NEESR Engineering Summer Camp Report

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Overview

The Network for Earthquake Engineering Simulation Research (NEESR) program is a National Science Foundation funded, engineering-based program which focuses on the seismic performance of nonstructural systems. This five-year grant has allowed for the Civil Engineering Department of the University of Nevada to work with ten other universities and institutions from around the nation, and has helped to fund the building of the NEES Equipment Site on the University of Nevada campus. This shake table facility is used to test and conduct research on geotechnical and structural systems in regard to earthquake engineering. Due to the educational impact of this facility, the use of the NEES equipment site has been utilized not only for undergraduate and graduate research, but also for K-12 engineering programs and community outreach.

The Raggio Research Center for STEM Education (RRC) portion of the NEESR grant concentrated on engineering outreach for K-12 students. Participants in the Dean’s Future Scholars (DFS) program through the College of Education were invited to attend the engineering camp held on the University of Nevada campus. The DFS program targets middle and high school students from disadvantaged backgrounds who identify themselves as Hispanic or Latino, who live in Spanish-speaking households, and who would be the first members of their families to attend college. By recruiting from the DFS program, the RRC planned to introduce the field of engineering and future engineering employment opportunities to students who otherwise may not have had access to this type of information and education.

Funding from the NEESR grant allowed DFS students to participate in up to two different one-week summer camps, during which they learned about many different types of engineering, including chemical, civil, mechanical, environmental, electrical, and biomedical engineering. Each engineering camp was also open to the public, which allowed for students from the Reno area that were not enrolled in the DFS program to participate.
In order to effectively plan for the engineering summer camps, two planning meetings were held by the RRC staff, and were attended by representatives from the College of Engineering and the DFS program. As a result of these efforts, the program ran more smoothly this year than last.

Participants

Each week-long summer session consisted of 25 to 30 student participants from middle schools and high schools in the Reno area. Students who participated in these camps consisted of DFS participants, as well as other interested local students. Students from the Davidson Academy of Nevada also participated in the summer camps. The Davidson Academy, housed on the University of Nevada campus, is a free public school for profoundly gifted middle and high school students. Students from the DFS program participated in the first (June 21-25), third (July 12-16), and fifth (July 26-30) weeks of the summer session, with three students in Week One, three students in Week Three and eight students in Week Five. These students were between the ages of 11 and 14 and all of them were from low-income middle schools where an emphasis on math and current technology may not be present in the classroom. Additionally, the RRC hired two former DFS students who are currently enrolled at the University of Nevada. They assisted the instructors and helped with student participant supervision.

The Engineering Summer Camp Experience

Each engineering camp was held Monday through Friday, beginning at 9 a.m. and ending at 3 p.m. Lunch was provided each day for every camp participant. In addition to classroom instruction, hands-on learning, and field work, students also engaged in computer
modeling, learning how it is used in many different fields of engineering. Introduction to technology was also a foundation in each of the summer camps.

Students spent most of each day in the Harry Reid Engineering Laboratory located on the University of Nevada campus. The College of Engineering created a weekly outline of activities specific to the type of engineering being taught during the week (Appendix B). For example, students that participated in the geotechnical engineering camp learned about floating concrete mix and making concrete canoes, bridge types, propulsion and aerodynamics, bottle rockets, electrical currents, digital gaming, and robotics. They toured the W. M. Keck Earth Science and Mineral Engineering Museum, a photo lab and the Seismology Lab, all on the University of Nevada campus. A trip to Manzanita Lake allowed the students to see if their canoes would float.

On the last day of each camp, students formed groups and made PowerPoint presentations to their instructors, parents and other participants, reflecting on what they had learned throughout the week. After the group presentations, awards and certificates were given to each participant.

The students were very excited about and engaged in what they were learning and experiencing. Two terms often heard in describing their experiences were “fun” and “cool” (Appendix C).

