New Orleans JAZZED about Engineering Education

Paper ID #14642

Community Service as a Means of Engineering Inspiration: An Initial Investigation into the Impact of the Toy Adaptation Program

Ms. Molly Y Mollica, The Ohio State University

Molly Mollica earned her BS in Biomedical Engineering from Ohio State University in 2014. She is currently a Master's student in Mechanical Engineering with a research focuses in bionanotechnology, mechanobiology, and engineering education. Molly has been working with the Toy Adaptation Project since its start at OSU in 2013.

Dr. Rachel Louis Kajfez, The Ohio State University

Dr. Rachel Louis Kajfez is an Assistant Professor of Practice in the Department of Engineering Education at The Ohio State University. She earned her B.S. and M.S. degrees in Civil Engineering from Ohio State and earned her Ph.D. in Engineering Education from Virginia Tech. Her research interests focus on the intersection between motivation and identity of undergraduate and graduate students, first-year engineering programs, mixed methods research, and innovative approaches to teaching. Currently, she teaches within the first-year engineering program at Ohio State while maintaining an active engineering education research program.

Ms. Elizabeth Riter, The Ohio State University

Elizabeth is currently in her 5th year as the Program Manager and Advisor for the Green Engineering Scholars Program at The Ohio State University. She graduated with her B.S. in Civil Engineering from Ohio State in 2007 and with her M.S. in Structural Engineering from Ohio State in 2013. She worked as a Structural Engineer for J.D. Stevenson & Associates in Chicago, IL for 2.5 years designing structural components within nuclear power plants in the midwest. In her current role, she teaches, mentors, and advises first and second year Ohio State engineering students in their pursuit of a degree and career in engineering.

Miss Meg West, The Ohio State University

Meg West is a third year Civil Engineering undergraduate student at The Ohio State University. She is an Undergraduate Teaching Assistant for the Engineering Education Department and a Toy Adaptation Program Intern at The Ohio State University.

Peter Vuyk, The Ohio State University

Peter Vuyk is a second year undergraduate honors student seeking his B.S. degree in Mechanical Engineering at The Ohio State University.

Community Service as a Means of Engineering Inspiration: An Initial Investigation into the Impact of the Toy Adaptation Program

Abstract

For many first-year engineering students, what it means to be an engineer is an abstract concept. Introducing major-related classes early in an engineer's education helps students answer, "what is an engineer?" However, these classes often lack connections between engineering and society. Additionally, current courses do not always effectively support students in becoming experienced problem solvers. To address the connection between engineering and society and to help students develop their confidence in problem solving, the Toy Adaptation Program (TAP) at The Ohio State University provides students with a hands-on experience modifying electronic toys for children with special needs. These adapted toys are donated to toy-lending libraries and families in-need, so that families are not burdened with the increased cost and inconvenience of purchasing marked-up adapted toys from select toy manufacturers. For this "In Progress" paper for the Community Engagement in Engineering Education Division, we will introduce the program in its current format along with our assessment techniques and next steps.

Introduction

The act of playing with an interactive toy can provide benefits to a child in ways that we often take for granted. An interactive toy is one that has the ability to produce sound, light, and/or movement and is battery-operated. Playing with these types of toys not only provides entertainment for a child but also teaches valuable concepts and life skills, potentially improving future developmental growth[1,2]. Examples of developmentally crucial proficiencies resultant from play include decision-making, self-mastery, increased motivation, and competency[1]. These experiences develop and assist children in becoming more productive members of society. However, children with severe physical or developmental disabilities may not have the ability to use an interactive toy and learn such valuable concepts because they are often unable to activate the toy in the manner in which it is was originally designed. For example, many of the children we serve have severe genetic degenerative disorders affecting and limiting their mobility[3]. Children affected by these diseases, such as Spinal Muscular Atrophy and Spina Bifida, may not be able to sit up to reach the toy or may not be able to move their arm or hand with the dexterity necessary to activate the toy. Despite these limitations, these children still have the need to learn valuable concepts and life skills[4,5].

