AC 2008-1024: KIDS BIRTHDAY PARTIES: “HAVING FUN AND LEARNING ENGINEERING”

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Abstract

According to the American Society of Mechanical Engineers (ASME), interest in science, math, and engineering among the next generation in the United States has been declining at an alarming rate for several decades. This may be caused from intimidation that these subjects pose to primary and secondary education students. Educating these students (K-12th grade) on the social and economic benefits of pursuing careers in science and technology through fun, unique, and interactive parties is an excellent opportunity and is the focus of this paper. These science-oriented parties can be used for a plethora of occasions including: birthday parties, Bar Mitzvahs, lock ins, celebrations, and much more. Typically, educational outreach programs teach students who are already interested in science and engineering. These engineering parties are a surprise and capture attention from children who have never expressed interest in science and math before. In addition, these parties, organized by volunteering college students at local universities and/or colleges, help parents plan and operate educational and fun parties. This paper discusses how programs can be developed at universities and colleges allowing college students to give to the community and serve as role models for the future generation of scientists and engineers. The program consists of college students coordinating entertaining activities for the parties that use safe, easy-to-do, and enjoyable games involving science and engineering. The program engages the community: parents, undergraduate students, graduate students, and educators. Examples of experiments and alternatives on how the program can be adopted and implemented by different colleges and universities for a birthday party are discussed.

Introduction

One of the problems that parents have every time their child’s birthday is approaching is “What can I do this year to make my child’s birthday experience fun and different? Planning an exciting, original, and rememberable birthday party is tedious and some times expensive. An outreach program implemented at a near by university or college willing to offer their services to help parents plan their child’s party is a solution. At the same time, such a program can serve as an alternative way of teaching children grades K-12 science and engineering by having fun in a non-traditional way which is “birthday parties”.

There are many outreach programs in place now for children grades K-12, but none of them involve a birthday party. The University of Colorado at Boulder has engineering workshops and engineering laboratories for children to attend with a goal in expanding the love of engineering in women and minorities. Montana State University’s Civil Engineering department works with 2nd and 3rd graders to show the exciting side of bridges and dams and their real life connections to mathematics and engineering in a workshop setting. Also, Oregon State University has a National Science Foundation funded program of graduate students who bring engineering activities to local elementary schools with the intent to participate minorities and women as much as possible.

Ohio University is working on a new type of non-traditional outreach program call “Engineering Birthday Parties”. This concept has the potential to outreach children with a more
diverse audience. Children going to a birthday party have no idea that they are going to learn
about engineering making the field of children potentially affected by this program not limited to
only children that already have an interest in engineering.

Within this context, the objective of this paper is to discuss how the Engineering
Birthday Parties program can be developed at universities and colleges to allow students to
outreach the community and serve as role models for the future generation of scientists and
engineers. A pilot program was designed to see how children respond to an engineering-based
birthday party and what aspects of the program need to be researched further for this to be
implemented.

Planning of the Pilot Program

The Engineering Birthday Parties Crew (authors of this paper) chose as a trial for the
pilot program the birthday party of a crew member’s daughters (principal investigator, PI, of the
Engineering Birthday Parties Program). The pilot program was designed for a combined
birthday party of two girls. Children attending the party were between three to seven years old
(pre-school children and first graders). The following criteria were considered for the design of
the program:

1. Theme of the party.
   The children’s opinion was taken into consideration to come up with the theme for the
   birthday party. The birthday girls chose to have the movie Cars as their theme, which provided a
   basis for what type of activities should be played at the party to coincide with the theme.

2. Location.
   The party was held in a craft room at a local recreational center. The location was chosen
to allow the planned activities to take place independently of the weather conditions.

3. Timing.
   A two-hour event was planned as this is the usual time that birthday parties last.

4. Activities.
   The intention of the team was to integrate engineering activities into the “traditional”
birthday party activities. The main engineering event that was chosen for the party was the “Fuel
Cell Car Race”, in which the PI has significant experience with integration in different outreach
programs and is in agreement with the theme of the party. After brainstorming, the team decided
on the following sketch for the party: 1. Warm up (Karaoke and dancing); 2. Team building
(grouping and fuel cell car decoration); 3. Fuel cell car race; 4. Bubbles demonstration; 5. Piñata;
6. Food and cake (Recycling Presentation); 7. Awards ceremony; and 8. Assessment (Survey).
All these activities are described in details in the next Section (see Birthday Party Description
Section).