**Evaluation, DFS Participants**

The foundation of the educational outreach portion of the NEESR project is the extension of mathematical, engineering, and technological education to a population of young students who may not be aware of the vast opportunities available to them within these fields. In order to determine whether these goals had been met, RRC staff distributed an evaluation instrument that was created in the summer of 2009 to the DFS participants (Appendix A). This instrument was distributed to the DFS participants during Week Three and Week Five of the summer camps. In order to ensure that data were collected from all of the DFS participants, representatives from DFS contacted those that were not initially surveyed during Week One.
They were contacted by the DFS director and asked to provide their answers to the survey verbally. No identifying information was released to the RRC staff. Data were not collected during Week Two and Week Four of the camps, because none of the DFS participants attended the camps during these weeks. Each question on the survey focused on objectives and goals discussed at the 2010 planning sessions. Students were asked to respond to each question using a Likert-type scale. Three participants were surveyed in Week One, three participants were surveyed in Week Three, and eight participants were surveyed in Week Five.

**Evaluation Results**

The results of the evaluation yielded positive feedback from the participants regarding their experience in the NEESR engineering summer camps. The program was unable to recruit any high school students into the summer camp program this year. Participants in this year’s DFS program were overwhelmingly middle school students; thus the participants in the NEESR engineering camps were younger and at a lower grade level than originally anticipated. Nonetheless, based on the responses from the participants, the objectives set for the educational outreach portion of the NEESR grant were met. A large percentage of the student participants surveyed were able to make connections between the knowledge they had gained in the classroom and the content introduced in the engineering summer sessions. Participants reported that they were able to apply both prior and new knowledge regarding math, science, and engineering to real world situations after participating in the NEESR summer programs. Future application of acquired content was one of the most important educational outreach objectives of this project, and as the data show, through participating in the NEESR summer programs, an overwhelming percentage of the DFS students surveyed indicated that they had gained knowledge regarding engineering career possibilities. In addition, a large percentage of the students also stated that their participation in this program was well worth their time. The results below indicate participant responses from the first, third, and fifth weeks of the engineering summer camps:
### NEESR Engineering Summer Camp: Week One Results (n=3)

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have been able to make connections between this Engineering Summer Camp and what I have learned in school.</td>
<td>• 66% of participants “Agree”&lt;br&gt;• 33% of participants “Can’t Say”&lt;br&gt;• The average participant response to this question was “Agree.”</td>
</tr>
<tr>
<td>I have been able to make connections between this Engineering Summer Camp and what I have learned in school math and science classes to the real world.</td>
<td>• 66% of participants “Agree”&lt;br&gt;• 33% of participants “Can’t Say”&lt;br&gt;• The average participant response to this question was “Agree.”</td>
</tr>
<tr>
<td>It was well worth my time to attend this Engineering Summer Camp.</td>
<td>• 100% of participants “Strongly Agree”</td>
</tr>
<tr>
<td>In Science Camp I have learned about careers and jobs that I may not have thought about before.</td>
<td>• 100% of participants “Agree”</td>
</tr>
</tbody>
</table>

### Demographic Statistics for Week One (n=3)

- **Gender:**<br>  • Female: 2<br>  • Male: 1<br>  • No response: 0
- **Age:**<br>  • Under 12: 0<br>  • Between 12-14: 3<br>  • 15 and older: 0<br>  • No response: 0
- **Grade Level:**<br>  • Middle school (grades 7-8): 3<br>  • High school (grades 9-12): 0<br>  • No response: 0