While their disability may be limiting, interactive toys can be modified electronically so that children with special needs are able to use and activate them through a switch mechanism unique to their disability[5,6]. Families have the option to purchase adapted toys from one of the few companies that sell them[7]. However, these toys are sold for up to five times the cost of the original, un-adapted version of the toy. For example, a simple bubble-making machine costs approximately $16 at Toys"R"Us[8] but costs $60 at Enabling Devices for the same toy in its adapted version[9]. These families are already spending a significant amount of time and money on simply caring for their child through treatment sessions, therapy, medication, hospital visits, etc. The added cost of adapted toys is an additional burden for them to bear.

Toy Adaptation Program

The Toy Adaptation Program (TAP), grounded in service and experiential learning, fills this educational and financial need by adapting toys for children with special needs through labs with first-year engineering students, workshops with families, and other events with community and corporate partners. Toy adaptation involves finding the circuit of an electronic toy, determining how to complete the circuit in order to activate the toy, and soldering a universal switch in parallel so that the toy can be activated by the standard method AND by an external switch specific to the child's needs and abilities.

Through our program, we donate adapted toys directly to families or to toy-lending libraries at which families can borrow toys, both, at no cost. The overall mission of the TAP is to:

- Provide children with special needs the opportunity to interactively play and develop valuable life skills despite any physical, developmental, financial, or other limitation they or their family may face.
- Provide eager students and volunteers the opportunity to use engineering skills through service and experiential learning to make a positive, societal impact on the community.
- Increase awareness about this need and other needs related to adaptive technology.

Through our work, we hope to impact the lives of families who have children with special needs while providing a unique societal focused project for our students, which has recently been cited as an area of growth for engineering education[10,11].

Our first toy adaptation workshop occurred in collaboration with Replay for Kids (Medina, Ohio) in April 2013. Since then, we have held 10+ toy adaptation workshops, adapted and donated 500+ toys, and developed partnerships with Katelyn's Krusade (Hilliard, Ohio), Nationwide Children's Hospital (Columbus, Ohio), May We Help (Cincinnati, Ohio), and Assistive Technology of Ohio (Columbus, Ohio). Within the next year, we will also hold workshops for parents and families of children with special needs.

2015-2016 Educational Context

The Ohio State University (OSU) is a large, public, land-grant institution located in central Ohio. The OSU College of Engineering contains 1500 first-year students[12] and toy adaptation workshops were conducted with three different first-year cohorts within the College.

The first cohort to complete a toy workshop during the 2015-2016 academic year was within the Fundamentals of Engineering for Honors course. This is an accelerated introductory engineering class for academically high achieving first-semester engineering students. Toy adaptation was facilitated in three course sections with 35 first-year students (cohort 1) in each section. Assistance during the lab was provided by the instructor, graduate teaching assistant, and undergraduate teaching assistants.

The second cohort of students participated in a toy adaptation experience during their first-year Scholars seminar. This course is a first-semester introduction to the Scholars program: a living-learning community that provides curricular and co-curricular engineering experiences to high-

achieving students. Toy adaptation was carried out in three Scholars seminar course sections with 40-60 first-year Scholars (cohort 2) in each section.

The third cohort included Scholars mentors that assisted in the first-year Scholars workshop (cohort 2 described above.) These mentors were upper-class (second-year and older) Scholars student volunteers that had previously had at least one toy adaptation experience.

Data was collected after each toy adaption event through an IRB approved voluntary online survey. The survey received 31 responses from cohort 1 (out of 105, 30%), 17 responses from cohort 2 (out of 125, 14%), and 9 responses from cohort 3 (out of 45, 20%). This yielded an overall response rate of 20.7%.

Results to Date

The survey asked students to rank various statements on a Likert scale from "Strongly Agree" to "Strongly Disagree." The collective responses (Figure 1) and responses by cohort (Figure 2) are displayed as stacked bar graphs. We chose to provide only descriptive statistics and sample quotes at this time due to the "In Progress" nature of the paper and our sample size. As we continue to collect more data, we hope to be able to perform statistical tests for significance and code our qualitative responses to better understand the effect of TAP.

Notably, 98% of students either "strongly agreed" or "agreed" that they enjoyed this experience and that the experience helped them see how engineering can have a direct, positive impact on people. Similarly, 91% "strongly agreed" or "agreed" that participation in this experience helped them feel more connected to the field of engineering. A first-year honors, female, mechanical engineering student commented, "This was my favorite lab so far and I felt like the skills I was acquiring were applicable to the real world."