   The Engineering Birthday Parties Crew decided to provide the children with a scientist
outfit, consisting of lab aprons and lab goggles. The cost of the plastic lab aprons were $0.60
each and were precut to fit on small children. The lab safety goggles cost $0.85 each.
Party preparation included, signing out a laptop, projector, and projector screen from the university. The Engineering Birthday Parties Crew designed PowerPoint presentations that coordinated with the party activities that were listed above. The presentations used can be found in Appendices A and B of this paper.

Surveys were designed in order to assess the event. The intention of the survey was to know the opinion of the children regarding not only the engineering activities but also traditional birthday party activities, such as dancing, piñata, cake, karaoke, etc. This allowed the investigators to measure the impact of the engineering activities on the children. The survey used can be found in Appendix C. One of the complications that the authors encountered was that not all of the children could read because of their ages. Additionally the investigators wanted to make the survey appealing to all of the children. In order to resolve this issue it was decided that smiley faces would be used to measure the level of fun.

5. Volunteers

Investigators knew they would be busy coordinating and implementing the activities at the party. Additionally, the number of children invited to the party was large (20). Because of this, it seemed necessary to obtain volunteers to help administrate the program. Three different university organizations volunteered people to help at this event. Society of Women Engineers, Phi Delta Theta, and Theta Tau offered a total of 12 volunteers. They are referred to in the paper as “the volunteers.”

Birthday Party Description

The party was held in a craft room at a local recreational center. In total, 20 children attended the party. The Engineering Birthday Parties crew members were responsible for presenting the PowerPoints and demonstrations necessary for the birthday party. They also trained the volunteers on the engineering activities. The volunteers did not need to meet beforehand but were informed by e-mail of what was expected of them, when to meet, and with what supplies. The volunteers were asked to wear a lab coats and lab safety goggles during the party to appear as scientists and to be consistent with the goals of the program. The Engineering Birthday Parties Crew met at the party site one hour before the party to help set up and show all volunteers each of the activities. The crew and volunteers also stayed 30 minutes after the party ended to help clean up.

A description of the activities that took place during the party is given next.

Warm up: The children arrived to find karaoke and dancing set up to give enough time for all of the children to arrive.

Team building: The children were broken up into groups. Volunteers helped group the children into teams of two or three trying to mix the two age groups as much as possible. One volunteer was assigned to each team with more volunteers helping pass out art supplies and cars to each team. The teams then designed a car name or number to

![Figure 1. Fuel Cell Car Science Kit by Horizon Fuel Cell](image-url)
color onto a paper template that would fit over the front half of the car (shown in Figure 1) to distinguish their car from the other teams.

**Fuel cell car race:** A PowerPoint presentation (see Appendix A) on how the fuel cell cars (Figure 1) work and what it means to be a scientist was given by an *Engineering Birthday Parties Crew* member. The fuel cell cars that were used belong to the university and were purchased from Horizon Fuel Cell Technologies in a “Fuel Cell Car Science Kit.”

Lab aprons and lab safety goggles were passed out by the volunteers so each child felt like they were a scientist for a day.

The fuel cell car race took place in the gym next door to the craft room. There were eight fuel cell car teams that raced, each with at least one volunteer to help them produce hydrogen and start the car. Each team decided how involved they wanted to be in producing hydrogen and starting the cars. Some teams wanted to watch the volunteers plug the battery packs into the fuel cells and some wanted to plug it in themselves. The intention of the race was to have the car go the longest distance. Therefore, the group members needed to “engineer” how to accomplish that.

The volunteers taped the paper templates into a box form and placed them on the fuel cell cars while the children were watching the fuel cell car PowerPoint. After the presentation, the volunteers helped the teams practice making hydrogen and running the cars across the table until the *Engineering Birthday Parties Crew* gave the order to start making hydrogen for the race.