### NEESR Engineering Summer Camp: Week Three Results (n=3)

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have been able to make connections between this Engineering Summer Camp and what I have learned in school.</td>
<td>• 66% of participants “Agree”&lt;br&gt;• 33% of participants “Can’t Say”&lt;br&gt;• The average participant response to this question was “Agree.”</td>
</tr>
<tr>
<td>I have been able to make connections between this Engineering Summer Camp and what I have learned in school math and science classes to the real world.</td>
<td>• 66% of participants “Agree”&lt;br&gt;• 33% of participants “Can’t Say”&lt;br&gt;• The average participant response to this question was “Agree.”</td>
</tr>
<tr>
<td>It was well worth my time to attend this Engineering Summer Camp.</td>
<td>• 33% of participants “Strongly Agree”&lt;br&gt;• 66% of participants “Can’t Say”&lt;br&gt;• The average participant response to this question was “Can’t Say.”</td>
</tr>
<tr>
<td>In Science Camp I have learned about careers and jobs that I may not have thought about before.</td>
<td>• 100% of participants “Agree”&lt;br&gt;• The average participant response to this question was “Agree.”</td>
</tr>
</tbody>
</table>
Demographic Statistics for Week Three (n=3)

Gender:
- Female: 3
- Male: 0
- No response: 0

Age:
- Under 12: 0
- Between 12-14: 3
- 15 and older: 0
- No response: 0

Grade Level:
- Middle school (grades 7-8): 3
- High school (grades 9-12): 0
- No response: 0

Engineering Summer Camp: Week Five Results (n=8)

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
</table>
| I have been able to make connections between this Engineering Summer Camp and what I have learned in school. | • 50% of participants “Strongly Agree”  
• 50% of participants “Agree”                                                      |
| I have been able to make connections between this Engineering Summer Camp and what I have learned in school math and science classes to the real world. | • 75% of participants “Strongly Agree”  
• 25% of participants “Agree”  
• The average participant response to this question was “Strongly Agree.”   |
| It was well worth my time to attend this Engineering Summer Camp.         | • 75% of participants “Strongly Agree”  
• 25% of participants “Agree”  
• The average participant response to this question was “Strongly Agree.”   |
| In Science Camp I have learned about careers and jobs that I may not have thought about before. | • 88% of participants “Strongly Agree”  
• 12% of participants “Agree”  
• The average participant response to this question was “Strongly Agree.”   |

Demographic Statistics for Week Five (n=8)

Gender:
- Female: 3
- Male: 5
- No response: 0

Age:
- Under 12: 0
- Between 12-14: 8
- 15 and older: 0
- No response: 0

Grade Level:
- Middle school (grades 7-8): 8
- High school (grades 9-12): 0
- No response: 0
Future Plans

The educational outreach portion of the NEESR grant ended this year, so future plans for this specific project will not be reflected. However, in early September 2010, two members of the research team met with representatives from DFS and the topic of recommendations for future programs was discussed. According to Robert Edgington, director of the DFS program, as well as his assistant, if the involvement of the Dean’s Future Scholars program in the engineering K-12 summer camps were to continue, or if similar programs were to become available, the following changes would be recommended:

- The DFS program hosted their own summer camp during the third week of the engineering summer camps, creating a conflict for DFS participants who wanted to attend both programs. Enrollment of DFS students into the engineering program would have increased had the students not had to choose between participating in the camp hosted by the DFS program and the concurrent engineering summer camps.

- It was also suggested that hosting an engineering camp strictly for DFS students would increase enrollment. It seems that many of the DFS students felt out of place among other engineering camp participants, most notably student participants from the Davidson Academy.

- A large group of DFS students wanted to participate in the engineering camp, but due to space limitations, not all who wanted to could attend. If the K-12 outreach portion of the NEESR grant were to continue in the future, DFS representatives suggested increasing the weekly number of spots allotted to DFS students.
Appendices
Appendix A: DFS Participant Survey Instrument

NO Names

Age ________________

Grade______________

Female________   Male________

Date_______________

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Can’t say</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have been able to make connections between this Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer Camp and what I have learned in school.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have been able to make connections between this Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer Camp and what I have learned in school, math and math</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>classes to the real world.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was well worth my time to attend Engineering Summer Camp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Science Camp I have learned about careers and jobs that I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>may not have thought about before.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Sample Schedule

