the task of designing and building a miniature Rose Float. Under given specifications the class brainstorms along the actual Rose Parade theme. During this 4 week project, engineering students learn the respective values of fellowship and leadership. Each section is required to follow specifications for the design of their floats and the animations. Some of the specifications included size, speed, number of animations, and decorations. There is a detailed specification sheet and a rubric used by the judges to score the mini rose floats in the competition. Each class uses 3D modeling tools to develop the design. The "Learn by Doing" project experience takes a project from concept to completion, very similar to what he or she would do in the field as an engineer. At the end of the 4 week project a competition is held and the floats are judged during a parade of the completed Mini Rose floats.**

Index Terms – Brainstorm, first year engineers, gears, learn by doing, mini rose float, motors, problem solving, teamwork.

INTRODUCTION

EGR100Lab is a one unit class that meets once a week for 2 hours and 50 minutes. It is typically taken after or concurrently with the lecture component of the class, which is 3 units. Participants in this course will learn how to develop projects or a lab congruent to a lecture to better prepare students for careers in engineering as well as developing student's leadership, communication, problem solving, and teamwork skills. Each year since 2009, Cal Poly has hosted the mini Rose Float competition with all the sections of EGR 100 Lab during the Winter Quarter. Class size is from 20 to 25 students, with 90% of those students are freshmen engineering students. The engineering disciplines include Aerospace, Chemical, Civil, Mechanical, Electrical, Computer, Industrial, Manufacturing, and Engineering Technology.

PROCEDURE

The specifications and rubric for the mini float are developed each year by the group of professors who will be teaching the lab during the Winter Quarter. Each year the group of 5 to 7 professors review and modify the previous year's specifications. Attached below is the specification and rubric for the mini float competition:

Mini Rose Parade Float Project – EGR100L Winter2013

The EGR 100L students shall undertake a class project to design and build a functional model of a parade float similar to those constructed for the annual Rose Parade in Pasadena, CA on New Year's Day. This effort shall be implemented by teams of students responsible for one or several aspects of the float, with continued overall class meetings to coordinate the efforts relative to the finished product. Materials shall be both at the discretion of the group and as specified by the instructor. The theme for the float designs shall be ***"Dreams Come True".*** The mini rose float parade route is 30 feet long. There is a speed bump at 10 feet and a bridge at 20 feet.

Mini Rose Float Specifications

1. The overall envelope of the float shall be 24 inches maximum in length, 12 inches maximum in width, and be capable of traveling under a bridge that has a 12 inch clearance. These dimensions are checked before the parade and can change once the float is in motion.
2. The float shall be powered by a motor, powered by batteries, with an on/off switch. Students are responsible for making sure the batteries are charged prior to the parade competition.
3. The float shall travel at a rate of four (4) feet per minute, plus or minus, so that the 30-foot parade route is completed in 7 to 8 minutes. Lower points will be earned for floats that travel too fast or too slow, or that need to be pushed.
4. The model should travel in a straight line, without steering. Lower points will be earned for floats that need to be touched by a team member to keep them in line.
5. The model must pass over a 0.5 inch high speed bump without assistance. Lower points will be earned for floats that need assistance to pass over the bump.
6. Commercially available building kits are not allowed. The float will be built from scratch, including decorations. Mini-figures such as ready-made dolls and models are not allowed. Lower points will be earned for floats that do not follow these rules.

7. Any items in question can be submitted to the team of EGR100L instructors for approval.
8. Remote control is not allowed.
9. The float shall contain a minimum of three (3) separate animated displays. The float with all animations shall fit within the above envelope.
10. The separate animation displays shall be powered by motors and 1.5 volt batteries. Each animation will have an on/off switch.
11. Subjects for the animations may take the form of:
    a. characters with movements
    b. merry-go-round
    c. slide
    d. parachute drop
    e. train
12. At least part of the float must be decorated with items found in nature.
13. The float covering and decorating materials shall be approved by the instructor. The maximum amount that a team may spend is $50 total per float. There will be no reimbursement.

FIGURE I
-ROSE FLOAT PROJECT RUBRIC

EGR 100L – Winter 2013
Rose Float Project Assessment Rubric
"Dreams Come True"

Date: March 7, 2013

Evaluator name:

Team name:

	Excellent(5)	Good(3)	Needs Improvement(1)	5	3	1
Correct Size – length, width, height	Correct dimensions and fits under bridge	Too big or too tall	Too big and too tall			
Speed	4 feet/min (completes the course in 7 to 8 minutes)	Too slow or too fast (completes in less than 7 minutes or more than 8 minutes)	Does not move, needs to be pushed			
Goes over the bump	Goes over smoothly	Goes over with difficulty	Requires help			
Goes straight	Goes straight	Deviates some	Requires help			
Animation System 1	Performs an interesting motion, creative ideas	Works	Doesn't work			
Animation System 2	Performs an interesting motion, creative ideas	Works	Doesn't work			
Animation System 3	Performs an interesting motion, creative ideas	Works	Doesn't work			
Completes the route	Finishes	Drops out after bridge	Drops out after bump			
Overall Creativity	Very clever	Interesting	Plain			
Overall Look	Beautiful	Looks good	Plain			
Overall Functionality	Works well	Needs help	Does not work			
Total Score						

During the 5th week of the quarter the students are given the specification and rubric for the mini float project and the engineering design process starts.