An *Engineering Birthday Parties Crew* member then asked the children as a group if they enjoyed the car race and what they liked most. The majority of children enjoyed the race and could answer questions about what they have learned about fuel cells and the science behind why their cars stopped.

**Bubbles demonstration:** After the fuel cell car race, a demonstration of how bubbles are made was done by one of the *Engineering Birthday Parties Crew* members, including using volunteers to show surface tension and a mixture of soap and water. Figure 2 shows a picture of the demonstration performed. Some of the volunteers lined up in front of the children, each with a sign indicating they were water, while an *Engineering Birthday Parties Crew* member explained to the children the physics behind bubbles. Since water is not flexible the volunteers are in a line and not in a bubble shape. When soap is added to the water (more volunteers came up in front of the children this time with signs indicating they were soap), the surface tension changed forming bubbles. In that case the volunteers (water and soap) came together and formed a bubble shape. This demonstration was reinforced by allowing the children to run and play in front of a bubble machine afterwards.
Piñata: After the bubbles, a usual birthday piñata was scheduled. The volunteers helped organize and supervise the children to make this a safe and fun activity. The lab safety goggles came in handy for this activity due to the fact that piñatas can be dangerous when not executed properly.

Food and cake (recycling presentation): The next planned event was food and cake. Volunteers helped the parents plate and distribute cake while an Engineering Birthday Parties crew member talked to the children about recycling. A PowerPoint presentation on recycling was given to the children, see Appendix B.

Awards Ceremony: After cake was finished and cleaned up, an Engineering Birthday Parties Crew member presented each child with a certificate which stated “Basic Skills of Hydrogen Fuel Cell Car Racing.” Each child left with a lab apron, lab safety goggles, a certificate, and a goody bag.

Assessment: A survey was distributed to the children to assess what activities they enjoyed the best. A copy of this survey can be found in Appendix C. Volunteers helped explaining the children how to fill out the survey.

Pilot Survey Results

Figure 3 shows that the engineering oriented activities (recycling, hydrogen cars, and bubbles) were as enjoyable as the conventional birthday party activities (cake, dancing, and decorating). This gets children interested in science and technology at an early age.
Implementing the program

More research will have to be done before a definite plan of implementation, but the planning that went into this pilot program would be similar to how a party would be planned with the parents, their child and Engineering Parties to come as entertainment. The parents would approach Engineering Parties at a local university or college and an Engineering Birthday Parties Crew member would have a menu of activities for their child’s age group that the parents could choose from. The menu would have a list of main activities like the fuel cell cars and a list of smaller activities. The parents would choose one main activity and two or three small activities for the party. An Engineering Birthday Parties Crew member would then sit down with the parents and discuss other activities the parents wanted to provide for the party and where the party will be held. A time frame would be developed so that both the parents and Engineering Birthday Parties Crew are on the same page when arriving at the party. Lab aprons and lab goggles will be provided for each child and depending on the activities the parents choose additional fees may apply.

The program should be started at universities and colleges with grant money during the implementation and trial stage. After the implementation stage, any fees the parents pay would be used towards the sustainability of the program. Undergraduate students could be employed by this program in different areas. They could work as designers for experiments and activities and would always be coming up with new and fun activities for each age group so that hopefully no two parties are exactly alike. Other undergraduate students would be working just on advertising of the program. They would be coming up with advertising and promoting the program at local schools, on local television channels, or even handing out flyers to faculty and staff. Some undergraduate students would also be needed, along with a university staff member’s supervision, to answer phone calls from parents wishing to plan an event and organizing menus.
of different age group activities. Another group of undergraduate students could be used only for going to the parties, the *Engineering Birthday Parties Crew*. They would be able to give volunteers assignments at an event and be able to control and entertain the children at the party. The volunteers for these events would be attained from any university or college organization. These volunteers would not be limited to engineering students. The volunteers for the pilot program were from an engineering fraternity, an engineering group focused on women, and a campus fraternity. The volunteers could be undergraduate education majors wanting experience working with large groups of children or as simple as a sorority in need of community service hours.