Below is the schedule for Week Three, the Introduction to Engineering summer camp:

<table>
<thead>
<tr>
<th>MONDAY</th>
<th>TUESDAY</th>
<th>WEDNESDAY</th>
<th>THURSDAY</th>
<th>FRIDAY</th>
</tr>
</thead>
</table>
| 9:00 - 9:45 Registration, Welcome, Introductions  
   ~ Debbie (Camp assistants: Katie, Perla, Tomas, Juan)  
   HREL 109-110 | 9:05 - 2:55  
   PLEASE be on time:  
   Field Trip:  
   NV Dept. of Trans (NDOT)  
   in Carson City  
   (Wear your camp t-shirts, bring games for the ride) | 10:00 - 11:00  
   Introductions, Overview of NDOT, City Design  
   ~ Rob Easton, Human Resources Director | 9:00 - 9:45  
   Will our concrete canoes float?  
   Manzanita Creek |
| 9:45 - 10:45 Intro to Engineering presentation/Build Bridges from K'nex  
   ~ Katie Bowden, Civil Engineering graduate student | 10:00 - 11:00  
   Digital Gaming Lesson, design your own video game using Game Maker  
   ~ Anya Getman  
   Computer Lab/SEM 231  
   (Computer Science Engineering) | 10:00 - 11:00  
   Soda Showers, Liquid Nitrogen and Shape Memory  
   ~ Jason Hastings & Cody Wagner, Chemical Engineering graduate students  
   LME 218 | 11:15 - 11:45  
   Tour Keck Mining Museum |
| 11:00 - 11:30 Tour our Structures Lab  
   ~ Danielle Smith | 11:00 - 12:00  
   First Tour, Materials or Photo Lab | Lunch + Break | Lunch + Break |
| Lunch + Break | Lunch + Break | Lunch + Break | Lunch + Break |
| 12:00 - 1:30  
   Will Concrete Float?  
   Design & Build Concrete Canoes  
   ~ Katie & Mark  
   Geotech Lab, SEM  
   (Civil Engineering) | 1:00 - 3:00  
   Electric Currents, Capacitors, Wires and Coils  
   ~ Dr. Henson  
   SEM 346  
   (Electrical Engineering) | 12:00 - 1:00  
   Lunch on Outdoor Patio & Water Balloon Grid Toss | 1:30 - 2:00  
   Break - Tour Robotics Lab  
   ~ Richard Kelley, LME 321  
   (Computer Science) |
| 1:30 - 3:00  
   Learn about and ride a Segway  
   ~ Callie Henderson  
   (Mechanical Engineering) | 2:00 - 2:55  
   Complete video games  
   ~ Anya | 12:30 - 1:50  
   Prepare PowerPoint presentations - computer lab  
   SEM 231 | 2:00 - 3:00  
   Camper Presentations  
   (Parents & Instructors Invited)  
   HREL 109 -110 |
Appendix C: College of Engineering Participant Responses

The information below was collected from the participants by the College of Engineering. These responses include opinions of all student participants, not only the DFS students. The responses were compiled into digest form by the College of Engineering; not all responses are verbatim. The responses are from two of the five weeks, Week One and Week Three. Responses from Week Five were not provided.

The responses reflect the camp activities for each week, student participant comments, positive and negative, and additional comments regarding what they learned and how they felt about the camps.