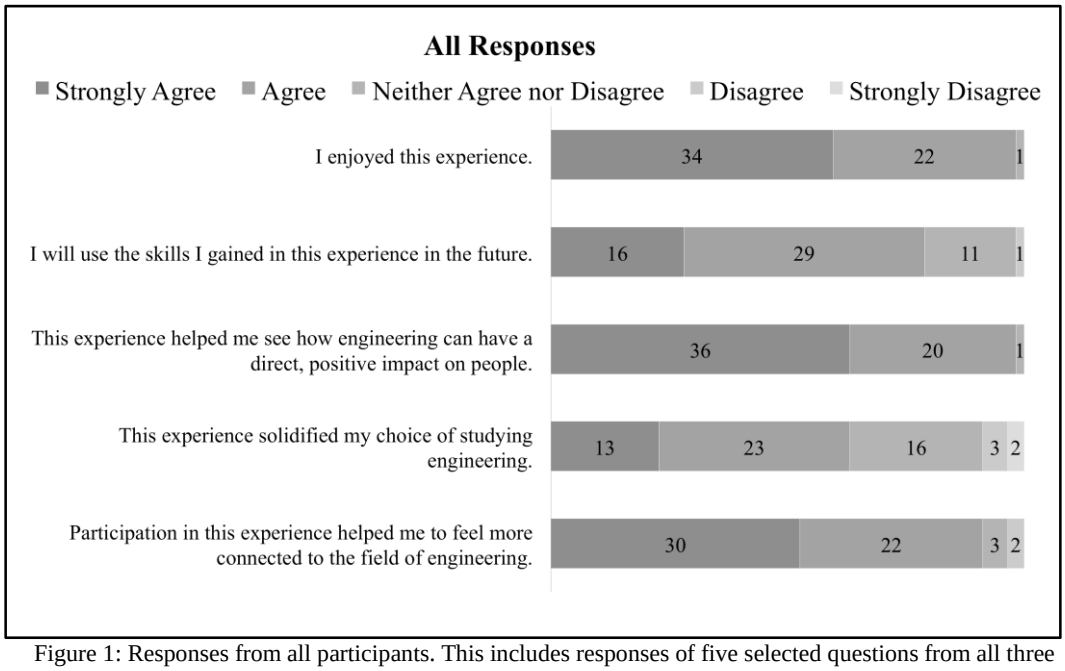

Figure 1: Responses from all participants. This includes responses of five selected questions from all three cohorts. Numbers show the quantity of students that selected each response (total number of students is 57.)

When responses are reported by cohort, it is noticeable that the experience was seemingly more influential in solidifying the student's choice of engineering for first-year students than for upper-class mentors; however, those upper-class mentors enjoyed the experience as much as the first-year students. One third-year, female, environmental engineering Scholars mentor commented that "I really enjoyed helping the first-years learn how to solder and adapt the toy."