A vision of the program is shown in Figure 4. The program can be run under a university and college environment as a scholars program, in this case, "*Engineering Birthday Parties Scholar Programs*.” Without further research it is difficult to determine the exact numbers of people required to execute such a program in a way that will be affordable for the parents. However it is expected that faculty, administrators, undergraduate, and graduate students will be involved. Figure 4 shows a potential organizational map for an *Engineering Birthday Parties Scholar Program*. At least one or two faculty members will be in charge of the students designing engineering party menus and demos. On the other hand, a university or college staff member will act as the program administrator. The administrator responsibilities include: recruitment, publicity, and parent liaison. This person will recruit students and volunteers to participate in the program.

**Figure 4.** Tentative Organizational map for the *Engineering Birthday Parties Scholar Program*

Impact of the Program

Further research and development is necessary to determine the impact of the program. Ideally, funds will be necessary to implement, run, and assess the program for at least four years. This will allow providing further recommendations and assessing the complete feasibility of the program. Back of the envelope calculations indicate that, if this program organizes two parties a month and each party had 20 children attend, the program would outreach at least 480 kids a year. The more parties are organized the more children would be outreached. The minimum
number of parties that needs to be carried out to guarantee the sustainability of the program has
to be determined (such that the program is cost effective and modules and demos are
continuously developed and up dated). The program should also include assessment of the
participants with time to track statistics on the number of individuals who chose and
engineering/science degree.

Conclusions

The educational advantages of the “Engineering Birthday Parties” program are
incalculable. The program engages the community: parents, undergraduate students, graduate
students, and educators. An engineering outreach program like this in a college community has
the potential to teach over a thousand children each year how fun and important science, math
and engineering is. This party-education coupling has the ability to reach more children than
most educational outreach programs already in existence that require prior interest in science and
technology by the child in order to sign up. Further research and development is needed to
evaluate the feasibility and sustainability of the program.

Acknowledgements

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Zack Graman. And the volunteers from Theta Tau: Ryan Wagner, Courtney Abram, Charla
Barnes, Danny Dylong, Dan Mester, and Samantha Hedges.

Citations

1. American Society of Mechanical Engineers Testimony Hearing on Math and Science Education at NSF.
Appendix A: Water Fuel Cell Car PowerPoint Presentation: presented at pilot program to children as an introduction to the water fuel cell car race.

Slide 1

Slide 2

Slide 3

Car Race: Decoration
- Work in groups and decorate the cars
- Follow instructions from volunteers

Thanks to Volunteers!
- Society of Women in Engineering
- Theta Tau
- Phi Delta Theta
**Car Race: Using the Car**
- Fuel cell Car
- Follow instructions from volunteers

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**Racing the car**
- Start with water

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**Racing the car**
- Make fuel Hydrogen
- And Oxygen

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**Racing the car**
- Let your car run and you will get water
Appendix B: Recycling PowerPoint Presentation: presented at pilot program to children on what recycling is and how to recycle.
Slide 3

**What can you put in the Recycling Bin?**

- Newspaper
- Aluminum cans
- Glass bottles
- Plastic Water bottles
- Milk Jugs

Slide 4

**Why should I recycle?**

- Recycling one aluminum can saves enough energy to run a TV for three hours!
  - That’s 6 Cartoon shows!

Slide 5

**Why should I recycle?**

- Americans use 85,000,000 tons of paper a year, about 880 pounds per person.
  - That’s the size of a Grizzly Bear!

Slide 6

**Why should I recycle?**

- Americans throw away 25,000,000 plastic beverage bottles every hour!
Appendix C: Birthday Party Survey: distributed to children at pilot program as a way to gauge what activities each child enjoyed the most.

*Birthday Party Survey (November 10, 2007)*

Age: __________________

How Fun were the following activities for you? Use smiling faces. The more smiling faces the funnier.

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<th>ACTIVITY</th>
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<th>FUN LEVEL</th>
<th>FUN LEVEL</th>
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<tbody>
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<td>Piñata</td>
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