<table>
<thead>
<tr>
<th>Camp Activity</th>
<th>Positive Comments</th>
<th>Negative Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro Slides</td>
<td>Most thought slides were informative, learned a lot about engineering jobs, they enjoyed the pictures.</td>
<td>Few negative comments but they wanted more pictures. Two put boring. One put not in depth.</td>
</tr>
<tr>
<td>Bridges</td>
<td>Fun activity. They learned about different types of bridges. Fun materials to use. Great presentation.</td>
<td>Lots of them wanted time to test them individually. Some didn’t want a model to be given so they can use their imagination. Two said easy.</td>
</tr>
<tr>
<td>Segway</td>
<td>Fun, amazing activity and cool presentation. Two put the best activity so far.</td>
<td>More time to ride the Segway. Want more than one Segway. A bit more explanation on how it works. Wanted an obstacle course.</td>
</tr>
<tr>
<td>Bottle Rockets</td>
<td>All of them thought the rocket activity was cool. Some put worth the challenge.</td>
<td>Not enough time, did not work in all trials, wanted more prizes to be given away.</td>
</tr>
<tr>
<td>Electricity</td>
<td>Loved blowing stuff up, awesome, speechless. Liked getting free computer software/motherboards.</td>
<td>None</td>
</tr>
<tr>
<td>N-Dot</td>
<td>Fun, learned a lot, cool, informative, liked pressure test.</td>
<td>Only one of them thought it was time-consuming, everyone else had no negative comments.</td>
</tr>
<tr>
<td>Materials</td>
<td>Fun, interesting testing weight, new things learned like interpreting maps, awesome, cool.</td>
<td>Wanted to do some sifting, wanted to feel the concrete, a couple of them thought it was boring.</td>
</tr>
<tr>
<td>Lab</td>
<td>Description</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Photo Lab</td>
<td>Fun, interesting, cool, learned a lot about how they make roads. A lot of them liked the 3-D images.</td>
<td>A couple of kids thought it was not that exciting. Liked Joe because he explains everything in an understandable manner.</td>
</tr>
<tr>
<td>Balloon Toss</td>
<td>Fun activity, funny also, wet and fun. Some of them commented on loving to win. Funny to watch when people got wet and also entertaining.</td>
<td>Wanted more balloons. A couple of them didn't like getting too wet. One of them thought it was boring.</td>
</tr>
<tr>
<td>Structures Lab</td>
<td>Cool, fun. Some kids loved the basement. Loved visiting the graveyard. Very interesting, awesome, informative, and detailed.</td>
<td>A couple of kids wanted to keep the stuff they made. One said they didn't pay attention.</td>
</tr>
</tbody>
</table>

**What scientific/engineering concepts did you learn from the day?**

- Resistance/current. Electricity is made of electrons, electricity can blow up things.
- How light bulbs work.
- Newton's Third Law.
- Roll and yaw from airplane movements.
- How similar rockets and arrows are, just add a huge explosion.
- Engineering is helpful to learn.
- Engineers design and build.
- There is more than one type of bridge.
- Magnetic fields appear.
- How much it takes to break a rock was amazing.
- Learned that imagery involves checking its accuracy by a visual test.
- What materials you use to make a structured road.
- Concrete is harder than tar.
- How aerial photos are taken. How aerial photos are made into maps.
- There are many steps to making maps.

**What scientific/engineering concepts did you not understand or feel were meaningful to you?**

- Did not understand why water was needed to launch the rockets.
- Did not understand how engineers would make a device, like a Segway, that reads and reacts to have far you lean.
- Did not understand how electrical circuits work.

**Any additional comments about the camp?**

- Great job!
- Adding new activities would be great.
- Awesome!
- Ideas for prizes--iTunes gift card, Starbucks gift cards, movie tickets, video games, food.
# Introduction to Engineering Camp #2, Week Three July 12-16