Taking a project from concept to finished project in a limited time frame in first year engineering courses, provides students a great opportunity to develop their skills:

- Brainstorming to generate concept ideas
- Concept selection
- Open-ended problem solving such as how to fit three animations within the specified float size.
- Generating concept visualization through the use of 3D tools like SolidWorks, Blender, or Google Sketchup.
- Time and Project Management – setting key completion dates and times
- Managing a budget
- The class is one big team working towards the same goal, within the large team are several smaller teams:
    - Animation 1 Team
    - Animation 2 Team
    - Animation 3 Team
    - Design Team and Chassis
    - Drive Train Team

RESULTS AND DISCUSSION

The students involved in this project not only develop life-long learning skills by exploring new areas of thinking outside the box, and finding solutions not as individuals but as a cohesive team of future engineers. They discover skills that not only they have but those of their classmates. Their teammates bring prior knowledge into the process in the form of new ideas and creativity to enhance the overall project. They learn and utilize the full design process as described in Landis' third edition of Studying Engineering, A Road Map to a Rewarding Career to optimize their design.[1] Sorby and Baartmans have developed specific courses to help improve 3D spatial visualization in first year engineering students, their results have shown higher retention rates for engineering students who have participated in their course, particularly females who consistently score lower on the pre-test evaluation than their male classmates. [2] Blender an open source software has been used in India and GoogleSketchup has been used in Spain to help improve spatial visualization for first year engineering students. Both studies found that instruction using Blender or GoogleSketchup for enhancing 3-D spatial skills is beneficial and engaging for the students, particularly female engineering students. [3][4] And finally they develop teamwork and interpersonal skills that will service them as they progress through their engineering studies and on to their future careers.

EGR100L Winter 2013 – End Survey:

Students completed a survey at the end of the quarter. Listed below were statements in this survey and the results from the 5 pt Likert scale where the combined % of 4-Somewhat Agree and 5-Strongly agree were reported.

TABLE I
SURVEY STATEMENT RESPONSES

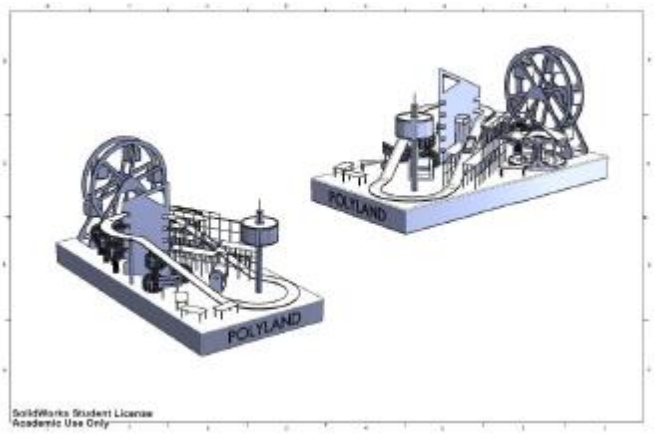
Statement	%Agree
I have had the opportunity to take part in active learning	81.8%
I have had the opportunity to practice time management skills.	67.4%
I have developed a sense of community by interacting with students, faculty, and staff.	78.1%
Working on a team helped me develop interpersonal skills.	75.8%
I understand the importance of pluralism, civility and interpersonal skills in a team environment.	81.1%
I enjoyed working on a team project.	72.7%

Students were also asked to respond to the following prompt:

Name one thing you learned in this course that was most useful for you (if anything). Some common themes:

- Teamwork
- Problem solving skills
- Time Management
- Leadership
- Communication and cooperation across teams
- Motors and gears

FIGURE II
CONCEPT



One of the main complaints about this project was that it was primarily a Mechanical Engineering focus with the use of motors and gears on the drive train and animations, however the 3D modeling aspect added another dimension, which could be a valuable tool for any engineering major.

FIGURE III
FINISHED PRODUCT

REFERENCES

[1] Landis, R. B., "Studying Engineering: A Roadmap to a Rewarding Career", 3rd ed. Discovery Press, 2007, pp. 38-39.

[2] S. A. Sorby and B. J. Baartmans, "The Development and Assessment of a Course for Enhancing the 3-D Spatial Visualization Skills of First Year Engineering Students," Journal of Engineering Education, vol. 89, no. 3, pp. 301–307, Jul. 2000.

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