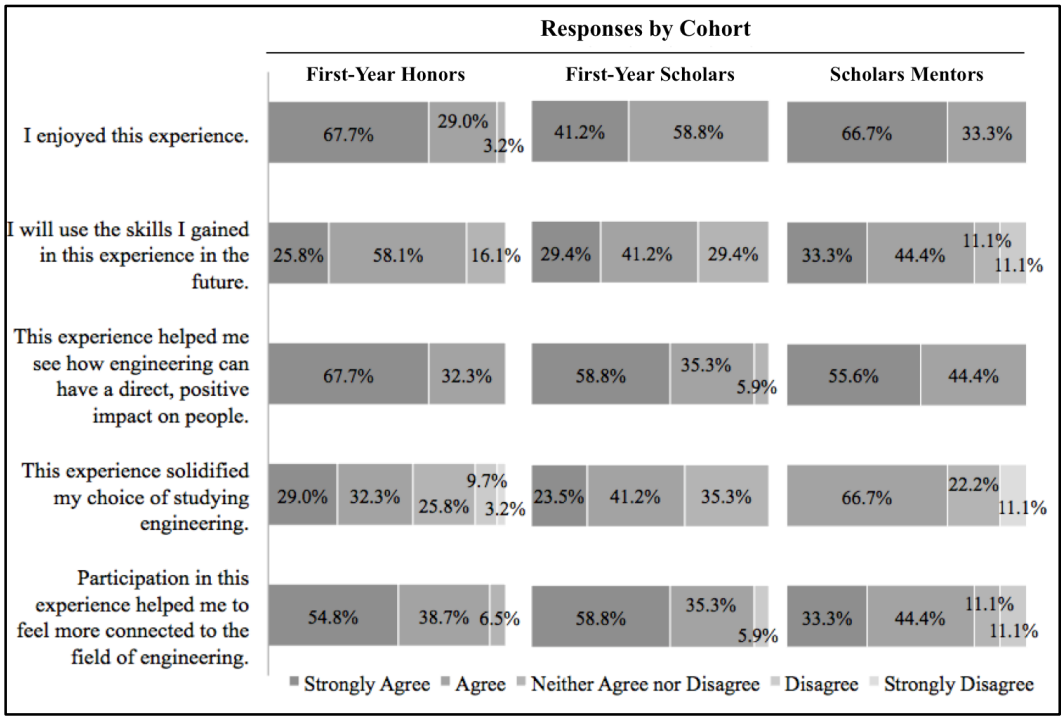

Figure 2: Responses by cohort. This includes responses of five selected questions from three cohorts.

Conclusion

The Toy Adaptation Program seeks to provide children and families with adapted, developmentally important toys while educating engineering students on technical skills and the connection between engineering and community impact. Preliminary results suggest that students overwhelmingly enjoy this experience and that it effectively displays the direct, positive impact engineering can have on people. Future work includes developing the program to serve more engineering students, providing workshops for parents and families of children with special needs, and beginning partnerships to extend toy adaptation to other cities and universities. Additionally, we will continue to expand our data collection to evaluate the program more completely and its impact on our students and the community.

Acknowledgement

This work is currently supported by the Battelle Engineering, Technology, and Human Affairs (BETHA) Endowment. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the BETHA Endowment.

Bibliography

1. Missiuna, C. & Pollock, N. (1991). Play deprivation of children with physical disabilities: The role of the occupational therapist in preventing secondary disability. *The American Journal of Occupational Therapy, 45* (10), 882-888.
2. Besio, S. (2004). Using assistive technologies to facilitate play by children with motor impairments: A methodological proposal. *Technology and Disability, 16*(3), 119-30.
3. Jones, M. A., McEwen, I. R., & Hansen, L. (2003). Use of power mobility for a young child with spinal muscular atrophy." *Journal of American Physical Therapy Association, 83*(3), 253-262.
4. Casey, J., Paleg, G., & Livingstone, R. (2013). Facilitating child participation through power mobility. *The British Journal of Occupational Therapy, 76*(3), 158-160.
5. Hamm, E. M., Mistrett, S. G., & Ruffino, A. G. (2006). Play outcomes and satisfaction with toys and technology of young children with special needs. *Journal of Special Education Technology, 21*(1), 29.
6. Proença, J. P., Quaresma, C., & Vieira, P. (2014). New application: Adaptation of toys for children with multiple disabilities. *Procedia Technology, 17*, 351-358.
7. Enabling Devices. (2016). Retrieved from https://enablingdevices.com/
8. ToysRUs: Hurricane Bubble Blower. (2016). Retrieved from http://www.toysrus.com/buy/bubbles/gazillion-bubble-hurricane-32417-2264918
9. Enabling Devices: Hurricane Bubble Blower. (2016). Retrieved from https://enablingdevices.com/catalog/toys_for_disabled_children/bubble-blowers/hurricane-bubble-blower
10. VanderSteen, J. (2011). Adaptive engineering. *Bulletin of Science, Technology & Society, 31*(2), 134-143.
11. Amadei, B., & Sandekian, R. (2010). Model of integrating humanitarian development into engineering education. *Journal of Professional Issues in Engineering Education and Practice, 136*(2), 84-92.
12. Ohio State Engineering Annual Statistical Report. (2016). Retrieved from https://intranet.engineering.osu.edu/faculty-resources/annual-statistical-report