<table>
<thead>
<tr>
<th>Camp Activity</th>
<th>Positive Comments</th>
<th>Negative Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>K’nex Bridges</td>
<td>Great beginning to civil engineering. Very fun to build and learn about bridges. Fun and challenging, awesome to build bridges.</td>
<td>Didn’t like following the model. Didn’t make their own. More about what they built it with and why. Could be longer. Didn’t want to take it apart.</td>
</tr>
<tr>
<td>Canoes</td>
<td>Working concrete is hard but fun. Creative task. One was excited about racing them. Found it cool that concrete canoes can float. Different and interesting. Safety was cool to learn about.</td>
<td>One said tedious, another said boring. Some had to leave.</td>
</tr>
<tr>
<td>Structures Lab</td>
<td>Gave insight on what might happen if you become an engineer. Cool. Liked seeing how earthquakes can impact buildings. Seeing the broken pillars. It’s awesome engineers get to test stuff all the time.</td>
<td>One wanted a small demonstration. Another wanted an actual demonstration that is life sized. Didn’t do much there. Guide needs to be louder.</td>
</tr>
<tr>
<td>Segway</td>
<td>Learned about what mechanical engineers do. Fun to ride a Segway. Riding it was awesome. Watching people ride it was also funny to one of them.</td>
<td>One wanted more time on them. One wanted more time to explain how it worked.</td>
</tr>
<tr>
<td>Bottle Rockets</td>
<td>Awesome launchings. Fun. Got to get wet. Got to learn the importance of parts. Sweet, interesting and exciting. Got to have lots of fun. Rockets went far. Exciting and had lots of fun.</td>
<td>Not enough time. Could use more materials. Did not need so many tests. More times to shoot them off.</td>
</tr>
<tr>
<td>Compressor</td>
<td>Awesome to watch things blow up. Got to blow things up and it was amazing to watch. Very explosive.</td>
<td>A couple wanted more time.</td>
</tr>
<tr>
<td>Materials Lab</td>
<td>Super cool. Got to see concrete get crushed. Cool seeing how they test road materials. Special. It was so cool to learn this. Fun smashing things. Awesome.</td>
<td>One thought stretching asphalt would be great. Hot. Two kids wrote down boring.</td>
</tr>
<tr>
<td>Activity</td>
<td>Comments</td>
<td>Additional Notes</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------------------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td>Photo Lab</td>
<td>3D was really awesome. Loved the stereo scope. Loved looking at the pictures. Entertaining. 3D pictures were cool. Cool and liked it.</td>
<td>Wanted to know more about infrared pictures. One said did not get to do much themselves. Bit of a wait.</td>
</tr>
<tr>
<td>Balloon Toss</td>
<td>People got splashed. Loved getting wet. So much fun. Amazing. Got to get wet.</td>
<td>More balloons. We should go even farther.</td>
</tr>
<tr>
<td>Gaming</td>
<td>Got to see how a simple game is made. Got to see how people make games we play. Good use of computers. Fun and technical. Got to mess around with the computers. Pretty cool to see how the computer thinks. Fun to play games.</td>
<td>Very fast. Confusing at times. Better directions. A lot of waiting. Not much help making the games. Too fast.</td>
</tr>
<tr>
<td>Robot Lab</td>
<td>Chance to see the new technology. The dog was adorable. Cool video. Awesome and cool to interact with the robots. Cool robots.</td>
<td>More demonstrations and robots in the class. Could not hear all of the instructions. Make the tour longer.</td>
</tr>
<tr>
<td>Floating Canoe</td>
<td>A chance to play with the water. Watching the canoes float was awesome. Fun wonderful experience. Super cool. Fun to make. Two thumbs up.</td>
<td>One wrote down more supervision. Didn’t get to race. Make it with colors next time.</td>
</tr>
</tbody>
</table>

**What scientific/engineering concept did you learn from the day?**

- It's hard to make a simple game.
- Chemistry.
- Arch suspension.
- In-depth civil and electronic engineering.
- Computer science needs to make more information for video games.
- Putting sugar and salt on concrete has different acceleration and deceleration effects.
- Water pressure makes rockets fly.
- Electric currents help transportation of all kinds.
- Types of bridges.
**What scientific/engineering concept did you not understand or feel were meaningful to you?**

- Loved building canoes.
- You use nitrogen to create ice cream.
- Electricity is essential to American life.

**Any additional comments**

- Chemical engineering is awesome!
- Awesome camp overall.
- Food could have been better.
- Fun camp overall.